

2025 IEEE 10th Southern Power Electronics Conference (SPEC 2025)

**Johannesburg, South Africa
1-4 December 2025**

IEEE Catalog Number:
ISBN:

CFP25F32-POD
979-8-3315-7189-4



Copyright © 2025, IEEE

All Rights Reserved

Copyright and Reprint Permissions:

Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

*** This is a print representation of what appears in the IEEE Digital Library. Some format issues inherent in the e-media version may also appear in this print version.

IEEE Catalog Number:	CFP25F32-POD
ISBN (Print-On-Demand):	979-8-3315-7189-4
ISBN (Online):	979-8-3315-7188-7
ISSN:	2832-2983

Additional Copies of This Publication Are Available From:

Curran Associates, Inc
57 Morehouse Lane
Red Hook, NY 12571 USA

Phone:	(845) 758-0400
Fax:	(845) 758-2633
E-mail:	curran@proceedings.com
Web:	www.proceedings.com

TABLE OF CONTENTS

Detection of Degradation with Junction Temperature Monitor and Extended Kalman Filter During Operation of Converters	1
<i>Michael Gleissner, Mark-M. Bakran</i>	
Enhanced Current Balancing Between Parallel Si IGBTs and SiC MOSFET by Co-Switching in High-Power Inverters	7
<i>Danielle Jaye S. Agron, Patrick R. Palmer, Stephen Makonin</i>	
Lifetime Assessment of Grid-Connected PV Inverters Considering Electrolytic DC-Link Capacitor Degradation and Climate Conditions	11
<i>Adamou Moussa, Mohamed Yasko, Diego Acevedo-Bueno, Bangli Du, Wilmar Martinez</i>	
Modeling Sodium-Ion Batteries for Electric Vehicles Using a Novel Hybrid-Modeling Framework	17
<i>Khanyisile Masemola, Cuthbert Nyamupangedengu, David G. Dorrell</i>	
Simplifying PV-WPT Integration: Single Converter Operation and Control Trade-Offs	23
<i>Malick Jappie, Sampath Jayalath</i>	
Single-Stage AC/AC Converter for Solid-State Transformer (SST) Based on Modified DAB Topology	28
<i>Wajahat Khan, Roberto Petrella, Mukesh Kumar Pathak</i>	
Modelling and Power Quality Analysis of a Medium-Voltage Grid with Optimal Placement and Sizing of Renewable Energy Sources	36
<i>Brandon Pillay, Faith Namhla Mtukushe, Evans Eshiemogie Ojo</i>	
Comparison of Soft Magnetic Core and Ferrite Based Rotary Transformers in EVs	42
<i>Stefan Botha, Nkosinathi Gule</i>	
Miller Charge Control for Voltage-Balancing of Series-Parallel Connected Gan HEMT Switch Cells	48
<i>Reece Cateley, Andrew Laphorn, Bill Heffernan, Vedang Gaikwad</i>	
Design of a Pulsed Charger Employing Active Ripple Energy Compensation for Electric Vehicle Batteries	56
<i>Reyyan Ahmad Khan, Sadik Cinik, Asim Ibrahim, Petar J. Grbović, Giuseppe De Falco, Roberto Petrella</i>	
Potential of Compact DC-DC Converters for Future HVDC Grids Enabled by Silicon Carbide MOSFETs	64
<i>Ashkan Raki, Hans-Peter Nee</i>	
Comparative Analysis of Duty Cycle and Dual Phase Shift Control for CC/CV Wireless Charging in EVs Employing an Asymmetric Magnetic Coupler	70
<i>Joel Adubofuor, Sachin De Zoysa, Sheldon S. Williamson</i>	
Enhanced Model Predictive Current Control in Variable-Speed Drives Through Online Compensation of Converter Nonlinearities	76
<i>Cristobal Duarte, Andrés Mora, Jorge Juliet, Ricardo P. Aguilera</i>	
Bidirectional Multilevel Solid-State Transformer for Medium-Voltage EV Charging Stations with Vehicle-To-Grid Capability	82
<i>H.S.H De Zoysa, Sheldon S. Williamson</i>	

Quantum-Enhanced Modeling and Optimization of Sodium-Ion Batteries	88
<i>Khanyisile Masemola, Cuthbert Nyamupangedengu, David G. Dorrell</i>	
An Enhanced Control Strategy for Three-Phase PFC Converter Integrated with DAB-Based Level-3 EV Chargers Under Non-Ideal Grid Conditions	94
<i>V.S.R. Varaprasad Oruganti, Sheldon Williamson</i>	
A Simple Approach to Realize a Power Hardware-in-the-Loop Machine Emulator Based on a B6-Inverter and a Bang-Bang Controller	100
<i>André Haspel, Matteo Eckstein, Chris Hermann, Jörg Roth-Stielow</i>	
Novel Current-Transformer-Based Current Sensor for High-Bandwidth Measurement of Power Transistor Switching Characteristics	106
<i>Reece Cateley, Andrew Laphorn, Bill Heffernan</i>	
Common-Mode Modeling of Variable Speed Drives in the IT-Grounding System: A Frequency-Domain Based Approach	112
<i>Shangheng Wu, Zhaoqing Zhang, Gerd Griepentrog</i>	
A Review of Inverter Drives for Hybrid Variable Flux Machines	118
<i>Luca Gnudi, Lesedi Masisi</i>	
Developmet of a Vehicle to Grid and Grid to Vehicle Emulator	124
<i>Lesedi Masisi</i>	
Low-Voltage Ride-Through Operation of a Modular DC-DC Converter Water Electrolyzer Power Supply	130
<i>Fadi Abughazaleh, Rik W. De Doncker</i>	
FPGA-Based Control Scheme for Voltage-Balancing of Series Arrangement of GaN HEMTs	136
<i>Vedang Gaikwad, Bill Heffernan, Andrew Laphorn, Reece Cateley</i>	
Parameter Identification and Adaptive Control of a High Power Medium Voltage Dual Active Bridge	141
<i>Tobias Merz, Nikolas Menger, Georg Zieglermaier, Fabian Sommer, Rüdiger Schwendemann, Marc Hiller</i>	
Self-Adapting Online Loss Minimization of a Dual Active Bridge in Buck and Boost Mode	147
<i>Tobias Merz, Fabian Sommer, Nikolas Menger, Sophie Knierim, Rüdiger Schwendemann, Marc Hiller</i>	
High-Frequency Resonant Inverter for Resistive Heating in Electrified Industrial Furnaces	153
<i>Daniel Baggen, Nikita Huber, Julius Wilker, Rik W. De Doncker</i>	
Flexible Hexagon, an Approach to Utilize Distributed Module Voltages to Reduce Voltage-Time Area Errors of Multilevel Converters	159
<i>Tobias Merz, Hannah Graute, Nikolas Menger, David Kraus, Rüdiger Schwendemann, Marc Hiller</i>	
A New Continually Growing Recursive Lean Instant Slope Constant Estimator for Online Measurement of Derivative and Actual Value of Oversampled Signals	165
<i>Jonathan Sattler, Benjamin Bachowsky, Benedikt Schmitz-Rode, Marc Hiller, Andreas Liske</i>	
Analysis of Switching Behavior of SiC MOSFETS Driven by an Adaptive Current Source Gate Driver	171
<i>Tim Lange, Johannes Kuhn, Erik Wehr, Ralf Wunderlich, Stefan Heinen</i>	
Machine Learning Based Design Optimization of a Rotary Transformer for EESG	177
<i>Farshid Mahmouditabar, Volker Pickert</i>	

A Novel Enhanced H-Bridge Converter with Short-Circuit Fault-Tolerant Capability for Four-Phase 16×12 SRM Drives	183
<i>Raúl Intriago, João P. Carvalho Silveira, Gabriel Intriago, Rolando R. Caicedo Castro</i> <i>Tárcio André dos S. Barros, Marcelo Vinícius de Paula</i>	
Control of Back-to-Back Converters between Microgrid and Utility Grid for AC Microgrid Autonomous Control and Operations	189
<i>Yai Pioth Yai Deng, Jinjun Liu, Sastry Pamidi</i>	
Thermally-Informed Neural Networks for Junction Temperature Estimation in SiC-Based Automotive Three-Phase Inverters	195
<i>Diego Kuderna Melgar, Shourya Shukla, Jeremy Nuzzo, Oleksandr Solomakha, Dominik Koch</i> <i>Ingmar Kallfass</i>	
An Auto-Tuned Delayed Triggering System for Ultrafast Rise Time Solid-State and Impedance-Matched Marx Pulsed Power Generators	201
<i>Mohsen Feizi, Bas Vermulst, Tom Huiskamp</i>	
Decoupling RoCoF Response and Reference Tracking in Grid-Forming Inverters using Modified PI Controller	208
<i>Andoni Urtasun, Ibai Urtasun, Luis Marroyo, Pablo Sanchis</i>	
All-Solid-State, Ultra-Fast Rise Time, High-Voltage, High-Repetition-Rate Pulsed Power Generator Using GaN Transistors	215
<i>Mohsen Feizi, Martijn Verhoven, Bas Vermulst, Tom Huiskamp</i>	
Enhancing the Efficiency of Dual Active Bridge Converter in Low-Voltage Supercapacitor Applications	222
<i>Henar Mike O. Canilang, Shuai Wang, Ning Zhu, Jiacheng Wang</i>	
Modulation Adaptation Method to Reduce Switching Losses in Three-Level Converters Using Delta-Sigma Modulation	228
<i>Jannik Maier, Philipp Czerwenka, Eckhard Hennig, Ertugrul Sönmez, Gernot Schullerus</i>	
Loss-Optimal Modulation for an MMC-Based Triple-Active-Bridge Topology	234
<i>Diego Vera, Maurice Roes, George Papafotiou</i>	
Hardware Design and Experimental Validation of a 30 kW, 800 V Three-Phase Three-Level ANPC Converter with 99% Efficiency	240
<i>Michael Glashauser, Jonas Wühr, Otto Kreutzer</i>	
A Bidirectional Transformerless Voltage Regulator for Single/Three Phase Applications Based on Direct AC-AC Converter	246
<i>S. M. Mortazavi, T. Huiskamp</i>	
A Compact High-Voltage Pulse Generator Using Series-Connected Mosfets and a Non-Isolated Boost Converter	252
<i>S. M. Mortazavi, T. Huiskamp</i>	
Unipolar/Bipolar 0-1 MHz Arbitrary Pulse Generator Using an Ultrafast Series-Stacked 20 kV MOSFET Module	258
<i>S. M. Mortazavi, T. Huiskamp</i>	
Low-Distortion Dual-Cell Power Amplifier with Ultra-High Small Signal Bandwidth	264
<i>Marziyeh Hajiheidari, Bas Vermulst, Jeroen Van Duivenbode</i>	

A Thermally Insulating Cryogenic Medium-Frequency Transformer for use in a Cryogenic GaN Dual Active Bridge	270
<i>Frank S.R., Ehrlich L., Schwendemann R., Hiller M.</i>	
A Novel Multi-Source Multilevel Inverter	277
<i>Eduardo Espinosa, Sebastian Neuman, Pedro Melin, José Espinoza, Carlos Baier, Jesús C. Hernandez Federico M. Serra, Osvaldo Gonzalez, Galina Mirzaeva</i>	
Accuracy Analysis of the Fundamental Harmonic Approximation for LLC Resonant Converters	283
<i>Juan Glicerio Manlapaz, Arvin Escultero, Carl Michael Odulio</i>	
Electrical and Thermal Characterization of PCB-Embedded 650 V GaN Half-Bridges on AlN Substrates	289
<i>Dominik Koch, Vladimir Polezhaev, Aline Reck, Michael Bosch, Jeremy Nuzzo, Mathias C.J. Weiser Till Huesgen, Ingmar Kallfass</i>	
Control Strategy for a Boost-Derived LCC Converter with Low Input Ripple and Wide-Range Operation for Fuel Cell Systems	295
<i>Arvin Escultero, Carl Michael Odulio</i>	
Hybrid Battery Balancing Utilizing Temperature Control for Second Life Batteries	301
<i>Alvin Huynh, Chandan Chetri, Sheldon Williamson</i>	
Beyond Metered Data: Bottom-Up Stochastic Survey Based Load Modelling in South Africa's Low-Income Communities	306
<i>Jonathan Meerholz, Nataly Bañol Arias, Marco E. T. Gerards, Jelena Popović</i>	
Near-Resonant Frequency Detection of LLC Converters Based on Quality Factor Design	312
<i>Arvin Escultero, Marvin Ralph Bautista, Carl Michael Odulio</i>	
Virtual-Flux Finite Control Set Model Predictive Control for Four-Phase H-Bridge Based SRM Drives	318
<i>Raúl Intriago, Gabriel Intriago, João P. Carvalho Silveira, Rolando R. Caicedo Castro Tércio André dos S. Barros, Marcelo Vinícius de Paula</i>	
Life Cycle Assessment Comparison of Multi-Phase IPM, IM, and EESM for EV Applications	324
<i>Farshid Mahmouditabar, Volker Pickert, Saleh. A. Ali</i>	
Soft-Switching 48-V Hybrid Switched-Capacitor Converter With Triangular Current Mode Operation	330
<i>Xinnuo Xu, Yenan Chen, Dehong Xu</i>	
Dead-Time Compensation Method for Instantaneous Control in a Three-Phase Dual-Active Bridge DC-DC Converter	336
<i>Mingwei Lu, Yuying He, Jingxin Hu</i>	
Extension of Unified Predictive Flux Control Through Harmonic Compensation for EESM, IM, PMSM and SyRM	342
<i>Johannes Stoß, Marc Hiller, Andreas Liske</i>	
A Novel 22 kW Bidirectional All-GaN Integrated Onboard Charger Using a 3L-NPC and Interleaved Dual-Buck With Low Common Mode Voltage	350
<i>Ebraam Fakhuri, Christian Klumpner, Md Rishad Ahmed, Ying Li</i>	
Neural Network-Based Reference Generator for Capacitor Voltage Control in Modular Multilevel Cascaded Converters	356
<i>Pablo Jiménez, Matías Correa, Andrés Mora</i>	

A 2kW, 100V Gan-Based Half-Bridge Power Module Using an Optimized PCB-Ceramic Stack-Up for High Efficiency and Power Density	362
<i>Manuel Rueß, Peter Mack, Jonas Pannasch, Jeremy Nuzzo, Mathias C. J. Weiser, Dominik Koch André Zimmermann, Ingmar Kallfass</i>	
Discrete-Time State Feedback Control with Extended Observer for Interleaved Boost Converter	368
<i>Galina Mirzaeva, Yunxun Mo, Eduardo Espinosa</i>	
Development of a Hybrid UPFC- Based Solution for Voltage Sag and Harmonic Mitigation in EV Charging Infrastructure in Uganda*	374
<i>Lilian Atwikiriize, Chricent Turinawe, Jane Namaganda Kiyimba, Ms Charlene Nagawa</i>	
Parameter Design of a DC-Link Inertia-Emulating Control Strategy for Grid-Connected Inverters	379
<i>Yunuo Yuan, Lingjun Yao, Yongheng Yang, Yinzhang Peng, Wenxin Li, Jinlong Tan</i>	
Power-Synchronization Loop in Grid-Forming Inverters Considering Power Limitation	385
<i>Ibai Urtasun, Andoni Urtasun, Luis Marroyo</i>	
A Novel Integrated Power Line Communication Coupler using Triaxial Conductors	391
<i>David Pentz</i>	
Performance Comparison of Triaxial Conductorbased Coupler to Planar Integrated Coupler - An Application	395
<i>David Pentz</i>	
Modeling of Hybrid Geothermal-Solar PV Power Generation in Uganda	399
<i>Akabway Rurangwa, Jesse Thornburg</i>	
Lissajous and Quadratic Modeling for Unbalanced Operation Analysis in Multilevel H-Bridge Inverters for Large-Scale Solar Applications	405
<i>P. M Lingom, Ideal O. Libouga, Roland Unruh, Joseph Song-Manguelle, Mamadou L. Doumbia Joao Pereira Pinto</i>	
A K-Neighbor Regressor Based Method for Locating Single Line to Ground Fault in Power Distribution Feeders	411
<i>Jawad Ahmad, Lal Zada</i>	
Electrical and Thermal Experimental Measurements of Domestic Refrigerators for DSM and Off-Grid Applications	416
<i>Muhammad Asmal, Doctor Yu-Chieh Yen, Professor Willie Cronje, Muhammed Aswat</i>	
Techno-Economic Assessment Tool for Hydrogen Production Systems Within Energy Storage and Power-To-X Frameworks	421
<i>Stefan Karamanski, Christopher Marz, Dimakatso Rapotu</i>	
Power System Design Trade-Offs in a Wild Animal Tracking Ear Tag	427
<i>Arnoldus S De Beer, Johan Meyer</i>	
Reactive Power Capability of Grid-Connected High-Power Hydrogen Electrolyzers Fed by Current Source Rectifiers	434
<i>Javier I. Beaumont, Álvaro Iribarren, Ernesto L. Barrios, Ianko Valero, Alfredo Ursúa, Pablo Sanchis</i>	
Modelling a STATCOM with Limited Energy Storage and PV Generation to Provide Grid Forming Capability to Enhance the Stability of a Distribution Grid	440
<i>Nuha Mohd Nazri, Christian Klumpner</i>	

Efficient Topology for Switching Accelerated Lifetime Testing of Gan Hemts Using High-Frequency Inductive Hard Switching	445
<i>Martijn Verhoeven, Bas Vermulst, Chengmin Li, Erik Lemmen</i>	
Small-Signal Stability Assessment of Inverter-Based Power System	450
<i>Marco de Villiers, Fredrick Mukundi Mwaniki</i>	
Design and Performance Analysis of a Single Inductor Continuous Input Current Buck-Boost Converter for Photovoltaic Applications	456
<i>Simisi Mosamane, Paul Barendse</i>	
Evaluation and Simulation of Stator Winding-To-Ground Insulation Fault in Long-Cable-Fed Variable Speed Drive Systems Using Common-Mode Current	462
<i>Shangheng Wu, Andrea Zingariello, Zhaoqing Zhang, Gerd Griepentrog</i>	
Comparative Analysis of Power Synchronization Control for Grid-Forming Converters	468
<i>Yang Shao, Lunbo Deng, Hao Ruan, Yi Xiao, Yongheng Yang</i>	
Experimental Validation of Predictive Load Current Control in a Single-Phase Matrix Converter	474
<i>Juan Quezada, Marco Rivera, Nicolás González, Javier Muñoz, Patrick Wheeler</i>	
A Scalable DC Coupled MW-Class Power Electronics-Based Energy System for Off-Grid Hydrogen Production From Hybrid AC/DC Sources	480
<i>Aswad Adib, Renata Kimpara, Joao Onofre Pereira Pinto, Marcio Magri Kimpara, Michael Starke Prasad Kandula, Madhu Chintavali</i>	
Performance Analysis of a BLDC Motor as Part of a Load Sided Resonant Inverter Under Fundamental Frequency Switching Operation	487
<i>Jan Loos, Kerstin Siebert, Holger Hirsch</i>	
Improving EV Charger Resiliency for MW Charging Systems	493
<i>Aswad Adib, Michael Starke, Joao Onofre Pereira Pinto, Renata Kimpara, Madhu Chinthavali</i>	
Operational Analysis and Control of a Multi-Port Solid-State Transformer with Integrated Batteries	500
<i>Zhen Huang, Thomas Langbauer, Marcus Vieira Soares, Wajahat Khan, Roberto Petrella Michael Hartmann</i>	
Evolution of a Bidirectional Low Frequency Trapezoidal Electromagnet Current Source	506
<i>Bill Heffernan, Michael Hayes, Ke Gao</i>	
Design and Evaluation of Transient Suppression Circuits for Solid-State Circuit Breakers in Dc Ev Charging Systems	514
<i>Kushan T. Lulbadda, Tarlochan Sidhu, Sheldon S. Williamson</i>	
First 6 MHz 8-Phases Regulated Lno Based Piezoelectric DC-DC Converter	520
<i>Alex Marques, Emile Bigot, Gaëtan Perez, Ghislain Despesse</i>	
Advanced Predictive Control Strategies for a Direct Matrix Converter	526
<i>Nicolás González, Marco Rivera, Javier Muñoz, Patrick Wheeler</i>	
DC-Link Capacitor Design for High-Speed Integrated Motor Drives: Reliability and System-Level Constraints	532
<i>Soroush Ahooye Atashin, Saeed Peyghami, Pooya Davari, Amol Ramesh Chopade, Norbert Hanigovszki Frede Blaabjerg</i>	

State Feedback Control with Adaptive Gains for Interleaved Boost Converter in DC Microgrid	537
<i>Galina Mirzaeva, Yunxun Mo</i>	