2010 Twenty-Fifth Annual IEEE Applied Power Electronics Conference and Exposition

(APEC 2010)

Palm Springs, California, USA 21 – 25 February 2010

Pages 1-767



IEEE Catalog Number: ISBN:

CFP10APE-PRT 978-1-4244-4782-4

TABLE OF CONTENTS

| Session A1L-A: DC-DC Converter I Tuesday, February 23, 8:30 - 10:10 Session Chairs: Van Niemela, Fairchild Semiconductor Haidong Yu, Phoenix International | |
|--|----|
| Minimum Deviation Digital Controller IC for Single and Two Phase DC-DC Switch-Mode Power Supplies Aleksandar Radić, University of Toronto, Canada Zdravko Lukić, University of Toronto, Canada Aleksandar Prodić, University of Toronto, Canada Robert de Nie, NXP Semiconductors, Netherlands | 1 |
| Modeling and Design Considerations of Coupled Inductor Converters Guangyong Zhu, Auscom Engineering, Inc., United States Kunrong Wang, Dell, Inc., United States | 7 |
| Design Procedure for High Frequency Operation of the Modified Series Resonant APWM Converter with Improved Efficiency and Reduced Size Darryl J. Tschirhart, Queen's University, Canada Praveen K. Jain, Queen's University, Canada | 14 |
| Expiremantal Results and Study of a Modified Adaptive Bus Voltage Controller Jaber A. Abu Qahouq, University of Alabama, United States Gautam Muralidhar, University of Alabama, United States | 19 |
| Session A1L-B: AC-DC Power Factor Correction Topologies I Tuesday, February 23, 8:30 - 10:10 Session Chairs: Gerry Moschopoulos, University of Western Ontario Omer Onar, Illinois Institute of Technology | |
| Bridgeless Buck PFC Rectifier Yungtaek Jang, Delta Products Corporation, United States Milan M. Jovanović, Delta Products Corporation, United States | 23 |
| An Active-Clamped Full-Wave Zero-Current-Switched Quasi-Resonant Boost Converter in Power Factor Correction Application E. Firmansyah, Kyushu University, Japan S. Abe, Kyushu University, Japan M. Shoyama, Kyushu University, Japan S. Tomioka, TDK-Lambda Corporation, Japan T. Ninomiya, Nagasaki University, Japan | 30 |

| Novel Adaptive Master-Slave Method for Interleaved Boundary Conduction Mode (BCM) PFC Converters |
|--|
| A Novel Bridgeless Single-Stage Half-Bridge AC-DC Converter |
| Session A1L-C: Power Electronics for Utility Interface I Tuesday, February 23, 8:30 - 10:10 Session Chairs: Zareh Soghomonian, BMT Syntek Technologies |
| Jin Wang, <i>Ohio State University</i> |
| Power Quality Improvement at Medium-Voltage Grids Using Hexagram Active Power Filter 47 Jun Wen, University of California, Irvine, United States Liang Zhou, University of California, Irvine, United States Keyue Smedley, University of California, Irvine, United States |
| A Generalized Capacitor Voltage Balancing Scheme for Flying Capacitor Multilevel Converters |
| Hossein Sepahvand, Missouri University of Science and Technology, United States Keith Corzine, Missouri University of Science and Technology, United States Mehdi Ferdowsi, Missouri University of Science and Technology, United States |
| An Active Damping Technique for a Current Source Inverter Employing a Virtual Negative Inductance 63 Ahmed Salah Morsy, Texas A&M University at Qatar, Qatar Shehab Ahmed, Texas A&M University at Qatar, Qatar Prasad Enjeti, Texas A&M University at Qatar, Qatar Ahmed Massoud, Qatar University, Qatar |
| Maximum Solar Power Transfer in Multi-Port Power Electronic Interface |
| Session A1L-D: Passive Devices I Tuesday, February 23, 8:30 - 10:10 Session Chairs: Laura Lyle, Wright Patterson Air Force Base Mike Schutten, General Electric |
| SMD Inductors Based on Soft-Magnetic Powder Compacts Etsuo Otsuki, <i>Toho Zinc Co., Ltd., Japan</i> Kenichiro Ishii, <i>Toho Zinc Co., Ltd., Japan</i> Shinya Nakano, <i>Toho Zinc Co., Ltd., Japan</i> |
| High Density Low Profile Coupled Inductor Design for Integrated Point-of-Load Converter 79 Qiang Li, Virginia Polytechnic Institute and State University, United States Yan Dong, Virginia Polytechnic Institute and State University, United States Fred C. Lee, Virginia Polytechnic Institute and State University, United States |

| Relationship of Quality Factor and Hollow Winding Structure of Coreless Printed Spiral Winding (CPSW) Inductor Y.P. Su, Virginia Polytechnic Institute and State University, United States Xun Liu, ConvenientPower HK Ltd., China C.K. Lee, Hong Kong Polytechnic University, China S.Y.R. Hui, City University of Hong Kong, China | 86 |
|--|-----|
| Modeling of Adaptable-Diameter Burners Formed by Concentric Planar Windings for Domestic Induction Heating Applications Jesus Acero, University of Zaragoza, Spain Claudio Carretero, University of Zaragoza, Spain Ignacio Millan, University of Zaragoza, Spain Oscar Lucía, University of Zaragoza, Spain Jose-Miguel Burdío, University of Zaragoza, Spain Rafael Alonso, University of Zaragoza, Spain | 92 |
| Session A1L-E: Controls in Motor Drives I Tuesday, February 23, 8:30 - 10:10 Session Chairs: Jonathan Kimball, <i>Missouri S&T</i> | |
| Flux Concentration and Pole Shaping in a Single Phase Hybrid Switched Reluctance Motor Drive Uffe Jakobsen, Aalborg University, Denmark Kaiyuan Lu, Aalborg University, Denmark | 98 |
| Parameter Independent Maximum Torque Per Ampere (MTPA) Control of IPM Machine Based on Signal Injection Sungmin Kim, Seoul National University, Korea, South Young-Doo Yoon, Seoul National University, Korea, South Seung-Ki Sul, Seoul National University, Korea, South Kozo Ide, Yaskawa Electric Corporation, Japan Koji Tomita, Yaskawa Electric Corporation, Japan | 103 |
| Performance Analysis of Three-Phase Capacitor Motor in Frequency Control System | 109 |
| Efficiency Improvement by Changeover of Phase Windings of Multiphase Permanent Magnet Synchronous Motor with Outer-Rotor Type Young-Gook Kim, Pusan National University, Korea, South Chae-Bong Bae, Pusan National University, Korea, South Jang-Mok Kim, Pusan National University, Korea, South Hyun-Cheol Kim, Agency for Defense Development, Korea, South | 112 |

| Session A1L-F: Digital Controls in DC-DC Converters I Tuesday, February 23, 8:30 - 10:10 Session Chairs: Dragan Maksimović, University of Colorado at Boulder Jason Neely, Purdue University | |
|--|-----|
| Digital Power Controller with Non-Linear Variable Switching Frequency Jaber A. Abu Qahouq, <i>University of Alabama, United States</i> | 120 |
| Digital Charge Balance Controller with an Auxiliary Circuit for Superior Unloading Transient Performance of Buck Converters Eric Meyer, Queen's University, Canada Dong Wang, Queen's University, Canada Liang Jia, Queen's University, Canada Yan-Fei Liu, Queen's University, Canada | 124 |
| One-Step Digital Dead-Time Correction for DC-DC Converters April Zhao, University of Toronto, Canada Armin Akhavan Fomani, University of Toronto, Canada Wai Tung Ng, University of Toronto, Canada | 132 |
| The Practical Aspects of Utilizing Digital Power Controller for Monitoring of Power Supply Operation Oleg Volfson, Intersil Corporation, United States | 138 |
| Session A1L-G: Wind Power Tuesday, February 23, 8:30 - 10:10 Session Chairs: Morgan Kiani, <i>University of Texas at Arlington</i> | |
| A Unity Power Factor, Maximum Power Point Tracking Battery Charger for Low Power Wind Turbines Gustavo Gamboa, University of Central Florida, United States John Elmes, University of Central Florida, United States Christopher Hamilton, University of Central Florida, United States Jonathan Baker, University of Central Florida, United States Michael Pepper, University of Central Florida, United States Issa Batarseh, University of Central Florida, United States | 143 |
| Maximum Power Point Tracking of a Wind Energy Conversion System Using Adaptive Nonlinear Approach Majid Pahlevaninezhad, Queen's University, Canada Suzan Eren, Queen's University, Canada Alireza Bakhshai, Queen's University, Canada Praveen Jain, Queen's University, Canada | 149 |
| A Hybrid Wind-Solar Energy System: a New Rectifier Stage Topology | 155 |

| Dynamic Operation and Control of a Hybrid Wind-Diesel Stand Alone Power Systems A.M.O. Haruni, University of Tasmania, Australia A. Gargoom, University of Tasmania, Australia M.E. Haque, University of Tasmania, Australia M. Negnevitsky, University of Tasmania, Australia | 162 |
|---|-----|
| Session A2L-A: DC-DC Converter II Tuesday, February 23, 10:40 - 11:55 Session Chairs: Van Niemela, Fairchild Semiconductor Haidong Yu, Phoenix International | |
| SystemC-AMS Modeling and Simulation of Digitally Controlled DC-DC Converters Matteo Agostinelli, University of Klagenfurt, Austria Robert Priewasser, University of Klagenfurt, Austria Mario Huemer, University of Klagenfurt, Austria Stefano Marsili, Infineon Technologies Austria AG, Austria Dietmar Straeussnigg, Infineon Technologies Austria AG, Austria | 170 |
| Modeling of Digitally Controlled Voltage Regulator Modules Yi Sun, Linear Technology, United States Fred C. Lee, Virginia Polytechnic Institute and State University, United States Jian Li, Linear Technology, United States | 176 |
| Design and Comparison of Digital Control Loops Analytical Models, Laboratory Measurements, and Simulation Results Philip Cooke, Infineon Technologies, United States Thomas G. Wilson, Jr., SIMPLIS Technologies, United States Rohan Samsi, Primarion, United States | 183 |
| Session A2L-B: AC-DC Power Factor Correction Topologies II Tuesday, February 23, 10:40 - 11:55 Session Chairs: Gerry Moschopoulos, University of Western Ontario Omer Onar, Illinois Institute of Technology | |
| Digital Control for Efficiency Improvements in Interleaved Boost PFC Rectifiers Fu-Zen Chen, <i>University of Colorado at Boulder, United States</i> Dragan Maksimović, <i>University of Colorado at Boulder, United States</i> | 188 |
| Reduction of the Output Capacitor in Power Factor Correctors by Distorting the Line Input Current Diego G. Lamar, Universidad de Oviedo, Spain Javier Sebastián, Universidad de Oviedo, Spain Manuel Arias, Universidad de Oviedo, Spain Arturo Fernández, Universidad de Oviedo, Spain | 196 |
| Universal-Input Single-Stage PFC Flyback with Variable Boost Inductance for High-Brightness LED Applications Yuequan Hu, Delta Products Corporation, United States Laszlo Huber, Delta Products Corporation, United States Milan M. Jovanović, Delta Products Corporation, United States | 203 |

| Session A2L-C: Power Electronics for Utility Interface II Tuesday, February 23, 10:40 - 11:55 Session Chairs: Zareh Soghomonian, BMT Syntek Technologies Jin Wang, Ohio State University | |
|--|-----|
| High Frequency High Efficiency Bidirectional DC-DC Converter Module Design for 10 kVA Solid State Transformer Haifeng Fan, Florida State University, United States Hui Li, Florida State University, United States | 210 |
| Synchronization of Three-Phase Converters and Virtual Microgrid Implementation Utilizing the Power-Hardware-in-the-Loop Concept O. Vodyakho, Florida State University, United States C.S. Edrington, Florida State University, United States M. Steurer, Florida State University, United States S. Azongha, Florida State University, United States F. Fleming, Florida State University, United States | 216 |
| A Single-Stage Grid-Connected Inverter with Wide Range Reactive Power Compensation Using Energy Storage System (Ess) Liming Liu, Florida State University, United States Zhichao Wu, Florida State University, United States Hui Li, Florida State University, United States | 223 |
| Session A2L-D: Passive Devices II Tuesday, February 23, 10:40 - 11:55 Session Chairs: Laura Lyle, Wright Patterson Air Force Base Mike Schutten, General Electric | |
| Polymer Bonded Soft Magnetics for EMI Filter Applications in Power Electronics S. Egelkraut, University of Erlangen-Nürnberg, Germany L. Frey, University of Erlangen-Nürnberg, Germany M. Rauch, Fraunhofer Institute for Integrated Systems and Device Technology, Germany A. Schletz, Fraunhofer Institute for Integrated Systems and Device Technology, Germany M. März, Fraunhofer Institute for Integrated Systems and Device Technology, Germany | 231 |
| Lead-Acid Battery Modeling and State of Charge Monitoring J.F. Araujo Leão, Universidade Federal de Campina Grande, Brazil L.V. Hartmann, Universidade Federal de Campina Grande, Brazil M.B.R. Corrêa, Universidade Federal de Campina Grande, Brazil A.M.N. Lima, Universidade Federal de Campina Grande, Brazil | 239 |
| Voltage and Current Ripple Considerations for Improving Lifetime of Ultra-Capacitors Used for Energy Buffer Applications at Converter Inputs Supratim Basu, Bose Research Pvt. Ltd., India Tore M. Undeland, Norwegian University of Science and Technology, Norway | 244 |

| Session A2L-E: Controls in Motor Drives II Tuesday, February 23, 10:40 - 11:55 Session Chairs: Jonathan Kimball, <i>Missouri S&T</i> | |
|---|-----|
| Implementation and Operational Investigations of Bipolar Gate Drivers Jean-Christophe Crebier, Grenoble Institute of Technology, France Manh Hung Tran, Grenoble Institute of Technology, France Jean Barbaroux, Grenoble Institute of Technology, France Pierre-Olivier Jeannin, Grenoble Institute of Technology, France | 248 |
| A Method for Impact Assessment of Faults on the Performance of Field-Oriented Control Drives: a First Step to Reliability Modeling Ali M. Bazzi, University of Illinois at Urbana-Champaign, United States Alejandro Dominguez-Garcia, University of Illinois at Urbana-Champaign, United States Philip T. Krein, University of Illinois at Urbana-Champaign, United States | 256 |
| A Fault Tolerant Control System for Hexagram Inverter Motor Drive Liang Zhou, University of California, Irvine, United States Keyue Smedley, University of California, Irvine, United States | 264 |
| Session A2L-F: Digital Controls in DC-DC Converters II Tuesday, February 23, 10:40 - 11:55 Session Chairs: Dragan Maksimović, University of Colorado at Boulder Jason Neely, Purdue University | 271 |
| Power Analog to Digital Converter for Voltage Scaling Applications M.C. Gonzalez, Universidad Politécnica de Madrid, Spain M. Vasić, Universidad Politécnica de Madrid, Spain P. Alou, Universidad Politécnica de Madrid, Spain O. Garcia, Universidad Politécnica de Madrid, Spain J.A. Oliver, Universidad Politécnica de Madrid, Spain J.A. Cobos, Universidad Politécnica de Madrid, Spain H. Visairo, Intel Corporation, Mexico | 271 |
| A Digital Pulse-Width Modulator for Phase-Shift Operation of Full-Bridge Isolated DC-DC Converters L. Corradini, University of Colorado at Boulder, United States D. Maksimović, University of Colorado at Boulder, United States | 277 |
| Digitally Controlled Integrated Pseudo-CCM SIMO Converter with Adaptive Freewheel Current Modulation Yi Zhang, University of Arizona, United States Dongsheng Ma, University of Arizona, United States | 284 |

| Tuesday, February 23, 10:40 - 11:55 Session Chairs: Morgan Kiani, <i>University of Texas at Arlington</i> | |
|--|-----|
| Analysis of Pulse-Link DC-AC Converter for Fuel Cells Applications Operated in Zero-Current-Slope Mode Kentaro Fukushima, <i>Kyushu University, Japan</i> Isami Norigoe, <i>I.N. Laboratory, Japan</i> Masahito Shoyama, <i>Kyushu University, Japan</i> Tamotsu Ninomiya, <i>Nagasaki University, Japan</i> Yosuke Harada, <i>Ebara Densan Ltd., Japan</i> Kenta Tsukakoshi, <i>Ebara Densan Ltd., Japan</i> | 289 |
| A Minimum Power-Processing Stage Fuel Cell Energy System Based on a Boost-Inverter with a Bi-Directional Back-Up Battery Storage Minsoo Jang, University of Sydney, Australia Vassilios G. Agelidis, University of Sydney, Australia | 295 |
| Power Conditioning System for Fuel Cell with 2-Stage DC-DC Converter Byung M. Han, Myongji University, Korea, South Jun-Young Lee, Myongji University, Korea, South Yu-Seok Jeong, Myongji University, Korea, South | 303 |
| Session B1L-A: DC-DC Converter III Wednesday, February 24, 8:30 - 10:10 Session Chairs: Alireza Khaligh, Illinois Institute of Technology Sheldon Williamson, Concordia University | |
| Real-Time FPGA-Based Hardware-in-the-Loop Development Test-Bench for Multiple Output Power Converters O. Lucía, University of Zaragoza, Spain O. Jiménez, University of Zaragoza, Spain L.A. Barragán, University of Zaragoza, Spain I. Urriza, University of Zaragoza, Spain J.M. Burdío, University of Zaragoza, Spain D. Navarro, University of Zaragoza, Spain | 309 |
| Oversampled Digital Controller IC Based on Successive Load-Change Estimation for DC-DC Converters Zdravko Lukić, University of Toronto, Canada Aleksandar Radić, University of Toronto, Canada Aleksandar Prodić, University of Toronto, Canada Simon Effler, University of Limerick, Ireland | 315 |
| Novel Nonlinear Control of Dual Active Bridge Using Simplified Converter Model | 321 |

Session A2L-G: Fuel Cells

| A Novel Digital Single-Wire Quasi-Democratic Stress Share Scheme for Paralleled Switching Converters Karl Rinne, Powervation Ltd., Ireland Anthony Kelly, Powervation Ltd., Ireland Eamon O'Malley, Powervation Ltd., Ireland | 328 |
|---|-----|
| Session B1L-B: AC-DC Conversion Control Strategies Wednesday, February 24, 8:30 - 10:10 Session Chairs: Alireza Khaligh, <i>Illinois Institute of Technology</i> Omer Onar, <i>Illinois Institute of Technology</i> | |
| Minimum-Sensing Current Control of Three-Phase PFC Converters Zhonghui Bing, Rensselaer Polytechnic Institute, United States Jian Sun, Rensselaer Polytechnic Institute, United States | 336 |
| Direct Power Control of a Dual Converter Operating As Synchronous Rectifier José Restrepo, Universidad Simón Bolívar, Venezuela José M. Aller, Universidad Simón Bolívar, Venezuela Alexander Bueno, Universidad Simón Bolívar, Venezuela Julio C. Viola, Universidad Simón Bolívar, Venezuela Alberto Berzoy, Universidad Simón Bolívar, Venezuela Thomas Habetler, Georgia Institute of Technology, United States | 343 |
| A Low-Cost Adaptive Multi-Mode Digital Control Solution Maximizing AC-DC Power Supply Efficiency Yong Li, iWatt Inc., United States Jerry Zheng, iWatt Inc., United States | 349 |
| Average Modeling and Control for Three-Phase Three-Level Non-Regenerate Rectifier with Unbalanced DC Loads Rixin Lai, GE Global Research Center, United States Fred Wang, University of Tennessee - Knoxville and Oak Ridge National Laboratory, United States Rolando Burgos, ABB Inc., United States Dushan Boroyevich, Virginia Polytechnic Institute and State University, United States | 355 |
| Session B1L-C: Active Power Filter Wednesday, February 24, 8:30 - 10:10 Session Chairs: Jingjun Liu, Xi'an Jiaotong Univ. Jin Wang, Ohio State University | |
| A Waveform Control Technique for High Power Shunt Active Power Filter Based on Repetitive Control Algorithm Zhiqiang Wang, Zhejiang University, China Chuan Xie, Zhejiang University, China Chao He, Zhejiang University, China Guozhu Chen, Zhejiang University, China | 361 |

| A Combined Series-Parallel Active Filter System Implementation Using Generalized Non-Active Power Theory Mehmet Ucar, Kocaeli University, Turkey Sule Ozdemir, Kocaeli University, Turkey Engin Ozdemir, Kocaeli University, Turkey | 367 |
|--|-----|
| A Novel Control Method for Unified Power Quality Conditioner (UPQC) Under Non-Ideal Mains Voltage and Unbalanced Load Conditions Metin Kesler, Kocaeli University, Turkey Engin Ozdemir, Kocaeli University, Turkey | 374 |
| Resonant Current Regulation for Transformerless Hybrid Active Filter to Suppress Harmonic Resonances in Industrial Power Systems Tzung-Lin Lee, National Sun Yat-sen University, Taiwan Yen-Ching Wang, National Sun Yat-sen University, Taiwan Josep M. Guerrero, Technical University of Catalonia, Spain | 380 |
| Session B1L-D: Semiconductor Devices Wednesday, February 24, 8:30 - 10:10 Session Chairs: Carl Blake, Transphorm Chuck Mullett, ON Semiconductor | |
| Performance Evaluation of High Voltage Super Junction MOSFETs for Zero-Voltage Soft-Switching Inverter Applications Sung-Yeul Park, University of Connecticut, United States Pengwei Sun, Virginia Polytechnic Institute and State University, United States Wensong Yu, Virginia Polytechnic Institute and State University, United States Jih-Sheng Lai, Virginia Polytechnic Institute and State University, United States | 387 |
| New 1.7kV IGBT Chip with Fine Pattern and Optimized Buffer Layer John F. Donlon, Powerex, Inc., United States Eric R. Motto, Powerex, Inc., United States K. Satoh, Mitsubishi Electric Corp, Japan K. Suzuki, Mitsubishi Electric Corp, Japan Y. Yoshihiura, Mitsubishi Electric Corp, Japan T. Takahashi, Mitsubishi Electric Corp, Japan | 392 |
| Novel Thermally Enhanced Power Package Juan A. Herbsommer, Texas Instruments, United States Jonathan Noquil, Texas Instruments, Philippines Chris Bull, Texas Instruments, United States Osvaldo Lopez, Texas Instruments, United States | 398 |
| Recent Advances in Silicon Carbide MOSFET Power Devices Ljubisa D. Stevanovic, GE Global Research, United States Kevin S. Matocha, GE Global Research, United States Peter A. Losee, GE Global Research, United States John S. Glaser, GE Global Research, United States Jeffrey J. Nasadoski, GE Global Research, United States Stephen D. Arthur, GE Global Research, United States | 401 |

| Session B1L-E: Sensorless Techniques in Motor Drives Wednesday, February 24, 8:30 - 10:10 Session Chairs: Patrick Chapman, <i>University of Illinois</i> | |
|---|-----|
| Start-Up Transient Improvement for Sensorless Control Approach of PM Motor Dong Jiang, Virginia Polytechnic Institute and State University, United States Rixin Lai, Virginia Polytechnic Institute and State University, United States Fred Wang, University of Tennessee - Knoxville, United States Rolando Burgos, Virginia Polytechnic Institute and State University, United States Dushan Boroyevich, Virginia Polytechnic Institute and State University, United States | 408 |
| Sensorless Position Control of Skewed Rotor Induction Machines Based on Multi Saliency Extraction | 414 |
| T.M. Wolbank, Vienna University of Technology, Austria M.K. Metwally, Vienna University of Technology, Austria | |
| Fuzzy Gain Scheduling PI Controller for a Sensorless Four Switch Three Phase BLDC Motor | 420 |
| Chung-Wen Hung, National Yunlin University of Science and Technology, Taiwan Jen-Ta Su, National Taiwan University, Taiwan Chih-Wen Liu, National Taiwan University, Taiwan Cheng-Tsung Lin, DynaPack Co., Ltd., Taiwan Jhih-Han Chen, National Yunlin University of Science and Technology, Taiwan | 0 |
| Equivalent EMF Based Position Observers for Sensorless Synchronous Machines | 425 |
| Session B1L-F: Modeling, Simulation & Control I Wednesday, February 24, 8:30 - 10:10 Session Chairs: Mahesh Krishnamurthy, Illinois Institue of Technology | |
| An Improved Winding Loss Analytical Model of Flyback Transformer Wei Yuan, Zhejiang University, China Xiucheng Huang, Zhejiang University, China Peipei Meng, Zhejiang University, China Guoxing Zhang, Zhejiang University, China Junming Zhang, Zhejiang University, China | 433 |
| Identification of the Material Properties Used in Domestic Induction Heating Appliances for System-Level Simulation and Design Purposes Jesus Acero, University of Zaragoza, Spain Oscar Lucía, University of Zaragoza, Spain Ignacio Millan, University of Zaragoza, Spain Luis Angel Barragán, University of Zaragoza, Spain Jose-Miguel Burdío, University of Zaragoza, Spain Rafael Alonso, University of Zaragoza, Spain | 439 |

| A Retrofit 60 Hz Current Sensor for Non-Intrusive Power Monitoring at the Circuit Breaker Zachary Clifford, Massachusetts Institute of Technology, United States John J. Cooley, Massachusetts Institute of Technology, United States Al-Thaddeus Avestruz, Massachusetts Institute of Technology, United States Zack Remscrim, Massachusetts Institute of Technology, United States Dan Vickery, Massachusetts Institute of Technology, United States Steven B. Leeb, Massachusetts Institute of Technology, United States | 444 |
|---|-----|
| Session B1L-G: Vehicle Electronics I Wednesday, February 24, 8:30 - 10:10 Session Chairs: Ali Emadi, Illinois Institute of Technology | |
| Feasibility of Capacitor Voltage Regulation and Output Voltage Harmonic Minimization in Cascaded H-Bridge Converters Hossein Sepahvand, Missouri University of Science and Technology, United States Mostafa Khazarei, Missouri University of Science and Technology, United States Mehdi Ferdowsi, Missouri University of Science and Technology, United States Keith Corzine, Missouri University of Science and Technology, United States | 452 |
| Examination of a PHEV Bidirectional Charger System for V2G Reactive Power Compensation Mithat C. Kisacikoglu, University of Tennessee, United States Burak Ozpineci, Oak Ridge National Laboratory, United States Leon M. Tolbert, University of Tennessee and Oak Ridge National Laboratory, United States | 458 |
| Optimal Selection and Design of the Supercapacitor Module for Fuel Cell Vehicles Sang-Hyun Kim, Soongsil University, Korea, South Tae-Hoon Kim, Soongsil University, Korea, South Wook Kim, Soongsil University, Korea, South Jong-Hak Lee, Soongsil University, Korea, South Woojin Choi, Soongsil University, Korea, South | 466 |
| Efficiency Evaluation of a 55kW Soft-Switching Module Based Inverter for High Temperature Hybrid Electric Vehicle Drives Application Pengwei Sun, Virginia Polytechnic Institute and State University, United States Jih-Sheng Lai, Virginia Polytechnic Institute and State University, United States Hao Qian, Virginia Polytechnic Institute and State University, United States Wensong Yu, Virginia Polytechnic Institute and State University, United States Chris Smith, Azure Dynamics Inc., United States John Bates, Azure Dynamics Inc., United States Beat Arnet, Azure Dynamics Inc., United States Alexander Litvinov, Powerex Inc., United States Scott Leslie, Powerex Inc., United States | 474 |

| Wednesday, February 24, 14:00 - 15:40 Session Chairs: Jin Wang, Ohio State University Wayne Weaver, Michigan Technological University | |
|---|-----|
| Real-Time Hybrid Model Predictive Control of a Boost Converter with Constant Power Load Jason Neely, Purdue University, United States Steve Pekarek, Purdue University, United States Ray DeCarlo, Purdue University, United States Nir Vaks, Purdue University, United States | 480 |
| Predictive Control of Buck Converter Using Nonlinear Output Capacitor Current Programming Victor Sui-pung Cheung, City University of Hong Kong, China Henry Shu-hung Chung, City University of Hong Kong, China Huai Wang, City University of Hong Kong, China | 491 |
| Analysis of a High Performance Voltage Regulator with Non-Linear Multi-Mode Control: Bandwidth and Large Transient Response S. Pan, Queen's University, Canada P.K. Jain, Queen's University, Canada | 499 |
| Multi-Output Synchronously-Rectified Forward Converter with Load Transient Considered K.I. Hwu, National Taipei University of Technology, Taiwan Y.T. Yau, National Taipei University of Technology, Taiwan | 507 |
| Session B2L-B: System Integration I Wednesday, February 24, 14:00 - 15:40 Session Chairs: Shamala Chickamenahalli, Intel | |
| Symmetric Current Balancing Circuit for Multiple DC Loads Sungjin Choi, Samsung Electronics Co., Ltd., Korea, South Pankaj Agarwal, Samsung Electronics Co., Ltd., Korea, South Teahoon Kim, Samsung Electronics Co., Ltd., Korea, South Joonhyun Yang, Samsung Electronics Co., Ltd., Korea, South Baikhee Han, Samsung Electronics Co., Ltd., Korea, South | 512 |
| A Simple Method for Configuring Multi-PWM Channels for Multi-Level Converter Applications Based on PWM IP Core Haibing Hu, Nanjing University of Aeronautics and Astronautics, China Xiaodong Ding, Nanjing Guojun Electric Co., Ltd., China Tao Xue, Nanjing Sute Electric Co., Ltd., China Wenxi Yao, Zhejiang University, China Zhengyu Lu, Zhejiang University, China | 519 |

Session B2L-A: DC-DC Converter IV

| Technology Roadmapping for Power Supply in Package (PSiP) and Power Supply on Chip (PwrSoC) Raymond Foley, University College Cork, Ireland Finbarr Waldron, Tyndall National Institute, Ireland John Slowey, University College Cork, Ireland Arnold Alderman, Anagenesis Inc., United States Brian Narveson, Texas Instruments, United States Cian Ó'Mathúna, Tyndall National Institute, Ireland | 525 |
|---|-----|
| Technology Road Map for High Frequency Integrated DC-DC Converter Qiang Li, Virginia Polytechnic Institute and State University, United States Michele Lim, Virginia Polytechnic Institute and State University, United States Julu Sun, Virginia Polytechnic Institute and State University, United States Arthur Ball, Virginia Polytechnic Institute and State University, United States Yucheng Ying, Virginia Polytechnic Institute and State University, United States Fred C. Lee, Virginia Polytechnic Institute and State University, United States K.D.T. Ngo, Virginia Polytechnic Institute and State University, United States | 533 |
| Session B2L-C: Resonant DC-DC Converters I Wednesday, February 24, 14:00 - 15:40 Session Chairs: Dustin Becker, Emerson Network Power Russell Spyker, USAF | |
| A New Valley-Detection Method for the Quasi-Resonance Switching Gwan-Bon Koo, Fairchild Semiconductor, Korea, South Sang-Cheol Moon, Fairchild Semiconductor, Korea, South Jin-Tae Kim, Fairchild Semiconductor, Korea, South | 540 |
| Secondary-Side Control of a Constant Frequency Series Resonant Converter Using Dual-Edge PWM Darryl J. Tschirhart, Queen's University, Canada Praveen K. Jain, Queen's University, Canada | 544 |
| A Non-Insulated Resonant Boost Converter Peng Shuai, RWTH Aachen University, Germany Yales R. De Novaes, ABB, Switzerland Francisco Canales, ABB, Switzerland Ivo Barbi, Federal University of Santa Catarina, Brazil | 550 |
| | |

| Session B2L-D: Miscellaneous Applications Wednesday, February 24, 14:00 - 15:40 Session Chairs: Alejandro Dominguez-Garcia, <i>University of Illinois</i> | |
|--|-----|
| ZVS and ZCS DC-DC PWM Full-Bridge Fuel Cell Converters Ahmad Mousavi, University of Western Ontario, Canada Pritam Das, University of Western Ontario, Canada Gerry Moschopoulos, University of Western Ontario, Canada | 564 |
| Effective Switching Mode Power Supplies Common Mode Noise Cancellation Technique with Zero Equipotential Transformer Models Yick Po Chan, University of Hong Kong, China Man Hay Pong, University of Hong Kong, China Ngai Kit Poon, University of Hong Kong, China Chui Pong Liu, University of Hong Kong, China | 571 |
| 50W Power Device (PD) Power in Power Over Ethernet (PoE) System with Input Current Balance in Four-Pair Architecture with Two DC-DC Converters Haimeng Wu, Zhejiang University, China Zhengshi Wang, Zhejiang University, China Jiande Wu, Zhejiang University, China Xiangning He, Zhejiang University, China Yan Deng, Zhejiang University, China | 575 |
| High-Resolution Physically-Windowed Sensors for Power Electronics Applications | 580 |
| Session B2L-E: LED Lighting I Wednesday, February 24, 14:00 - 15:40 Session Chairs: Regan Zane, University of Colorado | |
| Edison Revisited: Impact of DC Distribution on the Cost of LED Lighting and Distributed Generation Brinda A. Thomas, Carnegie Mellon University, United States | 588 |
| A Novel Passive Off-Line Light-Emitting Diode (LED) Driver with Long Lifetime S.Y.R. Hui, City University of Hong Kong, China S.N. Li, City University of Hong Kong, China X.H. Tao, City University of Hong Kong, China W. Chen, City University of Hong Kong, China W.M. Ng, City University of Hong Kong, China | 594 |
| Improving Current Regulation for Offline LED Driver | 601 |
| LED Driver Circuit with Inherent PFC D. Aguilar, University of Minnesota, United States C.P. Henze, Analog Power Design Inc., United States | 605 |

| Wednesday, Feb | ruary 24, 14:00 - 15:40 | |
|--|---|-----|
| Session Chairs: | Hui Li, Florida State University | |
| | Miaosen Shen, United Technologies Research Center | |
| Three-Phase AC M Hyunjae Yoo, Samsu | ign and Control to Reduce Input Harmonic Current for a lachine Drive System Having a Very Small DC-Link Capacitor ng Heavy Industries Co., Ltd., Korea, South National University, Korea, South | 611 |
| Parallel Inverters f Chien Liang Chen, Vi Jih-Sheng Lai, Virgini Daniel Martin, Virginia | ling, Analysis, and Implementation of For Microgrid Applications | 619 |
| Pulse Skipping Co Haibing Hu, <i>Universit</i> Wisam Al-Hoor, <i>Unive</i> Nasser Kutkut, <i>Unive</i> Issa Batarseh, <i>Unive</i> | ement of Grid-Tied Inverters at Low Input Power Using ontrol Strategy y of Central Florida, United States ersity of Central Florida, United States rsity of Central Florida, United States rsity of Central Florida, United States y of Central Florida, United States y of Central Florida, United States | 627 |
| Carlos D. Rodríguez- | op for Unbalanced Utility Conditions Valdez, Rockwell Automation, United States ockwell Automation, United States | 634 |
| Wednesday, Feb | Isolated DC-DC Converters I ruary 24, 14:00 - 15:40 Alexis Kwasinski, <i>The University of Texas at Austin</i> Sheldon Williamson, <i>Concordia University</i> | |
| RCD Snubber in F Peipei Meng, Zhejian Xinke Wu, Zhejiang U Jianyou Yang, Zhejian Henglin Chen, Zhejian | Iniversity, China ng University, China | 642 |
| Hybrid Pair of SJ-I Rejeki Simanjorang, I Hiroshi Yamaguchi, N Hiromichi Ohashi, Na | | 648 |

Session B2L-F: Power Electronics for Utility Interface III

| A 500 W Push-Pull DC-DC Power Converter with a 30 MHz Switching Frequency | 654 |
|---|-----|
| Input-Series Connnected High Frequency DC-DC Converters with One Transformer | 662 |
| Session B3L-A: Renewable Energy Wednesday, February 24, 16:10 - 17:25 Session Chairs: Chris Edrington, Florida State University Alex Huang, North Carolina State University | |
| Simple Photovoltaic Solar Cell Dynamic Sliding Mode Controlled Maximum Power Point Tracker for Battery Charging Applications Emil A. Jimenez-Brea, University of Puerto Rico-Mayaguez, Puerto Rico Eduardo I. Ortiz-Rivera, University of Puerto Rico-Mayaguez, Puerto Rico Andres Salazar-Llinas, University of Puerto Rico-Mayaguez, Puerto Rico Jesus Gonzalez-Llorente, University of Puerto Rico-Mayaguez, Puerto Rico | 666 |
| An Enhanced Circuit-Based Model for Single-Cell Battery Jiucai Zhang, University of Nebraska-Lincoln, United States Song Ci, University of Nebraska-Lincoln, United States Hamid Sharif, University of Nebraska-Lincoln, United States Mahmoud Alahmad, University of Nebraska-Lincoln, United States | 672 |
| A High Frequency Battery Model for Current Ripple Analysis Jin Wang, Ohio State University, United States Ke Zou, Ohio State University, United States Chingchi Chen, Ford Motor Company, United States Lihua Chen, Ford Motor Company, United States | 676 |
| Session B3L-B: System Integration II Wednesday, February 24, 16:10 - 17:25 Session Chairs: Shamala Chickamenahalli, Intel | |
| A Novel Power Line Communication Technique Based on Power Electronics Circuit Topology Jiande Wu, Zhejiang University, China Chushan Li, Zhejiang University, China Xiangning He, Zhejiang University, China | 681 |
| Compact Temperature Compensation of Inductive Fly-back Clamps for Integrated Power Switches Using a High-Voltage Base-Current-Compensated V _{be} Multiplier | 686 |

| Optimal Design for the Damping Resistor in RCD-R Snubber to Suppress Common-Mode Noise Peipei Meng, Zhejiang University, China Henglin Chen, Zhejiang University, China Sheng Zheng, Zhejiang University, China Xinke Wu, Zhejiang University, China Zhaoming Qian, Zhejiang University, China | 691 |
|--|-----|
| Session B3L-C: Resonant DC-DC Converters II Wednesday, February 24, 16:10 - 17:25 Session Chairs: Dustin Becker, <i>Emerson Network Power</i> Russell Spyker, <i>USAF</i> | |
| A High-Efficient LLCC Series-Parallel Resonant Converter Christian P. Dick, RWTH Aachen University, Germany Furkan Kaan Titiz, RWTH Aachen University, Germany Rik De Doncker, RWTH Aachen University, Germany | 696 |
| Accurate Switching Loss Model and Optimal Design of a Current Source Driver Considering the Current Diversion Problem Jizhen Fu, Queen's University, Canada Zhiliang Zhang, Nanjing University of Aeronautics and Astronautics, China Andrew Dickson, Queen's University, Canada Yan-Fei Liu, Queen's University, Canada P.C. Sen, Queen's University, Canada | 702 |
| Bidirectional Operation of Resonant Voltage Divider K.I. Hwu, National Taipei University of Technology, Taiwan Y.T. Yau, National Taipei University of Technology, Taiwan | 710 |
| Session B3L-D: RF Applications Wednesday, February 24, 16:10 - 17:25 Session Chairs: Alejandro Dominguez-Garcia, <i>University of Illinois</i> | |
| Multiple-Input Buck Converter Optimized for Accurate Envelope Tracking in RF Power Amplifiers M. Rodríguez, University of Oviedo, Spain P.F. Miaja, University of Oviedo, Spain A. Rodríguez, University of Oviedo, Spain J. Sebastián, University of Oviedo, Spain | 715 |
| Switching Capacities Based Envelope Amplifier for High Efficiency RF Amplifiers M. Vasić, Universidad Politécnica de Madrid, Spain O. García, Universidad Politécnica de Madrid, Spain J.A. Oliver, Universidad Politécnica de Madrid, Spain P. Alou, Universidad Politécnica de Madrid, Spain D. Diaz, Universidad Politécnica de Madrid, Spain J.A. Cobos, Universidad Politécnica de Madrid, Spain | 723 |

| Session B3L-E: LED Lighting II Wednesday, February 24, 16:10 - 17:25 Session Chairs: Regan Zane, University of Colorado Applying One-Comparator Counter-Based Sampling to Current Sharing Control of Multi-Channel LED Strings | High Efficiency Power Amplifier for High Frequency Radio Transmitters M. Vasić, Universidad Politécnica de Madrid, Spain O. García, Universidad Politécnica de Madrid, Spain J.A. Oliver, Universidad Politécnica de Madrid, Spain P. Alou, Universidad Politécnica de Madrid, Spain D. Diaz, Universidad Politécnica de Madrid, Spain J.A. Cobos, Universidad Politécnica de Madrid, Spain A. Gimeno, Universidad Politécnica de Madrid, Spain J.M. Pardo, Universidad Politécnica de Madrid, Spain C. Benavente, Universidad Politécnica de Madrid, Spain F.J. Ortega, Universidad Politécnica de Madrid, Spain | 729 |
|---|--|-----|
| Multi-Channel LED Strings K.I. Hwu, National Taipei University of Technology, Taiwan Y.T. Yau, National Taipei University of Technology, Taiwan High Frequency PWM Dimming Technique for High Power Factor Converters in LED Lighting D. Gacio, University of Oviedo, Spain J. M. Alonso, University of Oviedo, Spain J. Garcia, University of Oviedo, Spain L. Campa, University of Oviedo, Spain M. Crespo, University of Oviedo, Spain M. Rico-Secades, University of Oviedo, Spain M. Rico-Secades, University of Oviedo, Spain M. Rico-Secades, University of Arkansas, United States Do Hung Nguyen, University of Arkansas, United States Simon S. Ang, University of Arkansas, United States Simon S. Ang, University of Arkansas, United States Session B3L-F: Power Electronics for Utility Interface IIII Wednesday, February 24, 16:10 - 17:25 Session Chairs: Hui Li, Florida State University Miaosen Shen, United Technologies Research Center A Low Investment Single-Phase to Three-Phase Converter Operating with Reduced Losses José A.A. Dias, Instituto Federal de Educação, Ciência e Tecnologia da Paraiba, Brazil Euzeli C. dos Santos, Universidade Federal de Campina Grande, Brazil | Wednesday, February 24, 16:10 - 17:25 | |
| In LED Lighting D. Gacio, University of Oviedo, Spain J.M. Alonso, University of Oviedo, Spain J. Garcia, University of Oviedo, Spain L. Campa, University of Oviedo, Spain M. Crespo, University of Oviedo, Spain M. Rico-Secades, University of Oviedo, Spain M. Rico-Secades, University of Oviedo, Spain M. Rico-Secades, University of Arkansas, United States Do Hung Nguyen, University of Arkansas, United States Simon S. Ang, University of Arkansas, United States Simon S. Ang, University of Arkansas, United States Session B3L-F: Power Electronics for Utility Interface IIII Wednesday, February 24, 16:10 - 17:25 Session Chairs: Hui Li, Florida State University Miaosen Shen, United Technologies Research Center A Low Investment Single-Phase to Three-Phase Converter Operating with Reduced Losses José A.A. Dias, Instituto Federal de Educação, Ciência e Tecnologia da Paraíba, Brazil Euzeli C. dos Santos, Universidade Federal de Campina Grande, Brazil | Multi-Channel LED Strings K.I. Hwu, National Taipei University of Technology, Taiwan | 737 |
| A RGB-Driver for LED Display Panels Jaber Hasan, University of Arkansas, United States Do Hung Nguyen, University of Arkansas, United States Simon S. Ang, University of Arkansas, United States Session B3L-F: Power Electronics for Utility Interface IIII Wednesday, February 24, 16:10 - 17:25 Session Chairs: Hui Li, Florida State University Miaosen Shen, United Technologies Research Center A Low Investment Single-Phase to Three-Phase Converter Operating with Reduced Losses José A.A. Dias, Instituto Federal de Educação, Ciência e Tecnologia da Paraíba, Brazil Euzeli C. dos Santos, Universidade Federal de Campina Grande, Brazil | in LED Lighting D. Gacio, University of Oviedo, Spain J.M. Alonso, University of Oviedo, Spain J. Garcia, University of Oviedo, Spain L. Campa, University of Oviedo, Spain M. Crespo, University of Oviedo, Spain | 743 |
| Wednesday, February 24, 16:10 - 17:25 Session Chairs: Hui Li, Florida State University | A RGB-Driver for LED Display Panels Jaber Hasan, University of Arkansas, United States Do Hung Nguyen, University of Arkansas, United States | 750 |
| Operating with Reduced Losses | Wednesday, February 24, 16:10 - 17:25 Session Chairs: Hui Li, Florida State University | |
| | Operating with Reduced Losses José A.A. Dias, Instituto Federal de Educação, Ciência e Tecnologia da Paraíba, Brazil Euzeli C. dos Santos, Universidade Federal de Campina Grande, Brazil | 755 |

| Voltage and Power Balance Control for a Cascaded Multilevel Solid State Transformer Tiefu Zhao, North Carolina State University, United States Gangyao Wang, North Carolina State University, United States Jie Zeng, North Carolina State University, United States Sumit Dutta, North Carolina State University, United States Subhashish Bhattacharya, North Carolina State University, United States Alex Q. Huang, North Carolina State University, United States | 761 |
|--|-----|
| Grid-Connected Voltage Source Inverter for Renewable Energy Conversion System with Sensorless Current Control Suzan Eren, Queen's University, Canada Majid Pahlevaninezhad, Queen's University, Canada Alireza Bakhshai, Queen's University, Canada Praveen Jain, Queen's University, Canada | 768 |
| Session B3L-G: Isolated DC-DC Converters II Wednesday, February 24, 16:10 - 17:25 Session Chairs: Alexis Kwasinski, <i>The University of Texas at Austin</i> Sheldon Williamson, <i>Concordia University</i> | |
| Design of an 99%-Efficient, 5kW, Phase-Shift PWM DC-DC Converter for Telecom Applications U. Badstuebner, ETH Zurich, Switzerland J. Biela, ETH Zurich, Switzerland J.W. Kolar, ETH Zurich, Switzerland | 773 |
| DC-DC Transformer Multiphase Converter with Transformer Coupling for Two-Stage Architecture M.C. Gonzalez, Universidad Politécnica de Madrid, Spain P. Alou, Universidad Politécnica de Madrid, Spain O. Garcia, Universidad Politécnica de Madrid, Spain J.A. Oliver, Universidad Politécnica de Madrid, Spain J.A. Cobos, Universidad Politécnica de Madrid, Spain H. Visairo, Intel Corporation, Mexico | 781 |
| A Comparison of Classical Two Phase (2L) and Transformer – Coupled (XL) Interleaved Boost Converters for Fuel Cell Applications Kevin J. Hartnett, University College Cork, Ireland Marek S. Rylko, University College Cork, Ireland John G. Hayes, University College Cork, Ireland Michael G. Egan, University College Cork, Ireland | 787 |
| Session C1L-A: Applications of DC-DC Converter I Thursday, February 25, 8:30 - 10:10 Session Chairs: Chuck Mullett, ON Semiconductor Kevin Parmenter, Freescale | |
| Design Considerations for Narrow Vdc Based Power Delivery Architecture in Mobile Computing System Xiaoguo Liang, Intel Asia-Pacific Research & Development Ltd., China Gnanavel Jayakanthan, Intel Asia-Pacific Research & Development Ltd., China Meng Wang, Intel Asia-Pacific Research & Development Ltd., China | 794 |

| Active Clamp Boost Converter with Switched Capacitor and Coupled Inductor | 01 |
|--|----|
| Unified Modulation for Three-Phase Current-Fed Bidirectional DC-DC Converter Under Varied Input Voltage | 07 |
| Integrated Switched-Capacitor Voltage Doubler with Clock Transition Periods Boosting and Transfer Blocking Techniques | 13 |
| Session C1L-B: AC-DC Conversion Misc. Topics I Thursday, February 25, 8:30 - 10:10 Session Chairs: Frank Cirolia, Emerson Network Power Alireza Khaligh, Illinois Institute of Technology | |
| A Novel Class of Multipulse Converters Based on High-Frequency-Operated Transformers 8 Sheng Zheng, Zhejiang University, China Dong Chen, Zhejiang University, China Hai Lin, Zhejiang University, China Yousheng Wang, Zhejiang University, China Zhaoming Qian, Zhejiang University, China Fang Z. Peng, Michigan State University, United States | 18 |
| A High Efficiency Flyback Converter with New Active Clamp Technique 8. Xiucheng Huang, Zhejiang University, China Weijing Du, Zhejiang University, China Wei Yuan, Zhejiang University, China Junming Zhang, Zhejiang University, China Zhaoming Qian, Zhejiang University, China | 23 |
| Analysis and Design of a Novel Integrated Three-Phase Single-Stage AC-DC PWM Full-Bridge Converter Dunisha Wijeratne, University of Western Ontario, Canada Gerry Moschopoulos, University of Western Ontario, Canada | 29 |
| Three-Phase Voltage Doubler Rectifier Based on Three-State Switching Cell for Uninterruptible Power Supply Applications Using FPGA 8. Raphael A. da Câmara, Universidade Federal do Ceará, Brazil P.P. Praça, Universidade Federal do Ceará, Brazil C.M.T. Cruz, Universidade Federal do Ceará, Brazil R.P. Torrico-Bascopé, Universidade Federal do Ceará, Brazil C.E.A. Silva, Universidade Federal do Ceará, Brazil D.S. Oliveira, Jr., Universidade Federal do Ceará, Brazil L.H.S.C. Barreto, Universidade Federal do Ceará, Brazil | 37 |

| Thursday, February 25, 8:30 - 10:10 Session Chairs: Ali Bazzi, <i>University of Illinois</i> Patrick Chapman, <i>University of Illinois</i> | |
|---|-----|
| Multi-Loop Control Algorithms for Seamless Transition of Grid-Connected Inverter | 844 |
| Digital Controller Development for Grid-Tied Photovoltaic Inverter with Model Based Technique Zhigang Liang, North Carolina State University, United States Larry Alesi, MegaWatt Solar Inc., United States Xiaohu Zhou, North Carolina State University, United States Alex Q. Huang, North Carolina State University, United States | 849 |
| High-Performance and Cost-Effective Multiple Feedback Control Strategy for Standalone Operation of Grid-Connected Inverter Qin Lei, Michigan State University, United States Shuitao Yang, Zhejiang University, United States Fang Z. Peng, Michigan State University, United States | 854 |
| Current Control Optimization for Grid-Tied Inverters with Grid Impedance Estimation Guoqiao Shen, Zhejiang University, China Jun Zhang, Zhejiang University, China Xiao Li, Zhejiang University, China Chengrui Du, Zhejiang University, China Dehong Xu, Zhejiang University, China | 861 |
| Session C1L-D: Inverter I Thursday, February 25, 8:30 - 10:10 Session Chairs: Russell Spyker, USAF Haidong Yu, Phoenix International | |
| A New Direct Peak DC-Link Voltage Control Strategy of Z-Source Inverters Yu Tang, Nanjing University of Aeronautics and Astronautics, China Jukui Wei, Nanjing University of Aeronautics and Astronautics, China Shaojun Xie, Nanjing University of Aeronautics and Astronautics, China | 867 |
| High Performance Voltage Regulation of Current Source Inverters S.A.S. Grogan, Monash University, Australia D.G. Holmes, Monash University, Australia B.P. McGrath, Monash University, Australia | 873 |
| Development of a New Voltage Source Inverter (VSI) Average Model Including Low Frequency Harmonics S. Ahmed, Virginia Polytechnic Institute and State University, United States D. Boroyevich, Virginia Polytechnic Institute and State University, United States F. Wang, University of Tennessee - Knoxville, United States R. Burgos, ABB US Corporate Research Center, United States | 881 |

Session C1L-C: Grid Interconnection I

| Realization and Improvement of Repetitive Control in Rotating Frame for Active Power Filter System Baifeng Chen, Wuhan University, China Xiaoming Zha, Wuhan University, China Jinwu Gong, Wuhan University, China Suxuan Guo, Wuhan University, China Jianjun Sun, Wuhan University, China | 887 |
|--|-----|
| Session C1L-E: PWM in Motor Drives I Thursday, February 25, 8:30 - 10:10 Session Chairs: Dionysios Aliprantis, <i>Iowa State University</i> | |
| Current Constraints of PWM Rectifier Under Unbalanced Voltage Supply Miroslav Chomat, Institute of Thermomechanics, Czech Rep. Ludek Schreier, Institute of Thermomechanics, Czech Rep. Jiri Bendl, Institute of Thermomechanics, Czech Rep. | 895 |
| Space Vector PWM for a Direct Matrix Converter Based Open-End Winding AC Drives with Enhanced Capabilities Ranjan K. Gupta, University of Minnesota, United States Apurva Somani, University of Minnesota, United States Krushna K. Mohapatra, University of Minnesota, United States Ned Mohan, University of Minnesota, United States | 901 |
| Evaluation of the Hybrid Four-Level Converter Employing Half-Bridge Modules for Two Different Modulation Schemes Alessandro L. Batschauer, Santa Catarina State University, Brazil Arnaldo J. Perin, Federal University of Santa Catarina, Brazil Samir A. Mussa, Federal University of Santa Catarina, Brazil Marcelo L. Heldwein, Federal University of Santa Catarina, Brazil | 909 |
| A Comparative Study of Space Vector PWM Strategy for Dual Three-Phase Permanent-Magnet Synchronous Motor Drives Yanhui He, Xi'an Jiaotong University, China Yue Wang, Xi'an Jiaotong University, China Jinlong Wu, Xi'an Jiaotong University, China Yupeng Feng, Xi'an Jiaotong University, China Jinjun Liu, Xi'an Jiaotong University, China | 915 |
| Session C1L-F: Magnetics in DC-DC Converters Thursday, February 25, 8:30 - 10:10 Session Chairs: Arnold Alderman, PSMA | |
| A Novel Coupled Inductor for Interleaved Converters Qianhong Chen, Nanjing University of Aeronautics and Astronautics, China Ligang Xu, Nanjing university of aeronautics and astronautics, China Xiaoyong Ren, Nanjing University of Aeronautics and Astronautics, China Lingling Cao, Nanjing University of Aeronautics and Astronautics, China Xinbo Ruan, Nanjing University of Aeronautics and Astronautics, China | 920 |

| Transformer's Capacitance Effect on the Operation of Triangular-Current Shaped Soft-Switched Converters llya Zeltser, Ben-Gurion University of the Negev, Israel Sam Ben-Yaakov, Ben-Gurion University of the Negev, Israel | 928 |
|--|-----|
| An Input and Output Ripple Free Converter with a Four-Winding Coupled Inductor | 935 |
| Investigation on Transformer Design of High Frequency High Efficiency DC-DC Converters Dianbo Fu, Virginia Polytechnic Institute and State University, United States Fred C. Lee, Virginia Polytechnic Institute and State University, United States Shuo Wang, Virginia Polytechnic Institute and State University, United States | 940 |
| Session C1L-G: Photovoltaics I Thursday, February 25, 8:30 - 10:10 Session Chairs: Robert Balog, Texas A&M University | |
| A DSP-Based Single-Stage Maximum Power Point Tracking PV Inverter Wen Long Yu, National Taiwan University of Science and Technology, Taiwan Ting-Peng Lee, National Taiwan University of Science and Technology, Taiwan Guan-Hong Wu, National Taiwan University of Science and Technology, Taiwan Qing Su Chen, National Taiwan University of Science and Technology, Taiwan Huang-Jen Chiu, National Taiwan University of Science and Technology, Taiwan Yu-Kang Lo, National Taiwan University of Science and Technology, Taiwan Frank Shih, Macroblock Inc., Taiwan | 948 |
| A Simple Mixed-Signal MPPT Circuit for Photovoltaic Applications P. Mattavelli, University of Padova, Italy S. Saggini, University of Udine, Italy E. Orietti, University of Padova, Italy G. Spiazzi, University of Padova, Italy | 953 |
| Low-Power Maximum Power Point Tracker with Digital Control for Thermophotovoltaic Generators Robert C.N. Pilawa-Podgurski, Massachusetts Institute of Technology, United States Nathan A. Pallo, Massachusetts Institute of Technology, United States Walker R. Chan, Massachusetts Institute of Technology, United States David J. Perreault, Massachusetts Institute of Technology, United States Ivan L. Celanovic, Massachusetts Institute of Technology, United States | 961 |
| 11-Level Cascaded H-Bridge Grid-Tied Inverter Interface with Solar Panels Faete Filho, University of Tennessee, United States Yue Cao, University of Tennessee, United States Leon M. Tolbert, University of Tennessee, United States | 968 |

| Session C2L-A: Applications of DC-DC Converter II Thursday, February 25, 10:40 - 11:30 Session Chairs: Chuck Mullett, ON Semiconductor Kevin Parmenter, Freescale | |
|--|-------|
| A Life Prediction Scheme for Electrolytic Capacitors in Power Converters without Current Sensor H.M. Pang, University of Hong Kong, China M.H. Bryan Pong, University of Hong Kong, China | . 973 |
| Load-Interactive Steered-Inductor DC-DC Converter with Minimized Output Filter Capacitance S.M. Ahsanuzzaman, University of Toronto, Canada Amir Parayandeh, University of Toronto, Canada Aleksandar Prodić, University of Toronto, Canada Dragan Maksimović, University of Colorado at Boulder, United States | . 980 |
| Session C2L-B: AC-DC Conversion Misc. Topics II Thursday, February 25, 10:40 - 11:30 Session Chairs: Frank Cirolia, Emerson Network Power Alireza Khaligh, Illinois Institute of Technology | |
| EMI Filter Design for High Switching Frequency Three-Phase/Level PWM Rectifier Systems M. Hartmann, ETH Zurich, Switzerland H. Ertl, Vienna University of Technology, Austria J.W. Kolar, ETH Zurich, Switzerland | 986 |
| Self-Driven AC-DC Synchronous Rectifier for Power Applications – A Direct Energy-Efficient Replacement for Traditional Diode Rectifier W.X. Zhong, City University of Hong Kong, China W.C. Ho, ConvenientPower HK Ltd., China X. Liu, ConvenientPower HK Ltd., China S.Y.R. Hui, City University of Hong Kong, China | 994 |
| Session C2L-C: Grid Interconnection II Thursday, February 25, 10:40 - 11:30 Session Chairs: Ali Bazzi, University of Illinois | |
| A Robust Control Scheme for Grid-Connected Voltage Source Inverters Shuitao Yang, Zhejiang University and Michigan State University, China Qin Lei, Michigan State University, United States Fang Z. Peng, Michigan State University, United States Zhaoming Qian, Zhejiang University, China | 1002 |
| Application of Active NPC Converter on Generator Side for MW Direct-Driven Wind Turbine Jun Li, North Carolina State University, United States Alex Q. Huang, North Carolina State University, United States Subhashish Bhattacharya, North Carolina State University, United States Wei Jing, China University of Mining and Technology, United States | 1010 |

| Thursday, February 25, 10:40 - 11:30 Session Chairs: Russell Spyker, USAF Haidong Yu, Phoenix International | |
|--|------|
| Nonlinear Modeling of Switched Reluctance Motor Using Different Methods Jun Cai, Nanjing University of Aeronautics and Astronautics, China Zhiquan Deng, Nanjing University of Aeronautics and Astronautics, China Zeyuan Liu, Nanjing University of Aeronautics and Astronautics, China | 1018 |
| Simplified Synchronous Reference Frame Control of the Three Phase Grid Connected Inverter Abad Lorduy, Carlos III University of Madrid, Spain Antonio Lázaro, Carlos III University of Madrid, Spain Andrés Barrado, Carlos III University of Madrid, Spain Cristina Fernández, Carlos III University of Madrid, Spain Isabel Quesada, Carlos III University of Madrid, Spain Carlos Lucena, Carlos III University of Madrid, Spain | 1026 |
| Session C2L-E: PWM in Motor Drives II Thursday, February 25, 10:40 - 11:30 Session Chairs: Dionysios Aliprantis, <i>Iowa State University</i> | |
| A Novel Direct Digital SPWM Method for Multilevel Voltage Source Inverters Wanmin Fei, Nanjing Normal University, China Yanli Zhang, Nanjing Normal University, China Bin Wu, Ryerson University, Canada | 1034 |
| Weight Oriented Optimal PWM in Low Modulation Indexes for Multilevel Inverters with Unbalanced DC Sources Damoun Ahmadi, Ohio State University, United States Ke Zou, Ohio State University, United States Jin Wang, Ohio State University, United States | 1038 |
| Session C2L-F: Measurement and Testing Thursday, February 25, 10:40 - 11:30 Session Chairs: Patrick Chapman, University of Illinois | |
| Oscillation-Test Technique for Buck Voltage Regulator Jing-Yi Huang, National Cheng-Kung University, Taiwan Chun-Hsun Wu, National Cheng-Kung University, Taiwan Le-Ren Chang-Chien, National Cheng-Kung University, Taiwan Soon-Jyh Chang, National Cheng-Kung University, Taiwan | 1043 |
| Core Loss Predictions for General PWM Waveforms from a Simplified Set of Measured Data Charles R. Sullivan, Thayer School of Engineering at Dartmouth, United States John H. Harris, Thayer School of Engineering at Dartmouth, United States Edward Herbert, EMTT, Inc., United States | 1048 |

Session C2L-D: Inverter II

| Thursday, February 25, 10:40 - 11:30 Session Chairs: Robert Balog, Texas A&M University | |
|---|------|
| High-Efficiency Inverter with H6-Type Configuration for Photovoltaic Non-Isolated AC Module Applications | 1056 |
| Analyzing the Optimal Matching of DC Motors to Photovoltaic Modules via DC-DC Converters Jesus Gonzalez-Llorente, University of Puerto Rico-Mayaguez, Puerto Rico Eduardo I. Ortiz-Rivera, University of Puerto Rico-Mayaguez, Puerto Rico Andres Salazar-Llinas, University of Puerto Rico-Mayaguez, Puerto Rico Emil Jimenez-Brea, University of Puerto Rico-Mayaguez, Puerto Rico | 1062 |
| Session C3L-A: Load Management Interface I Thursday, February 25, 14:00 - 15:40 Session Chairs: Siamak Abedinpour, Freescale Jonathan Kimball, Missouri S&T | |
| Performance Analysis of an Interleaved High Step-Up Converter with Voltage Multiplier Cell Wuhua Li, Zhejiang University, China Yi Zhao, Zhejiang University, China Yan Deng, Zhejiang University, China Xiangning He, Zhejiang University, China | 1069 |
| FPGA-Based Multi-Phase Digital Pulse Width Modulator with Dual-Edge Modulation Martin Scharrer, University of Limerick, Ireland Mark Halton, University of Limerick, Ireland Tony Scanlan, University of Limerick, Ireland Karl Rinne, University of Limerick, Ireland | 1075 |
| Phase Doubler for High Power Voltage Regulators Chun Cheung, Intersil Corporation, United States Weihong Qiu, Intersil Corporation, United States Emil Chen, Intersil Corporation, United States Greg Miller, Intersil Corporation, United States | 1081 |
| Automatic Multi-Phase Digital Pulse Width Modulator Simon Effler, University of Limerick, Ireland Mark Halton, University of Limerick, Ireland Karl Rinne, University of Limerick, Ireland | 1087 |

Session C2L-G: Photovoltaics II

| Thursday, February 25, 14:00 - 15:40 Session Chairs: Chris Edrington, Florida State University Patrick Chapman, University of Illinois | |
|---|------|
| A Simple Current Sharing Scheme for Dual Three-Phase Permanent-Magnet Synchronous Motor Drives Yanhui He, Xi'an Jiaotong University, China Yue Wang, Xi'an Jiaotong University, China Jinlong Wu, Xi'an Jiaotong University, China Yupeng Feng, Xi'an Jiaotong University, China Jinjun Liu, Xi'an Jiaotong University, China | 1093 |
| Multilevel Current Source Inverter Topologies Based on the Duality Principle Jianyu Bao, Ningbo Institute of Technology, Zhejiang University, China Weibing Bao, Zhejiang University of Science and Technology, China Siran Wang, Zhejiang University, China Zhongchao Zhang, Zhejiang University, China | 1097 |
| 3-Level Power Converter with High-Voltage SiC-PiN Diode and Hard-Gate-Driving of IEGT for Future High-Voltage Power Conversion Systems Kazuto Takao, Toshiba Corporation, Japan Yasunori Tanaka, National Institute of Advanced Industrial Science and Technology, Japan Kyungmin Sung, Ibaraki National College of Technology, Japan Keiji Wada, Tokyo Metoropolitan University, Japan Takashi Shinohe, Toshiba Corporation, Japan Takeo Kanai, Toshiba Mitsubishi-Electric Industrial Systems Corporation, Japan Hiromichi Ohashi, National Institute of Advanced Industrial Science and Technology, Japan | 1101 |
| 18 kW Three Phase Inverter System Using Hermetically Sealed SiC Phase-Leg Power Modules Hui Zhang, Tuskegee University, United States Leon M. Tolbert, University of Tennessee, United States Jung Hee Han, Global Power Electronics, United States Madhu S. Chinthavali, Oak Ridge National Laboratory, United States Fred Barlow, University of Idaho, United States | 1108 |
| Session C3L-C: DC-DC Converter V Thursday, February 25, 14:00 - 15:40 Session Chairs: Frank Ciriola, Emerson Arnold Alderman, PSMA | |
| Multiphase Optimal Response Mixed-Signal Current-Programmed Mode Controller Jurgen Alico, University of Toronto, Canada Aleksandar Prodić, University of Toronto, Canada | 1113 |
| Switching Loss Analysis of Closed-Loop Gate Drive Lihua Chen, Michigan State University, United States Fang Z. Peng, Michigan State University, United States | 1119 |

Session C3L-B: Power Electronics in Motor Drives I

| Modeling and Analysis of Closed-Loop Gate Drive Lihua Chen, Michigan State University, United States Baoming Ge, Michigan State University, United States Fang Z. Peng, Michigan State University, United States | 124 |
|---|-----|
| Black-Box Modeling of DC-DC Converters Based on Transient Response Analysis and Parametric Identification Methods V. Valdivia, Carlos III University of Madrid, Spain A. Barrado, Carlos III University of Madrid, Spain A. Lázaro, Carlos III University of Madrid, Spain C. Fernández, Carlos III University of Madrid, Spain P. Zumel, Carlos III University of Madrid, Spain | 131 |
| Session C3L-D: Transportation Thursday, February 25, 14:00 - 15:40 Session Chairs: Jaber Abu Qahouq, <i>University of Alabama</i> Dionysios Aliprantis, <i>Iowa State University</i> | |
| Harmonic and Balance Compensation Using Instantaneous Active and Reactive Power Control on Electric Railway Systems 1 A. Bueno, Universidad Simón Bolívar, Venezuela J.M. Aller, Universidad Simón Bolívar, Venezuela J. Restrepo, Universidad Simón Bolívar, Venezuela T. Habetler, Georgia Institute of Technology, United States | 139 |
| Review of Non-Isolated Bi-Directional DC-DC Converters for Plug-in Hybrid Electric Vehicle Charge Station Application at Municipal Parking Decks Yu Du, North Carolina State University, United States Xiaohu Zhou, North Carolina State University, United States Sanzhong Bai, North Carolina State University, United States Srdjan Lukic, North Carolina State University, United States Alex Huang, North Carolina State University, United States | 145 |
| Control of Plug-in Hybrid Electric Vehicles for Mobile Power Generation and Grid Support Applications | 152 |
| Interface Issues of Mining Haul Trucks Operating on Trolley Systems | 158 |
| Session C3L-E: Power Converter Applications I Thursday, February 25, 14:00 - 15:40 Session Chairs: Vajapeyam Sukumar, Maxim Integrated Products | |
| Regenerative AC Electronic Load with One-Cycle Control In Wha Jeong, University of California, Irvine, United States Mikhail Slepchenkov, University of California, Irvine, United States Keyue Smedley, University of California, Irvine, United States Franco Maddaleno, University of California, Irvine, United States | 166 |

| A High Efficiency Regulated Charge Pump Over Wide Input and Load Range Rong Guo, North Carolina State University, United States Liyu Yang, North Carolina State University, United States Alex Huang, North Carolina State University, United States John Endredy, RF Micro Devices, United States | 1172 |
|---|------|
| High Performance, High-Power Capacitor Charging: Focus on Pulse-to-Pulse Repeatability A. Pokryvailo, Spellman High Voltage Electronics Corporation, United States C. Carp, Spellman High Voltage Electronics Corporation, United States C. Scapellati, Spellman High Voltage Electronics Corporation, United States | 1177 |
| Generalized AC-DC Single-Phase Boost Rectifier C.B. Jacobina, Universidade Federal de Campina Grande, Brazil Euzeli dos Santos, Universidade Federal de Campina Grande, Brazil Nady Rocha, Universidade Federal de Campina Grande, Brazil | 1183 |
| Session C3L-F: Utility Interface Applications Thursday, February 25, 14:00 - 15:40 Session Chairs: Ali Davoudi, University of Illinois | |
| Parallel Connection of Two Shunt Active Power Filters with Losses Optimization | 1191 |
| Design and Implementation of an Improved Controller for Parallel-Connected 400 Hz Frequency Converters B. Tamyurek, Eskisehir Osmangazi University, Turkey E. Birdane, Kaynak Electronic Machine Industry and Trade Co. Ltd., Turkey Adil Ceyhan, Kaynak Electronic Machine Industry and Trade Co. Ltd., Turkey | 1197 |
| Study on the Impact of the Complex Impedance on the Droop Control Method for the Parallel Inverters Wei Yao, Zhejiang university, China Mingzhi Gao, Zhejiang University, China Zheng Ren, Zhejiang university, China Min Chen, Zhejiang University, China Zhaoming Qian, Zhejiang University, China | 1204 |
| A Three-Phase Adaptive Approach to Extract Harmonic and Reactive Currents D. Yazdani, Queen's University, Canada A. Bakhshai, Queen's University, Canada P.K. Jain, Queen's University, Canada | 1209 |

| Session C3L-G: Soft Switching Techniques I Thursday, February 25, 14:00 - 15:40 Session Chairs: Jason Neely, Purdue University Wayne Weaver, Michigan Technological University | |
|--|------|
| Analysis, Optimized Design and Adaptive Control of a ZCS Full-Bridge Converter Without Voltage Over-Stress on the Switches Xin Zhang, Nanjing University of Aeronautics and Astronautics, China Henry Shu-hung Chung, City University of Hong Kong, China Xinbo Ruan, Huazhong University of Science and Technology, China Adrian Ioinovici, Holon Institute of Technology, Israel | 1214 |
| Analysis and Design of a Novel ZVS-PWM DC-DC Converter for Bidirectional Applications with Steep Conversion Ratio Pritam Das, University of Western Ontario, Canada Ahmad Mousavi, University of Western Ontario, Canada Gerry Moschopoulos, University of Western Ontario, Canada | 1222 |
| Three-Level Phase-Shift ZVS-PWM DC-DC Converter with High Frequency Transformer for High Performance Arc Welding Machines Tomokazu Mishima, Kure National College of Technology, Japan Hisayuki Sugimura, Daihen Corporation, Japan Khairy Fathy Sayed, Kyungnam University, Korea, South Soon Kurl Kwon, Kyungnam University, Korea, South Mutsuo Nakaoka, Kyungnam University and Yamaguchi University, Japan | 1230 |
| Fully Soft-Switched Bidirectional Resonant DC-DC Converter with a New CLLC Tank Wei Chen, Zhejiang University, China Siran Wang, Zhejiang University, China Xiaoyuan Hong, Zhejiang University, China Zhengyu Lu, Zhejiang University, China Shaoshi Ye, Delta Electronics (Shanghai) Co., LTD., China | 1238 |
| Session C4L-A: Load Management Interface II Thursday, February 25, 16:10 - 17:25 Session Chairs: Siamak Abedinpour, Freescale Jonathan Kimball, Missouri S&T | |
| Optimal Phase Changing Frequency Determination for Multiphase Voltage Regulator Modules Anand Ramamurthy, North Carolina State University, United States Subhashish Bhattacharya, North Carolina State University, United States Chris Thompson, Intersil Corporation, United States Jon Day, Intersil Corporation, United States | 1243 |
| A New Digital Adaptive Voltage Positioning Technique with Dynamically Varying Voltage and Current References S. Pan, Queen's University, Canada P.K. Jain, Queen's University, Canada | 1248 |

| A Three-Level Buck Converter and Digital Controller for Improving Load Transient Response Zhenyu Zhao, Exar Corp, Canada Aleksandar Prodić, University of Toronto, Canada | 1256 |
|--|------|
| Session C4L-B: Power Electronics in Motor Drives II Thursday, February 25, 16:10 - 17:25 Session Chairs: Chris Edrington, Florida State University Patrick Chapman, University of Illinois | |
| Trends in MW-Rated VSI Technology and Reliability for Adjustable Speed Drives Hiromi Hosoda, Toshiba Mitsubishi-Electric Industrial Systems Corporation, Japan Mostafa Al Mamun, Toshiba Mitsubishi-Electric Industrial Systems Corporation, Japan Teruo Yoshino, Toshiba Mitsubishi-Electric Industrial Systems Corporation, Japan | 1261 |
| Development of a Compact 750KVA Three-Phase NPC Three-Level Universal Inverter Module with Specifically Designed Busbar Jun Wang, Zhejiang University, China Binjian Yang, Zhejiang University, China Jing Zhao, Zhejiang University, China Yan Deng, Zhejiang University, China Xiangning He, Zhejiang University, China Xu Zhixin, Zhejiang University of Science and Technology, China | 1266 |
| Common Mode Voltage in DC-Fed Motor Drive System and its Impact on the EMI Filter Fang Luo, Virginia Polytechnic Institute and State University & Huazhong University of Science and Technology, United States Shuo Wang, GE Aviation Systems, United States Fred Wang, University of Tennessee - Knoxville and Oak Ridge National Laboratory, United States Dushan Boroyevich, Virginia Polytechnic Institute and State University, United States Nicolas Gazel, Virginia Polytechnic Institute and State University, United States Yong Kang, Huazhong University of Science and Technology, China | 1272 |
| Session C4L-C: DC-DC Converter VI Thursday, February 25, 16:10 - 17:25 Session Chairs: Arnold Alderman, PSMA Frank Cirolia, Emerson Network Power | |
| Black-Box Modeling of Three Phase Voltage Source Inverters Based on Transient Response Analysis V. Valdivia, Carlos III University of Madrid, Spain A. Lázaro, Carlos III University of Madrid, Spain A. Barrado, Carlos III University of Madrid, Spain P. Zumel, Carlos III University of Madrid, Spain C. Fernández, Carlos III University of Madrid, Spain M. Sanz, Carlos III University of Madrid, Spain | 1279 |
| Digital Autotuning of DC-DC Converters Based on Model Reference Impulse Response A. Costabeber, University of Padova, Italy P. Mattavelli, University of Padova, Italy S. Saggini, University of Udine, Italy A. Bianco, STMicroelectronics, Italy | 1287 |

| High-Fidelity and High-Speed Modeling and Simulation for Power Conversion Systems 129 Chunchun Xu, GE Global Research, United States Luis Garces, GE Global Research, United States Paul Szczesny, GE Global Research, United States | 95 |
|---|-----|
| Session C4L-D: Aerospace Thursday, February 25, 16:10 - 17:25 Session Chairs: Jaber Abu Qahouq, <i>University of Alabama</i> Dionysios Aliprantis, <i>Iowa State University</i> | |
| Electrical Power Distribution System (HV270DC), for Application in More Electric Aircraft 130 D. Izquierdo, <i>EADS</i> , <i>Spain</i> R. Azcona, <i>EADS</i> , <i>Spain</i> F.J. López del Cerro, <i>EADS</i> , <i>Spain</i> Carlos Fernández, <i>EADS</i> , <i>Spain</i> Bernardo Delicado, <i>EADS</i> , <i>Spain</i> | ,00 |
| Supercapacitor-Based Energy Management for Future Aircraft Systems R. Todd, University of Manchester, United Kingdom D. Wu, University of Manchester, United Kingdom J.A. dos Santos Girio, University of Manchester, United Kingdom M. Poucand, University of Manchester, United Kingdom A.J. Forsyth, University of Manchester, United Kingdom | .06 |
| Buck Boost Regulator (B²R) for Spacecraft Solar Array Power Conversion | 13 |
| Session C4L-E: Power Converter Applications II Thursday, February 25, 16:10 - 17:25 Session Chairs: Vajapeyam Sukumar, Maxim Integrated Products | |
| Quadratic Power Conversion for Industrial Applications | 20 |
| Multiple-Output Resonant Inverter Topology for Multi-Inductor Loads O. Lucía, University of Zaragoza, Spain J.M. Burdío, University of Zaragoza, Spain I. Millán, University of Zaragoza, Spain J. Acero, University of Zaragoza, Spain | 28 |
| Variable Frequency Pulse Density Modulation¹ for Efficient High Frequency Operation of Series Resonant Converters Operating As Voltage Regulators | 34 |

Flexible-Controlled High Power-Density Automotive HID Electronic Ballast Xinyi Yang, Zhejiang University, China Biwen Xu, Zhejiang University, China Chongguang Ma, Zhejiang University, China Min Chen, Zhejiang University, China Zhaoming Qian, Zhejiang University, China S.Y.R. Hui, City University of Hong Kong, China D.Y. Lin, City University of Hong Kong, China W.M. Ng, City University of Hong Kong, China W. Yan, City University of Hong Kong, China Simple Triac Dimmable Compact Fluorescent Lamp Ballast and Andre Tjokrorahardjo, International Rectifier, United States Session C4L-G: Soft Switching Techniques II Thursday, February 25, 16:10 - 17:25 Session Chairs: Jason Neely, Purdue University Wayne Weaver, Michigan Technological University High Efficiency Soft-Switched Step-Up DC-DC Converter with Wei Chen, Zhejiang University and Delta Electronics (Shanghai) Co., LTD., China Xiaoyuan Hong, Zhejiang University, China Siran Wang, Zhejiang University, China Zhengyu Lu, Zhejiang University, China Shaoshi Ye, Delta Electronics (Shanghai) Co., LTD., China Dong Cao, Michigan State University, United States Fang Zheng Peng, Michigan State University, United States Analysis and Design of the Half Bridge Magnetizing Inductor B.-C. Hyeon, Seoul National University, Korea, South

Session C4L-F: General Lighting Thursday, February 25, 16:10 - 17:25

B.-H. Cho, Seoul National University, Korea, South

Session Chairs: Ali Davoudi, University of Illinois

Session B4P-H: AC-DC Conversion Thursday, February 25, 11:30 - 13:30

| A High Power Density Single Phase PWM Rectifier with Active Ripple Energy Storage Ruxi Wang, Virginia Polytechnic Institute and State University, United States Fred Wang, University of Tennessee - Knoxville and Oak Ridge National Laboratory, United States Dushan Boroyevich, Virginia Polytechnic Institute and State University, United States Puqi Ning, Virginia Polytechnic Institute and State University, United States | 1378 |
|---|------|
| Design Considerations for High Efficiency Buck PFC with Half-Bridge Regulation Stage Bernard Keogh, Texas Instruments (Cork) Ltd., Ireland George Young, Texas Instruments (Cork) Ltd., Ireland Hagen Wegner, Texas Instruments (Cork) Ltd., Ireland | 1384 |
| Colin Gillmor, Texas Instruments (Cork) Ltd., Ireland | |
| A Novel Variable Frequency Soft Switching Method for Flyback Converter with Synchronous Rectifier | 1392 |
| Xiucheng Huang, <i>Zhejiang University, China</i> Weijing Du, <i>Zhejiang University, China</i> Wei Yuan, <i>Zhejiang University, China</i> | |
| Junming Zhang, <i>Zhejiang University, China</i> Zhaoming Qian, <i>Zhejiang University, China</i> | |
| Optimal Design of a Compact 99.3% Efficient Single-Phase PFC Rectifier J. Biela, ETH Zurich, Switzerland J.W. Kolar, ETH Zurich, Switzerland G. Deboy, Infineon Technologies Austria AG, Austria | 1397 |
| DCM Boost PFC Converter with High Input PF Kai Yao, Nanjing university of aeronautics and astronautics, China Xinbo Ruan, Nanjing University of Aeronautics and Astronautics, China Xiaojing Mao, Nanjing University of Aeronautics and Astronautics, China Zhihong Ye, Lite-on Technology Corp., China | 1405 |
| Interleaved Forward Converter with Ripple-Free Circuit for Humane Killer Poultry Applications | 1413 |
| SY. Tseng, Chang Gung University, Taiwan TY. Chiang, Chang Gung University, Taiwan KC. Wang, Chang Gung University, Taiwan SA. Chuang, Chang Gung University, Taiwan | 1410 |
| The Optimal Control Strategy for Rectifier Side of Low Switching | |
| Frequency Back-to-Back Converter | 1419 |
| Qiongxuan Ge, Chinese Academy of Sciences, China | |
| Zhenggang Yin, Chinese Academy of Sciences, China | |
| Congwei Liu, Chinese Academy of Sciences, China Yaohua Li, Chinese Academy of Sciences, China | |
| Transformer Structure and its Effects on Common Mode EMI Noise in | |
| Isolated Power Converters | 1424 |
| Pengju Kong, Virginia Polytechnic Institute and State University, United States Fred C. Lee, Virginia Polytechnic Institute and State University, United States | |

| A Single-Stage Single-Phase Bi-Directional Grid Interface Circuit with Digital Lookup Table Based Control Evan Reutzel, University of California, Berkeley, United States Seth Sanders, University of California, Berkeley, United States | 1430 |
|---|------|
| Session B4P-J: DC-DC Converter VII Thursday, February 25, 11:30 - 13:30 | |
| A High Performance Dual Output DC-DC Converter Combined the Phase Shift Full Bridge and LLC Resonant Half Bridge with the Shared Lagging Leg Yu Chen, Huazhong University of Science and Technology, China Xuejun Pei, Huazhong University of Science and Technology, China Li Peng, Huazhong University of Science and Technology, China Yong Kang, Huazhong University of Science and Technology, China | 1435 |
| Dual Output DC-DC Converter with Shared ZCS Lagging Leg Yu Chen, Huazhong University of Science and Technology, China Li Peng, Huazhong University of Science and Technology, China Xuejun Pei, Huazhong University of Science and Technology, China Yong Kang, Huazhong University of Science and Technology, China | 1441 |
| A Novel ZVS Full-Bridge Converter with Auxiliary Circuit Zhong Chen, Nanjing University of Aeronautics and Astronautics, China Biao Ji, Nanjing University of Aeronautics and Astronautics, China Feng Ji, Nanjing University of Aeronautics and Astronautics, China Lei Shi, Nanjing University of Aeronautics and Astronautics, China | 1448 |
| An Active Clamp ZVT Converter with Input-Parallel and Output-Series Configuration Yi Zhao, Zhejiang University, China Wuhua Li, Zhejiang University, China Weichen Li, Zhejiang University, China Xiangning He, Zhejiang University, China | 1454 |
| A Parallel Front-End LCL Resonant Push-Pull Converter with a Coupled Inductor for Automotive Applications Yuan Yisheng, East China Jiaotong University, China Chen Min, Zhejiang University, China Qian Zhaoming, Zhejiang University, China | 1460 |
| A Novel Full Bridge Dual Output DC-DC Converter with Complementary Pulse Widths and Frequency Modulation Yu Chen, Huazhong University of Science and Technology, China Xuejun Pei, Huazhong University of Science and Technology, China Li Peng, Huazhong University of Science and Technology, China Yong Kang, Huazhong University of Science and Technology, China | 1464 |
| Analysis and Design Considerations of an Improved ZVS Full-Bridge DC-DC Converter Zhong Chen, Nanjing University of Aeronautics and Astronautics, China Biao Ji, Nanjing University of Aeronautics and Astronautics, China Feng Ji, Nanjing University of Aeronautics and Astronautics, China Lei Shi, Nanjing University of Aeronautics and Astronautics, China | 1471 |

| High Side Switch in Buck Converter Xin Zhou, North Carolina State University, United States Zhigang Liang, North Carolina State University, United States Alex Huang, North Carolina State University, United States | 1477 |
|--|------|
| Switching Loss Analysis Considering Parasitic Loop Inductance with Current Source Drivers for Buck Converters Zhiliang Zhang, Nanjing University of Aeronautics and Astronautics, China Jizhen Fu, Queen's University, Canada Yan-Fei Liu, Queen's University, Canada P.C. Sen, Queen's University, Canada | 1482 |
| Improved Asymmetric Space Vector Modulation for Voltage Source Converters with Low Carrier Ratio Di Zhang, Virginia Polytechnic Institute and State University, United States Fred Wang, University of Tennessee - Knoxville and Oak Ridge National Laboratory, United States Said El-Barbari, GE Global Research, Germany Juan Sabate, GE Global Research, United States Dushan Boroyevich, Virginia Polytechnic Institute and State University, United States | 1487 |
| A Hybrid Switching Scheme for LLC Series-Resonant Half-Bridge DC-DC Converter in a Wide Load Range Woo-Young Choi, Virginia Polytechnic Institute and State University, United States Bong-Hwan Kwon, Pohang University of Science and Technology, Korea, South Jih-Sheng Lai, Virginia Polytechnic Institute and State University, United States | 1494 |
| Session B4P-K: Motor Drives & Inverters I Thursday, February 25, 11:30 - 13:30 | |
| | |
| Industrial Servo Applications of Linear Induction Motors Based on Dynamic Maximum Force Control Haidong Yu, Phoenix International, United States Babak Fahimi, University of Texas at Arlington, United States | 1498 |
| Dynamic Maximum Force Control Haidong Yu, Phoenix International, United States | |
| Dynamic Maximum Force Control Haidong Yu, Phoenix International, United States Babak Fahimi, University of Texas at Arlington, United States A Soft-Switching Interleaved Three-Level Inverter Yuan Yisheng, East China Jiaotong University, China Chen Min, Zhejiang University, China | 1503 |

| A Simplified Three Phase Three-Level Zero-Current-Transition Active Neutral-Point-Clamped Converter with Three Auxiliary Switches Jin Li, Xi'an Jiaotong University and Virginia Polytechnic Institute and State University, China Jinjun Liu, Xi'an Jiaotong University, China Dushan Boroyevich, Virginia Polytechnic Institute and State University, China | 1521 |
|---|------|
| Comparison and Implementation of a 3-Level NPC Voltage Link Back-to-Back Converter with SiC and Si Diodes Mario Schweizer, ETH Zurich, Switzerland Thomas Friedli, ETH Zurich, Switzerland Johann W. Kolar, ETH Zurich, Switzerland | 1527 |
| A Novel PWM Control Method to Eliminate the Effect of Dead Time on the Output Waveform for Hybrid Clamped Multilevel Inverters Jing Zhao, Zhejiang University, China Xiangning He, Zhejiang University, China Yunlong Han, Zhejiang University, China Yan Chen, Zhejiang University, China Rongxiang Zhao, Zhejiang University, China | 1534 |
| Study on Wide Range Robust Speed Sensorless Control of Medium Voltage Induction Motor Siran Wang, Zhejiang University, China Zhengyu Lu, Zhejiang University, China | 1542 |
| Fault Detection and Diagnostics for Non-Intrusive Monitoring Using Motor Harmonics Uzoma A. Orji, Massachusetts Institute of Technology, United States Zachary Remscrim, Massachusetts Institute of Technology, United States Christopher Laughman, Massachusetts Institute of Technology, United States Steven B. Leeb, Massachusetts Institute of Technology, United States Warit Wichakool, Massachusetts Institute of Technology, United States Christopher Schantz, Massachusetts Institute of Technology, United States Robert Cox, Massachusetts Institute of Technology, United States James Paris, Massachusetts Institute of Technology, United States James L. Kirtley, Jr., Massachusetts Institute of Technology, United States Les K. Norford, Massachusetts Institute of Technology, United States | 1547 |
| Reliability Evaluation of Three-Level Inverters Yi Ding, Nanyang Technological University, Singapore Poh Chiang Loh, Nanyang Technological University, Singapore Kuan Khoon Tan, Nanyang Technological University, Singapore Peng Wang, Nanyang Technological University, Singapore Feng Gao, Nanyang Technological University, Singapore | 1555 |
| Parallel Operation of PWM Inverters for High Speed Motor Drive System | 1561 |

Session B4P-L: Active Components Thursday, February 25, 11:30 - 13:30

| Reverse Conduction of a 100 a SiC DMOSFET Module in High-Power Applications | 1568 |
|---|------|
| Investigation of 1.2 kV SiC MOSFET for High Frequency High Power Applications Honggang Sheng, Monolithic Power Systems, United States Zheng Chen, Virginia Polytechnic Institute and State University, United States Fred Wang, University of Tennessee - Knoxville, United States Alan Millner, MKS Instruments, United States | 1572 |
| Comparative Analysis of Power Stage Losses for Synchronous Buck Converter in Diode Emulation Mode Vs. Continuous Conduction Mode at Light Load Condition | 1578 |
| Controllable dv/dt Behaviour of the SiC MOSFET/JFET Cascode an Alternative Hard Commutated Switch for Telecom Applications Daniel Aggeler, ETH Zurich, Switzerland Juergen Biela, ETH Zurich, Switzerland Johann W. Kolar, ETH Zurich, Switzerland | 1584 |
| Integral Micro-Channel Liquid Cooling for Power Electronics Ljubisa D. Stevanovic, GE Global Research, United States Richard A. Beaupre, GE Global Research, United States Arun V. Gowda, GE Global Research, United States Adam G. Pautsch, GE Global Research, United States Stephen A. Solovitz, Washington State University Vancouver, United States | 1591 |
| 3000V, 25A Pulse Power Asymmetrical Highly Interdigitated SiC Thyristors Ahmed Elasser, GE Global Research, United States Peter Losee, GE Global Research, United States Stephen Arthur, GE Global Research, United States Zachary Stum, GE Global Research, United States Jerome Garrett, GE Global Research, United States Michael Schutten, GE Global Research, United States | 1598 |
| Session B4P-M: System Integration III Thursday, February 25, 11:30 - 13:30 | |
| Low Inductance Power Module with Blade Connector Ljubisa D. Stevanovic, GE Global Research, United States Richard A. Beaupre, GE Global Research, United States Eladio C. Delgado, GE Global Research, United States Arun V. Gowda, GE Global Research, United States | 1603 |

| Design of Multi-Turn LTCC Inductors for High Frequency DC-DC Converters | 610 |
|---|-----|
| Session B4P-N: Utility Interface Thursday, February 25, 11:30 - 13:30 | |
| Topological Research and Comparison of Low Harmonic Input Three-Phase Rectifier with Passive Auxiliary Circuit Zhong Chen, Nanjing University of Aeronautics and Astronautics, China | 616 |
| Yingpeng Luo, Nanjing University of Aeronautics and Astronautics, China Yinyu Zhu, Nanjing University of Aeronautics and Astronautics, China | |
| The Reactive Power Compensation and Harmonic Filtering and the Over-Voltage Analysis of the ITER Power Supply System | 622 |
| Optimal Design Method of Three-Phase Rectifier with Near-Sinusoidal Input Currents 16 Zhong Chen, Nanjing University of Aeronautics and Astronautics, China Yingpeng Luo, Nanjing University of Aeronautics and Astronautics, China Yinyu Zhu, Nanjing University of Aeronautics and Astronautics, China Shunqing Wang, Nanjing University of Aeronautics and Astronautics, China | 627 |
| An Analysis on the Influence of Interface Inductor to STATCOM System with Phase and Amplitude Control and Corresponding Design Considerations | 633 |
| Vector Oriented Control of Voltage Source PWM Inverter As a Dynamic VAR Compensator for Wind Energy Conversion System Connected to Utility Grid | 640 |
| Control System Design for Bi-Directional Power Transfer in Single-Phase Back-to-Back Converter Based on the Linear Operating Region | 651 |

| Comparative Analysis of Low-Pass Output Filter for Single-Phase Grid-Connected Photovoltaic Inverter Hanju Cha, Chungnam National University, Korea, South Trung-Kien Vu, Chungnam National University, Korea, South | 1659 |
|--|------|
| Design and Development of Generation-I Silicon based Solid State Transformer Subhashish Bhattacharya, North Carolina State University, United States Tiefu Zhao, North Carolina State University, United States Gangyao Wang, North Carolina State University, United States Sumit Dutta, North Carolina State University, United Kingdom Seunghun Baek, North Carolina State University, United States Yu Du, North Carolina State University, United States Babak Parkhideh, North Carolina State University, United States Xiaohu Zhou, North Carolina State University, United States Alex Q. Huang, North Carolina State University, United States | 1666 |
| Power Calculation Method Used in Wireless Parallel Inverters Under Nonlinear Load Conditions Zheng Ren, Zhejiang University, China Mingzhi Gao, Zhejiang University, China Qiong Mo, Zhejiang University, China Kun Liu, Zhejiang University, China Wei Yao, Zhejiang University, China Min Chen, Zhejiang University, China Zhaomin Qian, Zhejiang University, China | 1674 |
| A Real-Time Fault Diagnosis System for UPS Based on FFT Frequency Analysis Won-Sul Shim, Kangwon National University, Korea, South Gi-Taek Kim, Kangwon National University, Korea, South Ha-Jin Jung, Powertron Engineering Co. Ltd., Korea, South Deuk-Soo Kim, Powertron Engineering Co. Ltd., Korea, South | 1678 |
| Control Strategy for a Buck-Boost Type Direct Interface Converter Using an Indirect Matrix Converter with an Active Snubber Koji Kato, Nagaoka University of Technology, Japan Jun-Ichi Itoh, Nagaoka University of Technology, Japan | 1684 |
| A PI Control Algorithm of Three-Level APF with Little Static Misadjustment for Tracking Harmonic Current Yingjie He, Xi'an Jiaotong University, China Jinjun Liu, Xi'an Jiaotong University, China Zhaoan Wang, Xi'an Jiaotong University, China Yunping Zou, Huazhong University of Science and Technology, China | 1692 |
| A Novel Topology of LLC Resonant Inverter with Two Resonant Tanks for Power Conditioning System Eun-Soo Kim, Jeonju University, Korea, South Kwang-Ho Lee, Jeonju University, Korea, South Bong-Gun Chung, Jeonju University, Korea, South Joo-Hoon Kim, Jeonju University, Korea, South Moon-Ho Kye, Powerplaza, United States | 1698 |

| Analysis and Realization of a Fast Repetitive Controller in Active Power Filter System 1704 Jinwu Gong, Wuhan University, China Xiaoming Zha, Wuhan University, China Suxuan Guo, Wuhan University, China Baifeng Chen, Wuhan University, China Jianjun Sun, Wuhan University, China |
|---|
| Session B4P-P: Modeling, Simulation & Control II Thursday, February 25, 11:30 - 13:30 Session Chairs: Jonathan Kimball, Missouri S&T Omer Onar, Illinois Institute of Technology |
| On Extended Kalman Filters with Augmented State Vectors for the Stator Flux Estimation in SPMSMs |
| State Equations Based Resonant Converters Modeling Technique |
| Design Considerations and Expiremental Results of an Adaptive Frequency Controller Under Variable Line and Load Conditions Jaber A. Abu Qahouq, University of Alabama, United States Wisam Al-Hoor, University of Central Florida, United States Issa Batarseh, University of Central Florida, United States |
| Modeling and Mitigation of Dynamic Load Beat-Frequency Oscillation in Multiphase Voltage Regulators with High-Gain Peak Current Control Scheme |
| Half-Wave Symmetry SHE-PWM Method for Multilevel Voltage Inverters |
| PI Type Dynamic Decoupling Control Scheme for PMSM High Speed Operation |
| High Performance Positive and Negative Sequence Filters in Stationary Frame Based on Complex Transfer Function |

| Simulation Study of Parameter Influence on Dynamic Voltage Rise Control Ming Li, Xi'an Jiaotong University, China Xiong Fang, Xi'an Jiaotong University, China Yue Wang, Xi'an Jiaotong University, China Leqiang Zhang, Xi'an Jiaotong University, China Ke Wang, Xi'an Jiaotong University, China Guopeng Zhao, Xi'an Jiaotong University, China | 1745 |
|--|------|
| Shaping of the Noise Spectrum in Power Electronic Converters Cristian Lascu, <i>University of Nevada, Reno, United States</i> Andrzej M. Trzynadlowski, <i>University of Nevada, Reno, United States</i> R. Lynn Kirlin, <i>University of Victoria, Canada</i> | 1749 |
| Grid Interactions and Stability Analysis of Distribution Power Network with High Penetration of Plug-in Hybrid Electric Vehicles Omer C. Onar, Illinois Institute of Technology, United States Alireza Khaligh, Illinois Institute of Technology, United States | 1755 |
| Rapid Simulation of Fourth-Order Multi-Resonant LLCC Converters with Capacitive Output Filter A. Bucher, University of Erlangen-Nürnberg, Germany T. Duerbaum, University of Erlangen-Nürnberg, Germany | 1763 |
| | |
| FHA-Based Voltage Gain Function with Harmonic Compensation for LLC Resonant Converter | 1770 |
| LLC Resonant Converter | 1770 |
| LLC Resonant Converter Hong Huang, Texas Instruments, United States Session B4P-Q: Aerospace & Transportation | |
| LLC Resonant Converter Hong Huang, Texas Instruments, United States Session B4P-Q: Aerospace & Transportation Thursday, February 25, 11:30 - 13:30 Analysis and Design of LCC Resonant Inverter for the Tranportation Systems Applications Mohamed Youssef, Bombardier Transportation Inc., Canada Jaber A. Abu Qahouq, University of Alabama, United States | 1778 |

| Electromagnetic Compatibility Results for an LCC Resonant Inverter for the Tranportation Systems Mohamed Youssef, Bombardier Transportation Inc., Canada Jaber A. Abu Qahouq, University of Alabama, United States Mohamed Orabi, South Valley University, Egypt | 1800 |
|---|------|
| Torque Impulse for Experimental Modal Analysis in Transmitted Vibration Study of Engine-Generators Elias Ayana, Cummins Power Generation & University of Minnesota, United States Steve Seidlitz, Cummins Power Generation, United States Sze Kwan Cheah, Cummins Power Generation, United States Ned Mohan, University of Minnesota, United States | 1804 |
| Session B4P-R: Power Converters & Applications Thursday, February 25, 11:30 - 13:30 | |
| Review and Analysis of the AC-DC Converter of ITER Coil Power Supply P. Fu, Institute of Plasma Physics, China G. Gao, Institute of Plasma Physics, China L.W. Xu, Institute of Plasma Physics, China Z.Q. Song, Institute of Plasma Physics, China Z.C. Sheng, Institute of Plasma Physics, China I. Benfatto, ITER Organization, France J. Tao, ITER Organization, France A.D. Mankani, ITER Organization, France J.S. Oh, National Fusion Research Institute, Korea, South C. Neumeyer, Princeton Plasma Physics Laboratory, United States | 1810 |
| Fault Tolerance on Interleaved Inverter with Magnetic Couplers K. Guépratte, Grenoble Electrical Engineering Laboratory, France D. Frey, Grenoble Electrical Engineering Laboratory, France PO. Jeannin, Grenoble Electrical Engineering Laboratory, France H. Stephan, Grenoble Electrical Engineering Laboratory, France JP. Ferrieux, Grenoble Electrical Engineering Laboratory, France | 1817 |
| Latest Practical Developments of Triplex Series Load Resonant Frequency-Operated High Frequency Inverter for Induction-Heated Low Resistivity Metallic Appliances in Consumer Built-in Cooktops Hideki Sadakata, Panasonic Corporation, Japan Atsushi Fujita, Panasonic Corporation, Japan Shinichiro Sumiyoshi, Panasonic Corporation, Japan Hideki Omori, Panasonic Corporation, Japan Bishwajit Saha, Kyungnam University / Yamaguchi University, Korea, South Tarek Ahmed, Kyungnam University / Yamaguchi University, Korea, South Mutsuo Nakaoka, Kyungnam University / Yamaguchi University, Korea, South | 1825 |
| A Study of Novel Flyback Converter with Very Low Power Consumption at the Standby Operating Mode Eun-Soo Kim, Jeonju University, Korea, South Bong-Gun Chung, Jeonju University, Korea, South Sang-Ho Jang, Jeonju University, Korea, South Mun-Gi Choi, LG Innotek, Korea, South Moon-Ho Kye, Powerplaza, United States | 1833 |

| Improved Two-Stage DC-Coupled Gate Driver for Enhancement-Mode SiC JFET Robin Kelley, SemiSouth Laboratories Inc., United States Andrew Ritenour, SemiSouth Laboratories Inc., United States David Sheridan, SemiSouth Laboratories Inc., United States Jeff Casady, SemiSouth Laboratories Inc., United States | 1838 |
|---|------|
| Design and Implementation of Multi-Channel Land Fowls Stunner with Current Sharing Controller SY. Fan, Wufeng Institute of Technology, Taiwan SY. Tseng, Chang Gung University, Taiwan YH. Su, Chang Gung University, Taiwan WC. Wu, Wufeng Institute of Technology, Taiwan | 1842 |
| High Voltage Generator Using Boost/Flyback Hybrid Converter for Stun Gun Applications SY. Tseng, Chang Gung University, Taiwan CM. Yang, Chang Gung University, Taiwan KC. Wang, Chang Gung University, Taiwan GW. Hsu, Chang-Gung University, Taiwan | 1849 |
| Session C5P-H: DC-DC Converter VIII Thursday, February 25, 11:30 - 13:30 | |
| A Method to Analysis and Design for Long Life Power Converter H.M. Pang, University of Hong Kong, China M.H. Bryan Pong, University of Hong Kong, China | 1857 |
| DC-DC Converter for Gate Power Supplies with an Optimal Air Transformer Christoph Marxgut, ETH Zurich, Switzerland Jürgen Biela, ETH Zurich, Switzerland Johann W. Kolar, ETH Zurich, Switzerland Reto Steiner, ABB, Switzerland Peter K. Steimer, ABB, Switzerland | 1865 |
| A Digitally Controlled DC-DC Buck Converter Using Frequency Domain ADCs | 1871 |
| Low-Dropout (LDO) Regulator Output Impedance Analysis and Transient Performance Enhancement Circuit Sungkeun Lim, North Carolina State University, United States Alex Q. Huang, North Carolina State University, United States | 1875 |
| A Design for Small Time-Delay Control Circuit for DPWM- POL Yoichi Ishizuka, Nagasaki University, Japan Yusuke Yamada, Nagasaki University, Japan Fumitoshi Hirose, Nagasaki University, Japan Mariko Nishi, Nagasaki University, Japan Hirofumi Matsuo, Nagasaki University, Japan | 1879 |

| Low Profile LLC Series Resonant Converter with Two Transformers Eun-Soo Kim, Jeonju University, Korea, South Joo-Hoon Kim, Jeonju University, Korea, South Sung-In Kang, LG Innotek, Korea, South Jun-Ho Park, LG Innotek, Korea, South Jae-Sam Lee, LG Innotek, Korea, South Dong-Young Huh, LG Innotek, Korea, South Yong-Chae Jung, Namseoul University, Korea, South | 1885 |
|---|------|
| Adaptive Frequency Control for ZVS Synchronous Boost Converters Operated in Average Current Mode Ben York, Virginia Polytechnic Institute and State University, United States Rae-Young Kim, Virginia Polytechnic Institute and State University, United States Jih-Sheng Lai, Virginia Polytechnic Institute and State University, United States | 1890 |
| Power Saving Control Strategies and Their Implementation in DC-DC Converter for Data and Telecommunication Power Supply Rais Miftakhutdinov, Texas Instruments Inc., United States | 1897 |
| Session C5P-J: DC-DC Converter IX Thursday, February 25, 11:30 - 13:30 | |
| Analysis and Optimized Design of an Efficient High-Voltage Converter with High Output Capacity Huai Wang, City University of Hong Kong, China Henry Shu-hung Chung, City University of Hong Kong, China Adrian Ioinovici, Holon Institute of Technology, Israel | 1904 |
| A Novel Three-Phase Three-Level ZVS PWM DC-DC Converter Eloi Agostini Junior, Federal University of Santa Catarina, Brazil Ivo Barbi, Federal University of Santa Catarina, Brazil | 1911 |
| Optimize the Synchronous Rectifier for LCC Converters Feng Zheng, Xidian University, China Zhengfeng Ming, Xidian University, China | 1919 |
| Digital Control Scheme for Robust Clock Tuning and PWM Phase Synchronization in Digitally Controlled Multi-POL Applications Eamon O'Malley, Powervation Ltd., Ireland Karl Rinne, Powervation Ltd., Ireland Anthony Kelly, Powervation Ltd., Ireland Basil Almukhtar, Powervation Ltd., Ireland Paul Kelleher, Powervation Ltd., Ireland | 1922 |
| Control Scheme and Transient Performance of Sigma VR Pengjie Lai, Virginia Polytechnic Institute and State University, United States Julu Sun, Virginia Polytechnic Institute and State University, United States Fred C. Lee, Virginia Polytechnic Institute and State University, United States | 1927 |
| A Three-Phase Current-Fed Push-Pull DC-DC Converter with Active Clamp for Fuel Cell Applications Sangwon Lee, Seoul National University of Technology, Korea, South Sewan Choi, Seoul National University of Technology, Korea, South | 1934 |

| Resonant Voltage Divider with Startup Considered K.I. Hwu, National Taipei University of Technology, Taiwan Y.T. Yau, National Taipei University of Technology, Taiwan | 42 |
|---|----|
| LLC Resonant Converter with Two Resonant Tanks Eun-Soo Kim, Jeonju University, Korea, South Joo-Hoon Kim, Jeonju University, Korea, South Kwang-Ho Lee, Jeonju University, Korea, South Yong-Seog Jeon, Jeonju University, Korea, South Jae-Sam Lee, LG Innotek, Korea, South Dong-Young Huh, LG Innotek, Korea, South | 49 |
| Session C5P-K: Motor Drives & Inverters II Thursday, February 25, 11:30 - 13:30 | |
| A Digital Control Strategy for Brushless DC Generators Nikola Milivojevic, Illinois Institute of Technology, United States Igor Stamenkovic, Illinois Institute of Technology, United States Mahesh Krishnamurthy, Illinois Institute of Technology, United States Ali Emadi, Illinois Institute of Technology, United States | 57 |
| Space Vector Based PWM Scheme Without Sector Identification for a 4-Level Dual Inverter Fed Induction Motor Drive with Asymmetrical DC Link Voltages | 63 |
| Control Method for a Novel Converter Topology for Permanent Magnet Drives | 70 |
| A Voltage Controlled Adjustable Speed PMBLDCM Drive Using a Single-Stage PFC Half-Bridge Converter Sanjeev Singh, Indian Institute of Technology Delhi, India Bhim Singh, Indian Institute of Technology Delhi, India | 76 |
| Comparison of HF Signal Injection Methods for Sensorless Control of PM Synchronous Motors Eisenhawer de M. Fernandes, Universidade Federal de Campina Grande, Brazil Alexandre C. Oliveira, Universidade Federal de Campina Grande, Brazil Cursino B. Jacobina, Universidade Federal de Campina Grande, Brazil Antonio M.N. Lima, Universidade Federal de Campina Grande, Brazil | 84 |
| A Robust Sensorless Fault Diagnosis Algorithm for Low Cost Motor Drives | 90 |
| High Dynamic Performance Constrained Optimal Control of Induction Motors | 95 |

| Sungyoon Jung, <i>Pohang University of Science and Technology, Korea, South</i> Beomseok Lee, <i>Pohang University of Science and Technology, Korea, South</i> Kwanghee Nam, <i>Pohang University of Science and Technology, Korea, South</i> | 2002 |
|--|------|
| Bridged-T Speed Controller for High Performance Switched Reluctance Motor Drives Gregory Pasquesoone, University of Akron, United States Iqbal Husain, University of Akron, United States Robert J. Veillette, University of Akron, United States | 2007 |
| Reducing Losses in Multilevel Coupled Inductor Inverters Using Interleaved Discontinuous SVPWM Behzad Vafakhah, University of Alberta, Canada Andy Knight, University of Alberta, Canada John Salmon, University of Alberta, Canada | 2013 |
| A Novel Elevator Load Torque Identification Method Based on Friction Mode Xiaoyuan Hong, Zhejiang University, China Zhe Deng, Zhejiang University, China Siran Wang, Zhejiang University, China Lijun Hang, Zhejiang University, China Wuhua Li, Zhejiang University, China Zhengyu Lu, Zhejiang University, China | 2021 |
| A Novel Digital Current Control Strategy for Torque Ripple Reduction in Permanent Magnet Synchronous Motor Drives | 2025 |
| Haidong Yu, <i>Phoenix International, United States</i> Session C5P-L: Passive Components Thursday, February 25, 11:30 - 13:30 | |
| Session C5P-L: Passive Components | 2030 |
| Session C5P-L: Passive Components Thursday, February 25, 11:30 - 13:30 Evaluation of a SiC Power Module Using Low-on-Resistance IEMOSFET and JBS for High Power Density Power Converters Kazuto Takao, Toshiba Corporation, Japan Takashi Shinohe, Toshiba Corporation, Japan Shinsuke Harada, National Institute of Advanced Industrial Science and Technology, Japan Kenji Fukuda, National Institute of Advanced Industrial Science and Technology, Japan | |

| Optimising the High Frequency Bandwidth and Immuntity to Interference of Rogowski Coils in Measurement Applications with Large local dV/dt |)50 |
|--|-----|
| PFC Inductor Selection Made Easy by "PL Product" |)57 |
| Evaluation of LTCC Capacitors and Inductors in DC-DC Converters 20 Laili Wang, Xi'an Jiaotong University, China Yunqing Pei, Xi'an Jiaotong University, China Xu Yang, Xi'an Jiaotong University, China Bo Song, Xi'an Jiaotong University, China Zhaoan Wang, Xi'an Jiaotong University, China Guopeng Zhao, Xi'an Jiaotong University, China | 060 |
| Session C5P-M: Vehicle Electronics II Thursday, February 25, 11:30 - 13:30 | |
| Bi-Directional Charging Topologies for Plug-in Hybrid Electric Vehicles |)66 |
| | |
| Session C5P-N: Renewable Energy Systems Thursday, February 25, 11:30 - 13:30 Session Chairs: Robert Balog, Texas A&M University | |
| Thursday, February 25, 11:30 - 13:30 |)73 |
| Thursday, February 25, 11:30 - 13:30 Session Chairs: Robert Balog, Texas A&M University Multi-Channel Three-Port DC-DC Converters As Maximum Power Tracker, Battery Charger and Bus Regulator | |

| Investigation of Fully Digital Controlled Li-Ion Battery Power Recovery System Siran Wang, Zhejiang University, China Xia Zhou, Zhejiang University, China Jifeng Chen, Zhejiang University, China Wenxi Yao, Zhejiang University, China Zhengyu Lu, Zhejiang University, China | 2091 |
|---|------|
| A Novel Control System for Harmonic Compensation by Using Wind Energy Conversion Based on DFIG Technology Grazia Todeschini, Worcester Polytechnic Institute, United States Alexander E. Emanuel, Worcester Polytechnic Institute, United States | 2096 |
| A Transformerless Modular Permanent Magnet Wind Generator System with Minimum Generator Coils Xibo Yuan, Tsinghua University, China Yongdong Li, Tsinghua University, China Jianyun Chai, Tsinghua University, China | 2104 |
| Small-Signal Modeling and Analysis of the Double-Input Buckboost Converter | 2111 |
| A Novel Power Distribution Strategy for Parallel Inverters in Islanded Mode Microgrid Xuan Zhang, Xi'an Jiaotong University, China Jinjun Liu, Xi'an Jiaotong University, China Ting Liu, Xi'an Jiaotong University, China Linyuan Zhou, Xi'an Jiaotong University, China | 2116 |
| Direct Power Control of Doubly-Fed Generator Based Wind Turbine Converters to Improve Low Voltage Ride-Through During System Imbalance | 2121 |
| Active Damping for Torsional Vibrations in PMSG Based WECS Hua Geng, Ryerson University, Canada Dewei Xu, Ryerson University, Canada Bin Wu, Ryerson University, Canada Geng Yang, Tsinghua University, China | 2126 |
| Voltage and Frequency Stabilization Using PI-Like Fuzzy Controller for the Load Side Converters of the Stand Alone Wind Energy Systems Ameen Gargoom, University of Tasmania, Australia Abu Mohammad Osman Haruni, University of Tasmania, Australia Md. Enamul Haque, University of Tasmania, Australia Michael Negnevitsky, University of Tasmania, Australia | 2132 |
| Dual-Stage Converter to Improve Transfer Efficiency and Maximum Power Point Tracking Feasibility in Photovoltaic Energy-Conversion Systems Sairaj V. Dhople, University of Illinois at Urbana-Champaign, United States Ali Davoudi, University of Illinois at Urbana-Champaign, United States Patrick L. Chapman, University of Illinois at Urbana-Champaign, United States | 2138 |

| A Novel Approach of Maximizing Energy Harvesting in Photovoltaic Systems Based on Bisection Search Theorem | 2143 |
|---|------|
| Simple Control Design for a Three-Port DC-DC Converter Based PV System with Energy Storage Sixifo Falcones, Arizona State University, United States Raja Ayyanar, Arizona State University, United States | 2149 |
| A Self-Powered Power Management Circuit for Energy Harvested by a Piezoelectric Cantilever Na Kong, Virginia Polytechnic Institute and State University, United States Travis Cochran, Virginia Polytechnic Institute and State University, United States Dong Sam Ha, Virginia Polytechnic Institute and State University, United States Hung-Chih Lin, National Tsing Hua University, Taiwan Daniel J. Inman, Virginia Polytechnic Institute and State University, United States | 2154 |
| A Maximum Power Point Tracker Implementation for Photovoltaic Cells Using Dynamic Optimal Voltage Tracking Emil Jimenez-Brea, University of Puerto Rico-Mayaguez, Puerto Rico Andres Salazar-Llinas, University of Puerto Rico-Mayaguez, Puerto Rico Eduardo Ortiz-Rivera, University of Puerto Rico-Mayaguez, Puerto Rico Jesus Gonzalez-Llorente, University of Puerto Rico-Mayaguez, Puerto Rico | 2161 |
| Development of the Novel Control Algorithm for the Small Proton Exchange Membrane Fuel Cell Stack Without External Humidification | 2166 |
| Session C5P-P: Modeling, Simulation & Control III Thursday, February 25, 11:30 - 13:30 Session Chairs: Jonathan Kimball, Missouri S&T Omer Onar, Illinois Institute of Technology | |
| Stabilization of Constant-Power Loads by Passive Impedance Damping Mauricio Céspedes, Rensselaer Polytechnic Institute, United States Troy Beechner, Rensselaer Polytechnic Institute, United States Lei Xing, Rensselaer Polytechnic Institute, United States Jian Sun, Rensselaer Polytechnic Institute, United States | 2174 |
| An Adaptive External Ramp Control of the Peak Current Controlled Buck Converters for High Control Bandwidth and Wide Operation Range | 2181 |

| Masterless Multirate Control of Parallel DC-DC Converters Anthony Kelly, Powervation Ltd., Ireland Karl Rinne, Powervation Ltd., Ireland Eamon O'Malley, Powervation Ltd., Ireland | 89 |
|--|-------------|
| FPGA-Based Spectral Envelope Preprocessor for Power Monitoring and Control | 94 |
| Sigma-Delta Modulation of Multi-Phase High Frequency Converters | 202 |
| Specialized Digital Signal Processor for Control of Multi-Rail/Multi-Phase High Switching Frequency Power Converters James Mooney, University of Limerick, Ireland Mark Halton, University of Limerick, Ireland Abdulhussain E. Mahdi, University of Limerick, Ireland | 207 |
| Computer-Aided Design for Class-E Switching Circuits Taking into Account Optimized Inductor Designs | <u>?</u> 12 |
| Characterization of IGBT Modules for System EMI Simulation | 220 |
| A Mathematical Model for Online Electrical Characterization of Thermoelectric Generators Using the P-I Curves at Different Temperatures Eduardo I. Ortiz-Rivera, University of Puerto Rico-Mayaguez, Puerto Rico Andres Salazar-Llinas, University of Puerto Rico-Mayaguez, Puerto Rico Jesus Gonzalez-Llorente, University of Puerto Rico-Mayaguez, Puerto Rico | 226 |
| A Novel Method for Permanent Magnet Demagnetization Fault Detection and Treatment in Permanent Magnet Synchronous Machines Amir Khoobroo, University of Texas at Arlington, United States Babak Fahimi, University of Texas at Arlington, United States | 231 |

Session C5P-Q: Alternative Energy Applications Thursday, February 25, 11:30 - 13:30

| Series Connection of IGBT | 2238 |
|--|-------|
| The-Van Nguyen, Grenoble Institute of Technology, France | |
| Pierre-Olivier Jeannin, Grenoble Institute of Technology, France | |
| Eric Vagnon, Grenoble Institute of Technology, France | |
| David Frey, Grenoble Institute of Technology, France | |
| Jean-Christophe Crebier, Grenoble Institute of Technology, France | |
| Jean-Officiophe Grebier, Orenoble Institute of Technology, France | |
| Three Phase Linear Permanent Magnet Energy Scavenger Based on | |
| Foot Horizontal Motion | 2245 |
| Igor Stamenkovic, Illinois Institute of Technology, United States | 2240 |
| Nikola Milivojevic, Illinois Institute of Technology, United States | |
| | |
| Cong Zheng, Illinois Institute of Technology, United States | |
| Alireza Khaligh, Illinois Institute of Technology, United States | |
| Bidirectional Communication Techniques for Wireless Battery Charging | |
| Systems and Portable Consumer Electronics | 2251 |
| W.P. Choi, ConvenientPower HK Ltd. and City University of Hong Kong, China | 2231 |
| | |
| W.C. Ho, ConvenientPower HK Ltd., China | |
| X. Liu, ConvenientPower HK Ltd., China | |
| S.Y.R. Hui, City University of Hong Kong, China | |
| Proposal of a DC-DC Converter with Wide Conversion Range Used in | |
| Photovoltaic Systems and Utility Power Grid for the Universal Voltage Range | 2250 |
| | 2236 |
| Jonas Reginaldo de Britto, <i>Universidade Federal de Uberlândia, Brazil</i> | |
| Fábio Vincenzi Romualdo da Silva, <i>Universidade Federal de Uberlândia, Brazil</i> | |
| Enane Antônio Alves Coelho, <i>Universidade Federal de Uberlândia, Brazil</i> | |
| Luiz Carlos de Freitas, <i>Universidade Federal de Uberlândia, Brazil</i> | |
| Valdeir José Farias, <i>Universidade Federal de Uberlândia, Brazil</i> | |
| João Batista Vieira, Jr., <i>Universidade Federal de Uberlândia, Brazil</i> | |
| Characterization of a F kW Solid Oxide Fuel Call Stock Hoing Bower Floatronic Excitation | 2264 |
| Characterization of a 5 kW Solid Oxide Fuel Cell Stack Using Power Electronic Excitation | 2204 |
| John J. Cooley, Massachusetts Institute of Technology, United States | |
| Eric Seger, Montana State University, United States | |
| Steven Leeb, Massachusetts Institute of Technology, United States | |
| Steven R. Shaw, Montana State University, United States | |
| Photovoltaio Parallal Pacanant DC Link Soft Switching Invertor Using | |
| Photovoltaic Parallel Resonant DC-Link Soft Switching Inverter Using | 0075 |
| | 2275 |
| Young-Ho Kim, Sungkyunkwan University, Korea, South | |
| Jun-Gu Kim, Sungkyunkwan University, Korea, South | |
| Young-Hyok Ji, Sungkyunkwan University, Korea, South | |
| Chung-Yuen Won, Sungkyunkwan University, Korea, South | |
| Yong-Chae Jung, Namseoul University, Korea, South | |
| Supercapacitor Pased Hybrid Storage Systems for Energy Heryesting in | |
| Supercapacitor-Based Hybrid Storage Systems for Energy Harvesting in | 2204 |
| Wireless Sensor Networks | 228 T |
| S. Saggini, <i>University of Udine, Italy</i> | |
| F. Ongaro, University of Udine, Italy | |
| C. Galperti, <i>Politecnico di Milano, Italy</i> | |
| P. Mattavelli, <i>University of Padova, Italy</i> | |

| The Faulty Module Bypass for Thermoelectric Generation Wei Qian, Michigan State University, United States Fang Z. Peng, Michigan State University, United States Sangmin Han, Michigan State University, United States | 2288 |
|--|------|
| Maximum Power Point Tracking Feasibility in Photovoltaic Energy-Conversion Systems . Sairaj V. Dhople, University of Illinois at Urbana-Champaign, United States Ali Davoudi, University of Illinois at Urbana-Champaign, United States Gerald Nilles, University of Illinois at Urbana-Champaign, United States Patrick L. Chapman, University of Illinois at Urbana-Champaign, United States | 2294 |
| Session C5P-R: Lighting Applications Thursday, February 25, 11:30 - 13:30 | |
| Realization of a General LED Lighting System Based on a Novel Power Line Communication Technology Chushan Li, Zhejiang University, China Jiande Wu, Zhejiang University, China Xiangning He, Zhejiang University, China | 2300 |
| Solid-State Lamp with Integral Occupancy Sensor John J. Cooley, Massachusetts Institute of Technology, United States Dan Vickery, Massachusetts Institute of Technology, United States Al-Thaddeus Avestruz, Massachusetts Institute of Technology, United States Amy Englehart, Massachusetts Institute of Technology, United States James Paris, Massachusetts Institute of Technology, United States Steven B. Leeb, Massachusetts Institute of Technology, United States | 2305 |
| A 0.9 PF LED Driver with Small LED Current Ripple Based on Series-Input Digitally-Controlled Converter Modules Qingcong Hu, University of Colorado at Boulder, United States Regan Zane, University of Colorado at Boulder, United States | 2314 |
| A Novel Dimmable Electronic Ballast for Compact Fluorescent Lamps Using Phase-Cut Incandescent Lamp Dimmers with Wide Dimming Range and Low Dimming Level Lamp Ignition Capability John Lam, Queen's University, Canada Praveen K. Jain, Queen's University, Canada | 2321 |

Author Index