

March 15-19, 2015

Charlotte
NORTH CAROLINA

**Applied Power
Electronics
Conference
and Exposition**

30th ANNIVERSARY • 1985-2015

APEC®

2015

APEC 2015 Sponsors



Table of Contents

Foreword	2
APEC 2015 Conference Committee & Management	4
Schedule-At-A-Glance	6
Conference Highlights	14
General Information	17
Important Rules, Notices & Conference Policies	21
Spouse Tours	24
Sponsor Meetings	26

Conference Program

Professional Education Seminars.....	31
Plenary Sessions	44
Rap Sessions	50
Saturday, March 14	54
Sunday, March 15.....	55
Monday, March 16	57
Tuesday, March 17	60
Wednesday, March 18	78
Thursday, March 19	102
Dialogue Session Floor Plan	128
Dialogue Sessions	130
Convention Center Floor Plan	162

2015 Exhibitors Directory

APEC 2015 Exposition	165
Exhibit Hall Floor Plan	188
Exhibitor Listing	190

For the latest news and information, access to on-line conference and hotel information download the **APEC2015 mobile app** on your mobile device. The app is accessible by scanning the below QR code, and can also be found directly through Google Play (Android) and iTunes App Store (IOS devices) when searching keyword **"APEC"**.



APEC2015

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Foreword

It is my great pleasure to welcome you to the 30th annual IEEE Applied Power Electronics Conference and Exposition (APEC2015) at Charlotte Convention Center in beautiful Charlotte, North Carolina.

For thirty years, APEC has established itself as the leading power electronics conference and exposition and also evolved as an annual get-together for applied power electronics professionals for knowledge exchange and networking. Like its predecessors, APEC2015 offers a rich and comprehensive program and an ideal environment for application and theory-based technical learning for all power electronics professionals.

The highly-regarded Professional Educational Seminars start on Sunday, March 15th before the official opening of the conference. Each of the three-and-a-half-hour seminars provides an in-depth discussion of important and complex power electronics topics and combines practical application with theory. The Plenary Session on Monday afternoon consists of distinguished speakers from industry and academia covering the key power electronics architectures, components, innovations, and technologies affecting our industry and society. The technical papers presented in lecture and dialogue formats are selected from over 900 digests submitted from 44 countries. Increasingly popular industry sessions have reached an all-time high with 93 accepted presentations in 15 sessions.

The exposition also hits its record high participation with 239 exhibitors. These global exhibitors will showcase the state-of-art technologies, products, and solutions on applied power electronics augmented by the exhibitor seminars. This year's rap sessions include three moderated debates on Wireless Transfer of Power, Variable Speed Drives, and the Who, What, Where When and Why of Wide-Bandgap devices.

The social event on Wednesday night will be at the NASCAR Hall of Fame. The 150,000 square foot complex is packed with high-tech, interactive fun where the APEC attendees can try their luck racing against other attendees at over 200 miles per hour (322 km/hr)

in the Racecar Simulator or race against time in the Pit Crew Challenge. A special guest Ray Everham, a three time Winston Cup Series Champion with driver Jeff Gordon, will provide insights to engineering challenges of racing.

New this year is a new APEC Mobile App, which will provide attendees access to an interactive directory and map of the exhibitors on their mobile devices. For the first time, APEC will also start providing on-line proceedings at the conference for easier access.

Charlotte, a first-time city for APEC, is located in the center of the East Coast, USA with its major airport serving more than 143 destinations worldwide via all major carriers. The airport to Center City is only 7 miles (11 km) and it is a very-walkable city with over 120 fine restaurants and over 50 entertainment destinations. I hope you will enjoy the city and all it has to offer. Charlotte's got a lot.

I would like to take this opportunity and thank each of the three sponsors – IEEE IAS, IEEE PELS, and PSMA. Special thanks are also due to the dedicated and untiring members of the organizing and steering committees, reviewers, session chairs, and other volunteers. You provide tremendous support. Finally, a big thank you to our loyal APEC exhibitors and attendees for your continued support and feedback which has helped APEC evolves to its current status and to meet your growing needs.



Aung Thet Yu

General Chair

IEEE Applied Power Electronics Conference
and Exposition 2015

APEC 2015

Conference Committee & Management

Conference Committee

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Mark Nelms
Auburn University (IAS)

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Russell Spyker
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Fairchild Semiconductor (PSMA)

Haidong Yu
Eaton (PELS/IAS)

Schedule-at-a-Glance

**Room assignments are tentative and subject to change.
Please check for updates on APEC Mobile App.

**All events take place at the Charlotte Convention Center
unless otherwise noted**

KEY: S = Professional Education Seminars	R = Rap Sessions	IS = Industry Sessions D = Dialogue Sessions	T = Technical Sessions
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Saturday, March 14

Registration	4:00 p.m. – 7:00 p.m.	A CONCOURSE
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Sunday, March 15

Registration	8:00 a.m. – 5:00 p.m.	A CONCOURSE
S1: Permanent Magnet Machine Drives	9:30 a.m. – 1:00 p.m.	ROOM 208A
S2: Recent Breakthroughs in Controls for Power Electronics	9:30 a.m. – 1:00 p.m.	ROOM 208B
S3: FPGA-Based Digital Control Development	9:30 a.m. – 1:00 p.m.	ROOM 213AB
S4: Optimal Design of Inductive Power Components Based on Accurate Loss and Thermal Models	9:30 a.m. – 1:00 p.m.	ROOM 213CD
S5: 3D Packaging for High Density and High Performance GaN-Based Circuits	9:30 a.m. – 1:00 p.m.	ROOM 217AB
S6: Advanced Condition Monitoring and Diagnosis for Electric Motors and Drives	9:30 a.m. – 1:00 p.m.	ROOM 217CD
S7: Introduction to Small Signal and Average Modeling	2:30 p.m. – 6:00 p.m.	ROOM 208A
S8: Periodic Control of Power Converters	2:30 p.m. – 6:00 p.m.	ROOM 208B
S9: Power Delivery Modeling and Simulation for Server Systems	2:30 p.m. – 6:00 p.m.	ROOM 213AB
S10: Thermal Management of Power Semi-Conductor Devices	2:30 p.m. – 6:00 p.m.	ROOM 213CD
S11: Robust and Reliable Circuit Designs with SiC Power Devices	2:30 p.m. – 6:00 p.m.	ROOM 217AB
S12: Fundamentals and Multi-Objective Design of Inductive Power Transfer Systems	2:30 p.m. – 6:00 p.m.	ROOM 217CD

Monday, March 16

Registration	7:30 a.m. – 5:00 p.m.	A CONCOURSE
Spouse Breakfast	8:00 a.m. – 9:00 a.m.	HARRIS – THE WESTIN CHARLOTTE
S13: High Power Si & SiC Module Technology & Application Considerations	8:30 a.m. – 12:00 p.m.	ROOM 208A
S14: Principles and Practices of Digital Current Regulation for AC Systems	8:30 a.m. – 12:00 p.m.	ROOM 208B
S15: Practical Implementation of Loop Control in Power Converters	8:30 a.m. – 12:00 p.m.	ROOM 213AB
S16: Power Electronics System Thermal Design	8:30 a.m. – 12:00 p.m.	ROOM 213CD
S17: Practical Application of 600 V GaN HEMTs in Power Electronics	8:30 a.m. – 12:00 p.m.	ROOM 217AB
S18: Power Supply on Chip Technology for High Frequency Integrated Voltage Regulation	8:30 a.m. – 12:00 p.m.	ROOM 217CD
Open Plenary Session	1:30 p.m. – 5:00 p.m.	BALLROOM AB
Exhibit Hall Welcome Reception	5:00 p.m. – 8:00 p.m.	EXHIBIT HALL
MicroMouse Contest	8:00 p.m. – 10:00 p.m.	BALLROOM C

**KEY: S = Professional
Education Seminars****R = Rap Sessions****IS = Industry Sessions
D = Dialogue Sessions****T = Technical Sessions****Tuesday, March 17**

Speaker Breakfast	7:00 a.m. – 8:00 a.m.	ROOM 203AB
Registration	7:30 a.m. – 5:00 p.m.	A CONCOURSE
IS1: Latest Advances in Power Semiconductors, a Less Biased Discussion	8:30 a.m. – 11:55 a.m.	ROOM 207AB
IS2: Transportation Power Electronics: Vehicles, Chargers, Components and Markets	8:30 a.m. – 11:55 a.m.	ROOM 207CD
IS3: PMBus Standards and Applications	8:30 a.m. – 11:55 a.m.	ROOM 208A
T1: Isolated DC-DC Converters	8:30 a.m. – 12:00 p.m.	ROOM 217A
T2: Three-Phase & Higher power AC-DC Converters	8:30 a.m. – 12:00 p.m.	ROOM 217BC
T3: Magnetic Devices and Components I	8:30 a.m. – 12:00 p.m.	ROOM 217D
T4: Photovoltaic Applications	8:30 a.m. – 12:00 p.m.	ROOM 213A
T5: Machines and Inverters	8:30 a.m. – 12:00 p.m.	ROOM 213BC
T6: Modeling of DC Energy Converters and Systems	8:30 a.m. – 12:00 p.m.	ROOM 213D
T7: DC-DC Converter Control I	8:30 a.m. – 12:00 p.m.	ROOM 218/219
Exposition	12:00 p.m. – 5:00 p.m.	EXHIBIT HALL
Exhibitor Seminars–Session 1 (Concurrent Sessions)	1:30 p.m. – 2:00 p.m.	SEE PAGE 169
Exhibitor Seminars–Session 2 (Concurrent Sessions)	2:15 p.m. – 2:45 p.m.	SEE PAGE 172
Exhibitor Seminars–Session 3 (Concurrent Sessions)	3:00 p.m. – 3:30 p.m.	SEE PAGE 175
Exhibitor Seminars–Session 4 (Concurrent Sessions)	3:45 p.m. – 4:15 p.m.	SEE PAGE 178
R1: Wireless Transfer of Power: Facts and Fictions	5:00 p.m. – 6:30 p.m.	ROOM 217A
R2: Wide Bandgap Semiconductor Devices in Power Electronics – Who, What, Where, When, and Why?	5:00 p.m. – 6:30 p.m.	ROOM 217D
R3: Future Expectations of Power Electronics for Variable Speed Drive Applications	5:00 p.m. – 6:30 p.m.	ROOMS 218/219

Wednesday, March 18

Speaker Breakfast	7:00 a.m. – 8:00 a.m.	ROOM 203AB
Registration	8:30 a.m. – 3:00 p.m.	A CONCOURSE
IS4: Constructing a Solar Powered World through Technology?	8:30 a.m. – 10:10 a.m.	ROOM 207AB
IS5: Nanotechnology – State & Federal Activities	8:30 a.m. – 10:10 a.m.	ROOM 207CD
IS6: Emerging Power Electronics Technologies for High Power and High Voltage Applications	8:30 a.m. – 10:10 a.m.	ROOM 208A
T8: Integrated and HF DC-DC Converters	8:30 a.m. – 10:10 a.m.	ROOM 217A
T9: Single Phase AC-DC Converters	8:30 a.m. – 10:10 a.m.	ROOM 217BC
T10: Miscellaneous Grid Topics	8:30 a.m. – 10:10 a.m.	ROOM 217D
T11: Inverter Control I	8:30 a.m. – 10:10 a.m.	ROOM 218/219
T12: Conductive and Inductive Chargers for Electric Vehicles	8:30 a.m. – 10:10 a.m.	ROOM 213A
T13: DC-DC Converter Control II	8:30 a.m. – 10:10 a.m.	ROOM 213BC
T14: Renewable Circuits I	8:30 a.m. – 10:10 a.m.	ROOM 213D
Exposition	10:00 a.m. – 2:00 p.m.	EXHIBIT HALL
Exhibitor Seminars–Session 5 (Concurrent Sessions)	10:30 a.m. – 11:00 a.m.	SEE PAGE 181

KEY: S = Professional Education Seminars	R = Rap Sessions	IS = Industry Sessions D = Dialogue Sessions	T = Technical Sessions
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Exhibitor Seminars—Session 6 (Concurrent Sessions)	11:15 a.m. – 11:45 a.m.	SEE PAGE 184
IS7: The Business and Market of Power Electronics	2:00 p.m. – 5:25 p.m.	ROOM 207AB
IS8: Substrate Embedded Components Enabling High Density 3D Power Packaging	2:00 p.m. – 5:25 p.m.	ROOM 207CD
IS9: Applications Dictate Capacitor Technology	2:00 p.m. – 5:25 p.m.	ROOM 208A
T15: Renewable Microgrids	2:00 p.m. – 5:30 p.m.	ROOM 217A
T16: WBG Device Performance & Circuit Interactions	2:00 p.m. – 5:30 p.m.	ROOM 217BC
T17: Inverter Topologies	2:00 p.m. – 5:30 p.m.	ROOM 217D
T18: LED Drivers	2:00 p.m. – 5:30 p.m.	ROOM 218/219
T19: Non-Isolated DC-DC Converters	2:00 p.m. – 5:30 p.m.	ROOM 213A
T20: Multilevel Converters and Power Transformers	2:00 p.m. – 5:30 p.m.	ROOM 213BC
T21: Component Modeling	2:00 p.m. – 5:30 p.m.	ROOM 213D
Evening Social Event (ticket required)	7:00 p.m. – 10:00 p.m.	NASCAR HALL OF FAME

Thursday, March 19

Speaker Breakfast	7:00 a.m. – 8:00 a.m.	ROOM 203AB
Dialogue Presenter Breakfast.	7:00 a.m. – 8:00 a.m.	BALLROOM AB
Registration	8:00 a.m. – 12:00 p.m.	A CONCOURSE
IS10: Power Electronics Application	8:30 a.m. – 11:30 a.m.	ROOM 207AB
IS11: IGBTs and Their Applications	8:30 a.m. – 11:30 a.m.	ROOM 207CD
IS12: Recent Industrial Development in Wireless Power Transfer.	8:30 a.m. – 11:30 a.m.	ROOM 208A
T22: DC-DC Converter Application.	8:30 a.m. – 11:20 a.m.	ROOM 213A
T23: System Integration	8:30 a.m. – 11:20 a.m.	ROOM 213BC
T24: Modeling of AC Energy Converters and Systems	8:30 a.m. – 11:20 a.m.	ROOM 213D
T25: What's in the Can, Combinational Semiconductors	8:30 a.m. – 11:20 a.m.	ROOM 217A
T26: Renewable Wind I	8:30 a.m. – 11:20 a.m.	ROOM 217BC
T27: Power Electronics for Transportation Electrification.	8:30 a.m. – 11:20 a.m.	ROOM 217D
T28: WBG Power Device Based Applications	8:30 a.m. – 11:20 a.m.	ROOM 218/219
D1: AC-DC Converters	11:30 a.m. – 2:00 p.m.	BALLROOM AB
D2: DC-DC Converters I	11:30 a.m. – 2:00 p.m.	BALLROOM AB
D3: DC-DC Converters II	11:30 a.m. – 2:00 p.m.	BALLROOM AB
D4: Power Electronics for Utility Interface I	11:30 a.m. – 2:00 p.m.	BALLROOM AB
D5: Power Electronics for Utility Interface II	11:30 a.m. – 2:00 p.m.	BALLROOM AB
D6: Power Electronics for Utility Interface III.	11:30 a.m. – 2:00 p.m.	BALLROOM AB
D7: Drives and Inverters I	11:30 a.m. – 2:00 p.m.	BALLROOM AB
D8: Drives and Inverters II	11:30 a.m. – 2:00 p.m.	BALLROOM AB
D9: High Performance Devices and Components	11:30 a.m. – 2:00 p.m.	BALLROOM AB
D10: Magnetic Devices and Components II	11:30 a.m. – 2:00 p.m.	BALLROOM AB

KEY: S = Professional Education Seminars		R = Rap Sessions	IS = Industry Sessions D = Dialogue Sessions	T = Technical Sessions
D11:	Power System Solutions		11:30 a.m. – 2:00 p.m.	BALLROOM AB
D12:	Modeling and Simulation		11:30 a.m. – 2:00 p.m.	BALLROOM AB
D13:	Control		11:30 a.m. – 2:00 p.m.	BALLROOM AB
D14:	Manufacturing, Quality, and Business Issues.		11:30 a.m. – 2:00 p.m.	BALLROOM AB
D15:	Renewable Grid		11:30 a.m. – 2:00 p.m.	BALLROOM AB
D16:	Renewable Wind II		11:30 a.m. – 2:00 p.m.	BALLROOM AB
D17:	Renewable Circuits II		11:30 a.m. – 2:00 p.m.	BALLROOM AB
D18:	Renewable PV Systems.		11:30 a.m. – 2:00 p.m.	BALLROOM AB
D19:	Transportation Power Electronics.		11:30 a.m. – 2:00 p.m.	BALLROOM AB
D20:	Power Electronics Applications I		11:30 a.m. – 2:00 p.m.	BALLROOM AB
D21:	Power Electronics Applications II		11:30 a.m. – 2:00 p.m.	BALLROOM AB
IS13:	Mission Critical Power Systems		2:00 p.m. – 5:25 p.m.	ROOM 207AB
IS14:	Wide Bandgap Semiconductors.		2:00 p.m. – 5:25 p.m.	ROOM 207CD
IS15:	Modeling & Simulation		2:00 p.m. – 5:25 p.m.	ROOM 208A
T29:	Resonant and Soft-Switching DC-DC Converters		2:00 p.m. – 5:30 p.m.	ROOM 213A
T30:	Power Converter Control		2:00 p.m. – 5:30 p.m.	ROOM 213BC
T31:	Inverter Control II		2:00 p.m. – 5:30 p.m.	ROOM 213D
T32:	Wireless Power Transfer		2:00 p.m. – 5:30 p.m.	ROOM 217A
T33:	Utility & Mixed Applications of Power Electronics.		2:00 p.m. – 5:30 p.m.	ROOM 217BC
T34:	Photovoltaics		2:00 p.m. – 5:30 p.m.	ROOM 217D
T35:	Grid and Microgrid Interfaces.		2:00 p.m. – 5:30 p.m.	ROOM 218/219

Conference Highlights

Plenary Session

APEC 2015 Plenary is designed to cover the history of power, the current needs in energy efficiency and the future possibilities. Topics include: Challenges in Electrical Systems for More Electric Aircraft; Power Architectures for the Next Generation of Solid-State Lighting; PSMA Power Technology Roadmap; DOE Perspectives on Microgrids; Optimizing Performance and Reliability of GaN MOSFET Devices; and finally, A New Emphasis on Industry Partnerships at Los Alamos: Finding Win-Win Outcomes that Benefit the Nation. Come see where power technology has been, and where it is headed.

Professional Education Seminars

APEC is the premier event in applied power electronics. The APEC Program addresses a broad range of topics in the use, design, manufacture and marketing of all kinds of power electronics equipment. If you are in the power electronics business, here is why you should make APEC a regular part of your career development: The combination of high quality professional education seminars, a full Program of refereed papers and an overflowing Exhibit Hall consistently provides an invaluable education each year. The value of APEC to working power electronics professional is shown by the ever growing number of participants.

Technical Seminars & Sessions

APEC Industry professionals just like you participated in a rigorous peer review process and have carefully picked 541 papers making up APEC's Technical Sessions. The review process highlights the most innovative technical solutions, and provides the highest quality possible. The technical Program includes papers of broad appeal scheduled for oral presentation from Tuesday morning to Thursday afternoon. Papers with a more specialized focus are available for discussion with authors at the Dialogue Sessions on Thursday at 11:30 a.m. The various technical venues cover all areas of technical interest to the practicing power electronics professional. The papers are sure to give you many new design ideas that you can apply to your work immediately.

The sessions were selected through a rigorous peer review process and are represented by papers in the APEC Proceedings. Each digest was evaluated using an author-blind process by at least three members of the Program Committee, volunteers from all over the world with expertise in the area of the specific digest.

Industry Sessions

APEC Industry Sessions track has expanded from 12 sessions to 15, facilitating the presentation of more content and perspectives for various industries. This track runs in parallel with the traditional Technical Sessions Track. Speakers are invited to make a presentation only, without submitting a formal manuscript for the APEC Proceedings. This allows APEC to present information on current topics in power electronics from sources that would not otherwise be present at an industry conference. While many of these sessions are technical in nature, some also target business-oriented people such as electronic system designers, regulatory agencies, business-oriented people such as purchasing agents, and other people who support the power electronics industry.

Rap Sessions

We have three exciting and contentious topics lined up for this year. Admission to all Rap Sessions is free with an Exhibits Only Registration and free refreshments will be available.

Exhibitor Seminars & Exposition

Looking for answers to the problems that are waiting for you when you get back to the office or lab? The APEC Exhibitor Seminars may have the answers you are looking for. These half hour presentations give you a more in-depth look at an Exhibitor's products or services than you can get by just dropping by their booth. With presentations on so many topics, you are sure to find several of interest. The seminars will be held Tuesday afternoon and Wednesday afternoons.

Entrance to the Exhibition is open to all conference attendees, including holders of the free Exhibits Only registration!

MicroMouse Contest



APEC will once again host the World-Famous APEC MicroMouse Competition, the only event of its kind in North America, drawing contestants from all over the world. The contest will take place at the Charlotte Convention Center, in Ballroom C, on the evening of Monday, March 16 starting at 8:00 p.m. **All are welcome!**

Conference Social Event

“Join Us in the Fast Lane,” on Wednesday March 18, 2015 at 7:00 p.m., for APEC’s social event celebration at the NASCAR Hall of Fame. A shrine to the history and heritage of NASCAR and a must see for all.

Enjoy an evening of fun and games, gourmet food and unique entertainment. All night long, you’ll have unlimited access to this historical multi-level venue, interactive exhibits and historical artifacts. In addition to delicious food and music, you’ll have the unique opportunity to join us in the driver’s seat for racing simulator games (limited availability) and a pit crew challenge! You will also be treated to a meet and greet with a current pit crew chief!

We are confident that this event will be one of the conference highlights. Tickets to the social event are included in full conference and technical session registration. The NASCAR Hall of Fame is located adjacent to the Charlotte Convention Center. Additional tickets are available for purchase through the registration site.

Spouse and Guest Program

APEC welcomes the spouses and guests of the APEC conference participants into the Plenary, Rap Sessions, the Exhibit Hall receptions and the MicroMouse Contest. A welcome breakfast will be held on Monday, March 16. The Spouse and Guest Hospitality Room, Harris Room – The Westin Charlotte (2nd Floor), will be open each morning to provide a place to meet, have coffee and make plans for the day. APEC 2015 has also arranged for two optional tours. Details can be found on “Spouse & Guest Program” on page 24.

General Information

Conference Location

Charlotte Convention Center

501 South College Street
Charlotte, NC 28202
Phone: 704-339-6000

In addition, APEC has several host hotels in the area which will be accommodating our participants and hosting functions.

- ▶ **The Westin Charlotte**
(one block to Convention Center)
601 South College Street
Charlotte, North Carolina, USA 28202
Phone: 704-335-2115 or 866-837-4148
- ▶ **Hilton Charlotte Center City**
(one block to Convention Center)
222 East Third Street
Charlotte, North Carolina, USA 28202
Phone: 703-337-1500
- ▶ **Aloft Charlotte Uptown at the Epicentre**
(three blocks to Convention Center)
201 East Trade Street
Charlotte, North Carolina, USA 28202
Phone: 704-333-1999
- ▶ **Hyatt Place Charlotte Downtown**
(.5 miles to Convention Center)
222 South Caldwell Street
Charlotte, North Carolina, USA 28202
Phone: 704-877-2655

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APEC – Applied Power Electronics Conference

Ground Transportation

AREA AIRPORTS

- ▶ **Charlotte-Douglas International Airport (CLT)**

PARKING

- ▶ **Charlotte Convention Center**
 - Parking is available at prevailing rates in parking lots and towers surrounding the Charlotte Convention Center.
 - The NASCAR Hall of Fame parking deck is open and conveniently located at 500 Brevard Street, adjacent to the Charlotte Convention Center. The NASCAR Hall of Fame parking deck is also connected to the Charlotte Convention Center via a convenient over-street walkway.
 - Additionally, metered parking is available along many of the main streets in Center City. Some parking garages offer parking after 5:00 p.m. at reduced rates
- ▶ **The Westin Charlotte**
\$18/day self-parking – \$25/day valet parking
- ▶ **Hilton Charlotte Center City**
\$18/day self-parking – \$25/day valet parking
- ▶ **Aloft Charlotte Uptown at the Convention Center**
\$20/day self-parking – \$25/day valet parking
- ▶ **Hyatt Place Charlotte Downtown**
\$20/day valet parking

GETTING AROUND TOWN

- ▶ **Many local attractions are within walking distance**
- ▶ **LYNX Blue Line Light Rail**
 - \$2.00 each way; children under 5 ride free
 - 704-336-RIDE (7433)
- ▶ **Sprinter Bus**
 - Runs every 20 minutes on week days and every 30 minutes at night and on weekends.
 - \$2.00 each way; children under 5 ride free
 - 704-336-RIDE (7433)
- ▶ **Gold Rush**
 - Free rubber wheeled trolleys that run along Trade Street
 - 704-336-RIDE (7433)
- ▶ **Charlotte Area Transit System (CATS) Bus Service**
 - Service from 5 a.m. to 1:30 a.m.
 - \$2.00 each way; children under 5 ride free

Conference Registration

In order to participate in the 2015 APEC Conference you must be registered. Prepaid conference registration is required for the professional educational seminars, presentation sessions and dialogue sessions.

To register or pick up your conference materials please visit the APEC Conference Registration Center at the Charlotte Convention Center (A Concourse).

Saturday, March 14	4:00 p.m. – 7:00 p.m.
Sunday, March 15	8:00 a.m. – 5:00 p.m.
Monday, March 16	7:30 a.m. – 5:00 p.m.
Tuesday, March 17	7:30 a.m. – 5:00 p.m.
Wednesday, March 18	8:00 a.m. – 3:00 p.m.
Thursday, March 19	8:00 a.m. – Noon

Information for Presenters

For presenters in the **Professional Education Seminars**, a breakfast will be provided for you the morning of your presentation. You should attend the breakfast only on the morning of your seminar. Breakfast will be served in **Room 203AB at the Charlotte Convention Center at 8 a.m. on Sunday and at 7 a.m. on Monday**. After breakfast, you will receive brief instructions from the Professional Education Seminar Chairs.

For presenters in the **Industry Sessions and the Oral Technical Sessions**, you must attend a mandatory speaker breakfast on the morning of your presentation. **On Tuesday and Wednesday the breakfast will be held at 7 a.m. in Room 203AB at the Charlotte Convention Center**. The Program Chair will host this breakfast at which you will be given your speaker ribbon and provided instructions. If you have not provided your biography to your sessions chair beforehand, you can give it to him or her at the breakfast. Immediately after breakfast you will be able to review your previously uploaded presentation with your session chair.

For those presenters in the **Dialogue Sessions**, a breakfast will be provided for you in **Ballroom AB at the Charlotte Convention Center at 7 a.m. on Thursday, March 19**. After breakfast and brief instructions you will be able to mount your presentation on the poster boards in the same room, using thumb tacks we will provide. Please do not go straight to your poster.



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Only copies on USB of the APEC Proceedings will be provided with the Full or Technical Sessions registration.

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	<i>On-site</i>
Conference Proceedings (USB Only)	\$180
Seminar Workbook (USB only)	\$180

Publications purchased on or before February 20th will be available for pick-up at the registration desk.

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All registrations sent by mail or fax must include payment. Payment methods include credit card, check or money order.

Checks may be personal, business or certified. Checks and money orders must be payable in United States dollars and drawn on a United States bank.

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Registrations must be submitted by March 14, after March 14 you have register on-site.

All requests for cancellation and refund of registration fees must be received in writing at the APEC offices no later than the close of business February 20, 2015. All refunds will be processed after the conclusion of the conference and will be subject to a \$50.00 processing fee.

For those who register and are unable to attend the conference, any Proceedings, Seminars on USB or other materials to which you are entitled will be shipped to you within 30 days of the conclusion of the conference.

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Badges are required for admission to all APEC events and activities. Badges are obtained by registering with the conference. APEC reserves the right to deny admission to any APEC event or activity to any person not showing an appropriate badge for that activity or event.

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Video and audio recording may be conducted in the Exhibit area, the MicroMouse contest, and public areas of APEC, but nowhere else except by express written permission from the Conference Chair.

Still photography at APEC is permitted, but with limitations. The general principle is that people may be photographed but photographing presentations and other content is prohibited unless permission from the presenter(s) is obtained in advance. For more details, please see show management.

Showcase Policy – NO SUITCASING

Please note that while all meeting attendees are invited to the showcase, any attendee who is observed to be soliciting business in the aisles or other public spaces, in another company's booth, or in violation of any portion of the Exhibition Policy, will be asked to leave immediately. Additional penalties may be applied. Please report any violations you may observe to Show Management. Show Management recognizes that suitcasing may also take the form of commercial activity conducted from a hotel guest room or hospitality suite; a restaurant, club, or any other public place of assembly. For the purposes of this policy, suitcasing violations may occur at venues other than the exhibition floor and at other events. Show Management must be informed of any hospitality suites, and expressed consent must be received prior to the event.

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In addition APEC may use the information you provide to contact you with information about APEC 2015 or any future APEC.

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Information Provided Other Than Through Registration

People who provide their names to APEC through the APEC Web site, direct contact, submitting a digest, volunteering to review or in any way other than registering for the conference, will not have their names and contact information distributed to any one or any organization, including APEC's sponsors. APEC will use the contact information only for transmitting information related to APEC.

Conference registrants will have their names and contact information, including name, affiliation, and mailing address provided to the exhibitors and media partners in the APEC for which they register. ***Emails will only be provided to exhibitors through the Lead Retrieval systems used on the show floor.*** Registering for APEC gives permission for your name and contact information to be provided to the exhibitors and media partners and for the exhibitors and media partners to contact you during or after the conference. APEC will not otherwise distribute names and contact information received through the registration process.

Spouse & Guest Program

APEC welcomes the spouses and guests of the APEC conference participants into conference activities including the Plenary, Rap Sessions, the Exhibit Hall receptions and the MicroMouse Contest.

- **Spouse and Guest Hospitality Room**
Monday, March 16 – Thursday, March 19
8:00 a.m. – 11:00 a.m.
HARRIS ROOM, THE WESTIN CHARLOTTE
- **Spouse and Guest Breakfast**
Monday, March 16 – Thursday, March 19
8:00 a.m. – 9:00 a.m.
HARRIS ROOM, THE WESTIN CHARLOTTE

Optional Tours

Pickup for all tours will be at the Harris Room, The Westin Charlotte

- **CULTURAL AFFAIR**
Monday, March 16
\$95/per person
9:30a.m. – 4:30 p.m. (7 hour tour)

Charlotte is home to an abundance of historical museums. A Charlotte Destination Group guide will meet you at the Convention Center and escort you by foot to the **Bechtler Museum of Modern Art**. You will experience the works of influential artists of the mid-20th century, including Picasso, Warhol and Nicholson. You will then make your way to the **Harvey B. Gantt Center for African American Art** where you will be treated to a private docent-led. The Harvey B. Gantt Center serves as a community epicenter for music, dance, theater, visual art, film, arts education programs, literature and community outreach.

You will then be escorted to the **Levin Museum of the New South** where you will be able to experience the nation's most comprehensive interpretation of post-Civil War Southern history.

Before embarking on the next part of your tour, you'll need your energy! Enjoy a delectable three-course lunch at an upscale restaurant in the heart of Charlotte's business center.

After lunch you will board the comfortable climate-controlled coach for **Daniel Stowe Botanical Gardens**. Daniel Stowe Botanical Gardens are one of the jewels in the Queen City's crown. Enjoy over 110 acres of beautifully manicured themed gardens and cultivation, receiving the honor of one of the nation's 20 Great Gardens in HGTV's popular book, *Flowering Gardening*.

- **A DAY WITH THE QUEEN**
Tuesday, March 17
\$85/per person
10:00 a.m. – 4:00 p.m. (6 hour tour)

Join us for a fun and fascinating day showcasing the Queen City of Charlotte, North Carolina!

First, you will be welcomed to Center-City Charlotte and its surrounding historical neighborhoods such as NODA, Plaza Midwood, Southend and Dilworth. You will see what the Queen City is all about as you learn about the history of Charlotte and its growth through athletic stadiums, entertainment centers, museums, historical churches, parks, gardens, unique architecture, statues and iconic landmarks.

You will then stop for an elegant lunch at **Duke Mansion**, one of Charlotte's most prized historical homes in Meyers Park. Duke Mansion is a gracious estate made famous by its former owner, James Buchanan Duke, founder of Duke Energy, Duke University, and the American and Britain Tobacco companies. After a three-course lunch the group will head to **Phillips Place in Southpark** to stroll its sidewalks full of upscale boutique stores, and if desired, take home some delectable treats from one of the few Dean&DeLuca markets outside of New York City. You will have time to explore the Southpark Mall with both unique and upscale name brand stores.

Sponsor Meetings

IAS

Tuesday, March 17

IEEE and PELS AdCom Joint Breakfast	7:00 a.m. – 9:00 a.m. . . .	ROOM 208B
IEEE IAS/PELS Young Professional Reception (by invitation only).	6:30 p.m. – 10:00 p.m. . . .	STRIKECITY @ THE EPICENTRE

PELS

Sunday, March 15

IEEE International Future Energy Challenge (IFEC) Workshop.	9:30 a.m. – 5:00 p.m. . . .	ROOM 207CD
IEEE International Future Energy Challenge (IFEC) Workshop – Breakout Session	9:30 a.m. – 5:00 p.m. . . .	ROOM 206AB
PELS Industry Advisory Board and Magazine Advisory Dinner	7:30 p.m. – 10:00 p.m. . . .	(OFFSITE)

Monday, March 16

PELS New AdCom Member Orientation.	9:00 a.m. – 12:00 p.m. . . .	ROOM 205
PELS TC2.8 – Technical Subcommittee, IWIPP2015 & ICDCM2015 Planning.	10:00 a.m. – 12:00 p.m. . . .	ROOM 206A
PELS Technical Committee and Standing Committee Chairs	12:00 p.m. – 1:30 p.m. . . .	ROOM 203AB
PELS Membership Committee Meeting (Students / Liaisons & Chapter Chairs)	3:00 p.m. – 4:30 p.m. . . .	ROOM 206A
PELS Education Committee Dinner (Seminar Speakers & Chairs).	7:30 p.m. – 9:30 p.m. . . .	(OFFSITE)

Tuesday, March 17

PELS AND IAS AdCom Joint Breakfast	7:00 a.m. – 9:00 a.m. . . .	ROOM 208B
PELS Southern Conference Steering Committee (SPEC).	9:00 a.m. – 10:00 a.m. . . .	ROOM 204
PELS Digital Media Meeting.	9:00 a.m. – 10:00 a.m. . . .	ROOM 205
IEMDC Steering Committee	9:30 a.m. – 11:30 a.m. . . .	ROOM 209
PELS TC6 – High Performance and Emerging Technologies	10:30 a.m. – 12:00 p.m. . . .	ROOM 204
PELS Exec Team and CPSS Representatives Meeting (25).	11:00 a.m. – 12:00 p.m. . . .	ROOM 205
PELS Fellows Committee (Members Only) (10).	12:00 p.m. – 1:00 p.m. . . .	ROOM 209
PELS TC1 – Power and Control Core Technologies	12:00 p.m. – 2:00 p.m. . . .	ROOM 206AB
Transportation Electrification Sub-committee on Conferences and Workshops (15).	1:30 p.m. – 2:30 p.m. . . .	ROOM 204
PELS TC2 – Power Conversion Systems and Components	2:00 p.m. – 3:30 p.m. . . .	ROOM 205
PELS / IAS Joint Vehicle and Transportation Systems Meeting.	3:00 p.m. – 4:00 p.m. . . .	ROOM 209/210
PELS TC7 – Communication Energy Systems	4:00 p.m. – 5:30 p.m. . . .	ROOM 204
PELS TC5 – Sustainable Energy Technical Committee.	6:30 p.m. – 7:30 p.m. . . .	ROOM 205
IEEE IAS/PELS Young Professional Reception (by invitation only).	6:30 p.m. – 10:00 p.m. . . .	STRIKECITY @ THE EPICENTRE

Wednesday, March 18

ECCE 2015 Organizing Committee	8:00 a.m. – 9:00 a.m.	ROOM 205
IEEE PELS Women In Engineering Breakfast (WIPELS) ** <i>Speaker: Professor Keyue Smedley, UC Irvine</i> **	8:00 a.m. – 9:00 a.m.	ROOM 209/210
PELS Exec Team Meeting (10)	9:00 a.m. – 10:00 a.m.	ROOM 206A
PELS Editorial Board – IEEE Transactions on Power Electronics	11:30 a.m. – 1:30 p.m.	ROOM 209/210
ECCE Global Partnership Coordinating Meeting (Committee Members Only)	12:00 p.m. – 2:00 p.m.	ROOM 205
PELS JESTPE Editorial Board Meeting	2:00 p.m. – 4:00 p.m.	ROOM 206A

Thursday, March 19

PELS Conferences Committee Breakfast	7:00 a.m. – 8:00 a.m.	ROOM 206AB
PELS Conferences Committee Meeting	8:00 a.m. – 12:00 p.m.	ROOM 209/210
PELS Standards Committee Meeting	10:00 a.m. – 11:30 a.m.	ROOM 205
PELS Conferences & Operations Committee Lunch	12:00 p.m. – 1:00 p.m.	ROOM 206AB
PELS Technical Operations & Products Committee Meeting	1:00 p.m. – 5:00 p.m.	ROOM 209/210
PELS Administrative Committee Dinner	6:00 p.m. – 9:30 p.m.	OFFSITE

Friday, March 20

PELS Administrative Committee Breakfast (Companions Welcome)	7:00 a.m. – 8:00 a.m.	ROOM 206AB
PELS Administrative Committee Meeting	8:00 a.m. – 3:00 p.m.	ROOM 209/210
PELS Administrative Committee Lunch (Companions Welcome)	11:30 a.m. – 12:30 p.m.	ROOM 206AB

PSMA**Monday, March 16**

PSMA Annual Meeting – followed by March BoD Meeting	7:30 a.m. – 1:00 p.m.	ROOM 218/219
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Tuesday, March 17

PSMA Energy Efficiency Committee Meeting	8:00 a.m. – 10:00 a.m.	ROOM 201B
PSMA Packaging Committee Meeting	10:00 a.m. – 12:00 p.m.	ROOM 201B
PSMA Marketing Committee Meeting	12:00 p.m. – 2:00 p.m.	ROOM 201B
PSMA Alternative Energy Committee Meeting	2:00 p.m. – 4:00 p.m.	ROOM 201B

Wednesday, March 18

PSMA Semiconductor Committee Meeting	8:00 a.m. – 10:00 a.m.	ROOM 201A
PSMA Magnetics Committee Meeting	8:00 a.m. – 10:00 a.m.	ROOM 201B
PSMA Transportation Committee Meeting	10:00 a.m. – 12:00 p.m.	ROOM 201A
PSMA Capacitor Committee Meeting	10:00 a.m. – 12:00 p.m.	ROOM 201B
PSMA Industry-Education Committee Meeting	12:00 p.m. – 1:00 p.m.	ROOM 201A
PSMA Roadmap Committee Meeting	12:00 p.m. – 2:00 p.m.	ROOM 201B
PSMA Nanotechnology Committee Meeting	1:00 p.m. – 3:00 p.m.	ROOM 201A

Conference Program



Notes

Professional Education Seminars

APEC strives to offer seminars with a practical mix of theory and application for the professional working in power electronics. APEC 2015 features 18 professional education seminars with a broad range of topics.

Sunday, March 15

9:30 a.m. – 1:00 p.m.

FUNDAMENTALS

S1: Permanent Magnet Machine Drives

Mehdi Abolhassani, *University of Houston*
ROOM 208A

PM motors/generators are gaining popularity for variety of reasons. Because the excitation of a PM machine is provided by permanent magnets, brushes and slip rings are eliminated, resulting in a simple and rugged structure. Permanent magnet excitation is current-free and lossless, enabling PM machines to rank among the highest efficiency and power density (kW/kg) as compared to other electric machines. The advent of high quality, high coercivity, high energy product, and high temperature grade (180 °C) NdFeB permanent magnet material is the driving force behind the wide-spread use of PM motors in one industrial sector after another, especially in servo drives and traction drives where harsh operating conditions and space limitations put a premium on performance and reliability. The structure and unique operation mode of PM motors provides additional advantages in speed and position control. In particular, the IPM (interior-mount PM) rotor is arguably much simpler and more reliable design than that of induction motor, and the absence of any major heat source on the rotor definitely contributes to much lower possibility of rotor structure deformation and bearing failure. The IPM motor is also capable of field-weakening operation to achieve wide constant power speed range similar to that of the series-DC motor characteristic, a very desirable feature for traction drive systems.

This tutorial has been organized to address the state-of-the-art of drive control methods of PM machines for different applications. In this tutorial, practical implementation of digital control method of sensored and sensorless variable speed PM motor drives for both SPM and IPM machines for different applications are discussed.

It is believed that this intermediate to advanced level short course represents a special opportunity for engineers in industry and academia to receive a comprehensive review of the application-oriented and hardware implementation of control methods of this intriguing PM machines and drives systems.

CONTROL

S2: Recent Breakthroughs in Controls for Power Electronics

Tobias Geyer, *ABB*

Sudip K. Mazumder, *NextWatt LLC*

ROOM 208B

This tutorial provides a radically different perspective to control of switching power electronic systems. It is based on controlling the time evolution of the switching states (i.e., switching sequences) as well as controlling the switching transition of the power semiconductor device of the solid state electronic system. The former – i.e., switching-sequence based control (SBC) yields rapid response under transient condition, optimal equilibrium response, and yields seamless transition between the two states of dynamics. By enabling integration of modulation and control, SBC precludes the need for ad-hoc offline modulation synthesis. In other words, an optimal switching sequence for the power converter is generated dynamically without the need for prior determination of a modulation scheme (which generates a pre-determined switching sequence) in typical conventional approaches. One of the distinctions between SBC and conventional model predictive control (MPC) is that SBC ensure optimal determination of the switching sequence of the power converter under stability bound. The tutorial will provide the mechanism to carry out SBC and MPC control syntheses and demonstrate the differences between SBC and MPC. Several device, converter, and network level implementations (e.g., motor drive, multilevel converter, microgrid, parallel inverters, aircraft power system) of the SBC will be provided.

The second part of the tutorial will focus on switching transition control (STC). The primary objective of STC is to demonstrate how key power electronic system parameters including $\frac{dv}{dt}$ and $\frac{di}{dt}$ stress, switching loss, electromagnetic noise emission can be controlled dynamically by modulating the dynamics of the power semiconductor devices. Both electrical and newly developed optical control mechanisms to achieve STC will be demonstrated. In the context of the latter, mechanisms for monolithic integration of switching sequence control as well as switching transition control will be outlined and the revolutionary impact of such a novel integration on system performance will be demonstrated with practical applications.

Intended Audience: This tutorial is intended for a wide spectrum of researchers and industry professional reflecting the typical distribution of APEC audience.

CONTROL IMPLEMENTATION

S3: FPGA-Based Digital Control Development

Jason Katcha, *All Digital Power*

Michael Parker, *Altera Corp*

ROOM 213AB

The Field Programmable Gate Array (FPGA) offers opportunities for improved performance and design flexibility for digital control of power electronics. However, the complexity of Hardware Description Language (HDL) coding can be a barrier for the design engineer. This tutorial will present a system modeling and development environment for FPGA-based digital control that also has the ability to auto-generate HDL code. The method uses Altera DSP Builder technology in a MATLAB / SIMULINK environment to develop a digital power electronics controller.

Altera DSP Builder libraries will be presented along with debug tools, Advanced DSP Builder capabilities and existing target hardware. This design flow allows the user to build floating point designs in low cost Cyclone class FPGAs.

The tutorial will take attendees through the complete design process of a current control loop for a grid-tie solar inverter. This includes basic control design and linear simulation using Matlab/Simulink and SimPowerSystems. The linear control blocks are then replaced with DSP Builder blocks and simulation results compared. VHDL code will then be auto-generated, compiled and loaded onto a grid-tie inverter control board for actual demonstration. A 3-phase grid-tie inverter with active and reactive power control will be presented. The controller is built with Altera Advanced DSP builder blocks with math functions that have floating point capability. This includes 3-phase PLL, synchronous PI and proportional resonant controllers. The development process will be presented along with actual results from a 10kW wind turbine gridtie converter.

The tutorial will be at an intermediate level useful for power electronics engineers, controls engineers, students and professors / teachers.

THERMAL MANAGEMENT

S4: Optimal Design of Inductive Power Components Based on Accurate Loss and Thermal Models

Jonas Muehlethaler, *Gecko-Simulations*

ROOM 213CD

In the first part of the presentation, loss and thermal models of inductive components are presented in detail. The impact of peak-to-peak flux density B, frequency f, DC pre-magnetization HDC, temperature T, core shape, minor and major loops, flux waveform, and material on the core loss calculation are discussed. In order to calcu-

late winding losses, formulas for round conductors and litz wires, each considering skin- and proximity effects (including the influence of an air-gap fringing field) are shown. Thermal modeling part is concluded with a discussion about how thermally model inductive components. A high level of accuracy is achieved by combining the best state-of-the-art loss and thermal models with newly-developed models. These loss and thermal models will further form the basis for the design of inductive components. Therefore, the focus of the second part of the presentation will be placed on how to optimally design inductive components of power electronic applications. All required formulas and all performed steps are presented such that a tutorial presentation arises. The topic will be treated in-depth. An intermediate level is expected from the intended audience.

After the presentation, the audience should have an increased understanding of magnetic core and winding losses. Furthermore, with the introduced steps, the participant of the tutorial should be able to optimally design inductive power components.

WBG DEVICES AND APPLICATIONS

S5: 3D Packaging for High Density and High Performance GaN-Based Circuits

Douglas Hopkins, Haotao Ke, *NC State University*
ROOM 217AB

Are you ready for 3D packaging? With the recent availability of essentially chip-scale packaged GaN, the onus is on power electronics designers to expand their packaging understanding to incorporate high-density devices at the board level. Though electro-physical design (packaging) follows established electrical and manufacturing "design rules," newer processes, such as 3D stacking and 3D printing, can now expand the "design rules" to provide higher densities in speed, weight, and volume.

This in-depth course for intermediate and advanced designers, excerpted from a 45 cr-hr university power-electronics packaging course, systematically introduces fundamental understanding and resulting "design rules" for board-level design of high-current (100'sA), high speed GaN circuits, and use of 3D printing. Fundamental topics include high-frequency electrical measurements, electrical parasitics, stress v. CTE effects, partial discharge, etc. Design Rules are developed for high-density power flip-chip and packaging, including high-speed bus bars, high current connectors and interconnects, and integrated two-sided cooling. The course, then covers, new stacked-3D and embedded gate drive approaches, and use of evolving 3D printing techniques for rapid prototyping, and the possibility of printing low volume circuits and systems.

SYSTEMS

S6: Advanced Condition Monitoring and Diagnosis for Electric Motors and Drives

Seungdeog Choi, *The University of Akron*
ROOM 217CD

Due to environmental issues such as global warming and air pollution, the demand for green energy system has been dramatically increasing in the market. Electric motors play a vital role in green energy system including hybrid and electric vehicle (HEV/EV) and alternative/renewable energy generation system while minimizing the use of fossil energy usage and the emission of pollutant. Nowadays, almost all electric energy systems are equipped with an onboard diagnosis system. This system has been used for warnings and monitoring critical failures. If a problem or malfunction is detected, then the diagnosis system sets a malfunction indicator light that is readily visible to the operator on the dashboard to inform that a problem exists. This health monitoring system is a valuable tool that assists in the service and repair by providing a simple, quick, and effective way to pinpoint problems by retrieving vital diagnostics. This education seminar provides semi in-depth presentation of fault diagnosis of electric motors and expected level of the intended audience is with entry and intermediate background in electrical and mechanical engineering

Sunday, March 15

2:30 p.m. – 6:00 p.m.

FUNDAMENTALS

S7: Introduction to Small Signal and Average Modeling

Robert White, *Embedded Power Labs*
ROOM 208A

In order to properly design a controller for a switched mode converter we need a good small signal model of the converter. The most common way to derive small signal models is to average the operation of the converter over one switching cycle. With a small signal model in hand we can then derive the converters transfer functions, such as the control-to-output transfer function. This seminar is an introduction to deriving small signal models and transfer functions of switched mode converters.

The first part of the seminar starts with the averaging of a buck converter over one switching cycle. The averaged equations are perturbed and linearized, the results of which can be used to create a small signal equivalent circuit model of the buck converter. Next, the small signal equivalent circuit model of a flyback converter operating in continuous conduction mode is derived.

The concept of the averaged switch model is introduced. This model used to model and simulate most any kind of switched mode converter. The second half of the seminar is devoted to deriving the control-to-output, audio susceptibility (input to output), and output impedance (output current to output voltage) transfer functions. These transfer functions are derived in detail for a buck converter and boost converter operating in continuous conduction mode. The seminar concludes with a brief discussion of measuring these transfer functions.

CONTROL

S8: Periodic Control of Power Converters

Keliang Zhou, *University of Glasgow*

ROOM 208B

Power converters which can precisely and efficiently convert, control and condition electricity, play a key role in the integration of various distributed generators, loads and transmission devices. However, in the processing of periodic dc or ac electricity, power converters will inject harmonic distortions to degrade the power quality and even the stability of power systems. To assure good power quality and stable power system operation, power converters highly demand optimal control strategies for compensating periodic signals with high accuracy, fast transient response, good robustness, and easy implementation. Simple but very effective internal model principle (IMP) based periodic controllers, such as integral control, resonant control, repetitive control, and so on, offer attractive control solutions to power converters.

This seminar will comprehensively present in-depth IMP based periodic control technology for power converters, which will cover fundamental IMP as well as most recent frequency adaptive periodic control. Including analysis and synthesis of periodic control systems, it will present a general "PID" control solution to periodic signal compensation for power converters. Plenty of application examples will be provided. The seminar is intended for intermediate and advanced audiences in the field of power electronics, who are looking for advanced control solutions to power converters.

CONTROL IMPLEMENTATION

S9: Power Delivery Modeling and Simulation for Server Systems

Jiangqi He, David Figueroa, *Intel*

ROOM 213AB

Power delivery has been a key technical aspect to optimize computer systems design, especially for high power systems such as enterprise system, high performance computing and datacenters. While industry paid a lot effort on voltage regulator technology improvements such as low loss power stage, nonlinear control functionalities, there is little attention on how to lever-

age best analysis methodology to optimize whole power delivery system to lower cost and optimize performance.

This short course will be focusing on how to use modeling and simulation to predict power delivery performance at motherboard level from DC-DC voltage regulator and up to CPU. It will first detail power delivery requirements for CPU performance, traditional process to design power delivery by testing and validations using VR test tool kit. It will then give details how to predict power performance by using modeling and simulations and how to optimize designs. A lot of correlation and applications will be illustrated at the third section.

THERMAL MANAGEMENT

S10: Thermal Management of Power Semi-Conductor Devices

David Levett, *Infineon Technologies*

ROOM 213CD

With increasing chip shrinkage and market demands for smaller power electronic converters, thermal management has become a key technical engineering design challenge. The goal of this seminar is to review the main engineering design requirements for keeping power semi-conductor devices operating within their temperature limits. The focus will be on the major facets of thermal management with an emphasis on a practical and hands-on approach to real-world product design.

Subjects to be covered include: power semi-conductor temperature limits; accurate power loss calculations; thermal modelling, from simple linear to finite element analysis; and air, water and phase change fluid based cooling systems. The seminar will be given by design engineers for design engineers with the aim of benefiting anyone involved in power converter design from entry level to veteran.

The seminar will be most relevant to engineers designing converters in the 1kW to 10MW power range and will emphasize power modules using IGBT's, diodes or SiC devices.

WBG DEVICES AND APPLICATIONS

S11: Robust and Reliable Circuit Designs with SiC Power Devices

Marcelo Schupbach, *Technical Marketing*

ROOM 217AB

Power converters made with Silicon Carbide (SiC) devices offer the promise of expanding current design space with regards to energy efficiency, power density and reliability while delivering lower BOM. To achieve these benefits, power converters must be redesigned in order to take full advantage of SiC devices. While characteristics and system-level advantages of SiC diodes have been well understood by the power electronics

community for many years, in-depth knowledge and system-level advantages brought forward by SiC MOSFET is less prevalent despite the fact that SiC MOSFET are now entering mainstream power electronic applications and products with unprecedented performance.

The seminar will provide experienced designers with expert knowledge in SiC MOSFET technology and how it compares against existing Si MOSFET and IGBTs technologies. It will describe the state of the art of SiC MOSFET technology including latest qualification and extended reliability data. Additionally, topics to be addressed include advanced characterization of SiC devices such as typical voltage and current de-rating, avalanche and high dv/dt characteristics and high pulsed current performance. Moreover, examples regarding optimal gate driver circuits, protections and layout will be presented. Finally, application examples which show system-level optimization for efficiency, power density and lower BOM cost will be provided.

SYSTEMS

S12: Fundamentals and Multi-Objective Design of Inductive Power Transfer Systems

Johann W. Kolar, Roman Bosshard, *ETH Zurich / PES Lab*

ROOM 217CD

The main aims of the seminar are to introduce the participants to the concepts and the multi-objective design challenges of Inductive Power Transfer (IPT) systems in a comprehensive, easy-to-follow fashion, to generate an understanding of the performance limits and to finally present experimental results of optimized industry-type demonstrator systems.

First, different application areas and IPT solutions existing in industry and academia are presented. The main components of an Electric Vehicle (EV) battery charging IPT system with three-phase power factor corrected mains interface are explained. Furthermore, the design challenges of an IPT system are discussed in immediate comparison to the design of a conventional isolated DC/DC converter, in order to bridge the knowledge gap between both areas and to allow practicing engineers in industry and researchers in academia to seamlessly extend and complete their understanding of the subject area based on knowledge of general power converter design.

Subsequently, a multi-objective design and optimization approach for IPT transmission coils along with the required calculation models for the high-frequency power losses in the main IPT system power components are presented in detail. The method takes into account the required system performance (air gap, battery charging power), as well as the boundary conditions imposed by

geometrical size limitations of the application, the electrical interface, the restrictions of the stray field as given by standards, and the thermal limitations of the components. Experimental results obtained from a 96.5% efficient 5 kW IPT system are presented to demonstrate the validity of the used calculation methods and the optimization process. In the last part of the seminar, the IPT system is discussed in the context of the complete power conversion chain from three phase mains via the IPT link to the vehicle battery. The feasibility of IPT systems for EV battery charging is discussed critically and requirements for implementation by industry are presented along with advantageous application areas.

Monday, March 16

8:30 a.m. – Noon

FUNDAMENTALS

S13: High Power Si & SiC Module Technology & Application Considerations

Toshiya Nakano, *Mitsubishi Electric Co.*

John Donlon and Eric Motto, *Powerex, Inc.*

ROOM 208A

High Power Semiconductor modules are the workhorse power switch for industrial applications. This seminar will discuss the issues a designer must deal with in using these devices including interpretation of device ratings, gate drive requirements, and providing device and system protection. The intent of this seminar is to aid the designer in choosing and applying a power module to a new product. Questions and concerns a designer might have will be addressed by the various techniques and circuit examples that will be presented. Chip technology and packaging options will be discussed with special attention to the tradeoffs between silicon and silicon carbide. The practical application of SiC power devices today and in the future will be discussed. The attendee should leave the course with a better understanding of the power module, specifically as a device and how it functions in an application. The goal will be to impart an understanding of desirable features, characteristics, and limitations. This will include the application in power circuits, protection from internal and external disturbances, and an understanding of thermal design, handling, and reliability considerations. The seminar is intended for design engineers having to deal with confusing and conflicting information on device data sheets.

CONTROL

S14: Principles and Practices of Digital Current Regulation for AC Systems

Grahame Holmes, *RMIT University*
ROOM 208B

Current regulation plays a key role in power electronic conversion systems. The basic concept is to compare a measured current against a defined reference, and to minimise the error between these two quantities by adjusting the switching of the associated power electronic converter. However, while simple in principle, achieving this goal for AC current regulators has proved to be very challenging.

This tutorial will present the current state-of-the-art for digital current regulation of AC converter systems. It will begin by showing how PWM transport and sampling delays are the primary constraints for linear regulators. Strategies to overcome these constraints will then be explored, including backEMF compensation, PR resonant control and its equivalent synchronous d-q frame implementation. An analytical approach to calculate the maximum gains for these strategies will be developed, verified by simulation and matching experimental results. The concepts will then be applied to the more challenging problems of current regulation with an LCL filter, and the influence of common mode EMI filtering on the current regulation process. Finally, the latest advances in hysteresis regulation will be presented, using variable hysteresis bands to maintain a constant switching frequency, and digitally implementing what is usually regarded as an analogue regulation system.

CONTROL IMPLEMENTATION

S15: Practical Implementation of Loop Control in Power Converters

Christophe Basso, *ON Semiconductor*
ROOM 213AB

Loop control and stability analysis represent an important part of power converters design. Small-signal analysis and tools to derive converters transfer functions have been introduced in seminars the author conducted in the previous years. In these theoretical seminars, practical details such as product gain-bandwidth or operational amplifier slew-rate limits were purposely ignored for the sake of simplicity. However, when you must build high-bandwidth systems, these aspects can no longer be ignored. Understanding their origins and accounting for them at design stage is always better than observing their deleterious impact once the prototype has been assembled. In this new seminar, the author covers some of the typical problems you will discover when stabilizing a converter. Op amp characteristics influence, fast lane ac pollution, monotonic start-up sequence or optocoupler response are among the subjects I will present. Using

mathematical analysis and SPICE, the author maintains a permanent link between theory and practical reality with bench results presented through the documents. Balancing analytical aspects and real case examples, the seminar targets an audience with an intermediate background in the presented subject.

THERMAL MANAGEMENT

S16: Power Electronics System Thermal Design

Roger Stout, *ON Semiconductor*
ROOM 213CD

This three-part, half-day seminar is designed for entry-to mid-level electronics system engineers, who are reasonably comfortable with Microsoft® Excel.

The first part will introduce the overall approach to semiconductor device thermal characterization. Pitfalls in the use and misuse of typically published semiconductor device thermal data will be discussed.

The second part will focus on the principle of linear superposition as applied to thermal system design. The goal is to provide the attendee with sufficient understanding to construct and use relatively simple spreadsheet-based tools in real-life system thermal designs. In the process, the following points will be covered: how to correctly utilize published thermal data in a system-level thermal model; how to predict actual operating temperatures of the significant power devices; how to predict the operating temperatures of low power but temperature sensitive devices; how this approach may be used in conjunction with more sophisticated thermal analysis tools.

The third section will be an in-depth presentation of specific and highly non-linear thermal failure mechanism, thermal runaway; whence it arises and how it may be analyzed. The focus will be within the particular context of power semiconductor devices, but it should also become evident how the concept may be applied more generally.

WBG DEVICES AND APPLICATIONS

S17: Practical Application of 600 V GaN HEMTs in Power Electronics

Eric Persson, *Infineon*
ROOM 217AB

600 V GaN High Electron Mobility Transistors (HEMTs) are now becoming available from several major semiconductor manufacturers, and are moving from prototype to production in a variety of power electronic applications. This practical, application-oriented seminar begins with device characteristics, explaining similarities and differences compared to Silicon FETs and IGBTs. Gate drive and switching characteristics in both hard and soft-switching topologies are covered in detail. Sev-

PROF. EDUCATION SEMINARS

Bruno Allard, INSA-Lyon

This seminar for entry and intermediate level power electronics engineers, will focus on particular aspects of the integration of switched mode power supplies to address Voltage Regulation (VR) in System-on-Chip (SoC) applications including microprocessor power delivery. The complete integration on-die and integration within package are of prime interest for increased efficiency, voltage quality and reduced footprint. The course will review the current state of power supply technology platforms with a focus on high switching frequencies technologies and cover all major aspects of Integrated VR development, including Power Management IC design, circuit topology, passives (on-chip magnetics, capacitors) & system integration. The focal topics for this seminar are the strategies for addressing circuit and system needs for high switching frequencies as well as advanced technologies for the design and manufacture of these passives. The key enabling technologies including integration of passive components on Silicon, CAD tool and new circuits and topologies to facilitate greater granularity and higher efficiency will also be presented. Finally, future trends, key challenges and potential solutions in the realizing the 'holy grail' of monolithically-integrated power supplies (PwrSoC) will be given.

NOTES

[illegible]

Plenary Session

Monday, March 16

1:30 p.m. – 5:00 p.m.

BALLROOM AB

The plenary session leads off with Hao Huang who will discuss Challenges in Electrical Systems for More Electric Aircraft. This will be followed by David Cox describing Power Architectures for the Next Generation of Solid-State Lighting. Dhaval Dalal will then lead a discussion on PSMA Power Technology Roadmap. After a short break, Kerry Cheung will present the DOE Perspectives on Microgrids. Next, Veena Misra will give an overview of Optimizing Performance and Reliability. The plenary session will end with a discussion on A New Emphasis on Industry Partnerships at Los Alamos: Finding Win-Win Outcomes that Benefit the Nation by David Pesiri.

Challenges in Electrical Systems for More Electric Aircraft

1:30 p.m. – 2:00 p.m.



SPEAKER:
Hao Huang
GE Aviation

Because of their higher energy efficiency, lower NOx emission, and less audible noise, more electric aircraft (MEA) has become an inevitable, irreversible trend for the evolution of aviation. This process is called Electrification, and in the last one and half decades, there has been tremendous progress made, e.g., Boeing 787 and Airbus 380. However, there are still significant challenges that block the aerospace industry to fully harvest the advantages of the MEA.

One major challenge is weight. Although MEA provides the previously mentioned advantages, the MEA approach does not always achieve lower weight. An important reason is the weight of the power electronics boxes due to complex power electronic circuitries, required EMI filtering, and associated additional cooling. This weight issue diminishes the benefit of MEA on energy efficiency to a considerable extent.

Wide Band Gap (WBG) devices, such as SiC or GaN, are a viable solution to address the weight issue. This presentation will provide the audience with a brief summary regarding the progress made by GE on SiC MOS-

FET device maturation and reliability, the development of the SiC MOSFET based aircraft electronics subsystems, and some key findings related to how to appropriately implement the SiC in aircraft electric systems.

It is clear that WBG enhanced power electronics will accelerate the Electrification process, open up tremendous opportunities for the power electronics industries in aerospace, and cause a substantial evolution in the aviation history.

Power Architectures for the Next Generation of Solid-State Lighting

2:00 p.m. – 2:30 p.m.



SPEAKER:
David Cox
Cree

This talk will discuss real world requirements, solutions and challenges and tradeoffs facing power architectures for the next generation of solid state lighting. Applications covered will include street & area lighting; commercial & industrial general illumination; residential lighting, including replacement lamps (A19, GU10, PAR, BR, MR); and automotive lighting. The topics covered will range from high voltage, high power, and high reliability to low voltage (Emerge, POE) and consumer lighting.

PSMA Power Technology Roadmap

2:30 p.m. – 3:00 p.m.



SPEAKER:
Dhaval Dalal
ON Semiconductor

The crystal ball that the power electronics industry employs to gaze into the future is the PSMA Power Technology roadmap. This is a regular biennial activity where many industry experts come together to outline the future directions of our industry. This presentation will provide a retrospective overview and analysis of past roadmaps and compare their predictions to subsequent results. The intent of this exercise is to polish the crystal ball and enable future roadmaps to be even more effective.

The results of Power Technology roadmap published in 2015 will also be highlighted in this presentation. The PSMA roadmap activity differs from many commercially available documents as it has contributions from industry insiders with significant technology awareness and depth. Over past few years, the roadmap activity has evolved into a three-dimensional approach where component level trends, application level trends and technology trends are interposed to give a more comprehensive view. The roadmap also captures the industry trends through invited webinars from various industry experts regarding the trends. While casual readers will be able to take away the evolution of pertinent metrics in various application categories, more voracious perusal of the roadmap content will undoubtedly give many more illuminating insights to the readers.

BREAK

3:00 p.m. – 3:30 p.m.

DOE Perspectives on Microgrids

3:30 p.m. – 4:00 p.m.



SPEAKER:

Kerry Cheung

Department of Energy

As modern society becomes more dependent on digital devices, concerns with climate change prompt greater deployment of clean energy technologies, and the impacts of extreme weather events become more apparent, the electric grid is being asked to do more and more to ensure safe, reliable, and cost-effective delivery of electricity. These changing demands have significant implications for how the grid needs to be designed, control, and protected. This presentation will share perspectives for the future grid and discuss the potential role of microgrids. DOE experiences with microgrids, future opportunities, and remaining challenges will also be discussed.

Optimizing Performance and Reliability of GaN MOSFET Devices

4:00 p.m. – 4:30 p.m.



SPEAKER:

Veena Misra

North Carolina State University

Owing to a high critical electric field and high electron mobility, GaN based lateral Heterojunction Field Effect Transistors (HFETs) are sought after for high voltage power and RF applications. However the device reliability continues to be a critical challenge to be overcome before successful commercialization. In this work, different dielectrics deposited by Atomic Layer Deposition (ALD) have been investigated for improving the threshold voltage stability and dynamic reliability of AlGaN/GaN based Metal-Oxide-Semiconductor-HFETs (MOS-HFETs). This work includes a first-of-its-kind comprehensive analysis of electrical characterization techniques and physics-based models required to evaluate and recommend any dielectric for mitigating surface trapping phenomena in the gate stack or the access-regions. Comparing the efficacy of different methods for characterization of dielectric/AlGaN interface traps, it is found that the popular conductance method has a severely constrained detection limit when the AlGaN barrier offers high resistance to the de-trapping electrons. A capacitance-based method is immune to the issue of barrier resistance, but is still restrictive in its range. To improve the range and accuracy of trap detection, a novel pulsed-IV-based methodology is developed and demonstrated to be applicable for detecting both shallow and deep traps and implemented on evaluating different high-k and low-k ALD dielectrics. Using physics-based simulation models and experimental data, it is demonstrated that the leakage at the surface of the AlGaN, whether through the passivation dielectric bulk or the dielectric/AlGaN interface, must be minimized to restrict the formation of a “virtual gate” and minimize current collapse. It was also found that an optimal passivation dielectric must create a high density of shallow interface donor traps to quicken the de-trapping of electrons from the “virtual gate” and the recovery of the channel underneath. Combining simulation and experimental results, an optimal set of ALD dielectrics for a reliable gate stack and access-region passivation regions, respectively, was determined and will be discussed. The effectiveness of the resulting optimal dual dielectric passivation stack in mitigating current collapse and ensuring contact isolation is also demonstrated.

A New Emphasis on Industry Partnerships at Los Alamos: Finding Win-Win Outcomes that Benefit the Nation

4:30 p.m. – 5:00 p.m.



SPEAKER:

David Pesiri

Los Alamos National
Laboratory

We believe innovation is the key to addressing many challenges facing the Nation today. On all levels, Los Alamos National Laboratory is being asked to move the needle on

issues of domestic and global security, advancing the scientific enterprise on energy concerns, and effective leveraging of the latest technologies and capabilities to bolster US industry and, ultimately, the US economy. This is our charge by the public trust, a duty to both country and the world community. To create significant impact demands a new way of thinking about how the Lab engages industry in partnership to produce phenomenal outcomes. The Richard P. Feynman Center for Innovation is leading the change from traditional technology transfer to a robust form of innovation engineering, where our community of business professionals creates collaborations that meet the needs of the Lab and our partners, create significant value and impact for the Nation, and that change the world.

Notes

[illegible]

NOTES

Rap Sessions

R1: Wireless Transfer of Power: Facts and Fictions

Tuesday, March 17

5:00 p.m. – 6:30 p.m.

ROOM 2017A

MODERATOR:

Dr. John M. Miller, *JNC Miller plc*

PANELISTS:

- ▶ Mr. Ted Bohn, *Argonne National Laboratory*
- ▶ Dr. Omer C. Onar, *Oak Ridge National Laboratory*
- ▶ Prof. Joachem Taiber, *Clemson University International Center for Automotive Research*
- ▶ Dr. Michael de Rooji, *Efficient Power Corp*

This interesting and controversial panel will aim to inform, confirm or deflate, existing notions of what it means, and what it takes, to transfer electrical power without wires. The panelists; experts from industry, academia, and national laboratories, will tell you if what you are hearing, seeing, and reading about wireless power transfer (WPT) is fact, or perhaps wishful thinking. Members of the panel have designed and validated WPT implementations operating from 10's of Watts to 10's of kilo-Watts. Plan to attend to find out more and enjoy some refreshments as well. It promises to be an exciting evening!

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R2: Wide Bandgap Semiconductors Devices in Power Electronics – Who, What, Where, When, and Why?

Tuesday, March 17

5:00 p.m. – 6:30 p.m.

ROOM 217D

MODERATOR:

Kevin Parmenter, *Excelsys Technologies*

PANELISTS:

- ▶ Ionel Dan Jitaru, *Rompower*
- ▶ Alex Lidow, Ph.D., *Efficient Power Conversion*
- ▶ JJ Wilkerson, *Excelsys Technologies*
- ▶ Eric Persson, *IR / Infineon*
- ▶ Larry Spaziani, *GaN Systems*
- ▶ Robert White, *Embedded Power Labs*
- ▶ Ron Vinsant, *Vishay*

What's up with all this wide bandgap semiconductor stuff? Gallium Nitride (GaN) has been a hot topic in the new compound semiconductors. Silicon Carbide is also finding its stride in power electronics applications. We've heard that GaN was supposed to be take over almost every application by now, or is taking over by now, or will imminently... There seems to be a lot of confusion.

Is there a wide gap in the perception band between expectations and reality? Are we on the verge of a revolution that is taking place now or is this something that will become mainstream in 5, 10, or 20 years? What are the impediments to wide bandgap power devices being widely adopted. Why is it taking the time it's taking? How much longer will the VCs hang in there? Some niche applications have happened but where's the revolution? Is there a killer application? Is reliability still an issue or do we have enough data to say it's not? Are the reliability metrics different for these new materials? What are the technical hurdles and packaging constraints? Who will the players be? How do we measure the device performance of 1-5 ns slew-rate devices and with what test equipment? Are there advantages in using these devices in existing design? Where is the demonstrable evidence of improved performance? What is keeping design engineers from using it for everything? Are new killer applications needed for these to succeed? And many more questions linger.

R3: Future Expectations of Power Electronics for Variable Speed Applications?

Tuesday, March 17

5:00 p.m. – 6:30 p.m.

ROOM 218/219

MODERATOR:

Dr. Babak Fahimi, *University of Texas at Dallas*

PANELISTS:

- Johann Kohlar, *ETH*
- Steven Pekarek, *Purdue University*
- Dr. Abas Goodarzi, *US Hybrid Corporation*
- Steven Schulz, *FF Inc.*

Variable speed motor drives and power electronic driven products play a key role in electrification of many industries. This rap session is focused on power electronics-related implications of the electrification process in industrial drives and transportation industry. To this end a quick overview of the state-of-the-art in electric motor and power electronic converters will be offered. A technical overview of the main contenders of today and near future in each category will be discussed. The discussion will also highlight the expectations (power density, thermal response, cost density, etc.) for power electronic drivers used in industrial and transportation. This session welcomes questions on challenges and goals that are set for the next twenty years. These challenges will outline the necessary components (motors, passive elements, switches, thermal management, packaging, and EMI/EMC). Anticipations from the growth of market size and hence desired cost densities of the future generation of power electronic inverter systems will be discussed as well.

Saturday March 14, 2015

4:00 p.m. – 7:00 p.m.

Registration
A CONCOURSE



SATURDAY

Sunday March 15, 2015

8:00 a.m. – 5:00 p.m.

Registration
A CONCOURSE

9:30 a.m. – 1:00 p.m.

Professional Education Seminars
(please go to page 31 for complete details)

- 9:30 a.m. – 1:00 p.m.
- S1: Permanent Magnet Machine Drives**
Mehdi Abolhassani, *University of Houston*
ROOM 208A
- 9:30 a.m. – 1:00 p.m.
- S2: Recent Breakthroughs in Controls for Power Electronics**
Tobias Geyer, *ABB*
Sudip K. Mazumder, *NextWatt LLC*
ROOM 208B
- 9:30 a.m. – 1:00 p.m.
- S3: FPGA-Based Digital Control Development**
Jason Katcha, *All Digital Power*
Michael Parker, *Altera Corp*
ROOM 213AB
- 9:30 a.m. – 1:00 p.m.
- S4: Optimal Design of Inductive Power Components Based on Accurate Loss and Thermal Models**
Jonas Muehlethaler, *Gecko-Simulations*
ROOM 213CD
- 9:30 a.m. – 1:00 p.m.
- S5: 3D Packaging for High Density and High Performance GaN-Based Circuits**
Douglas Hopkins, Haotao Ke, *NC State University*
ROOM 217AB
- 9:30 a.m. – 1:00 p.m.
- S6: Advanced Condition Monitoring and Diagnosis for Electric Motors and Drives**
Seungdeog Choi, *The University of Akron*
ROOM 217CD

SUNDAY

2:30 p.m. – 6:00 p.m.

Professional Education Seminars

(please go to page 35 for complete details)

S7: 2:30 p.m. – 6:00 p.m.
Introduction to Small Signal and Average Modeling
 Robert White, *Embedded Power Labs*
 ROOM 208A

S8: 2:30 p.m. – 6:00 p.m.
Periodic Control of Power Converters
 Kelian Zhou, *University of Glasgow*
 ROOM 208B

S9: 2:30 p.m. – 6:00 p.m.
Power Delivery Modeling and Simulation for Server Systems
 Jiangqi He, David Figueroa, *Intel*
 ROOM 213AB

S10: 2:30 p.m. – 6:00 p.m.
Thermal Management of Power Semiconductor Devices
 David Levett, *Infineon Technologies*
 ROOM 213CD

S11: 2:30 p.m. – 6:00 p.m.
Robust and Reliable Circuit Designs with SiC Power Devices
 Marcelo Schupbach, *Technical Marketing*
 ROOM 217AB

S12: 2:30 p.m. – 6:00 p.m.
Fundamentals and Multi-Objective Design of Inductive Power Transfer Systems
 Johann W. Kolar, Roman Bosshard,
ETH Zurich / PES Lab
 ROOM 217CD

Monday March 16, 2015

7:30 a.m. – 5:00 p.m.

Registration

A CONCOURSE

8:00 a.m. – 9:00 a.m.

Spouse & Guest Welcome Breakfast

HARRIS ROOM – THE WESTIN CHARLOTTE

8:00 a.m. – 11:00 a.m.

Spouse & Guest Hospitality Room Open

HARRIS ROOM – THE WESTIN CHARLOTTE

8:30 a.m. – 12:00 p.m.

Professional Education Seminars

(please go to page 39 for complete details)

S13: 8:30 a.m. – 12:00 p.m.
High Power Si & SiC Module Technology & Application Considerations
 Toshiya Nakano, *Mitsubishi Electric Co.*
 John Donlon and Eric Motto, *Powerex, Inc.*
 ROOM 208A

S14: 8:30 a.m. – 12:00 p.m.
Principles and Practices of Digital Current Regulation for AC Systems
 Grahame Holmes, *RMIT University*
 ROOM 208B

S15: 8:30 a.m. – 12:00 p.m.
Practical Implementation of Loop Control in Power Converters
 Christophe Basso, *ON Semiconductor*
 ROOM 213AB

S16: 8:30 a.m. – 12:00 p.m.
Power Electronics System Thermal Design
 Roger Stout, *ON Semiconductor*
 ROOM 213CD

8:30 a.m. – 12:00 p.m.

S17: Practical Application of 600 V GaN HEMTs in Power Electronics

Eric Persson, *Infineon*

ROOM 217AB

8:30 a.m. – 12:00 p.m.

S18: Power Supply on Chip Technology for High Frequency Integrated Voltage Regulation

Bruno Allard, *INSA-Lyon*

Jose Cobos, *Universidad Politécnica de Madrid*

Santosh Kulkarni and Cian O'Mathuna, *Tyndall National Institute*

ROOM 217CD

10:00 a.m.

Spouse Tour “A CULTURAL AFFAIR” Departs

HARRIS ROOM – THE WESTIN CHARLOTTE



1:30 p.m. – 5:00 p.m.

Opening Plenary Session

(For more information about the plenary, see page 44)

BALLROOM AB

1:30 p.m. – 2:00 p.m.

Challenges in Electrical Systems for More Electric Aircraft

Hao Huang, *GE Aviation*

2:00 p.m. – 2:30 p.m.

Power Architectures for the Next Generation of Solid-State Lighting

David Cox, *Cree*

2:30 p.m. – 3:00 p.m.

PSMA Power Technology Roadmap

Dhaval Dalal, *ON Semiconductor*

3:00 p.m. – 3:30 p.m.

Break

3:30 p.m. – 4:00 p.m.

DOE Perspectives on Microgrids

Kerry Cheung, *Department of Energy*

4:00 p.m. – 4:30 p.m.

Optimizing Performance and Reliability of GaN MOSFET Devices

Veena Misra, *North Carolina State University*

4:30 p.m. – 5:00 p.m.

A New Emphasis on Industry Partnerships at Los Alamos: Finding Win-Win Outcomes that Benefit the Nation

David Pesiri, *Los Alamos National Laboratory*

5:00 p.m. – 8:00 p.m.

Exhibit Hall Welcome Reception

EXHIBIT HALL

8:00 p.m. – 10:00 p.m.

MicroMouse Contest

BALLROOM C

MONDAY

MONDAY

Tuesday

March 17, 2015

7:00 a.m. – 8:00 a.m.

Speaker Breakfast

ROOM 203AB

7:30 a.m. – 5:00 p.m.

Registration

A CONCOURSE

8:00 a.m. – 11:00 a.m.

Spouse & Guest Hospitality Room Open

HARRIS ROOM – THE WESTIN CHARLOTTE

8:30 a.m. – 11:55 a.m.

INDUSTRY SESSION 1: Latest Advances in Power Semiconductors, a Less Biased Discussion

ROOM 207AB

SESSION CHAIRS:

Ranbir Singh, *GeneSiC*

Carl Blake, *Transphorm*

8:30 a.m. – 8:55 a.m.

IS1.1 Market and Technology Trends in WBG Power Module Packaging

Pierric Gueguen, *Yole Developpement, France*

8:55 a.m. – 9:20 a.m.

IS1.2 Industry Requirements and General Trends for Compound Semiconductors

Alan Hefner, *NIST, United States*

9:20 a.m. – 9:45 a.m.

IS1.3 Wide Band Gap Power Device Evaluation Challenges and Technologies

Ryo Takeda, *Keysight Technologies International Japan G.K., Japan*

9:45 a.m. – 10:10 a.m.

IS1.4 Low Voltage GaN “ Discussion of Initial Application Adoption and State of Reliability Achievement

Alex Lidow, *EPC, United States*

Break

10:40 a.m. – 11:05 a.m.

IS1.5 State of Demonstrated HV GaN Reliability and Further Requirements

Tim McDonald, *International Rectifier, United States*

11:05 a.m. – 11:30 a.m.

IS1.6 Silicon Carbide Switches in Emerging Applications

Ranbir Singh, *GeneSiC Semiconductor Inc., United States*

11:30 a.m. – 11:55 a.m.

IS1.7 Advanced Silicon Devices Applications and Technology Trends

Gerald DeBoy, *Infineon, United States*

8:30 a.m. – 11:55 a.m.

INDUSTRY SESSION 2: Transportation Power Electronics: Vehicles, Chargers, Components and Markets

ROOM 207CD

SESSION CHAIRS:

Ralph Taylor, *Delphi*

Yunqi Zheng

8:30 a.m. – 8:55 a.m.

IS2.1 Novel and Ruggedized Power Electronics for Off-Highway Vehicles

Brij Singh², Kent Wanner², Zimin Vilar¹, ¹John Deere Construction & Forestry, United States; ²John Deere Electronic Solutions, United States

8:55 a.m. – 9:20 a.m.

IS2.2 Challenging Questions for Power Electronics Engineers/Researchers in Vehicle Electrification

Jun Kikuchi, *Ford, United States*

9:20 a.m. – 9:45 a.m.

IS2.3 High Temperature Dielectric Materials and Capacitors for Transportation Power Electronics

Michael Lanagan, *Penn State, United States*

9:45 a.m. – 10:10 a.m.

- IS2.4 EV-HEV Market and Technology Trends**
Pierric Gueguen, *Yole Developpement, France*

Break

10:40 a.m. – 11:05 a.m.

- IS2.5 Assessing the N.A. Supply Chain for Power Electronics and Motors: Views on Bottlenecks and Potential Solutions**
Chris Whaling², Steven Boyd¹, ¹DOE, *United States*; ²Synthesis Partners, *United States*

11:05 a.m. – 11:30 a.m.

- IS2.6 Wireless Charging Standards**
Ted Bohn, *Argonne National Labs, United States*

11:30 a.m. – 11:55 a.m.

- IS2.7 How Does Charging EDV's Affect the Electrical Infrastructure**
Arindam Maitra, John Halliwell, *EPRI, United States*

8:30 a.m. – 11:55 a.m.

INDUSTRY SESSION 3: PMBus Standards and Applications

ROOM 208A

SESSION CHAIRS:

Robert V. White, *Embedded Power Labs*
Travis Summerlin, *Texas Instruments*

8:30 a.m. – 8:55 a.m.

- IS3.1 Open Standard AVS for ASICs, CPUs, and FPGAs**
Brian Carpenter, Travis Summerlin, *Texas Instruments, United States*

8:55 a.m. – 9:20 a.m.

- IS3.2 Dynamic Optimization for Precision FPGA Power via PMBus**
Tamara Schmitz, *Xilinx, United States*

9:20 a.m. – 9:45 a.m.

- IS3.3 PMBus Considerations for Interoperability in a Complete Digital Power Ecosystem**
Mark Adams, *CUI Inc, United States*

9:45 a.m. – 10:10 a.m.

- IS3.4 The Benefits and Challenges of Using PMBus for Scalability in Telecommunication Systems**
Björn Olsson, *Ericsson, Sweden*

Break

10:40 a.m. – 11:05 a.m.

- IS3.5 PMBus Firmware: Using Arduino for Prototyping and Designing PMBus Solutions**
Michael Jones, *LTC, United States*

11:05 a.m. – 11:30 a.m.

- IS3.6 Evolution of PMBus in AC-DC Applications**
Conor Quinn, Richard Caubang, *Artesyn Embedded Technologies, United States*

11:30 a.m. – 11:55 a.m.

- IS3.7 Real World Applications of PMBus in the Data Center**
Ed Stanford, Brian Griffith, Willie Wen, *Intel Corporation, United States*

8:30 a.m. – 12:00 a.m.

TECHNICAL SESSION 1: Isolated DC-DC Converters

ROOM 217A

TRACK: DC-DC Converters

SESSION CHAIRS:

Wenduo Liu, *International Rectifier*
Wisam Moussa, *International Rectifier*

8:30 a.m. – 8:50 a.m.

- T1.1 An Improved Asymmetric Half-Bridge Converter with Zero DC Offset of Magnetizing Current**
S. Chakraborty, S. Chattopadhyay, *Indian Institute of Technology Kharagpur, India*

8:50 a.m. – 9:10 a.m.

- T1.2 PLL Based Bridge Synchronization as an Alternative to Digital Isolators for Dual Active Bridge DC-DC Converters**
S. Poshtkouhi, A. Eski, O. Trescases, *University of Toronto, Canada*

- 9:10 a.m. – 9:30 a.m.
T1.3 Dual Edge Tracking Control for Synchronous Rectification (SR) of LLC Resonant Converter
H. Choi, *Fairchild Semiconductor*
- 9:30 a.m. – 9:50 a.m.
T1.4 A Robust Low-RMS-Current Passive Auxiliary Circuit for ZVS Operation of Both Legs in Full Bridge Converters
A. Safaee¹, P. Jain², A. Bakhshai², ¹OSRAM Sylnavia; ²Queen's University, Canada
- 9:50 a.m. – 10:10 a.m.
T1.5 A New Isolated Hybrid Boosting Converter
B. Wu, K. Smedley, *University of California, Irvine*
- Break**
- 10:40 a.m. – 11:00 a.m.
T1.6 A Secondary-Side Phase-Shift-Controlled Soft-Switching DC/DC Converter Utilizing Two Transformers with Wide Voltage Gain for High Step-Down Applications
H. Wu, L. Chen, Y. Xing, P. Xu, H. Hu, *Nanjing University of Aeronautics and Astronautics, China*
- 11:00 a.m. – 11:20 a.m.
T1.7 Novel Transformer-Flux-Balancing Control of Dual-Active-Bridge Bidirectional Converters
Y. Panov, M. Jovanovic, B. Irving, *Delta Products Corporation*
- 11:20 a.m. – 11:40 a.m.
T1.8 Bidirectional Flyback Converter with Multiple Series Connected Outputs for High Voltage Capacitive Charge and Discharge Applications
P. Thummala, H. Schneider, Z. Zhang, M. Andersen, *Danmarks Tekniske Universitet, Denmark*
- 11:40 a.m. – 12:00 p.m.
T1.9 Soft Switching High Frequency AC-Link DC-DC Buck-Boost Converters
T. Wang, S. Sen, M. Amirabadi, *University of Illinois at Chicago*

8:30 a.m. – 12:00 p.m.

TECHNICAL SESSION 2: Three-Phase & Higher Power AC-DC Converters

ROOM 217BC

TRACK: AC-DC Converters

SESSION CHAIRS:

Gerry Moschopoulos, *Western University, Canada*
Laszlo Balogh, *Fairchild Semiconductor*

- 8:30 a.m. – 8:50 a.m.
T2.1 Hardware Verification of a Hyper-Efficient (98%) and Super-Compact (2.2kW/dm³) Isolated AC/DC Telecom Power Supply Module Based on Multi-Cell Converter Approach
M. Kasper¹, C. Chen³, D. Bortis¹, J. Kolar¹, G. Deboy², ¹ETH Zürich, Switzerland; ²Infineon Technologies Austria AG, Austria; ³National Taiwan University, Taiwan
- 8:50 a.m. – 9:10 a.m.
T2.2 Design and Implementation of Interleaved Vienna Rectifier with Greater Than 99% Efficiency
Q. Wang², X. Zhang², R. Burgos², D. Boroyevich², A. White¹, M. Kheraluwala¹, ¹United Technology Aerospace Systems; ²Virginia Polytechnic Institute and State University
- 9:10 a.m. – 9:30 a.m.
T2.3 A Modular Three Phase Power Factor Correction (PFC) Approach with Two Single Phase PFC Stages and an Electronic Phase Shifter
M. Albader, P. Enjeti, *Texas A&M University*
- 9:30 a.m. – 9:50 a.m.
T2.4 Three-Phase Buck Type Rectifier Topology Integrated with Current Fed Full-Bridge
J. Molina, P. Alou, J. Oliver, M. Silva, J. Cobos, *Universidad Politécnica de Madrid, Spain*
- 9:50 a.m. – 10:10 a.m.
T2.5 Analysis of a Three-Phase Flying Converter Cell Rectifier Operating in Light/No-Load Condition
M. Makoschitz², M. Hartmann¹, H. Ertl², ¹Schneider Electric Power Drives, Austria; ²Technische Universität Wien, Austria

Break

- T2.6** 10:40 a.m. – 11:00 a.m.
Implementation and Performance Comparison of Five DSP-Based Control Methods for Three-Phase Six-Switch Boost PFC Rectifier

L. Huber, M. Kumar, M. Jovanovic, *Delta Products Corporation*

- T2.7** 11:00 a.m. – 11:20 a.m.
Design of Control System for Solid State Variable Capacitor with Minimum DC Capacitor

R. Chen, Y. Liu, P. Taskas, F. Peng, *Michigan State University*

- T2.8** 11:20 a.m. – 11:40 a.m.
Surge Voltage Suppression Methods for Three-Phase to Single-Phase Matrix Converter
Y. Kadoshima³, K. Koiwa³, J. Itoh³, F. Anne², A. Gerlaud², J. Sasaki¹, ¹*Mersen Japan K.K., Japan*; ²*Mersen St Sylvain d'Anjou France, France*; ³*Nagaoka University of Technology, Japan*

- T2.9** 11:40 a.m. – 12:00 p.m.
An Improved Active-Front-End Rectifier Using Model Predictive Control
M. Parvez³, S. Mekhilef³, N. Tan², H. Akagi¹, ¹*Tokyo Institute of Technology, Japan*; ²*Universiti Tenaga Nasional, Malaysia*; ³*University of Malaya, Malaysia*

8:30 a.m. – 12:00 p.m.

TECHNICAL SESSION 3: Magnetic Devices and Components I

ROOM 217D

TRACK: Devices and Components

SESSION CHAIRS:

Stephen M. Carlsen, *Raytheon*
Matt Wilkowski, *Altera*

- T3.1** 8:30 a.m. – 8:50 a.m.
Power Losses Calculations in Windings of Gapped Magnetic Components: the Extended 2-D Method
F. Holguin, R. Prieto, R. Asensi, J. Cobos, *Universidad Politécnica de Madrid, Spain*

8:50 a.m. – 9:10 a.m.

- T3.2** **Investigation, Development and Verification of Printed Circuit Board Embedded Air-Core Solenoid Transformers**
J. Mønster, M. Madsen, J. Pedersen, A. Knott, *Danmarks Tekniske Universitet, Denmark*

9:10 a.m. – 9:30 a.m.

- T3.3** **Improving the Efficiency and Dynamics of 3D Integrated POL**
D. Hou, Y. Su, Q. Li, F. Lee, *Virginia Polytechnic Institute and State University*

9:30 a.m. – 9:50 a.m.

- T3.4** **Investigation of Gallium Nitride Devices Benefits on LLC Resonant DC-DC Converter**
W. Zhang, Y. Cui, F. Wang, L. Tolbert, B. Blalock, D. Costinett, *University of Tennessee*

9:50 a.m. – 10:10 a.m.

- T3.5** **A Stacked Common Mode Inductor with Small External Magnetic Field Susceptibility, Low Magnetic Field Emission and High Differential Mode Inductance**
Y. Chu³, S. Wang², N. Zhang³, D. Fu¹, ¹*Huawei Technologies Co., Ltd*; ²*University of Florida*; ³*University of Texas at San Antonio*

Break

10:40 a.m. – 11:00 a.m.

- T3.6** **Design Considerations for High-Efficiency Leakage Transformers**
J. Pollock², C. Sullivan¹, ¹*Dartmouth College*; ²*Tesla Motors*

11:00 a.m. – 11:20 a.m.

- T3.7** **A Tunable Common Mode Inductor with an Auxiliary Winding Network**
D. Xu, W. Ng, S. Kiratipongvoot, C. Lee, B. Pong, *University of Hong Kong, Hong Kong*

11:20 a.m. – 11:40 a.m.

- T3.8** **Design and Optimization of Small Inductors on Extra-Thin PCB for Flexible Cooking Surfaces**
J. Serrano, I. Lope, J. Acero, J. Burdío, C. Carretero, R. Alonso, *Universidad de Zaragoza, Spain*

11:40 a.m. – 12:00 p.m.

T3.9 Design Methodology of Series DC Coupling Transformer in a Medium-Voltage DC Amplifier System

R. Beddingfield, A. De, H. Mirzae, S. Bhattacharya, *North Carolina State University*

8:30 a.m. – 12:00 p.m.

TECHNICAL SESSION 4: Photovoltaic Applications

ROOM 213A

TRACK: Renewable Energy Systems

SESSION CHAIRS:

Robert Pilawa-Podgurski, *University of Illinois*

Tiefu Zhao, *Eaton*

8:30 a.m. – 8:50 a.m.

T4.1 A Phase Shift Controlled Current-Fed Quasi-Switched-Capacitor Isolated DC/DC Converter with GaN HEMTs for Photovoltaic Applications

L. Fu, X. Zhang, F. Guo, J. Wang, *Ohio State University*

8:50 a.m. – 9:10 a.m.

T4.2 Simple Instantaneous Power Modulation Scheme for Single-Phase High-Frequency Link Microinverter for Low-Power PV Applications

A. Aganza-Torres¹, V. Cardenas¹, M. Pacas², ¹*Universidad Autónoma de San Luis Potosí, Mexico*; ²*Universität Siegen, Germany*

9:10 a.m. – 9:30 a.m.

T4.3 A Novel Platform for an Accurate Modeling and Precise Control of Photovoltaic Modules with Maximum Operating Efficiency

A. Shawky¹, H. Radwan¹, M. Orabi¹, M. Youssef², ¹*Aswan University, Egypt*; ²*University of Ontario Institute of Technology, Canada*

9:30 a.m. – 9:50 a.m.

T4.4 Open-Circuit Fault Diagnosis for a Grid-Connected NPC Inverter with Unity Power Factor

U. Choi¹, F. Blaabjerg¹, J. Lee², K. Lee², ¹*Aalborg University, Denmark*; ²*Ajou University, Korea, South*

9:50 a.m. – 10:10 a.m.

T4.5 A Novel Low Cost PV Micro-Inverters Based on Analog Control and Interleaving Method
E. Najm, A. Huang, W. Yu, *North Carolina State University*

Break

10:40 a.m. – 11:00 a.m.

T4.6 An Optimized Efficiency-Based Control Strategy for Islanded Paralleled PV Micro-Converters

H. Gui¹, Y. Zhang¹, Z. Zhang¹, Y. Liu², ¹*Nanjing University of Aeronautics and Astronautics, China*; ²*Queen's University, Canada*

11:00 a.m. – 11:20 a.m.

T4.7 PV Panel Power Optimization Using Sub-Panel MPPT

E. Marti-Arbona, D. Mandal, B. Bakkaloglu, S. Kiaei, *Arizona State University*

11:20 a.m. – 11:40 a.m.

T4.8 Design of a LCL Filter for Leakage Current Reduction in Transformerless PV Grid-Connected Three-Level Inverter

J. Giacomini, L. Michels, L. Schuch, H. Pinheiro, C. Rech, *Universidade Federal de Santa Maria, Brazil*

11:40 a.m. – 12:00 p.m.

T4.9 GaN HEMT Based 250W CCM Photovoltaic Micro-Inverter

J. McLamara, A. Huang, *North Carolina State University*

8:30 a.m. – 12:00 p.m.

TECHNICAL SESSION 5: Machines and Inverters

ROOM 213BC

TRACK: Motor Drives and Inverters

SESSION CHAIRS:

Alexis Kwasinski, *University of Texas – Austin*

8:30 a.m. – 8:50 a.m.

T5.1 DC Assisted Bipolar Switched Reluctance Machine

T. Husain², Y. Sozer², I. Husain¹, ¹*North Carolina State University*; ²*University of Akron*

8:50 a.m. – 9:10 a.m.
T5.2 Experimental Studies on Drive Performances of Wound Field Synchronous Motor Drive Integrated with ZSI
 G. Tajima, T. Kosaka, N. Matsui, *Nagoya Institute of Technology, Japan*

9:10 a.m. – 9:30 a.m.
T5.3 An Innovative Multiphase PWM Control Strategy for a PMSM with Segmented Stator Windings
 C. Lin, Y. Tzou, *National Chiao Tung University, Taiwan*

9:30 a.m. – 9:50 a.m.
T5.4 Measurement of Core Losses in Electrical Steel in the Saturation Region Under DC Bias Conditions
 B. Tekgun, Y. Sozer, I. Tsukerman, *University of Akron*

9:50 a.m. – 10:10 a.m.
T5.5 A Dual Inverter for an Open End Winding Induction Motor Drive Without an Isolation Transformer
 S. Chowdhury, P. Wheeler, C. Gerada, S. Lopez Arevalo, *University of Nottingham, United Kingdom*

Break

10:40 a.m. – 11:00 a.m.
T5.6 A Highly Integrated Drive Inverter Using DirectFETs and Ceramic DC-Link Capacitors for Open-End Winding Machines in Electric Vehicles
 G. Engelmann, M. Kowal, R. De Doncker, *Rheinisch-Westfälische Technische Hochschule Aachen, Germany*

11:00 a.m. – 11:20 a.m.
T5.7 Investigation and Loss Comparison of 6.6kV 5-Level Converters
 H. Zhang², A. Khambadkone¹, K. Ogura³, ¹Agency for Science, Technology and Research, Singapore; ²Meiden Asia Pte Ltd, Singapore; ³Meidensha Corporation, Japan

11:20 a.m. – 11:40 a.m.
T5.8 Analysis of SiC Based Power Electronic Inverters for High Speed Machines
 D. Han, Y. Li, B. Sarlioglu, *University of Wisconsin-Madison*

11:40 a.m. – 12:00 p.m.
T5.9 Loss Comparison of Si- and SiC-Based Modular Multilevel Converter for Medium/High-Voltage Applications
 L. Wu², J. Qin², M. Saeedifard², O. Wasynczuk³, K. Shenai¹, ¹Argonne National Laboratory; ²Georgia Institute of Technology; ³Purdue University

8:30 a.m. – 12:00 p.m.

TECHNICAL SESSION 6: Modeling of DC Energy Converters and Systems

ROOM 213D

TRACK: Modeling and Simulation

SESSION CHAIRS:

Jaber Abu Qahouq, *The University of Alabama*
 Leo Wang, *Cree Power Application*

8:30 a.m. – 8:50 a.m.
T6.1 Robust Analysis and Synthesis Design Tools for Digitally Controlled Power Converters
 M. Halton, P. Iordanov, J. Mooney, *University of Limerick, Ireland*

8:50 a.m. – 9:10 a.m.
T6.2 Discrete-Time Modelling, Stability Analysis, and Active Stabilization of DC Distribution Systems with Constant Power Loads
 M. Karbalaye Zadeh¹, R. Gavagsaz-Ghoachani², J. Martin², S. Pierfederici², B. Nahid-Mobarakeh², M. Molinas¹, ¹Norwegian University of Science and Technology, Norway; ²University of Lorraine, France

9:10 a.m. – 9:30 a.m.
T6.3 Design of Current Observer Based on Generalized Model of Multiphase Boost Converter
 L. Wei, D. Zhan, Y. Yao, Y. Zhang, *Tongji University, China*

9:30 a.m. – 9:50 a.m.
T6.4 New ZVS Analysis of PWM Converters Applied to Super-Junction, GaN and SiC Power FETs
 R. Miftakhutdinov, *Texas Instruments Inc.*

- 9:50 a.m. – 10:10 a.m.
T6.5 Modeling and Sensitivity Analysis of Consensus Algorithm Based Distributed Hierarchical Control for DC Microgrids
 L. Meng¹, T. Dragicevic¹, J. Vasquez¹, J. Guerrero¹, J. Roldán Pérez², ¹Aalborg University, Denmark; ²Universidad Pontificia Comillas, Spain

Break

- 10:40 a.m. – 11:00 a.m.
T6.6 Static and Dynamic Analysis of a 300W Series Connection Flyback Converter Applied to Photovoltaic Panels
 D. López del Moral, A. Barrado, M. Sanz, H. Miniguano, C. Fernández, C. Raga, A. Lázaro, Universidad Carlos III de Madrid, Spain

- 11:00 a.m. – 11:20 a.m.
T6.7 Real-Time Model-Based Fault Diagnosis for Switching Power Converters
 J. Poon, I. Konstantakopoulos, C. Spanos, S. Sanders, University of California, Berkeley

- 11:20 a.m. – 11:40 a.m.
T6.8 Reduced Order Discrete Time Modeling of ZVS Transition Dynamics in the Dual Active Bridge Converter
 D. Costinett, University of Tennessee

- 11:40 a.m. – 12:00 p.m.
T6.9 On Limit Cycle Oscillations in Discrete-Time Digital Linear Regulators
 S. Nasir, A. Raychowdhury, Georgia Institute of Technology

8:30 a.m. – 12:00 p.m.

TECHNICAL SESSION 7: DC-DC Converter Control I

ROOM 218/219

TRACK: Control

SESSION CHAIRS:

Shamim Choudhury, *Texas Instruments*

Akshay Kumar Rathore, *National University of Singapore*

- 8:30 a.m. – 8:50 a.m.
T7.1 Switching-Cycle Capacitor Voltage Control for the Modular Multilevel DC/DC Converters
 J. Wang, R. Burgos, D. Boroyevich, Virginia Polytechnic Institute and State University

- 8:50 a.m. – 9:10 a.m.
T7.2 DCM Control Scheme for Single-Inductor Multiple-Output DC-DC Converter with No Cross-Regulation
 W. Huang, J. Abu Qahouq, Z. Dang, C. Johnson, University of Alabama

- 9:10 a.m. – 9:30 a.m.
T7.3 Dual-Loop Geometric-Based Control of Buck Converters
 I. Galiano Zurbriggen, M. Anun, M. Ordonez, University of British Columbia, Canada

- 9:30 a.m. – 9:50 a.m.
T7.4 Fast Adaptive on Time Control for Transient Performance Improvement
 S. Bari, Q. Li, F. Lee, Virginia Polytechnic Institute and State University

- 9:50 a.m. – 10:10 a.m.
T7.5 Beyond Time Optimal Performance Using SIMO DC-DC Converters in Dynamic Voltage Scaling
 S. Kapat, Indian Institute of Technology Kharagpur, India

Break

- 10:40 a.m. – 11:00 a.m.
T7.6 Variable Switching Noise Mitigation in Hysteretic Power Converters Using Spur-Free Control
 M. Nashed, A. Fayed, Iowa State University

- 11:00 a.m. – 11:20 a.m.
T7.7 Overview, Equivalences and Design Guidelines of v^{*}1 Concept: a Voltage Mode Control That Behaves as a Current-Mode with Near Time-Optimal Response
 J. Cortés, V. Svikovic, P. Alou, J. Oliver, J. Cobos, Universidad Politécnica de Madrid, Spain

- 11:20 a.m. – 11:40 a.m.
T7.8 Control of Input-Series and Output-Independent Power Converter Building Block System Based on Buck Converter Topology
 Y. Li, Y. Han, University of Wisconsin-Madison

- 11:40 a.m. – 12:00 p.m.
T7.9 Controller Scalability Methods for Digital Point of Load Converters
 M. Meola, A. Cinti, A. Kelly, Zentrum Mikroelektronik Dresden AG, Ireland

9:00 a.m.

Spouse Tour “A WITH THE QUEEN” Departs

HARRIS ROOM – THE WESTIN CHARLOTTE

12:00 p.m. – 5:00 p.m.

Exhibit Hall Open

EXHIBIT HALL

1:30 p.m. – 2:00 p.m.

Exhibitor Seminars – Session 1

(please go to page 169 for complete details)

CIRASYS

Higher Performance Buck and Boost
Converter Solutions From Nonlinear
Control Methods

ROOM 218/219

COILCRAFT

Get the Power You Deserve from Your
Inductor

Room 213A

DEWETRON GMBH

Dewetron's Power Analyzer

Room 217BC

HOFFMANN & CO ELEKTROKOHLE AG

Aluminium Graphite: A Revolutionary
Thermal Management Solution in High
Reliability Applications

Room 217D

TOWERJAZZ

Smart Lighting System in Bulb enabled by
700V Ultra High Density Logic Platform

Room 217A

VENABLE

Stability Analysis of a Digital Controller
Based Power Supply using the Venable
Mixed Signal Analyzer.

Room 213D

2:15 p.m. – 2:45 p.m.

Exhibitor Seminars – Session 2

COGNIPOWER

Compound Converter Topology Can Take
Many Forms

ROOM 217A

FREESCALE SEMICONDUCTOR, INC.

Efficient Thermal Management for Motor
Control

ROOM 217D

GECKO-SIMULATIONS

Optimally Design PE Systems with
GeckoCIRCUITS & GeckoMAGNETICS

ROOM 217BC

MAGNETICS

XFlux Designs for High Current Applications

ROOM 213BC

POWEREX, INC.

Powerex Technology Update: Featuring 7th
Generation, Three Level and SiC Devices

ROOM 213A

SIMPLIS TECHNOLOGIES

SIMPLIS – Verilog HDL Co-simulation and
SIMetrix/SIMPLIS 8.0 New Features

ROOM 213D

ZES ZIMMER

New PWM and VFD power measuring
methods with DualPath

ROOM 218/219

3:00 p.m. – 3:30 p.m.

Exhibitor Seminars – Session 3

FERROXCUBE USA, INC.

New and Evolving Ferrite Power Materials

ROOM 213BC

INTEGRATED ENGINEERING SOFTWARE

Integrated Engineering Software Version 9.3
Release Highlights

ROOM 217D

NH RESEARCH

Lowering Risk & Speeding Development
by Using Flexible Test Hardware & Test
Software

ROOM 213D

ON SEMICONDUCTOR

Innovations in Ultra-High Density AC/DC
Power Supply Designs

ROOM 213A

POWER ELECTRONICS INDUSTRY COLLABORATIVE.

Power Matters – How the Power Electronics
Industry Collaborative is working to shape
the future of the power electronics industry
in the United States

ROOM 217BC

STELLAR INDUSTRIES CORP.
Direct Bond Copper Substrates for High
Power and High Thermal Applications
ROOM 218/219

TELEDYNE LECROY
Three-phase Electrical and Mechanical
Motor Drive Power Analysis Using an 8
Channel, 12-bit, 1GHz Oscilloscope
ROOM 217A

3:45 p.m. – 4:15 p.m.

Exhibitor Seminars – Session 4

DINO-LITE SCOPES (BIGC)
Dino-Lite Digital Microscope: EDGE Series
ROOM 217BC

DUCATI CAPACITORS / ICONOPOWER
New High-Temperature, High Capacity
DC-Link PP Film Capacitors
ROOM 217A

GLOBAL POWER TECHNOLOGIES GROUP
SiC Power Module, Subsystem and their
Applications
ROOM 217D

KEYSIGHT TECHNOLOGIES
Keysight Test Solutions Improve Power
Circuit Design Success
ROOM 213D

**NATIONAL PROGRAM FOR INTELLIGENT
ELECTRONICS**
Strengthening Modern Electronics Industry
through the National Program for Intelligent
Electronics in Taiwan
ROOM 218/219

SEMTECH CORPORATION
Greener, Smarter, Smaller Power Solutions
ROOM 213BC

WURTH ELECTRONICS MIDCOM INC.
REDEXPERT & STS
ROOM 213A

5:00 p.m. – 6:30 p.m.

Rap Session 1: Wireless Transfer of Power: Facts and Fictions

ROOM 217A

*(For more information about all of the rap sessions,
see page 50)*

MODERATOR:

Dr. John M. Miller, *JNC Miller plc*

PANELISTS:

Mr. Ted Bohn, *Argonne National Laboratory*
Dr. Omer C. Onar, *Oak Ridge National Laboratory*
Prof. Joachem Taiber, *Clemson University*
International Center for Automotive Research
Dr. Michael de Rooji, *Exec. Dir. Appl. Engr.,*
Efficient Power Corp.

5:00 p.m. – 6:30 p.m.

Rap Session 2: Wide Bandgap Semiconductors devices in Power Electronics – Who, What, Where, When and Why?

ROOM 217D

MODERATOR:

Kevin Parmenter, *Excelsys Technologies*

PANELISTS:

Ionel Dan Jitaru, *Rompower*
Alex Lidow, Ph.D., *Efficient Power Conversion*
JJ Wilkerson, *Excelsys Technologies*
Eric Persson, *IR / Infineon*
Larry Spaziani, *GaN Systems*
Robert White, *Embedded Power Labs*
Ron Vinsant, *Vishay*

5:00 p.m. – 6:30 p.m.

Rap Session 3: Future Expectations of Power Electronics for Variable Speed Drive Application

ROOM 218/219

MODERATOR:

Dr. Babak Fahimi, *University of Texas at Dallas*

PANELISTS:

Johann Kohlar, *ETH*
Steven Pekarek, *Purdue University*
Dr. Abas Goodarzi, *President, US Hybrid*
Corporation
Steven Schulz, *FF Inc.*

Wednesday

March 18, 2015

7:00 a.m. – 8:00 a.m.

Speaker Breakfast

ROOM 203AB

8:00 a.m. – 3:00 p.m.

Registration

A CONCOURSE

8:00 a.m. – 11:00 a.m.

Spouse & Guest Hospitality Room Open

HARRIS ROOM – THE WESTIN CHARLOTTE

8:30 a.m. – 10:10 a.m.

INDUSTRY SESSION 4: Constructing a Solar Powered World through Technology?

ROOM 207AB

SESSION CHAIR:

Chavonne Yee, *ABB*

John McManus, *Consultant*

8:30 a.m. – 8:55 a.m.

IS4.1 Performance Modeling and Testing of Distributed Electronics in PV Systems

Chris Deline, *National Renewable Energy Laboratory, United States*

8:55 a.m. – 9:20 a.m.

IS4.2 The Evolution of Distribution Interconnection Standards

Abraham Ellis, *Sandia National Laboratories, United States*

9:20 a.m. – 9:45 a.m.

IS4.3 Clean Technology & Renewables, Trends & Opportunities

Alexander Von Welczek, *Clean Power Capital, United States*

9:45 a.m. – 10:10 a.m.

IS4.4 Improving Performance and Form Factors in Next Generation Solar Modules

Venkatesan Murali, *GT Advanced Technologies, United States*

8:30 a.m. – 10:10 a.m.

INDUSTRY SESSION 5: Nanotechnology – State & Federal Activities

ROOM 207CD

SESSION CHAIR:

Kevin Parmenter, *Excelsys Technologies*

Doug, Osterhout *ON Semiconductor*

8:30 a.m. – 8:55 a.m.

IS5.1 The Role of Consortia and Public / Private Partnerships in Nanotechnology

Paul Farrar Jr., *United States*

8:55 a.m. – 9:20 a.m.

IS5.2 Nano 300 Introduction

J. Michael Rice, *Aerolearn, Inc.*

9:20 a.m. – 9:45 a.m.

IS5.3 Commercializing Nanoscience and Microtechnology Breakthroughs in Oregon's Silicon Forest

Robert Rung, *Oregon Nanoscience and Microtechnologies Institute, United States*

9:45 a.m. – 10:10 a.m.

IS5.4 Nano-magnetics for High Efficiency Power Supplies

Santosh Kulkarni, *Tyndall National Institute of Technology, Ireland*

8:30 a.m. – 10:10 a.m.

INDUSTRY SESSION 6: Emerging Power Electronics Technologies for High Power and High Voltage Applications

ROOM 208A

SESSION CHAIR:

River-Tinho Li, *ABB*

Nan, Chen *ABB*

8:30 a.m. – 8:55 a.m.

IS6.1 Prospects of Modular Multilevel Converters

Martin Pieschel, *Siemens, Germany*

8:55 a.m. – 9:20 a.m.

IS6.2 HVDC Technology Trends and Prospective

Alireza Nami, *ABB Limited, Sweden*

9:20 a.m. – 9:45 a.m.

IS6.3 Advanced Power Electronics for HVDC Applications

Michel Guyennet, *Alstom and SuperGrid Institute, France*

9:45 a.m. – 10:10 a.m.

IS6.4 Real-Time Hardware-in-the-Loop Simulation for Emerging Highly Dynamic Distribution Grid: Test and Verification of Grid Connected Battery, PV, Wind, and Facts Converters

Ivan Celanovic, *Typhoon HIL, Switzerland*

8:30 a.m. – 10:10 a.m.

TECHNICAL SESSION 8: Integrated and HF DC-DC Converters

ROOM 217A

TRACK: DC-DC Converters

SESSION CHAIRS:

Zhigang Liang, *International Rectifier*

David Perreault, *Massachusetts Institute of Technology*

8:30 a.m. – 8:50 a.m.

T8.1 A Configurable Power Management IC for Low-Volume DC-DC Converter Applications with High Frequency Current Programmed Mode Control

S. Ahsanuzzaman, D. Johns, A. Prodic, *University of Toronto, Canada*

8:50 a.m. – 9:10 a.m.

T8.2 An on-Chip Integrated Auto-Tuned Hybrid Current-Sensor for High-Frequency Low-Power DC-DC Converters

S. Ahsanuzzaman, A. Prodic, *University of Toronto, Canada*

9:10 a.m. – 9:30 a.m.

T8.3 A 100-V 2-MHz Isolated QSW-ZVS Three-Level DC-DC Converter with on-Chip Dynamic Dead-Time Controlled Synchronous Gate Driver for eGaN Power FETs

J. Xue, L. Cong, H. Lee, *University of Texas at Dallas*

9:30 a.m. – 9:50 a.m.

T8.4 Analysis and Design of a 30 MHz Resonant SEPIC Converter

J. Lin¹, Y. Zhou¹, Z. Zhang¹, X. Ruan¹, Y. Liu², ¹*Nanjing University of Aeronautics and Astronautics, China*; ²*Queen's University, Canada*

9:50 a.m. – 10:10 a.m.

T8.5 Comparison of a 12V, 10A, 3MHz Buck Converter and a Series Capacitor Buck Converter

P. Shenoy, M. Amaro, D. Freeman, J. Morroni, *Texas Instruments Inc.*

8:30 a.m. – 10:10 a.m.

TECHNICAL SESSION 9: Single Phase AC-DC Converters

ROOM 217BC

TRACK: AC-DC Converters

SESSION CHAIRS:

Dusty Becker, *Emerson*

Pritam Das, *National University of Singapore*

8:30 a.m. – 8:50 a.m.

T9.1 Analysis, Modeling and Design of a True Bridgeless Single Stage PFC with Galvanic Isolation

S. Nigsch², S. Cuk¹, K. Schenk², ¹*TESLAcO*; ²*University of Applied Sciences NTB, Switzerland*

8:50 a.m. – 9:10 a.m.

T9.2 Analysis and Design of DCM SEPIC PFC with Adjustable Output Voltage

R. Chen, J. Lai, *Virginia Polytechnic Institute and State University*

9:10 a.m. – 9:30 a.m.

T9.3 A Novel Variable Duty Cycle Control to Achieve Optimal Reduction of the Electrolytic Capacitor Ripple Current for DCM Boost PFC Converter

K. Yao, X. Hu, W. Hu, W. Tang, J. Lyu, *Nanjing University of Science and Technology, China*

9:30 a.m. – 9:50 a.m.

T9.4 Design Improvements for Primary-Side-Regulated High-Power Flyback Converters in Continuous-Conduction-Mode

B. Keogh, B. Long, J. Leisten, *Texas Instruments Inc., Ireland*

9:50 a.m. – 10:10 a.m.

- T9.5 High-Power-Factor Quasi-Resonant Flyback Converters Draw Sinusoidal Input Current**
C. Adragna, G. Gritti, *STMicroelectronics, Italy*

8:30 a.m. – 10:10 a.m.

TECHNICAL SESSION 10: Miscellaneous Grid Topics

ROOM 217D

TRACK: Power Electronics for Utility Interface

SESSION CHAIRS:

Thomas Gietzold, *United Technologies Corporation (UTC)*

Ali Bazzi, *University of Connecticut*

8:30 a.m. – 8:50 a.m.

- T10.1 A Series-LC-Filtered Active Damper for AC Power Electronics Based Power Systems**
X. Wang, P. Loh, F. Blaabjerg, Y. Pang,
Aalborg University, Denmark

8:50 a.m. – 9:10 a.m.

- T10.2 Improved Capacitance Ratio Optimization Methodology for Stacked Switched Capacitor Energy Buffers**
S. Pervaiz, Y. Ni, K. Afridi, *University of Colorado Boulder*

9:10 a.m. – 9:30 a.m.

- T10.3 A New Single-Phase PLL Based on Discrete Fourier Transform**
H. Liu, Y. Sun, H. Hu, Y. Xing, *Nanjing University of Aeronautics and Astronautics, China*

9:30 a.m. – 9:50 a.m.

- T10.4 Simplified Medium/High Frequency Transformer Isolation Approach for Multi-Pulse Diode Rectifier Front-End Adjustable Speed Drives**
H. Krishnamoorthy, P. Enjeti, P. Garg,
Texas A&M University

9:50 a.m. – 10:10 a.m.

- T10.5 Dynamic Analysis and Controller Design for a Center-Point-Clamped AC-AC Converter**
P. Bhowmik, S. Yellapragada, M. Manjrekar,
University of North Carolina at Charlotte

8:30 a.m. – 10:10 a.m.

TECHNICAL SESSION 11: Inverter Control I

ROOM 218/219

TRACK: Motor Drives and Inverters

SESSION CHAIRS:

Iqbal Husain, *North Carolina State University*

Kent Wanner, *John Deere*

8:30 a.m. – 8:50 a.m.

- T11.1 Model Predictive Control of Induction Motor with Delay Time Compensation: an Experimental Assessment**
M. Uddin², S. Mekhilef², M. Nakaoka²,
M. Rivera¹, ¹*Universidad de Talca, Chile;*
²*University of Malaya, Malaysia*

8:50 a.m. – 9:10 a.m.

- T11.2 Copper Loss Minimizing Control of Doubly Fed Wound Machine**
Y. Han, J. Ha, *Seoul National University, Korea, South*

9:10 a.m. – 9:30 a.m.

- T11.3 Direct Torque Control of IPMSM Driven by a Three Level NPC Inverter with Torque and Capacitor Voltage Ripple Reduction**
D. Mohan, Z. Xinan, G. Foo, *Nanyang Technological University, Singapore*

9:30 a.m. – 9:50 a.m.

- T11.4 Subharmonic Reduction for Six Step Operation of Three-Phase Inverter**
Z. Ke, J. Zhang, *Oregon State University*

9:50 a.m. – 10:10 a.m.

- T11.5 Small-Signal Modeling, Analysis and Testing of Parallel Three-Phase-Inverters with a Novel Autonomous Current Sharing Controller**
Y. Guan, J. Vasquez, J. Guerrero, E. Coelho,
Aalborg University, Brazil

8:30 a.m. – 10:10 a.m.

TECHNICAL SESSION Room 12: Conductive and Inductive Chargers for Electric Vehicles

ROOM 213A

TRACK: Transportation Power Electronics

SESSION CHAIRS:

Omer Onar, *Oak Ridge National Laboratory*
Khurram Afridi, *University of Colorado Boulder*

8:30 a.m. – 8:50 a.m.

- T12.1 Design of Integrated Transformer and Inductor for High Frequency Dual Active Bridge GaN Charger for PHEV**
M. Mu³, L. Xue³, D. Boroyevich³, B. Hughes¹, P. Mattavelli², ¹*HRL Laboratories*; ²*Università di Padova, Italy*; ³*Virginia Polytechnic Institute and State University*

8:50 a.m. – 9:10 a.m.

- T12.2 Interleaved SEPIC PFC Converter Using Coupled Inductors in PEV Battery Charging Applications**
H. Wang, A. Khaligh, *University of Maryland, College Park*

9:10 a.m. – 9:30 a.m.

- T12.3 Wireless Power Transfer via Harmonic Current for Electric Vehicles Application**
H. Zeng, S. Yang, F. Peng, *Michigan State University*

9:30 a.m. – 9:50 a.m.

- T12.4 Output Power and Efficiency Sensitivity to Circuit Parameter Variations in Double-Sided LCc-Compensated Wireless Power Transfer System**
F. Lu, H. Hofmann, J. Deng, C. Mi, *University of Michigan*

9:50 a.m. – 10:10 a.m.

- T12.5 The Optimal Design of GaN-Based Dual Active Bridge for Bi-Directional Plug-in Hybrid Electric Vehicle (PHEV) Charger**
L. Xue², M. Mu², D. Boroyevich², P. Mattavelli¹, ¹*Università di Padova, Italy*; ²*Virginia Polytechnic Institute and State University*

8:30 a.m. – 10:10 a.m.

TECHNICAL SESSION 13: DC-DC Converter Control II

ROOM 213BC

TRACK: Control

SESSION CHAIRS:

Bilal Akin, *University of Texas at Dallas*
Yilmaz Sozer, *Univ of Akron*

8:30 a.m. – 8:50 a.m.

- T13.1 Soft Start-Up for High Frequency LLC Resonant Converter with Optimal Trajectory Control**
C. Fei, F. Lee, Q. Li, *Virginia Polytechnic Institute and State University*

8:50 a.m. – 9:10 a.m.

- T13.2 Introducing State-Trajectory Control for the Synchronous Interleaved Boost Converter**
R. Peña-Alzola², P. Ksiazek², M. Ordonez², H. Wang¹, F. Blaabjerg¹, ¹*Aalborg University, Denmark*; ²*University of British Columbia, Canada*

9:10 a.m. – 9:30 a.m.

- T13.3 Input Voltage Ripple Based Sensorless Current Sharing Auto-Tuning Controller for Multiphase DC-DC Converters**
W. Huang, J. Abu Qahouq, *University of Alabama*

9:30 a.m. – 9:50 a.m.

- T13.4 Digital I² Average Current Mode Control for Switch-Mode Power Supplies**
S. He, R. Nelms, *Auburn University*

9:50 a.m. – 10:10 a.m.

- T13.5 Reconfigurable Bi-Frequency DPWM with Custom Spectral Shaping in a Synchronous Buck Converter**
S. Kapat, *Indian Institute of Technology Kharagpur, India*

8:30 a.m. – 10:10 a.m.

TECHNICAL SESSION 14: Renewable Circuits I

ROOM 213D

TRACK: Renewable Energy Systems

SESSION CHAIRS:

Jason Stauth, *Dartmouth College*

Bulent Sarlioglu, *University of Wisconsin – Madison*

8:30 a.m. – 8:50 a.m.

T14.1 A New Multi-Input Three-Level Integrated DC/DC Converter for Renewable Energy Systems

S. Dusmez, X. Li, B. Akin, *University of Texas at Dallas*

8:50 a.m. – 9:10 a.m.

T14.2 A High Efficiency Cascaded Thermoelectric Generation System with Power Balancing Mechanism

Z. Qiu², K. Sun², H. Wu¹, J. Huang¹, Y. Xing¹,
¹*Nanjing University of Aeronautics and Astronautics, China*; ²*Tsinghua University, China*

9:10 a.m. – 9:30 a.m.

T14.3 Low Power Integrated on-Chip Current to Digital Converter

E. Marti-Arbona, D. Mandal, B. Bakkaloglu, S. Kiaei, *Arizona State University*

9:30 a.m. – 9:50 a.m.

T14.4 A MOSFET Transformerless Inverter with Reactive Power Capability for Micro-Inverter Applications

B. Chen, C. Zheng, B. Gu, L. Zhang, J. Lai, *Virginia Polytechnic Institute and State University*

9:50 a.m. – 10:10 a.m.

T14.5 A Single-Step, Single-Inductor Energy-Harvesting-Based Power Supply Platform with a Regulated Battery Charger for Mobile Applications

A. Abdelmoaty, A. Fayed, *Iowa State University*

10:00 a.m. – 2:00 p.m.

Exhibit Hall Open

EXHIBIT HALL

10:30 a.m.- 11:00 a.m.

Exhibitor Seminar – Session 5

ADAPTIVE POWER SYSTEMS, INC.

Latest Advances in Programmable AC Power Source Designs

ROOM 213D

EFFICIENT POWER CONVERSION

GaN Transistors for Efficient Power Conversion

ROOM 217A

MICROCHIP TECHNOLOGY INC.

Tradeoffs Between Analog and Digital Implementations for Power Supplies

ROOM 213A

PACIFIC SOWA CORPORATION

Atmix's Soft Magnetic Powder

ROOM 213BC

TAIWAN SEMICONDUCTOR CO.

New Generation Semiconductors for Improved Power Efficiency

ROOM 217D

VISHAY TECHNOLOGIES

Adding Vishay Performance to Your Power Application Solar Main Inverter

ROOM 217BC

ZIPALOG INC.

Mixed-Signal Integrated Circuit Verification for Power Electronics Systems

ROOM 218/219

11:15 a.m.-11:45 a.m.

Exhibitor Seminar – Session 6

ALPHA

Ultra-Fast-Sintering with Alpha Argomax

ROOM 217BC

FAIRCHILD

Optimized Discrete Device and Power System Design

ROOM 231D

INTERNATIONAL RECTIFIER CORPORATION

Get to Market Faster with IR's scalable Digital Power

ROOM 213A

GMW ASSOCIATES

Current & Voltage Transducers for accurate power measurements in high power Variable Speed Motor Drives

ROOM 213BC

MERSEN

Safety and Reliability for Electrical Power

ROOM 213BC

PLEXIM

Multi-Domain Modeling with PLECS

ROOM 217A

POWER ELECTRONIC MEASUREMENTS LTD

The Practicalities of Measuring Fast Switching/Transient Currents in Power Electronic Applications Using Rogowski Transducers

ROOM 218/219

ZHEJIANG KEDA MAGNETOELECTRICITY CO LTD

New Generation of Alloy Powder Core Material in Power Inductor Design

ROOM 217D

2:00 p.m. – 5:30 p.m.

INDUSTRY SESSION 7: The Business and Market of Power Electronics

ROOM 207AB

SESSION CHAIR:

Ada Cheng, *Adaclock*

Ed Massey, *Cisco*

2:00 p.m. – 2:25 p.m.

IS7.1 Is Patent Licensing Worth It?

Terry Ludlow, *Chipworks, Canada*

2:25 p.m. – 2:50 p.m.

IS7.2 Is Patent Licensing Worth It? (Continued)

Terry Ludlow, *Chipworks, Canada*

2:50 p.m. – 3:15 p.m.

IS7.3 Strengthening the Domestic Power Ecosystem

Keith Evans², Dave Hurst¹,

¹PEIC & NextEnergy, *United States*;

²PIEC & Kyma Technologies, *United States*

3:15 p.m. – 3:40 p.m.

IS7.4 Online Tools for Application Support and Marketing

Brian Thomas, *Transim, United States*

Break

4:00 p.m. – 4:35 p.m.

IS7.5 Changes in the Market for Power Management & Control

Stephan Ohr, *Gartner Inc., United States*

4:35 p.m. – 5:00 p.m.

IS7.6 Semiconductor Cycles – Can They Be Managed? (Panel Discussion)

Carl Blake¹, Rick Fishbune², ¹CBK, *United States*; ²IBM, *United States*

5:00 p.m. – 5:25 p.m.

IS7.7 Semiconductor Cycles – Can They Be Managed? (Panel Discussion Continued)

Carl Blake¹, Rick Fishbune², ¹CBK, *United States*; ²IBM, *United States*

2:00 p.m. – 5:30 p.m.

INDUSTRY SESSION 8: Substrate Embedded Components Enabling High Density 3D Power Packaging

ROOM 207CD

SESSION CHAIR:

Brian Narveson, *Narveson Innovative Consulting*

Ernie Parker, *Crane Aerospace and Electronics*

2:00 p.m. – 2:25 p.m.

IS8.1 (Pi)CB – Power-Integration Circuit Board

Nick Renaud-Bezot, *AT&S, Austria*

2:25 p.m. – 2:50 p.m.

IS8.2 12V PowerStage in Embedded Die System-in-Package

Greg Miller, *Sarda, United States*

2:50 p.m. – 3:15 p.m.

IS8.3 Significant Developments and Trends in 3D Packaging with Focus on Embedded Substrate Technologies (Overview of 3D Power Packaging Special Project Phase 2 Report)

Ernie Parker¹, Brian Narveson², ¹PSMA

Packaging Committee, *United States*; ²PSMA

Packaging Committee Co-Chair, *United States*

3:15 p.m. – 3:40 p.m.

IS8.4 Additive Manufacturing in Power Electronics Packaging

Doug Hopkins, Haotao Ke, *NC State, United States*

Break

4:00 p.m. – 4:35 p.m.

- IS8.5 Maximizing GaN Power Transistor Performance with Embedded Packaging**
John Roberts, *GaN Systems, Canada*

4:35 p.m. – 5:00 p.m.

- IS8.6 Technology for Increasing the Density of Air Cooled Power Supplies**
Nelson Gernert, *Thermacore, United States*

5:00 p.m. – 5:25 p.m.

- IS8.7 A Package and Platform View of Intel's Fully Integrated Voltage Regulator (FIVR)**
Ted Burton, *Intel, United States*

2:00 p.m. – 5:30 p.m.

INDUSTRY SESSION 9: Applications Dictate Capacitor Technology

ROOM 208A

SESSION CHAIR:

Ralph Kerrigan, *NWL*

2:00 p.m. – 2:25 p.m.

- IS9.1 Supercapacitors in Transportation Applications**
James Lewis, *KEMET, United States*

2:25 p.m. – 2:50 p.m.

- IS9.2 Film Capacitors for High Temperature Switches and Power Electronics Applications Above 125°C**
Joseph A. Bond, *Electronic Concepts, Inc., United States*

2:50 p.m. – 3:15 p.m.

- IS9.3 Modeling of Transient Electrical, Thermal and Lifetime Behavior of Aluminum Electrolytic Capacitors, Focusing on Large (>0.1 Liter) DC Link Capacitors**
Sam G. Parler Jr., *Cornell Dubilier, United States*

3:15 p.m. – 3:40 p.m.

- IS9.4 Quantifying Allowable AC Parameters for DC Rated Ceramic Capacitors**
Jeremy Coe, *TDK USA, United States*

Break

4:00 p.m. – 4:35 p.m.

- IS9.5 DC Filter Capacitors with Metallized Film Technology Show Volumetric Efficiencies for Medium Voltage Motor Drives**
Ralph Kerrigan, *NWL, United States*

4:35 p.m. – 5:00 p.m.

- IS9.6 High Operating Temperature Metallized Film Capacitors for Downhole Tools in the Oil and Gas Industry**
David Slupe, *W. L. Gore and Associates, United States*

5:00 p.m. – 5:25 p.m.

- IS9.7 New Polymer Capacitors for DC to DC Convertors in Automobile Infotainment Systems**
Jayson Young, *Kemet, United States*

2:00 p.m. – 5:30 p.m.

TECHNICAL SESSION 15: Renewable Microgrids

ROOM 217A

TRACK: Renewable Energy Systems

Session Chairs:

Behrooz Mirafzal, *Kansas State University*

Haihua Zhou, *International Rectifier*

2:00 p.m. – 2:20 p.m.

- T15.1 Distributed Energy Storage Device Integration with Three Phase Distribution Grid Using a Transformerless Intelligent Power Substation**
S. Madhusoodhanan, A. Tripathi, K. Mainali, D. Patel, A. Kadavelugu, S. Bhattacharya, *North Carolina State University*

2:20 p.m. – 2:40 p.m.

- T15.2 Stationary-Frame-Based Generalized Control Diagram for PWM AC-DC Front-End Converters with Unbalanced Grid Voltage in Renewable Energy Systems**
Y. Liu, N. Li, Y. Fu, J. Wang, Y. Ji, *Harbin Institute of Technology, China*

2:40 p.m. – 3:00 p.m.

T15.3 DC Electric Springs – an Emerging Technology for DC Grids

K. Mok, M. Wang, S. Tan, S. Hui, *University of Hong Kong, Hong Kong*

3:00 p.m. – 3:20 p.m.

T15.4 Stability Analysis and Controller Design of DC Microgrids with Constant Power Loads

L. Herrera, J. Wang, *Ohio State University*

3:20 p.m. – 3:40 p.m.

T15.5 A 13.8-kV 4.75-MVA Microgrid Laboratory Test Bed

Y. Liu, C. Farnell, J. Balda, A. Mantooth, *University of Arkansas*

Break

4:10 p.m. – 4:30 p.m.

T15.6 A Scalable DC Microgrid Architecture for Rural Electrification in Emerging Regions

P. Madduri, J. Poon, J. Rosa, M. Podolsky, E. Brewer, S. Sanders, *University of California, Berkeley*

4:30 p.m. – 4:50 p.m.

T15.7 A Non-Isolated Bidirectional Soft Switching Current Fed LCL Resonant DC/DC Converter to Interface Energy Storage in DC Microgrid

D. Patil, A. Rathore, D. Srinivasan, *National University of Singapore, Singapore*

4:50 p.m. – 5:10 p.m.

T15.8 Naturally Clamped Snubberless Soft-Switching Bidirectional Current-Fed Three-Phase Push-Pull DC/DC Converter for DC Micro-Grid Application

S. Bal, A. Rathore, D. Srinivasan, *National University of Singapore, Singapore*

5:10 p.m. – 5:30 p.m.

T15.9 Energy Management Strategy for Supercapacitor in Autonomous DC Microgrid Using Virtual Impedance

Y. Zhang, Y. Li, *University of Alberta, Canada*

2:00 p.m. – 5:30 p.m.

TECHNICAL SESSION 16: WBG Device Performance & Circuit Interactions

ROOM 217BC

TRACK: Devices and Components

SESSION CHAIRS:

Alex Q. Huang, *North Carolina State University*

Juan Carlos Balda, *University of Arkansas*

2:00 p.m. – 2:20 p.m.

T16.1 A Gate Drive Circuit with Mid-Level Voltage for GaN Transistors in a 7-MHz Isolated Resonant Converter

Z. Dong¹, Z. Zhang¹, X. Ren¹, X. Ruan¹, Y. Liu², ¹*Nanjing University of Aeronautics and Astronautics, China*; ²*Queen's University, Canada*

2:20 p.m. – 2:40 p.m.

T16.2 Loss Analysis During Dead Time and Thermal Study of Gallium Nitride Devices

H. Zhang, R. Balog, *Texas A&M University*

2:40 p.m. – 3:00 p.m.

T16.3 Effectively Paralleling Gallium Nitride Transistors for High Current and High Frequency Applications

D. Reusch, J. Strydom, *Efficient Power Conversion Corporation*

3:00 p.m. – 3:20 p.m.

T16.4 Paralleling GaN HEMTs for Diode-Free Bridge Power Converters

Z. Wang, Y. Wu, J. Honea, L. Zhou, *Transphorm Inc*

3:20 p.m. – 3:40 p.m.

T16.5 GaN-Based High Frequency Totem-Pole Bridgeless PFC Design with Digital Implementation

L. Xue², Z. Shen², D. Boroyevich², P. Mattavelli¹, ¹*Università di Padova, Italy*; ²*Virginia Polytechnic Institute and State University*

Break

4:10 p.m. – 4:30 p.m.

T16.6 A Self-Powered Ultra-Fast DC Solid State Circuit Breaker Using a Normally-on SiC JFET

Z. Miao², G. Sabui², A. Chen², Y. Li², Z. Shen², J. Wang¹, Z. Shuai¹, A. Luo¹, X. Yin¹, M. Jiang¹,
¹Hunan University, China; ²Illinois Institute of Technology

4:30 p.m. – 4:50 p.m.

T16.7 Active Gate Driver for Fast Switching and Cross-Talk Suppression of SiC Devices in a Phase-Leg Configuration

Z. Zhang, F. Wang, L. Tolbert, B. Blalock, D. Costinett, *University of Tennessee*

4:50 p.m. – 5:10 p.m.

T16.8 Closed-Loop Control of Switching Transition of SiC MOSFETs

H. Riazmontazer¹, A. Rahnamaee¹, A. Mojab¹, S. Mehrnami¹, S. Mazumder², M. Zefran¹,
¹University of Illinois at Chicago; ²University of Illinois at Chicago / NextWatt LLC

5:10 p.m. – 5:30 p.m.

T16.9 Evaluation of 1.2 kV, 100A SiC Modules for High-Frequency, High-Temperature Applications

A. Lemmon², R. Graves², J. Gafford¹, ¹Mississippi State University; ²University of Alabama

2:00 p.m. – 5:30 p.m.

TECHNICAL SESSION 17: Inverter Topologies

ROOM 217D

TRACK: Motor Drives and Inverters

SESSION CHAIRS:

Babak Nahidmobarakeh, *University of Lorraine*

Yichao Tang, *University of Maryland*

2:00 p.m. – 2:20 p.m.

T17.1 A New Hybrid Active Neutral Point Clamped Flying Capacitor Multilevel Inverter

R. Naderi, K. Smedley, *University of California, Irvine*

2:20 p.m. – 2:40 p.m.

T17.2 New Modular Multilevel Converter with Power Channels Between Upper- and Lower Arms Suitable for MV Drives

L. He¹, K. Zhang¹, J. Xiong¹, S. Fan¹, X. Chen¹, Y. Xue², ¹Huazhong University of Science and Technology, China; ²Siemens Corporation

2:40 p.m. – 3:00 p.m.

T17.3 Minimized Quasi-Z Source Network for Single-Phase Inverter

B. Ge¹, H. Abu-Rub², Y. Liu², R. Balog¹, ¹Texas A&M University; ²Texas A&M University at Qatar, Qatar

3:00 p.m. – 3:20 p.m.

T17.4 Ripple Voltage Minimization in Single Phase Floating Bridge Converter Modules Using a Transformer Coupled Asymmetrical Bridge Converter

R. Ul Haque, S. Leng, N. Perera, J. Salmon, *University of Alberta, Canada*

3:20 p.m. – 3:40 p.m.

T17.5 Practical Implementation of Dual Purpose No Voltage Drives for Bearingless Motors

E. Severson, S. Gandikota, N. Mohan, *University of Minnesota*

Break

4:10 p.m. – 4:30 p.m.

T17.6 An Active Filter Method to Eliminate DC-Side Low-Frequency Power for Single-Phase Quasi-Z Source Inverter

B. Ge¹, H. Abu-Rub², Y. Liu², R. Balog¹,
¹Texas A&M University; ²Texas A&M University at Qatar, Qatar

4:30 p.m. – 4:50 p.m.

T17.7 Space-Vector-Modulated for Z-Source Three-Level T-Type Converter with Neutral Voltage Balancing

X. Xing, A. Chen, W. Wang, C. Zhang, Y. Li, C. Du, *Shandong University, China*

4:50 p.m. – 5:10 p.m.

T17.8 Design Considerations for a Voltage-Boosting DC-AC Modular Multilevel Converter

J. Reed³, G. Venkataramanan³, D. Ramírez¹, C. Soriano², ¹Universidad Politécnica de Madrid, Spain; ²University of Colorado Denver; ³University of Wisconsin-Madison

5:10 p.m. – 5:30 p.m.

T17.9 A Discontinuous PWM Strategy Optimized for High-Frequency Pulsating-DC Link Inverters

A. Rahnamaee, H. Riazmontazer, A. Mojab, S. Mazumder, M. Zefran, *University of Illinois at Chicago*

2:00 p.m. – 5:30 p.m.

TECHNICAL SESSION 18: LED Drivers

ROOM 218/219

TRACK: Power Electronics Applications

Session Chairs:

Jim Spangler, *Spangler Prototype Inc.*

Zobair Roohani, *International Rectifier*

2:00 p.m. – 2:20 p.m.

T18.1 High Efficiency Hybrid Current Balancing Method for Multi-Channel LED Drive

R. Zhao, J. Zhang, *Zhejiang University, China*

2:20 p.m. – 2:40 p.m.

T18.2 A Novel Passive Type LED Driver for Static LED Power Regulation by Multi-Stage Switching Circuits

E. Lee, D. Nguyen, C. Rim, *KAIST, Korea, South*

2:40 p.m. – 3:00 p.m.

T18.3 A Ring Diode-Capacitor Network for Current-Balancing Multiple LED Strings

R. Zhang, H. Chung, *City University of Hong Kong, Hong Kong*

3:00 p.m. – 3:20 p.m.

T18.4 The LED Driver Compatible with Electronic Ballasts by Variable Switched Capacitor

D. Nguyen, E. Lee, C. Rim, *KAIST, Korea, South*

3:20 p.m. – 3:40 p.m.

T18.5 A Scalable HB-LED Driver for Multi-Color Adaptive Lighting Systems

K. Modepalli, L. Parsa, *Rensselaer Polytechnic Institute*

Break

4:10 p.m. – 4:30 p.m.

T18.6 Line-Frequency Dual Input-Voltage-Level LED Driver

T. Liang, J. Wu, W. Tseng, P. Lin, S. Chen, *National Cheng Kung University, Taiwan*

4:30 p.m. – 4:50 p.m.

T18.7 A 110-V AC, 17.1-W Multi-Segmented LED Driver with 96.2% Power Factor

T. Jeong, J. Kim, *Seoul National University, Korea, South*

4:50 p.m. – 5:10 p.m.

T18.8 A Novel Bipolar Series Ripple Compensation Method for Single-Stage High-Power LED Driver

Y. Qiu, L. Wang, Y. Liu, P. Sen, *Queen's University, Canada*

5:10 p.m. – 5:30 p.m.

T18.9 Single Stage Switched Capacitor LED Driver with High Power Factor and Reduced Current Ripple

E. Eloi Dos Santos Filho, E. Mineiro Sá Jr., R. Linhares Dos Santos, P. Miranda, F. Antunes, *Universidade Federal do Ceará, Brazil*

2:00 p.m. – 5:30 p.m.

TECHNICAL SESSION 19: Non-Isolated DC-DC Converters

ROOM 213A

TRACK: DC-DC Converters

SESSION CHAIRS:

Cahit Gezgin, *International Rectifier*

Qiang Li, *Virginia Tech*

2:00 p.m. – 2:20 p.m.

T19.1 Improving Loading and Unloading Transient Response of a Voltage Regulator Module Using a Load-Side Auxiliary Gyrator Circuit

O. Kirshenboim, A. Cervera, M. Peretz, *Ben-Gurion University of the Negev, Israel*

2:20 p.m. – 2:40 p.m.

T19.2 Multi-Mode Control Strategy in Three-Level DC-DC Converter for Higher Efficiency Operation Under Light-Load and Standby Conditions

L. Liu, W. Yao, Z. Lu, *Zhejiang University, China*

2:40 p.m. – 3:00 p.m.

T19.3 Novel Interleaved Multiphase Proposal for a Three Level Neutral Point Clamped Buck Converter

A. Pevere¹, R. Petrella¹, C. Mi², S. Zhou²,
¹Università degli Studi di Udine, Italy;
²University of Michigan

3:00 p.m. – 3:20 p.m.

T19.4 Reset-Sensing Quasi-V² Single-Inductor Multiple-Output Buck Converter with Reduced Cross-Regulation

T. Lee, S. Tan, S. Hui, P. Chan, J. Sin,
University of Hong Kong, Hong Kong

3:20 p.m. – 3:40 p.m.

T19.5 Soft-Switching SiC Interleaved Boost Converter

M. Ahmed, G. Calderon-Lopez, F. Bryan,
R. Todd, A. Forsyth, *University of Manchester,
United Kingdom*

Break

4:10 p.m. – 4:30 p.m.

T19.6 An Optimized Layout with Low Parasitic Inductances for GaN HEMTs Based DC-DC Converter

K. Wang, H. Ma, H. Li, Y. Guo, X. Yang, X.
Zeng, X. Yu, *Xi'an Jiaotong University, China*

4:30 p.m. – 4:50 p.m.

T19.7 The Direct-Conversion Resonant Switched Capacitor Architecture with Merged Multiphase Interleaving: Cost and Performance Comparison

K. Kesarwani, J. Stauth, *Dartmouth College*

4:50 p.m. – 5:10 p.m.

T19.8 Server Power Management with Integrated Lithium-Ion Ultracapacitor and Bi-Directional DC-DC Converter for Distributed Ups and Reactive Power Mitigation

S. Zhao, N. Khan, Y. Wen, O. Trescases,
University of Toronto, Canada

5:10 p.m. – 5:30 p.m.

T19.9 Voltage-Mode Digital Pulse Train Control for Light Load DC-DC Converters with Spread Spectrum

S. Kapat, *Indian Institute of Technology
Kharagpur, India*

2:00 p.m. – 5:30 p.m.

TECHNICAL SESSION 20: Multilevel Converters and Power Transformers

ROOM 213BC

TRACK: Power Electronics for Utility Interface

SESSION CHAIRS:

Daniel Ludois, *University of Wisconsin – Madison*

Julia Zhang, *Oregon State University*

2:00 p.m. – 2:20 p.m.

T20.1 A Novel Control Strategy of a Modular Multilevel Converter (MMC) Based VSC-HVDC Transmission System

S. Cui, J. Jung, Y. Lee, S. Sul, *Seoul National
University, Korea, South*

2:20 p.m. – 2:40 p.m.

T20.2 Operation and Control of MMCs Using Cells with Power Transfer Capability

F. Briz, M. López, A. Zapico, A. Rodríguez,
D. Díaz-Reigosa, *Universidad de Oviedo, Spain*

2:40 p.m. – 3:00 p.m.

T20.3 Double-Clamp Cell with Reduced Losses for DC Short-Circuit Current Limitation in MMC

A. Zapico, M. López, F. Briz, D. Díaz-Reigosa,
Universidad de Oviedo, Spain

3:00 p.m. – 3:20 p.m.

T20.4 A Fault Tolerant Operation Technique for STATCOMs Based on Star-Connected Cascaded H-Bridges Multilevel Converter

C. Lee, H. Chen, P. Wu, C. Wang, C. Yang, P.
Cheng, *National Tsing Hua University, Taiwan*

3:20 p.m. – 3:40 p.m.

T20.5 A Gallium Nitride Device Based Switched Capacitor Multilevel Converter for UPS Applications

M. Alsolami, M. Scott, J. Wang, *Ohio State
University*

Break

4:10 p.m. – 4:30 p.m.

T20.6 Auxiliary Power Supply for Solid State Transformer with Ultra High Voltage Capacitive Driving

S. Zong², Q. Zhu¹, W. Yu¹, A. Huang¹,
¹*North Carolina State University;*
²*Zhejiang University, China*

4:30 p.m. – 4:50 p.m.

T20.7 Start-Up Scheme for Solid State Transformers Connected to Medium Voltage Grids

K. Mainali, S. Madhusoodhanan, A. Tripathi, D. Patel, S. Bhattacharya, *North Carolina State University*

4:50 p.m. – 5:10 p.m.

T20.8 An Evaluation of Selected Solid-State Transformer Topologies for Electric Distribution Systems

R. Garcia Montoya, A. Mallela, J. Balda, *University of Arkansas*

5:10 p.m. – 5:30 p.m.

T20.9 A New Hybrid Power Electronics on-Load Tap Changer for Power Transformer

N. Chen, L. Jonsson, *ABB Corporate Research, Sweden*

2:00 p.m. – 5:30 p.m.

TECHNICAL SESSION 21: Component Modeling

ROOM 213D

TRACK: Modeling and Simulation

SESSION CHAIRS:

Sheldon Williamson, *University of Ontario Institute of Technology*

Vahidreza Nasirian, *University of Texas-Arlington*

2:00 p.m. – 2:20 p.m.

T21.1 A Knowledge-Based Magnetic Component Design System with Finite Element Analysis Integration

S. Janghorban, Q. Wang, D. Holmes, X. Yu, *RMIT University, Australia*

2:20 p.m. – 2:40 p.m.

T21.2 On-Chip Three-Phase Coupled Power Inductor for Switching Power Converters

Z. Dang, J. Abu Qahouq, *University of Alabama*

2:40 p.m. – 3:00 p.m.

T21.3 4H-SiC 15kV n-IGBT Physics-Based Sub-Circuit Model Implemented in Simulink/MATLAB

M. Lee, G. Wang, A. Huang, *North Carolina State University*

3:00 p.m. – 3:20 p.m.

T21.4 An Accurate MATLAB/Simulink Based SiC MOSFET Model for Power Converter Applications

G. Kampitsis, M. Antivachis, S. Kokosis, S. Papathanassiou, S. Manias, *National Technical University of Athens, Greece*

3:20 p.m. – 3:40 p.m.

T21.5 Temperature-Dependent Performance of Lithium Ion Batteries in Electric Vehicles

X. Gong², C. Mi¹, ¹*University of Michigan*; ²*University of Michigan-Dearborn*

Break

4:10 p.m. – 4:30 p.m.

T21.6 Permanent Magnet Power Inductor with EE Core for Switching Power Converters

Z. Dang, J. Abu Qahouq, *University of Alabama*

4:30 p.m. – 4:50 p.m.

T21.7 A Finite Differential Method Based IGBT Model in PSPICE

P. Ning, J. Meng, X. Wen, *Institute of Electrical Engineering Chinese Academy of Sciences, China*

4:50 p.m. – 5:10 p.m.

T21.8 Experimental Modeling and Analysis of Lithium-Ion Battery Temperature Dependence

A. Hussein, *United Arab Emirates University, U.A.E.*

5:10 p.m. – 5:30 p.m.

T21.9 Surface Temperature Estimation of Li-Ion Battery via Thermal Impulse Response Technique

Y. Xiao², D. Torregrossa¹, M. Paolone¹, ¹*École Polytechnique Fédérale de Lausanne, Switzerland*; ²*University of Texas at Dallas*

7:00 p.m. – 10:00 p.m.

Join Us in the Fast Lane Evening Social Event

NASCAR HALL OF FAME

The NASCAR Hall of Fame is located adjacent to the Charlotte Convention Center.

Thursday March 19, 2015

7:00 a.m. – 8:00 a.m.

Speaker Breakfast

ROOM 203AB

7:00 a.m. – 8:00 a.m.

Poster Presenter Breakfast

BALLROOM AB

8:00 a.m. – 11:00 a.m.

Spouse & Guest Hospitality Room Open

HARRIS ROOM – THE WESTIN CHARLOTTE

8:00 a.m. – 12:00 p.m.

Registration

A CONCOURSE

8:30 a.m. – 11:30 a.m.

INDUSTRY SESSION 10: Power Electronics Applications

ROOM 207AB

SESSION CHAIR:

Jim Spangler, *Consultant*

Chris Jones, *Artesyn Embedded Technologies*

8:30 a.m. – 8:55 a.m.

IS10.1 Voltage Control Schemes for Intermediate Bus Converters

Magnus Karlsson, Oscar Persson,
R&D Ericsson Power Modules, Sweden

8:55 a.m. – 9:20 a.m.

IS10.2 Multi-Sourcing Standards for PoL and IBC Digital Power Supplies

Mark Adams, *CUI Inc, United States*

9:20 a.m. – 9:45 a.m.

IS10.3 Simple Adaptive Voltage Scaling Through Standard PMBus

Peter Miller, *Texas Instruments, United States*

9:45 a.m. – 10:10 a.m.

IS10.4 Benefits of Combining a Microcontroller with Precision Analog in a High-Voltage Process When Developing Intelligent Power Systems

Terry Cleveland, *Microchip Technology Inc., United States*

Break

10:40 a.m. – 11:05 a.m.

IS10.5 Offline Led Lighting Architectures: Which One Is Best for Your Project?

John Wiggenghorn, *Monolithic Power Systems, United States*

11:05 a.m. – 11:30 a.m.

IS10.6 High Performance Power Conversion from Non-Linear Control Methods Demonstrated in Multiple Applications

Paul Nichols, *Cirasys, Inc., United States*

8:30 a.m. – 11:30 a.m.

INDUSTRY SESSION 11: IGBTs and Their Applications

ROOM 207CD

SESSION CHAIR:

Dennis Stephens, *Continental Corporation*

8:30 a.m. – 8:55 a.m.

IS11.1 Understanding the Switching Characteristics of IGBT's and FREDs in IGBT Modules

Paul Schimel, *International Rectifier HiRel an Infineon company, United States*

8:55 a.m. – 9:20 a.m.

IS11.2 Next Generation IGBT Module Technology: a Peek Into the Future

Nitesh Satheesh, *Fuji Electric Corp of America, United States*

9:20 a.m. – 9:45 a.m.

IS11.3 Passive Components – Integrated Architecture Design for manufacturability and Performance

Emmanuel Carmier, Philippe Roussel, *Mersen, France*

9:45 a.m. – 10:10 a.m.

IS11.4 From Discrete IGBT Modules to Power Stacks

Kevork Haddad, Paul Drexhage, Gary Genet, *SEMIKRON Inc., United States*

Break

10:40 a.m. – 11:05 a.m.

IS11.5 Heat Pipes Case Studies for Power Electronics

Cliff Weasner², Ahmed Zaghlol¹,
¹Mersen Canada Toronto, Imc, Canada;
²Mersen Canada Toronto, Inc, Canada

11:05 a.m. – 11:30 a.m.

IS11.6 Trench Gate Field Stop IGBTs Extend the Operative Range to 100kHz in Hard-Switching Applications

Thomas Hopkins, *STMicroelectronics, United States*

8:30 a.m. – 11:30 a.m.

INDUSTRY SESSION 12: Recent Industrial Development in Wireless Power Transfer

ROOM 208A

SESSION CHAIR:

Siu-Chung Wong, *The Hong Kong Polytechnic University*

8:30 a.m. – 8:55 a.m.

IS12.1 Recent Industrial Development in Wireless Power Transfer

Omer Onar, Madhu Chinthavali, Perry Jones,
Oak Ridge National Laboratory, United States

8:55 a.m. – 9:20 a.m.

IS12.2 Interoperable Solution for Wireless EV and PHEV Charging

Grzegorz Ombach, *Qualcomm, United States*

9:20 a.m. – 9:45 a.m.

IS12.3 Simulation Driven Design of Wireless Charging Systems Using a Unified Circuit-Field Approach

Scott Stanton, *ANSYS, Inc., United States*

9:45 a.m. – 10:10 a.m.

IS12.4 Innovative Wireless Charging Solution for Cars

Academus Tian, *ZTE Corporation, China*

Break

10:40 a.m. – 11:05 a.m.

IS12.5 Is Flexible Material the Future of WPT?

Raghu Narayanan, Stefan Messing, *Würth Elektronik eiSos, United States*

11:05 a.m. – 11:30 a.m.

IS12.6 The Personal Electronic Device – Wireless Power Design Considerations

John Rice, *Texas Instruments, United States*

8:30 a.m. – 11:20 a.m.

TECHNICAL SESSION 22: DC-DC Converter Applications

ROOM 213A

TRACK: DC-DC Converters

SESSION CHAIRS:

Olivier Trescases, *University of Toronto*

Xin Zhou, *Maxim Integrated*

8:30 a.m. – 8:50 a.m.

T22.1 10kV SiC-Based Isolated DC-DC Converter for Medium Voltage-Connected Solid-State Transformers

D. Rothmund, G. Ortiz, T. Guillod, J. Kolar, *ETH Zürich, Switzerland*

8:50 a.m. – 9:10 a.m.

T22.2 A Medium Voltage Bidirectional DC-DC Converter Combining Resonant and Dual Active Bridge Converters

L. Wang, Q. Zhu, W. Yu, A. Huang,
North Carolina State University

9:10 a.m. – 9:30 a.m.

T22.3 A Dual-Active-Bridge Converter-Based High Step-Up Converter with Voltage-Multiplier for High-Efficiency PV Application

Y. Lu¹, H. Wu¹, Y. Xing¹, K. Sun², ¹Nanjing University of Aeronautics and Astronautics, China; ²Tsinghua University, China

9:30 a.m. – 9:50 a.m.

T22.4 Capacitor Coupled Transformer-Less DC-DC Boost Converter with Large Conversion Ratios

P. Channegowda, G. Venkataramanan,
University of Wisconsin-Madison

9:50 a.m. – 10:10 a.m.

T22.5 A Novel Bi-Directional DC-DC Converter for Distributed Energy Storage Device

F. Xue², R. Yu², W. Yu², A. Huang², Y. Du¹,
¹ABB Corporate Research; ²North Carolina State University

Break

10:40 a.m. – 11:00 a.m.

- T22.6 ZVS Double-Side LCC Compensated Resonant Inverter with Magnetic Integration for Electric Vehicle Wireless Charger**
J. Deng³, F. Lu², W. Li³, R. Ma¹, C. Mi²,
¹Northwestern Polytechnical University, China;
²University of Michigan; ³University of Michigan-Dearborn

11:00 a.m. – 11:20 a.m.

- T22.7 Efficient High Step-Up Topology for Renewable Energy Source Interfacing**
G. Spiazzi, S. Buso, D. Biadene, Università di Padova, Italy

8:30 a.m. – 11:20 a.m.

TECHNICAL SESSION 23: System Integration
ROOM 213BC

TRACK: System Integration

SESSION CHAIRS:

Ernie Parker, *Crane Aerospace & Electronics*

John Vigars, *Allegro Microsystems*

8:30 a.m. – 8:50 a.m.

- T23.1 Dead-Time Optimization of SiC Devices for Voltage Source Converter**
Z. Zhang², F. Wang², D. Costinett², L. Tolbert²,
B. Blalock², H. Lu¹, ¹Tsinghua University, China;
²University of Tennessee

8:50 a.m. – 9:10 a.m.

- T23.2 Assessment of Switching Frequency Impact on the Prediction Capability of Common-Mode EMI Emissions of SiC Power Converters Using Unterminated Behavioral Models**
B. Sun, R. Burgos, *Virginia Polytechnic Institute and State University*

9:10 a.m. – 9:30 a.m.

- T23.3 Low Profile Coupled Inductor Substrate with Fast Transient Response**
Y. Su, D. Hou, F. Lee, Q. Li, *Virginia Polytechnic Institute and State University*

9:30 a.m. – 9:50 a.m.

- T23.4 Planar Inductor Structure with Variable Flux Distribution --- a Benefit or Impediment?**
Y. Su, Q. Li, F. Lee, D. Hou, S. She, *Virginia Polytechnic Institute and State University, China*

9:50 a.m. – 10:10 a.m.

- T23.5 Analysis of Dead Time Influence on Common Mode Volt-Second and Inductor Saturation in Three-Phase DC-Fed Motor Drive Systems**
X. Zhang, D. Boroyevich, R. Burgos, *Virginia Polytechnic Institute and State University*

Break

10:40 a.m. – 11:00 a.m.

- T23.6 An Isolated Step-Up DC -- DC Converter Using Series Connect Sine Amplitude Converters**
A. Patel, *Vicor Corporation*

11:00 a.m. – 11:20 a.m.

- T23.7 DBC Switch Module for Management of Temperature and Noise in 220-W/in³ Power Assembly**
J. Shin, W. Kim, K. Ngo, *Virginia Polytechnic Institute and State University*

8:30 a.m. – 11:20 a.m.

TECHNICAL SESSION 24: Modeling of AC Energy Converters and Systems
ROOM 213D

TRACK: Modeling and Simulation

SESSION CHAIRS:

Zobair Roohani, *International Rectifier*

Ali Davoudi, *University of Texas at Arlington*

8:30 a.m. – 8:50 a.m.

- T24.1 Design of an Efficient Multilevel Inverter for a 1500V Railway Propulsion System Applications**
M. Youssef³, M. Orabi¹, M. Tarbouchi²,
¹Aswan University, Egypt; ²Royal Military College, Canada; ³University of Ontario Institute of Technology, Canada

8:50 a.m. – 9:10 a.m.

- T24.2 Stabilization of Multiple Unstable Modes for Small-Scale Inverter-Based Power Systems with Impedance-Based Stability Analysis**
C. Yoon, X. Wang, C. Bak, F. Blaabjerg, *Aalborg University, Denmark*

9:10 a.m. – 9:30 a.m.
T24.3 A Novel 3D Thermal Impedance Model for High Power Modules Considering Multi-Layer Thermal Coupling and Different Heating/Cooling Conditions
 A. Bahman, K. Ma, F. Blaabjerg, *Aalborg University, Denmark*

9:30 a.m. – 9:50 a.m.
T24.4 Influence of Voltage Feed-Forward Control on Small-Signal Stability of Grid-Tied Inverters
 X. Zhang, F. Wang, W. Cao, Y. Ma, *University of Tennessee*

9:50 a.m. – 10:10 a.m.
T24.5 Discrete-Time Modeling and Stability Analysis of Grid-Connected Inverter Based on Equivalent Circuit
 X. Wu, G. Xiao, Y. Lu, F. Chen, D. Lu, *Xi'an Jiaotong University, China*

Break

10:40 a.m. – 11:00 a.m.
T24.6 A Novel Modulation Scheme and Voltage Balancing Algorithm for Modular Multilevel Converter
 A. Dekka², B. Wu², N. Zargari¹, ¹Rockwell Automation, Canada; ²Ryerson University, Canada

11:00 a.m. – 11:20 a.m.
T24.7 Range and Misalignment Tolerance Comparisons Between Two-Coil and Four-Coil Wireless Power Transfer Systems
 Z. Dang, J. Abu Qahouq, *University of Alabama*

8:30 a.m. – 11:20 a.m.

TECHNICAL SESSION 25: What's in the Can, Combinational Semiconductors

ROOM 217A

TRACK: Devices and Components

SESSION CHAIRS:

Yang Xu, *NC State University*

Paul Schimel, *International Rectifier HiRel an Infineon company*

8:30 a.m. – 8:50 a.m.
T25.1 Photonic Power Electronics: Past, Present, and Future
 S. Mazumder, *University of Illinois at Chicago / NextWatt LLC*

8:50 a.m. – 9:10 a.m.

T25.2 New Single-Bias All-Optical ETO Configuration for a 15 kV-100A SiC Thyristor Eliminating the Turn-on Leakage Current
 H. Riazmontazer¹, A. Mojab¹, A. Rahnamaee¹, S. Mehrnami¹, S. Mazumder², M. Zefran¹, ¹University of Illinois at Chicago; ²University of Illinois at Chicago / NextWatt LLC

9:10 a.m. – 9:30 a.m.

T25.3 Unified Theory of Reverse Blocking Dynamics in High-Voltage Cascode Devices
 J. Roig, F. Bauwens, A. Banerjee, W. Jeon, A. Young, J. McDonald, B. Padmanabhan, C. Liu, *ON Semiconductor*

9:30 a.m. – 9:50 a.m.

T25.4 New Electrical Overstress and Energy Loss Mechanisms in GaN Cascodes
 S. Bahl, M. Seeman, *Texas Instruments Inc.*

9:50 a.m. – 10:10 a.m.

T25.5 The Next Generation 1200V Trench Clustered IGBT Technology with Improved Trade-Off Relationship
 H. Long¹, M. Sweet¹, M. De Souza², E. Sankara Narayanan², ¹University of Sheffield, United Kingdom; ²University of Sheffield / Eco semiconductors Ltd, United Kingdom

Break

10:40 a.m. – 11:00 a.m.

T25.6 Online Junction Temperature Measurement Using Peak Gate Current
 N. Baker, S. Munk-Nielsen, F. Iannuzzo, M. Liserre, *Aalborg University, Denmark*

11:00 a.m. – 11:20 a.m.

T25.7 An Optimal Switching Pattern for "SiC+Si" Hybrid Device Based Voltage Source Converters
 T. Zhao¹, J. He², ¹Eaton Corporation; ²Marquette University

8:30 a.m. – 11:20 a.m.

TECHNICAL SESSION 26: Renewable Wind I

ROOM 217BC

TRACK: Renewable Energy Systems

SESSION CHAIRS:

William Erdman, *Cinch LLC*

Haoyu Wang, *Shanghai Tech University*

8:30 a.m. – 8:50 a.m.

T26.1 A 2.3-MW Medium-Voltage, Three-Level Wind Energy Inverter Applying a Unique Bus Structure and 4.5-kV Si/SiC Hybrid Isolated Power Modules

W. Erdman¹, J. Keller³, D. Grider², E. VanBrunt²,
¹Cinch LLC; ²Cree Inc.; ³National Renewable Energy Laboratory

8:50 a.m. – 9:10 a.m.

T26.2 Diode Rectifier Bridge-Based Structure for DFIG-Based Wind Turbine

R. Zhu¹, Z. Chen¹, X. Wu², ¹Aalborg university, Denmark; ²China University of Mining and Technology, China

9:10 a.m. – 9:30 a.m.

T26.3 High Stability Vector-Based Direct Power Control for DFIG-Based Wind Turbine

R. Zhu¹, Z. Chen¹, X. Wu², ¹Aalborg university, Denmark; ²China University of Mining and Technology, China

9:30 a.m. – 9:50 a.m.

T26.4 Control Algorithm for Improving Voltage Quality of PMSG Wind Turbines Under Distorted Network

J. Kang¹, D. Han¹, Y. Suh¹, B. Jung², J. Kim², J. Park², Y. Choi², ¹Chonbuk National University, Korea, South; ²Hyosung Co., Korea, South

9:50 a.m. – 10:10 a.m.

T26.5 Solid-State Transformer Interfaced PMSG Wind Energy Conversion System

R. Gao, I. Husain, F. Wang, A. Huang, North Carolina State University

Break

10:40 a.m. – 11:00 a.m.

T26.6 Fault Tolerance Control for Outer Switches of a 3-Level Rectifier in Wind Turbine Systems

J. Lee, K. Lee, *Ajou University, Korea, South*

11:00 a.m. – 11:20 a.m.

T26.7 Nine-Switch-Converter-Based DFIG Wind Power System and its Dynamic Port-Current Assigned Approach for Low Voltage Riding Through (LVRT)

G. Wen, Y. Chen, P. Zhang, Y. Kang, *Huazhong University of Science and Technology, China*

8:30 a.m. – 11:20 a.m.

TECHNICAL SESSION 27: Power Electronics for Transportation Electrification

ROOM 217D

TRACK: Transportation Power Electronics

SESSION CHAIRS:

Omer Onar, *Oak Ridge National Laboratory*

Sheldon Williamson, *University of Ontario Institute of Technology*

8:30 a.m. – 8:50 a.m.

T27.1 Ultracapacitor/Battery Hybrid Energy Storage System with Real-Time Power-Mix Control Validated Experimentally in a Custom Electric Vehicle

L. Shao³, M. Moshirvaziri³, C. Malherbe³, A. Moshirvaziri³, A. Eski³, S. Dallas², F. Hurzook¹, O. Trescases³, ¹Arcx Inc., Canada; ²Toronto Electric, Canada; ³University of Toronto, Canada

8:50 a.m. – 9:10 a.m.

T27.2 Performance Evaluation of a High-Speed High-Power Switched Reluctance Motor Drive

H. Li, E. Fairall, B. Bilgin, A. Emadi, *McMaster University, Canada*

9:10 a.m. – 9:30 a.m.

T27.3 New Compact, High Performance 7th Generation IGBT Module with Direct Liquid Cooling for EV/HEV Inverters

K. Hussein¹, M. Ishihara¹, N. Miyamoto¹, Y. Nakata¹, T. Nakano¹, J. Donlon², E. Motto²,
¹Mitsubishi Electric Corp., Japan; ²Powerex, Inc.

9:30 a.m. – 9:50 a.m.

T27.4 A Hybrid-PWM Based DC-Link Voltage Balancing Algorithm for a 3-Level Neutral-Point-Clamped (NPC) DC/AC Traction Inverter Drive

A. Choudhury, P. Pillay, S. Williamson,
Concordia University, Canada

9:50 a.m. – 10:10 a.m.

T27.5 A Novel Vehicular Integrated Power System Realized with Multi-Port Series AC Link Converter

B. Farhangi, H. Toliyat, *Texas A&M University*

Break

10:40 a.m. – 11:00 a.m.

T27.6 A Topological Evaluation of Isolated DC/DC Converters for Auxiliary Power Modules in Electrified Vehicle Applications

R. Hou, P. Magne, B. Bilgin, A. Emadi,
McMaster University, Canada

11:00 a.m. – 11:20 a.m.

T27.7 A Novel Design and Performance Characterization of a Very High Current Low Voltage DC-DC Converter for Application in Micro and Mild Hybrid Vehicles

A. Ogale², B. Sarlioglu², Y. Wang¹, ¹*Johnson Controls Inc.*; ²*University of Wisconsin-Madison*

8:30 a.m. – 11:20 a.m.

TECHNICAL SESSION 28: WBG Power Device Based Applications

ROOM 218/219

TRACK: Power Electronics Applications

SESSION CHAIRS:

Jin Wang, *Ohio State University*

Yifeng Wu, *Transphorm, Inc.*

8:30 a.m. – 8:50 a.m.

T28.1 Advanced Induction Heating Appliances Using High-Voltage GaN Gate Injection Transistors

H. Sarnago, O. Lucia, J. Burdío, *Universidad de Zaragoza, Spain*

8:50 a.m. – 9:10 a.m.

T28.2 Design and Implementation of Planar Inductors for Low Voltage GaN-Based Power Converters

L. Jenkins, J. Aggas, B. Rhea, W. Abell,
C. Wilson, R. Dean, *Auburn University*

9:10 a.m. – 9:30 a.m.

T28.3 GaN FET Based CubeSat Electrical Power System

S. Singh², A. Shrivastav¹, S. Bhattacharya¹,
¹*North Carolina State University*; ²*North Carolina State University / IBM*

9:30 a.m. – 9:50 a.m.

T28.4 Medium Voltage Power Converter Design and Demonstration Using 15 kV SiC N-IGBTs

A. Kadavelugu³, K. Mainali³, D. Patel³, S. Madhusoodhanan³, A. Tripathi³, K. Hatua², S. Bhattacharya³, S. Ryu¹, D. Grider¹, S. Leslie⁴, ¹*Cree Inc.*; ²*Indian Institute of Technology Madras, India*; ³*North Carolina State University*; ⁴*Powerex, Inc.*

9:50 a.m. – 10:10 a.m.

T28.5 Fast Tracking Electrosurgical Generator Using GaN Switches

S. Jensen², D. Maksimovic², D. Friedrichs¹, J. Gilbert¹, ¹*Covidien Surgical Solutions*; ²*University of Colorado Boulder*

Break

10:40 a.m. – 11:00 a.m.

T28.6 Enhancement Mode Gallium Nitride Transistor Reliability

R. Strittmatter, C. Zhou, A. Lidow, Y. Ma,
Efficient Power Conversion Corporation

11:00 a.m. – 11:20 a.m.

T28.7 Two Phase Interleaved ISOP Connected High Step Down Ratio Phase Shift Full Bridge DC/DC Converter with GaN FETs

Y. Cui, W. Zhang, L. Tolbert, D. Costinett,
F. Wang, B. Blalock, *University of Tennessee*

11:30 – 1:30 p.m.

Dialogue Sessions

(See page 130) for more information

BALLROOM AB

2:00 p.m. – 5:25 p.m.

INDUSTRY SESSION 13: Mission Critical Power Systems

ROOM 207AB

SESSION CHAIR:

Dusty Becker, *Emerson Network Power*

2:00 p.m. – 2:25 p.m.

IS13.1 Mission Critical Power – What and How

Dustin Becker, *Emerson Network Power, United States*

2:25 p.m. – 2:50 p.m.

IS13.2 Hacking Can Make Critical Power “Go Critical”

Edward Herbert, *Co-Chairman, PSMA Energy Efficiency Committee, United States*

2:50 p.m. – 3:15 p.m.

IS13.3 Maximizing the Efficiency of Hospital Distribution Systems Through the Use of Advancing Technology and Design Creativity

Travis Jackson, *Rex Hospital, United States*

3:15 p.m. – 3:40 p.m.

IS13.4 Data Centers Modular / Prefab Construction: Speed, Reliability, Quality

Jack Pouchet, *Emerson, United States*

Break

4:00 p.m. – 4:35 p.m.

IS13.5 380V dc Power for Data Centers & Micro-Grids

David Geary, *Universal Electric Corp., United States*

4:35 p.m. – 5:00 p.m.

IS13.6 Emerging Mission Critical Space Power Distribution Technology and Products

Don Tan, *Northrop Grumman, United States*

5:00 p.m. – 5:25 p.m.

IS13.7 Design Considerations for Flight Critical Power Systems

Jon Beutler, *Crane Aerospace & Electronics, United States*

2:00 p.m. – 5:25 p.m.

INDUSTRY SESSION 14: Wide Bandgap Semiconductors

ROOM 207CD

SESSION CHAIR:

Sal Akram, *Fairchild Semiconductor*

2:00 p.m. – 2:25 p.m.

IS14.1 A Pathway to Commercialization of Wide Band-Gap Semiconductors in Power Electronics

David Henshall², Tim Heidel², Pawel Gradzki², Marina Sofos¹, Anant Agarwal¹, ¹AMO/ DOE, *United States*; ²ARPA-E/ DOE, *United States*

2:25 p.m. – 2:50 p.m.

IS14.2 SiC FET in Motor Control Applications

Tsing Hsu, *Active-Semi Inc., United States*

2:50 p.m. – 3:15 p.m.

IS14.3 Potential System Benefits of Silicon Carbide in Medical Imaging Applications

Edgar Ayerbe, *Cree, United States*

3:15 p.m. – 3:40 p.m.

IS14.4 GaN Gate Injection Transistor for Energy-Efficient Power Electronics – Status and Challenge

Tetsuzo Ueda, *Panasonic Corporation, Japan*

Break

4:00 p.m. – 4:35 p.m.

IS14.5 Successful Demonstrations of Stable High Temperature Dynamic R_{ds(on)} and UIS Capability of GaN Power Devices

Charlie Liu, *ON Semiconductor, United States*

4:35 p.m. – 5:00 p.m.

IS14.6 SiC Trench MOSFETs – Performance, Reliability, and Application Examples

David Doan, *Rohm Semiconductor, United States*

5:00 p.m. – 5:25 p.m.

IS14.7 A High Current, Low Inductance Wide Bandgap Power Module for High Performance Motor Drive Applications

Brice McPherson, Brandon Passmore, Robert Shaw, Tony Berry, Jared Hornberger, Peter Killeen, Kraig Olejniczak, Ty McNutt, Alex Lostetter, *APEI, Inc., United States*

2:00 p.m. – 5:25 p.m.

INDUSTRY SESSION 15: Modeling & Simulation

ROOM 208A

SESSION CHAIR:

Chris Bridge, *SIMPLIS Technologies*

2:00 p.m. – 2:25 p.m.

IS15.1 Processor-in-the-Loop (PIL) Simulation with PLECS

Kristofer Eberle, *Plexim, United States*

2:25 p.m. – 2:50 p.m.

IS15.2 Solving Package & PCB Converter Power Delivery & EMI Challenges

Steven Pytel, *ANSYS, United States*

2:50 p.m. – 3:15 p.m.

IS15.3 Power Converter Worst Case Analysis Using Behavioral Modeling

Carl Bycraft, *Mentor Graphics, United States*

3:15 p.m. – 3:40 p.m.

IS15.4 Virtual Prototyping Using Discrete Time Simulation

Donovan Davidson, *Gleneagles Technologies Ltd., Canada*

Break

4:00 p.m. – 4:35 p.m.

IS15.5 Advanced Design Enablement for Optimized Discrete Device and Power System Design

James Victory, Mehrdad Baghaie Yazdi, Stan Benczkowski, Michael Palmgren, Thomas Neyer, *Fairchild Semiconductor, Germany*

4:35 p.m. – 5:00 p.m.

IS15.6 Achieving Rapid Control Prototyping with Offline and Hardware-in-the-Loop Simulation

Albert Dunford, *Powersim Inc, Canada*

2:00 p.m. – 2:20 p.m.

TECHNICAL SESSION 29: Resonant and Soft-Switching DC-DC Converters

ROOM 213A

TRACK: DC-DC Converters

SESSION CHAIRS:

Bulent Sarioglu, *University of Wisconsin – Madison*

Xin Zhou, *Maxim Integrated*

2:00 p.m. – 2:20 p.m.

T29.1 Efficiency Optimization of LLC Resonant Converters Operating in Wide Input- and/or Output-Voltage Range by on-the-Fly Topology-Morphing Control

M. Jovanovic, B. Irving, *Delta Products Corporation*

2:20 p.m. – 2:40 p.m.

T29.2 Secondary-Side Phase-Shift-Controlled High Step-Up Hybrid Resonant Converter with Voltage Multiplier for High Efficiency PV Applications

H. Wu, T. Xia, Y. Xing, P. Xu, H. Hu, Z. Zhang, *Nanjing University of Aeronautics and Astronautics, China*

2:40 p.m. – 3:00 p.m.

T29.3 The Third Harmonics Current Injection Scheme for LLC Topology to Reduce the RMS of the Output Current

R. Ren, F. Zhang, Z. Shen, S. Liu, *Nanjing University of Aeronautics and Astronautics, China*

3:00 p.m. – 3:20 p.m.

T29.4 Impedance Control Network Resonant DC-DC Converter for Wide-Range High-Efficiency Operation

J. Lu², D. Perreault¹, K. Afridi², ¹Massachusetts Institute of Technology; ²University of Colorado Boulder

3:20 p.m. – 3:40 p.m.

T29.5 Charge Current Control for LLC Resonant Converter

H. Choi, *Fairchild semiconductor*

Break

4:10 p.m. – 4:30 p.m.

T29.6 Series-Resonant Converter with Reduced-Frequency-Range Control

Y. Jang², M. Jovanovic², J. Ruiz², G. Liu¹,
¹Delta Electronics, China; ²Delta Products Corporation

4:30 p.m. – 4:50 p.m.

T29.7 A Novel Active-Current-Sharing Method for Interleaved Resonant Converters

Y. Jang², M. Jovanovic², J. Ruiz², M. Kumar²,
G. Liu¹, ¹Delta Electronics, China; ²Delta Products Corporation

4:50 p.m. – 5:10 p.m.

T29.8 Fourth Order L3C Resonant Converter for Wide Output Voltage Regulation

N. Shafiei², M. Ordóñez², C. Botting¹, M. Craciun¹, M. Edington¹, ¹Delta-Q Technologies Corp, Canada; ²University of British Columbia, Canada

5:10 p.m. – 5:30 p.m.

T29.9 A 1.2 MHz, 25 V to 100 V GaN-Based Resonant Dickson Switched-Capacitor Converter with 1011 W/in³ (61.7 kW/L) Power Density

B. Macy, Y. Lei, R. Pilawa-Podgurski, *University of Illinois at Urbana-Champaign*

2:00 p.m. – 5:30 p.m.

TECHNICAL SESSION 30: Power Converter Control

ROOM 213BC

TRACK: Control

SESSION CHAIRS:

Bilal Akin, *University of Texas at Dallas*

Mahshid Amirabadi, *University of Illinois at Chicago*

2:00 p.m. – 2:20 p.m.

T30.1 Harmonics Mitigation of Dead Time Effects in PWM Converters Using a Repetitive Controller

Y. Yang¹, K. Zhou², H. Wang¹, F. Blaabjerg¹,
¹Aalborg University, Denmark; ²University of Glasgow, United Kingdom

2:20 p.m. – 2:40 p.m.

T30.2 Implementation of Parabolic Current Control for Dual-Carrier PWM

L. Zhang, J. Dominic, B. Gu, B. Chen, C. Zheng, J. Lai, *Virginia Polytechnic Institute and State University*

2:40 p.m. – 3:00 p.m.

T30.3 Oversampled Dead-Beat Current Controller for Voltage Source Converters

S. Buso², T. Caldognetto², D. Iglesias Brandao¹,
¹Universidade Estadual de Campinas, Brazil; ²Università di Padova, Italy

3:00 p.m. – 3:20 p.m.

T30.4 Analysis and Compensation of Dead-Time Effect Considering Parasitic Capacitance and Ripple Current

C. Li², Y. Gu², W. Li², X. He², Z. Dong¹,
G. Chen¹, C. Ma¹, L. Zhang¹, ¹Shanghai Electric, China; ²Zhejiang University, China

3:20 p.m. – 3:40 p.m.

T30.5 Optimizing Efficiency and Performance for Single-Phase Photovoltaic Inverter with Dual-Half Bridge Converter

Y. Zhang, J. Umhoza, H. Liu, C. Farnell, A. Mantooth, *University of Arkansas*

Break

4:10 p.m. – 4:30 p.m.

T30.6 Model-Predictive Control to Realize the Switching-Cycle Capacitor Voltage Control for the Modular Multilevel Converters

J. Wang, R. Burgos, D. Boroyevich, *Virginia Polytechnic Institute and State University*

4:30 p.m. – 4:50 p.m.

T30.7 Improvement of Control-Law Derivation for D-Sigma Digital Controlled Three-Phase Four-Wire Inverter

T. Wu, L. Lin, P. Lin, Y. Chen, Y. Chang, *National Tsing Hua University, Taiwan*

4:50 p.m. – 5:10 p.m.

T30.8 Characteristic Analysis and Experimental Verification of a Novel Capacitor Voltage Control Strategy for Three-Phase MMC-DSTATCOM

C. Xu, K. Dai, Y. Kang, C. Liu, *Huazhong University of Science and Technology, China*

5:10 p.m. – 5:30 p.m.

T30.9 Vector Based Dead-Time Compensation for a Three-Level T-Type Converter

X. Li, S. Dusmez, B. Akin, K. Rajashekara,
University of Texas at Dallas

2:00 p.m. – 5:30 p.m.

TECHNICAL SESSION 31: Inverter Control II

ROOM 213D

TRACK: Motor Drives and Inverters

SESSION CHAIRS:

Keith Corzine, *Clemson*

Dimitri Torregrossa, *École polytechnique fédérale de Lausanne*

2:00 p.m. – 2:20 p.m.

T31.1 Hybrid Position Controller for an Indirect Field-Oriented Induction Motor Drive

A. de Souza Junior, T. Fernandes Neto,
D. Honório, L. Barreto, L. dos Reis,
Universidade Federal do Ceará, Brazil

2:20 p.m. – 2:40 p.m.

T31.2 A New Sensor-Less Position Estimation Method for a Nine-Phase Interior Permanent Magnet Machine Using a High Frequency Injection in a Non-Torque Generating Circuit

M. Ramezani, J. Ojo, *Tennessee Technological University*

2:40 p.m. – 3:00 p.m.

T31.3 A Modulation Strategy to Control the Matrix Converter Under Unbalanced Input Voltage Conditions

J. Dasika², M. Saeedifard¹, ¹*Georgia Institute of Technology*; ²*Purdue University*

3:00 p.m. – 3:20 p.m.

T31.4 An Optimized Control Strategy for the Modular Multilevel Converter Based on Space Vector Modulation

Y. Deng, M. Saeedifard, R. Harley, *Georgia Institute of Technology*

3:20 p.m. – 3:40 p.m.

T31.5 DSP-Based Sensorless Speed Control Drive System for Two-Phase Synchronous Motors

S. Ziaeeinejad², Y. Sangsefidi², A. Mehrizi-Sani²,
A. Shoulaie¹, ¹*Iran University of Science and Technology, Iran*; ²*Washington State University*

Break

4:10 p.m. – 4:30 p.m.

T31.6 A Robust V/F Based Sensorless MTPA Control Strategy for IPM Drives

Z. Tang, B. Akin, *University of Texas at Dallas*

4:30 p.m. – 4:50 p.m.

T31.7 A New SVPWM for Phase Currents Reconstruction of Three-Phase Three-Level T-Type Converters

X. Li, S. Dusmez, B. Akin, K. Rajashekara,
University of Texas at Dallas

4:50 p.m. – 5:10 p.m.

T31.8 Unbalanced Selective Harmonic Elimination for Fault-Tolerant Operation of Three Phase Multilevel Cascaded H-Bridge Inverters

M. Aleenejad, P. Moamaei, H. Mahmoudi, R. Ahmadi, *Southern Illinois University Carbondale*

5:10 p.m. – 5:30 p.m.

T31.9 An Improved Nearest-Level Modulation Method for the Modular Multilevel Converter

Y. Deng, M. Saeedifard, R. Harley, *Georgia Institute of Technology*

2:00 p.m. – 5:30 p.m.

TECHNICAL SESSION 32: Wireless Power Transfer

ROOM 217A

TRACK: Power Electronics Applications

SESSION CHAIRS:

Juan Rivas, *Stanford University*

Sheldon Williamson, *University of Ontario Institute of Technology*

2:00 p.m. – 2:20 p.m.

T32.1 Wireless Phase -- Locked Loop Control for Inductive Power Transfer Systems

E. Gati, G. Kampitsis, I. Stavropoulos,
S. Papathanassiou, S. Manias, *National Technical University of Athens, Greece*

2:20 p.m. – 2:40 p.m.

T32.2 The ZVS Voltage-Mode Class-D Amplifier, an Egan® FET-Enabled Topology for Highly Resonant Wireless Energy Transfer

M. de Rooij, *Efficient Power Conversion Corporation*

2:40 p.m. – 3:00 p.m.

- T32.3 Wireless Charging Power Control for HESS Through Receiver Side Voltage Control**
T. Hiramatsu, X. Huang, M. Kato, T. Imura, Y. Hori, *University of Tokyo, Japan*

3:00 p.m. – 3:20 p.m.

- T32.4 Phase-Shift and Amplitude Control for an Active Rectifier to Maximize the Efficiency and Extracted Power of a Wireless Power Transfer System**
A. Berger², M. Agostinelli¹, S. Vesti¹, J. Oliver³, J. Cobos³, M. Huemer², ¹*Infineon Technologies Austria AG, Austria*; ²*Johannes Kepler University Linz, Austria*; ³*Universidad Politécnica de Madrid, Spain*

3:20 p.m. – 3:40 p.m.

- T32.5 Output Current Characterization of Parallel-Series/Series Compensated Resonant Converter for Contactless Power Transfer**
J. Hou², Q. Chen², S. Wong¹, X. Ren², X. Ruan², ¹*Hong Kong Polytechnic University, China*; ²*Nanjing University of Aeronautics and Astronautics, China*

Break

4:10 p.m. – 4:30 p.m.

- T32.6 Extended-Range Two-Coil Adaptively Reconfigurable Wireless Power Transfer System**
Z. Dang, J. Abu Qahouq, *University of Alabama*

4:30 p.m. – 4:50 p.m.

- T32.7 An Inductive Wireless Charger for Electric Vehicle by Using LLC Resonance with Matrix Ferrite Core Group**
H. Hsieh², T. Huang¹, S. Shih², ¹*Chung Yuan Christian University, Taiwan*; ²*National Chiayi University, Taiwan*

4:50 p.m. – 5:10 p.m.

- T32.8 Elimination Method for the Transmission Efficiency Valley of Death in Laterally Misaligned Wireless Power Transfer Systems**
Z. Dang, J. Abu Qahouq, *University of Alabama*

5:10 p.m. – 5:30 p.m.

- T32.9 Wireless Power Transfer System with an Asymmetric 4-Coil Resonator for Electric Vehicle Battery Chargers**
S. Moon¹, G. Moon², ¹*Fairchild Semiconductor, Korea, South*; ²*KAIST, Korea, South*

2:00 p.m. – 5:30 p.m.

TECHNICAL SESSION 33: Utility & Mixed Applications of Power Electronics

ROOM 217BC

TRACK: Power Electronics Applications

SESSION CHAIRS:

Paul Schimel, *International Rectifier HiRel an Infineon company*

Omer Onar, *Oak Ridge National Laboratory*

2:00 p.m. – 2:20 p.m.

- T33.1 A Detailed Power Loss Analysis of Modular Multilevel Converter**
F. Ertürk, A. Hava, *Middle East Technical University, Turkey*

2:20 p.m. – 2:40 p.m.

- T33.2 A New High Efficient Transformerless Inverter for Single Phase Grid-Tied Photovoltaic System with Reactive Power Control**
M. Islam, S. Mekhilef, *University of Malaya, Malaysia*

2:40 p.m. – 3:00 p.m.

- T33.3 Research on Fast Open-Loop Phase Locking Scheme for Three-Phase Unbalanced Grid**
L. Xiong, F. Zhuo, X. Liu, M. Zhu, Y. Chen, F. Wang, *Xi'an Jiaotong University, China*

3:00 p.m. – 3:20 p.m.

- T33.4 An OCC-APF Control Strategy for Unbalanced Grid Conditions**
A. Lock¹, E. da Silva¹, D. Fernandes¹, M. Elbuluk², ¹*Universidade Federal da Paraíba, Brazil*; ²*University of Akron*

3:20 p.m. – 3:40 p.m.

- T33.5 A Crossed Pack-to-Cell Equalizer Based on Quasi-Resonant LC Converter with Adaptive Fuzzy Logic Equalization Control for Series-Connected Lithium-Ion Battery Strings**
Y. Shang², C. Zhang², N. Cui², J. Guerrero¹, K. Sun³, ¹*Aalborg University, Denmark*; ²*Shandong University, China*; ³*Tsinghua University, China*

Break

- 4:10 p.m. – 4:30 p.m.
T33.6 A Modified Two Switched-Inductors Quasi Z-Source Inverter
 A. Bakeer, M. Ismeil, M. Orabi, Aswan University, Egypt
- 4:30 p.m. – 4:50 p.m.
T33.7 A Bridgeless BHB ZVS-PWM AC-AC Converter for High-Frequency Induction Heating Applications and Non-Smoothed DC-Link Characteristics
 T. Mishima¹, Y. Nakagawa¹, M. Nakaoka², ¹Kobe University, Japan; ²Kyungnam University, Korea, South
- 4:50 p.m. – 5:10 p.m.
T33.8 Investigation of Time-Varying Magnetic Field in Thyristor Rectifiers of 19kA in Chlor-Alkali Industry
 S. Shirmohammadi, Y. Suh, Chonbuk National University, Korea, South
- 5:10 p.m. – 5:30 p.m.
T33.9 A High Power Density Dual-Buck Full-Bridge Inverter Based on Carrier Phase-Shifted SPWM Control
 T. Su, F. Zhang, J. Xie, W. Meng, J. Wang, Nanjing University of Aeronautics and Astronautics, China

2:00 p.m. – 5:30 p.m.

TECHNICAL SESSION 34: Photovoltaics

ROOM 217D

TRACK: Renewable Energy Systems

SESSION CHAIRS:

Brandon Pierquet, Tesla Motors

Haoyu Wang, Shanghai Tech University

- 2:00 p.m. – 2:20 p.m.
T34.1 A PEF Based Control for Single-Phase Multifunctional SECS with Adaptive DC Link Structure for PCC Voltage Variations
 C. Jain, B. Singh, Indian Institute of Technology Delhi, India
- 2:20 p.m. – 2:40 p.m.
T34.2 A Capacitance Minimization Control Strategy for Single-Phase PV Quasi-Z-Source Inverter
 Y. Zhou², H. Li¹, H. Li¹, X. Lin³, ¹Florida State University; ²Ford Motor Company; ³Huazhong University of Science and Technology, China

- 2:40 p.m. – 3:00 p.m.
T34.3 Multi-Phase Smart Converter for PV System
 Z. Cao, Q. Li, F. Lee, Virginia Polytechnic Institute and State University

- 3:00 p.m. – 3:20 p.m.
T34.4 The New Family of High Step Ratio Modular Multilevel DC-DC Converters
 X. Zhang, T. Green, Imperial College London, United Kingdom

- 3:20 p.m. – 3:40 p.m.
T34.5 A New Discrete-in-Time Extremum Seeking Based Technique for Maximum Power Point Tracking of Photovoltaic Systems
 R. Ahmadi², H. Zargarzadeh¹, ¹Southeast Missouri State University; ²Southern Illinois University Carbondale

Break

- 4:10 p.m. – 4:30 p.m.
T34.6 A Dual-Input Full-Bridge Current-Source Isolated DC/DC Converter Based on Quasi-Switched-Capacitor Circuit for Photovoltaic Systems with Energy Storage
 F. Guo², L. Fu², H. Li², M. Alsolami², X. Zhang², J. Wang², J. Zhang¹, ¹Hubei University of Technology, China; ²Ohio State University

- 4:30 p.m. – 4:50 p.m.
T34.7 Hybrid Pulsewidth Modulated Single-Phase Quasi-Z-Source Grid-Tie Photovoltaic Power System
 Y. Liu², H. Abu-Rub², B. Ge¹, ¹Texas A&M University, China; ²Texas A&M University at Qatar, Qatar

- 4:50 p.m. – 5:10 p.m.
T34.8 Modeling and Control of a Three-Port DC-DC Converter for PV-Battery Systems
 J. Zeng, W. Qiao, L. Qu, University of Nebraska-Lincoln

- 5:10 p.m. – 5:30 p.m.
T34.9 A Self-Reconfiguration Control Regarding Recovery Effect to Improve the Discharge Efficiency in the Distributed Battery Energy Storage System
 Y. Cai², Z. Zhang², Y. Zhang¹, Y. Liu³, ¹Jiangsu Electric Power Company / Nanjing Power Supply Company, China; ²Nanjing University of Aeronautics and Astronautics, China; ³Queen's University, Canada

2:00 p.m. – 5:30 p.m.

TECHNICAL SESSION 35: Grid and Microgrid Interfaces

ROOM 218/219

TRACK: Power Electronics for Utility Interface

SESSION CHAIRS:

Fernando Briz, *University of Oviedo, Spain*

Haihua Zhou, *International Rectifier*

2:00 p.m. – 2:20 p.m.

T35.1 Harmonic Interaction Analysis in Grid Connected Converter Using Harmonic State Space (HSS) Modeling

J. Kwon, X. Wang, C. Bak, F. Blaabjerg, *Aalborg University, Denmark*

2:20 p.m. – 2:40 p.m.

T35.2 A Constant Duty Cycle Control, Single-Phase Inverter Design for Distributed Static Series Compensators

A. Brissette², A. Hoke¹, D. Maksimovic²,
¹National Renewable Energy Laboratory;
²University of Colorado Boulder

2:40 p.m. – 3:00 p.m.

T35.3 Fractionally Rated Transformer-Less Unified Power Flow Controllers for Interconnecting Synchronous AC Grids

D. Gunasekaran, S. Yang, F. Peng, *Michigan State University*

3:00 p.m. – 3:20 p.m.

T35.4 Current Control of Grid Converters Connected with Series AC Capacitor

X. Wang, F. Blaabjerg, P. Loh, Y. Pang, *Aalborg University, Denmark*

3:20 p.m. – 3:40 p.m.

T35.5 Control and Implementation of Converter Based AC Transmission Line Emulation

B. Liu, S. Zheng, Y. Ma, F. Wang, L. Tolbert, *University of Tennessee*

Break

4:10 p.m. – 4:30 p.m.

T35.6 An Accurate Power-Sharing Control Method Based on Circulating-Current Power Model for Voltage-Source-Inverter Parallel System

M. Gao, C. Zhang, M. Qiu, W. Li, M. Chen, Z. Qian, *Zhejiang University, China*

4:30 p.m. – 4:50 p.m.

T35.7 Double Synchronous Frame Current Regulation of Distributed Generation Systems Under Unbalanced Voltage Conditions Without Sequence Current Separation

R. Kabiri, D. Holmes, B. McGrath, *RMIT University, Australia*

4:50 p.m. – 5:10 p.m.

T35.8 Harmonic Analysis and Practical Implementation of a Two-Phase Microgrid System

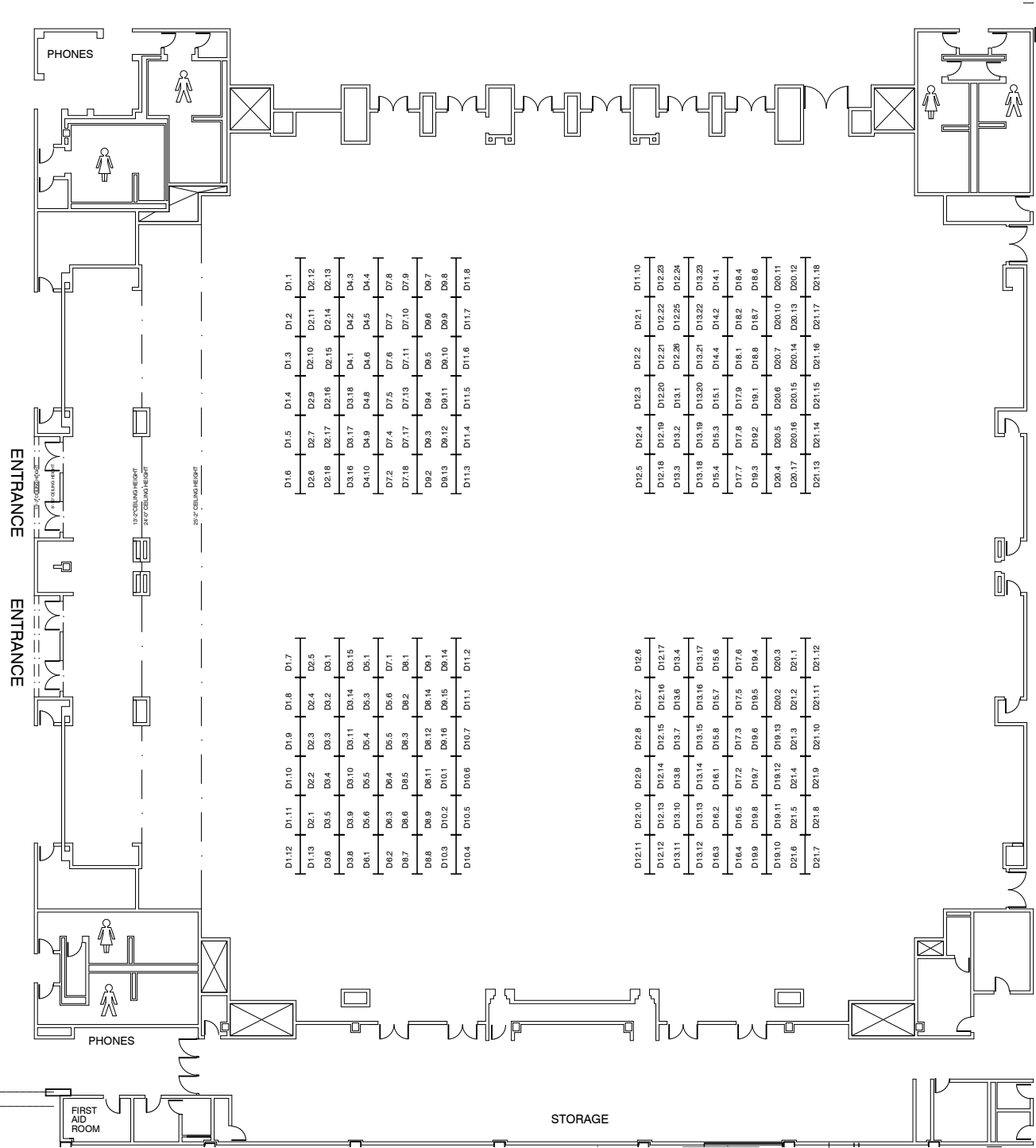
M. Alibeik², E. Dos Santos Jr.², Y. Yang¹, X. Wang¹, F. Blaabjerg¹, ¹Aalborg University, Denmark; ²Indiana University Purdue University Indianapolis

5:10 p.m. – 5:30 p.m.

T35.9 Self-Disciplined Stabilization of DC Microgrids by Passivity-Based Control

Y. Gu², W. Zheng¹, W. Li², X. He², ¹Shanghai Marine Equipment Research Institute, China; ²Zhejiang University, China

Dialogue Sessions
Floor Plan



Dialogue Sessions

Dialogue Session papers have been selected through the same rigorous peer review process as papers in the Presentation Sessions. They are represented by papers in the APEC Proceedings.

In the Dialogue Sessions you will have the opportunity to talk at length with the authors about their work, something that is not possible in the oral presentation sessions.

Session D1: AC-DC Converters

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

Nathan Weise, *University of Maine*

Daniel Costinett, *University of Tennessee*

- D1.1 A Single-Stage Three-Phase AC/DC Converter with Y-Delta Three-Phase Transformer**
L. Gu, K. Jin, *Nanjing University of Aeronautics and Astronautics, China*
- D1.2 Inhibiting Mains Current Distortion for SWISS Rectifier -- a Three-Phase Buck-Type Harmonic Current Injection PFC Converter**
R. Chen¹, Y. Yao¹, L. Zhao¹, M. Xu²,
¹FSP-Powerland Technology Inc., China;
²Xi'an Jiaotong University, China
- D1.3 Analysis, Control and Design of a Long-Lifetime AC-DC Bus Converter Within a Nanogrid**
H. Wu¹, S. Wong¹, C. Tse¹, Q. Chen²,
¹Hong Kong Polytechnic University, Hong Kong; ²Nanjing University of Aeronautics and Astronautics, China
- D1.4 Performance Comparison of Three-Step and Six-Step PWM in Average-Current-Controlled Three-Phase Six-Switch Boost PFC Rectifier**
L. Huber, M. Kumar, M. Jovanovic, *Delta Products Corporation, United States*
- D1.5 Optimum Design on the Single-Stage Forwardflyback PFC Converter with Two Different QR Controls**
J. Li, X. Xie, K. Peng, C. Zhao, *Hangzhou Dianzi University, China*

- D1.6 A Novel Matrix Based Isolated Three Phase AC-DC Converter with Reduced Switching Losses**
A. Singh, P. Das, S. Panda, *National University of Singapore, Singapore*
- D1.7 A Novel Control Scheme of Three-Phase Single-Switch DCM Boost PFC Converter**
K. Yao, Q. Meng, W. Hu, W. Tang, J. Lyu, *Nanjing University of Science and Technology, China*
- D1.8 Variable Frequency and Constant Frequency Modulation Techniques for GaN Based MHz H-Bridge PFC**
N. Haryani, R. Burgos, D. Boroyevich, *Virginia Polytechnic Institute and State University, United States*
- D1.9 Power Supply Topology Operating at Highly Discontinuous Input Voltages for Two-Wire Connected Control Devices in Digital Load-Side Transmission (DLT) Systems for Intelligent Lighting**
L. Lohaus, A. Rossius, R. Wunderlich, S. Heinen, *Rheinisch-Westfälische Technische Hochschule Aachen, Germany*
- D1.10 Zero Voltage Switching Differential Inverters**
B. Koushki, A. Safaee, P. Jain, A. Bakhshai, *Queen's University, Canada*
- D1.11 Characterization and Evaluation of 600 V Range Devices for Active Power Factor Correction in Boundary and Continuous Conduction Modes**
J. Hernandez, L. Petersen, M. Andersen, *Danmarks Tekniske Universitet, Denmark*
- D1.12 Multi-Mode Controlled Push-Pull Boost Power Factor Corrector**
C. Lin⁴, J. Lai³, Y. Lo¹, H. Chiu², C. Yang², Y. Liu⁵, ¹Lite-On Technology Corp., Taiwan; ²National Taiwan University of Science and Technology, Taiwan; ³Virginia Polytechnic Institute and State University, United States; ⁴Virginia Polytechnic Institute and State University/Flextronics Power, United States
- D1.13 New Way to Regulate DC Link Voltage for Adaptive Travel Adaptor Applications**
J. Guo, *Fairchild Semiconductor, United States*

Session D2: DC-DC Converters I

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

Dave Freeman, *Texas Instruments*

Haihua Zhou, *International Rectifier*

- D2.1 Adaptive-on-Time Control Technique for Output Ripple Reduction and Light-Load Efficiency Enhancement in Low-Power Switched-Capacitor DC-DC Regulators**
Z. Hua, H. Lee, *University of Texas at Dallas, United States*
- D2.2 A Single-Stage Three-Port Boost Converter with High Voltage Gain Based on the Bidirectional Version of the Three-State Switching Cell**
D. Alves², P. Praça², D. Oliveira Jr.², L. Barreto², L. de Freitas¹, ¹*Universidade Federal de Uberlândia, Brazil*; ²*Universidade Federal do Ceará, Brazil*
- D2.3 Research and Realization of a Novel Active Common-Mode EMI Filter**
X. Chang, W. Chen, Y. Yang, K. Wang, X. Yang, *Xi'an Jiaotong University, China*
- D2.4 Digital Multiphase Constant on-Time Regulator Supporting Energy Proportional Computing**
A. Zafarana¹, O. Zambetti¹, G. Lingua¹, S. Saggini², ¹*STMicroelectronics, Italy*; ²*Università degli Studi di Udine, Italy*
- D2.5 A High Step-Down Non-Isolated Bus Converter with Partial Power Conversion Based on Synchronous LLC Resonant Converter**
L. Chen², H. Wu², P. Xu², H. Hu², C. Wan¹, ¹*Beijing Spacecrafts, China*; ²*Nanjing University of Aeronautics and Astronautics, China*
- D2.6 A Novel Ide Control to Improve Light Load Efficiency for a Full-Bridge DC/DC Converter**
S. Xu, J. Wang, *Texas Instruments Inc., China*
- D2.7 A High-Frequency Resonant Gate Driver for Enhancement-Mode GaN Power Devices**
Y. Long², W. Zhang², D. Costinett², B. Blalock², L. Jenkins¹, ¹*Auburn University, United States*; ²*University of Tennessee, United States*
- D2.9 A Single Stage 54V to 1.8V Multi-Phase Cascaded Buck Voltage Regulator Module**
K. Leong¹, G. Deboy¹, K. Krischan², A. Muetze², ¹*Infineon Technologies Austria AG, Austria*; ²*Technische Universität Graz, Austria*
- D2.10 Self-Oscillating Galvanic Isolated Bidirectional Very High Frequency DC-DC Converter**
J. Pedersen, M. Madsen, A. Knott, M. Andersen, *Danmarks Tekniske Universitet, Denmark*
- D2.11 A New Family of GaN Transistors for Highly Efficient High Frequency DC-DC Converters**
D. Reusch, J. Strydom, A. Lidow, *Efficient Power Conversion Corporation, United States*
- D2.12 Predictive Adaptive Method for Synchronous Rectification**
A. Iorio, A. Bianco, M. Foresta, G. Scappatura, C. Adragna, S. DeSimone, *STMicroelectronics, Italy*
- D2.13 Bi-Directional Piezoelectric Transformer Based Converter for High-Voltage Capacitive Applications**
M. Rødgaard, *Noliac A/S, Denmark*
- D2.14 Dynamical Modeling of Power Converters with Power Semiconductor Filter**
W. Fan, K. Yuen, H. Chung, *City University of Hong Kong, Hong Kong*
- D2.15 A 100V Reconfigurable Synchronous Gate Driver with Comparator-Based Dynamic Dead-Time Control for High-Voltage High-Frequency DC-DC Converters**
L. Cong, J. Xue, H. Lee, *University of Texas at Dallas, United States*
- D2.16 Design and Analysis of an Ultra-High Efficiency Phase Shifted Full Bridge GaN Converter**
R. Ramachandran, M. Nymand, *University of Southern Denmark, Denmark*
- D2.17 A High Efficiency Wireless DC-DC Converter**
A. Savu², A. Lita², I. Jitaru¹, ¹*Rompower Energy Systems, United States*; ²*Rompower International S.R.L., Romania*
- D2.18 The Cost-Efficient, Common-Ground, Non-Isolated Three-Port Converter Deduced from the Single-Inductor Dual-Output (SIDO) Topology**
P. Zhang, Y. Chen, Z. Lu, Y. Kang, *Huazhong University of Science and Technology, China*

Session D3: DC-DC Converters II

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

Akshay Kumar Rathore, *National University of Singapore*

William G. Dunford, *The University of British Columbia*

D3.1 Output Filter Design in High-Efficiency Wide-Bandwidth Multi-Phase Buck Envelope Amplifiers

Y. Zhang, M. Rodríguez, D. Maksimovic, *University of Colorado Boulder, United States*

D3.2 Extending the Operational Limits of the Push-Pull Converter with SiC Devices and an Active Energy Recovery Clamp Circuit
B. Whitaker, D. Martin, E. Cilio, *Arkansas Power Electronics International Inc., United States*

D3.3 An Extra-Low-Frequency RS-SCALDO Technique: a New Approach to Design Voltage Regulator Modules
T. Wickramasinghe, N. Kularatna, D. Steyn-Ross, *University of Waikato, New Zealand*

D3.4 High-Efficiency Ultracapacitor Charger Using a Soft-Switching Full-Bridge DC-DC Converter
M. Yang, H. Cho, S. Lee, W. Choi, *Chonbuk National University, Korea, South*

D3.5 High-Efficiency Low-Cost Soft-Switching DC-DC Converter for EV on-Board Battery Chargers
M. Yang, H. Cho, S. Lee, W. Choi, *Chonbuk National University, Korea, South*

D3.6 A Novel Full Load Range ZVS DC-DC Full-Bridge Converter with Natural Hold-Up Time Operation
P. Das¹, M. Pahlevaninezhad², ¹*National University of Singapore, Singapore*; ²*Queen's University, Canada*

D3.8 A Soft-Switching Multi-Phase Converter with Coupled Inductors and Switch-Time-Delay Control
G. Zhu², T. Qian², B. Lehman¹, ¹*Northeastern University, United States*; ²*Tongji University, China*

D3.9 A Three-Port DC-DC Converter with Low Frequency Current Ripple Reduction Technique

Z. Chen, Q. Wu, M. Li, Y. Xu, Q. Wang, *Nanjing University of Aeronautics and Astronautics, China*

D3.10 MHz GaN-Based Interleaved CRM Bi-Directional Buck/Boost Converter with Coupled Inductor
X. Huang, F. Lee, Q. Li, W. Du, *Virginia Polytechnic Institute and State University, United States*

D3.11 Efficiency Impact of MOSFET Output Junction Capacitance on a High Step Down Ratio Phase Shift Full Bridge DC/DC Converter
Y. Cui, W. Zhang, L. Tolbert, D. Costinett, F. Wang, B. Blalock, *University of Tennessee, United States*

D3.14 A Multilevel VR Implementation and MIMO Control Scheme for Vertically-Stacked Microprocessor Cores
C. Schaef, J. Stauth, *Dartmouth College, United States*

D3.15 Voltage Regulation and Efficiency Optimization in a 100 MHz Series Resonant DC-DC Converter
A. Sepahvand², L. Scandola¹, Y. Zhang², D. Maksimovic², ¹*Università di Padova / Infineon Technologies Italia S.r.l., Italy*; ²*University of Colorado Boulder, United States*

D3.16 Bidirectional DC-DC Converter Using Secondary LLC Resonant Tank
E. Kim¹, J. Park¹, J. Joo¹, S. Lee², K. Kim², Y. Kong³, ¹*Jeonju University, Korea, South*; ²*KACO new energy Inc., Korea, South*; ³*National Forensic Service, Korea, South*

D3.17 Optimal Design of a Redundant High Current DC/DC Converter
C. Nan¹, S. Angkititrakul², Z. Liang², ¹*Arizona State University, United States*; ²*Intersil Corporation, United States*

D3.18 Resonant Converter Building Blocks for High Power, High Voltage Applications
M. Agamy², M. Dame², J. Dai², X. Li², P. Cioffi³, R. Sellick², R. Gupta¹, ¹*First Solar, United States*; ²*GE Global Research Center, United States*; ³*General Electric Global Research Center, United States*

Session D4: Power Electronics for Utility Interface I

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

Babak Parkhideh, *University of North Carolina, Charlotte*

Jing Xu, *ABB Inc*

- D4.1 Identification of Resonances in Parallel Connected Grid Inverters with LC- and LCL-Filters**
R. Juntunen, J. Korhonen, T. Musikka, L. Smirnova, O. Pyrhönen, P. Silventoinen, *Lappeenranta University of Technology, Finland*
- D4.2 Eliminating the Influence of Capacitor Voltage Ripple on Current Control for Grid-Connected Modular Multilevel Converter**
D. Wu, L. Peng, *Huazhong University of Science and Technology, China*
- D4.3 Smooth Mode Transition of a DC Bus Voltage Controlled PV Inverter Using a Novel Phase Locked Loop Method**
P. Das, S. Chattopadhyay, *Indian Institute of Technology Kharagpur, India*
- D4.4 Modulation and Control of a High Performance Hybrid Cascade H-Bridge Seven-Level Active Power Filter with Star Configuration**
Z. Chen, Y. Xu, Z. Wang, M. Li, *Nanjing University of Aeronautics and Astronautics, China*
- D4.5 Power-Weighting-Based Multiple Input and Multiple Output Control Strategy for Single-Phase PV Cascaded H-Bridge Multilevel Grid-Connected Inverter**
Q. Huang, M. Wang, W. Yu, A. Huang, *North Carolina State University, United States*
- D4.6 PLL-Less Robust Active and Reactive Power Controller for Single Phase Grid-Connected Inverter with LCL Filter**
X. Li, R. Balog, *Texas A&M University, United States*
- D4.8 A Real-Time Selective Harmonic Compensation (SHC) Based on Asymmetric Switching Angle Modulation and Current Feedback Control for Cascaded Modular Multilevel Inverters**
H. Zhao, S. Wang, *University of Florida, United States*

- D4.9 Indirect Thermal Control for Improved Reliability of Modular Multilevel Converter by Utilizing Circulating Current**
M. Bakhshizadeh², K. Ma¹, P. Loh¹, F. Blaabjerg¹, ¹*Aalborg University, Denmark*; ²*University of Tehran, Iran*
- D4.10 Startup Schemes for Modular Multilevel Converter Under Different Load Conditions**
X. Shi, B. Liu, Z. Wang, Y. Li, L. Tolbert, F. Wang, *University of Tennessee, United States*

Session D5: Power Electronics for Utility Interface II

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

Dong Cao, *North Dakota State University*
Davide Giacomini, *International Rectifier*

- D5.1 Development of a Power-Hardware-in-the-Loop Application ----- Power Grid Emulator by Using 'Voltage Source Inverter Cumulation'**
G. Si, J. Cordier, R. Kennel, *Technische Universität München, Germany*
- D5.3 STATCOM-Based Virtual Inertia Control for Wind Power Generation**
Y. Liu, S. Yang, D. Gunasekaran, F. Peng, *Michigan State University, United States*
- D5.4 Planar Common Mode Inductor Design for EMI Filter**
Y. Zhang, F. Zheng, Y. Xie, Y. Qiao, G. Peng, *Xidian University, China*
- D5.5 A Family of Single-Phase Transformerless Inverters with Asymmetric Phase-Legs**
B. Chen, J. Lai, *Virginia Polytechnic Institute and State University, United States*
- D5.6 Power Factor Correction of LED Drivers with Third Port Energy Storage**
S. Anwar, M. Badawy, Y. Sozer, *University of Akron, United States*

Session D6: Power Electronics for Utility Interface III

Thursday, March 19, 11:30 a.m. – 1:30 p.m.
BALLROOM AB

CHAIRS:

Ali Bazzi, *University of Connecticut*

Julia Zhang, *Oregon State University*

- D6.1 FPGA Based DSC-PLL for Grid Harmonics and Voltage Unbalance Effect Elimination**
J. Jo¹, B. Han², H. Cha¹, ¹*Chungnam National University, Korea, South*; ²*Myongji University, Korea, South*
- D6.2 Open-Circuit Fault Diagnosis in Neutral-Point-Clamped Active Power Filters Based on Instant Voltage Error with No Additional Sensors**
L. Caseiro, A. Mendes, P. Lopes, *Universidade de Coimbra, Portugal*
- D6.3 Protected Control Method for Voltage Source Converter (VSC) in AC/DC Hybrid Grid Under Grid Unbalanced Faults**
M. Zhu, L. Hang, G. Li, *Shanghai Jiao Tong University, China*
- D6.4 Subharmonic Power Line Carrier (PLC) Based Island Detection**
S. Perlenfein¹, M. Ropp¹, J. Neely², S. Gonzalez², L. Rashkin², ¹*Northern Power Plains Technologies, United States*; ²*Sandia National Laboratories, United States*
- D6.5 A Unique Active Anti-Islanding Protection for a Quasi-Z-Source Based Power Conditioning System**
M. Trabelsi, H. Abu-Rub, *Texas A&M University at Qatar, Qatar*
- D6.6 Current Commutation in a Medium Voltage Hybrid DC Circuit Breaker Using 15 kV Vacuum Switch and SiC Devices**
C. Peng, A. Huang, X. Song, *North Carolina State University, United States*

Session D7: Drives and Inverters I

Thursday, March 19, 11:30 a.m. – 1:30 p.m.
BALLROOM AB

CHAIRS:

Jonathan Kimball, *Missouri University of Science and Technology*

Tianjun Fu, *John Deere*

- D7.1 Efficiency Evaluation on a CoolMos Switching and IGBT Conducting Multilevel Inverter**
A. Anthon², Z. Zhang², M. Andersen², T. Franke¹, ¹*Danfoss Silicon Power GmbH, Germany*; ²*Danmarks Tekniske Universitet, Denmark*
- D7.2 Predictive Control Method for Load Current of Single-Phase Voltage Source Inverters**
J. Baek², S. Kim¹, S. Kwak¹, ¹*Chung-Ang University, Korea, South*; ²*Korea Railroad Research Institute, Korea, South*
- D7.4 Analysis of a Modulation Technique Applied to FC Inverter for THD Reduction**
D. Joca¹, A. Barbosa¹, D. Oliveira Jr.¹, P. Praça¹, L. Barreto¹, R. Silva², ¹*Universidade Federal do Ceará, Brazil*; ²*Universidade Federal do Piauí, Brazil*
- D7.5 Active Thermal Protection and Lifetime Extension in 3L-NPC-Inverter in the Low Modulation Range**
T. Phan², G. Riedel¹, N. Oikonomou¹, M. Pacas², ¹*ABB Switzerland Ltd., Switzerland*; ²*Universität Siegen, Germany*
- D7.6 A FFT Based Harmonic Calculation on Voltage Source Inverters with DPWM**
H. Zheng, K. Li, G. Tang, Z. Liang, *University of Electronic Science and Technology of China, China*
- D7.7 Time Optimal, Loss Minimizing Current Trajectory for Interior Permanent Magnet Synchronous Machines in Overmodulation**
W. Xu, F. Syed, *Ford Motor Company, United States*
- D7.8 Modular Multilevel Converter with Full-Bridge Submodules and Improved Low-Frequency Ripple Suppression for Medium-Voltage Drives**
L. He¹, K. Zhang¹, J. Xiong¹, S. Fan¹, Y. Xue², ¹*Huazhong University of Science and Technology, China*; ²*Siemens Corporation, United States*

- D7.9 An Inrush Current Mitigation Approach of the Output Transformer for Inverter**
Z. Chen, X. Pei, L. Peng, S. Wang,
Huazhong University of Science and Technology, China
- D7.10 Analog Control of AC Link Universal Power Converters: the Key to Very High Frequency AC Link Conversion Systems**
M. Amirabadi, *University of Illinois at Chicago, United States*
- D7.11 A New Zero Voltage Switching Three-Level NPC Inverter**
N. He², Y. Chen², D. Xu², K. Ma¹, F. Blaabjerg¹,
¹Aalborg University, Denmark; ²Zhejiang University, China
- D7.13 An Isolated Bi-Directional Soft-Switched DC-AC Converter Using Wide-Band-Gap Devices with Novel Carrier-Based Unipolar Modulation Technique Under Synchronous Rectification**
M. Wang, Q. Huang, W. Yu, A. Huang,
North Carolina State University, United States
- D7.17 Evaluation of Design Variables in Thompson Coil Based Operating Mechanisms for Ultra-Fast Opening in Hybrid AC and DC Circuit Breakers**
C. Peng, I. Husain, A. Huang, *North Carolina State University, United States*
- D7.18 A Startup Scheme for Zero-Voltage-Switching PV Inverter**
J. Xi, Y. Chen, M. Chen, P. Chen, D. Xu,
Zhejiang University, China

Session D8: Drives and Inverters II

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

Maryam Saeedifard, Georgia Tech
Kent Wanner, John Deere

- D8.1 Low-Order Harmonics Analysis and Suppression Method for 400Hz Single-phase VSI**
G. Yuan¹, S. Luo¹, S. Zhou¹, X. Zou¹, K. Zou²,
¹HuaZhong University of Science and Technology, China; ²Naval Aeronautical Engineering Institute, China
- D8.2 A Resonant Current Control of an Open-End Winding Induction Motor Fed by an Indirect Matrix Converter**
J. Riedemann², R. Peña³, R. Blasco-Gimenez¹,
¹Universitat Politècnica de València, Spain;
²University of Bio-Bío, Chile; ³University of Concepción, Chile

- D8.3 Calculation of Conduction Power Losses in Double Flying Capacitor Multicell Converter**
A. Khoshkbar-Sadigh², V. Dargahi¹, K. Corzine¹,
¹Clemson University, United States; ²University of California, Irvine, United States
- D8.5 Analytic Determination of Conduction Power Losses in Flying Capacitor Multicell Power Converter**
V. Dargahi¹, A. Khoshkbar-Sadigh², K. Corzine¹,
¹Clemson University, United States; ²University of California, Irvine, United States
- D8.6 Hybrid Double Flying Capacitor Multicell Converter for Renewable Energy Integration**
V. Dargahi¹, A. Khoshkbar-Sadigh², K. Venayagamoorthy¹, K. Corzine¹, ¹Clemson University, United States; ²University of California, Irvine, United States
- D8.7 Isolated Bias Power Supply for IGBT Gate Drives Using the Fly-Buck Converter**
X. Fang, Y. Meng, *Texas Instruments Inc., United States*
- D8.8 Hybrid Multilevel Inverter System for Open-End Winding (OEW) Induction Motor Drive Based on Double-Star Chopper-Cells (DSCC) Converter**
I. da Silva², C. Jacobina², A. Oliveira², G. de Almeida Carlos¹, M. Corrêa², ¹Instituto Federal de Alagoas, Brazil; ²Universidade Federal de Campina Grande, Brazil
- D8.9 A Class of Modular Multilevel Motor Drives with Design Flexibility and Reduced Components Number**
J. Wang, Y. Han, *University of Wisconsin-Madison, United States*
- D8.11 Switching Rule Based on Min-Projection Strategy for Single Phase DC-AC Converter**
W. Xiao, B. Zhang, *South China University of Technology, China*
- D8.12 Digital Notch Filter Based Active Damping for LCL Filters**
W. Yao², Y. Yang¹, X. Zhang², F. Blaabjerg¹,
¹Aalborg University, Denmark; ²Northwestern Polytechnical University, China
- D8.14 Smooth Switching Controllers for Reliable Induction Motor Drive Operation After Sensor Failures**
M. Stettenbenz, Y. Liu, A. Bazzi, *University of Connecticut, United States*

Session D9: High Performance Devices and Components

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

H Zhang, Transphorm

Jason Kulick, Indiana Integrated Circuits, LLC

D9.1 An Energy-Based Method for the Assessment of Battery and Battery-Ultracapacitor Energy Storage Systems in Pulse-Load Applications

Y. He, R. Zhang, J. Kassakian, *Massachusetts Institute of Technology, United States*

D9.2 Compact Power Module for Integrated Traction Inverters with Highest Power Density

O. Mühlfeld, K. Olesen, L. Paulsen, R. Bredtmann, *Danfoss Silicon Power GmbH, Germany*

D9.3 Energy Analysis and Performance Evaluation of GaN Cascode Switches in an Inverter Leg Configuration

L. Murillo Carrasco, A. Forsyth, *University of Manchester, United Kingdom*

D9.4 Design of DC-Side Stray Inductance for High Speed Switching Inverter Based on Normalization Procedure

M. Ando, K. Wada, *Tokyo Metropolitan University, Japan*

D9.5 A New DC Arc Fault Detection Method Using DC System Component Modeling and Analysis in Low Frequency Range

G. Seo², K. Kim³, K. Lee¹, K. Lee², B. Cho², *¹Interpower Co., Ltd., Korea, South; ²Seoul National University, Korea, South; ³Ulsan National Institute of Science and Technology, Korea, South*

D9.6 Overview of 1.2kV -- 2.2kV SiC MOSFETs Targeted for Industrial Power Conversion Applications

A. Bolotnikov, P. Losee, A. Permuy, G. Dunne, S. Kennerly, B. Rowden, J. Nasadoski, M. Harfman-Todorovic, R. Raju, F. Tao, P. Cioffi, F. Mueller, L. Stevanovic, *General Electric Global Research Center, United States*

D9.7 Gain and Phase (Gap) Measurement Device

S. Arora², P. Balsara², D. Bhatia², R. Taylor¹, B. Hunt¹, *¹Cirasys Inc., United States; ²University of Texas at Dallas, United States*

D9.8 Reliability and Efficiency Improvement in LLC Resonant Converter by Adopting GaN Transistor

T. Sun, X. Ren, Q. Chen, Z. Zhang, X. Ruan, *Nanjing University of Aeronautics and Astronautics, China*

D9.9 New High Efficiency Transfer Mold Module with Parallel IGBT and Super Junction MOSFET

J. Donlon², E. Motto³, M. Kato¹, M. Shiramizu¹, T. Tanaka¹, *¹Mitsubishi Electric Co., Japan; ²Powerex Inc., United States; ³Powerex, Inc., United States*

D9.10 Class E Resonant Inverter Optimized Design for High Frequency (MHz) Operation Using eGaN HEMTs

K. Peng, E. Santi, *University of South Carolina, United States*

D9.11 High-Voltage GaN HEMT Evaluation in Micro-Inverter Applications

C. Lin², Y. Liu³, J. Lai¹, B. Chen¹, *¹Virginia Polytechnic Institute and State University, United States; ²Virginia Polytechnic Institute and State University/Flextronics Power, United States; ³Virginia Polytechnic Institute and State University/National Taiwan University of Science and*

D9.12 Acoustic Emission Caused by the Failure of a Power Transistor

T. Kärkkäinen², J. Talvitie², M. Kuisma², P. Silventoinen², E. Mengotti¹, *¹ABB Switzerland Ltd., Switzerland; ²Lappeenranta University of Technology, Finland*

D9.13 A Novel Gate Charge Measurement Method for High-Power Devices

A. Mikata, *Keysight Technologies International Japan, Japan*

D9.14 Fabrication and Testing of 3500V/15A SiC JFET Based Power Module for High-Voltage, High-Frequency Applications

S. Chen, J. He, H. Wang, K. Sheng, *Zhejiang University, China*

D9.15 Sensing IGBT Junction Temperature Using Gate Drive Output Transient Properties

H. Niu, R. Lorenz, *University of Wisconsin-Madison, United States*

D9.16 Reliability-Oriented IGBT Selection for High Power Converters

J. Wang, R. Burgos, D. Boroyevich, *Virginia Polytechnic Institute and State University, United States*

Session D10: Magnetic Devices and Components II

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

Ed Herbert

Stephen M. Carlsen, *Raytheon*

D10.1 A Simplified Capacitive Model for Center-Tapped Multi-Windings Transformers

F. Holguin, R. Asensi, R. Prieto, J. Cobos,
Universidad Politécnica de Madrid, Spain

D10.2 Minimization of Vias in PCB Implementations of Planar Coils with Litz-Wire Structure

I. Lope, J. Acero, J. Serrano, C. Carretero,
R. Alonso, J. Burdío, *Universidad de Zaragoza, Spain*

D10.3 Coil Structure Optimization Method for Improving Coupling Coefficient of Wireless Power Transfer

H. Li, K. Wang, L. Huang, J. Li, X. Yang,
Xi'an Jiaotong University, China

D10.4 Qualification of Soft-Magnetic Shielding Materials Used in Inductive Wireless Power Transmission Systems

C. Dick¹, E. Waffenschmidt¹, A. Krause¹,
C. Polak², ¹*Fachhochschule Köln, Germany*;
²*Vacuumschmelze GmbH & Co. KG, Germany*

D10.5 Current Measurement Method for Characterization of Fast Switching Power Semiconductors with Silicon Steel Current Transformer

H. Li, S. Beczkowski, S. Munk-Nielsen, K. Lu,
Q. Wu, *Aalborg University, Denmark*

D10.6 Design Methodology and Optimization of a Medium Frequency Transformer for High Power DC-DC Applications

A. Bahmani¹, T. Thiringer¹, M. Kharezy²,
¹*Chalmers University of Technology, Sweden*;
²*SP Technical Research Institute of Sweden, Sweden*

D10.7 Toward Flexible Ferromagnetic-Core Inductors for Wearable Electronic Converters

Y. Tang, B. Lee, M. Vural, P. Kofinas,
A. Khaligh,
University of Maryland, College Park, United States

Session D11: Power System Solutions

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

John Vigars, *Allegro Microsystems*

Ernie Parker, *Crane Aerospace & Electronics*

D11.1 Investigation of Vehicle Immunity Against RF Noise

C. Wang, C. Chen, *Ford Motor Company, United States*

D11.2 Inductive Power Transfer for Auxiliary Power of Medium Voltage Converters

B. Wunsch¹, J. Bradshaw¹, I. Stevanovic²,
F. Canales¹, W. Van-Der-Merwe¹, D. Cottet¹,
¹*ABB Switzerland Ltd., Switzerland*; ²*Federal Office of Communications, Switzerland*

D11.3 Low-Inductance Snubber Arrays for High-Power, High-Bandwidth Switch-Mode Amplifiers

D. Rogers, P. Lakshmanan, *Cardiff University, United Kingdom*

D11.4 A Hybrid Modulation Method for Lifetime Extension of Power Semiconductors in Wind Power Converters

X. Du¹, G. Li¹, P. Sun¹, L. Zhou¹, H. Tai²,
¹*Chongqing University, China*; ²*University of Tulsa, Armenia*

D11.5 Electro Thermal Stochastic Optimization of a Smart Actuator for an Automotive Application

F. Robert¹, F. Vinci Dos Santos², P. Vidal²,
P. Dessante², ¹*EFi Automotive, France*;
²*Supélec, France*

D11.6 Embedded Structure for a Voltage Clamping Circuit

W. Feng, L. Xu, W. Zhang, H. Wu, *Delta Electronics, China*

D11.7 Isolated 100% PWM Gate Driver with Auxiliary Energy and Bidirectional FM/AM Signal Transmission via Single Transformer

A. Seidel¹, M. Costa³, J. Joos², B. Wicht¹,
¹*Hochschule Reutlingen, Germany*; ²*Robert Bosch GmbH, Germany*; ³*Universität Stuttgart, Germany*

D11.8 Microgrid Central Controller Development and Hierarchical Control Implementation in the Intelligent MicroGrid Lab of Aalborg University

L. Meng¹, M. Savaghebi², F. Andrade³, J. Vasquez¹, J. Guerrero¹, M. Graells³, ¹*Aalborg University, Denmark*; ²*Karaj Branch, Islamic Azad University, Denmark*; ³*Universitat Politècnica de Catalunya, Spain*

D11.10 Thermal Design of Motor Drives for High Power Density and Long Life in Harsh Environments

I. Josifovic², J. Popovic-Gerber², B. Ferreira², U. Drofenik¹, E. Mengotti¹, ¹ABB Switzerland Ltd., Switzerland; ²Technische Universiteit Delft, Netherlands

Session D12: Modeling and Simulation

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

Jaber Abu Qahouq, *The University of Alabama*

Sheldon Williamson, *University of Ontario Institute of Technology*

D12.1 Small-Signal Modeling of I2 Average Current Mode Control

S. He, J. Hung, R. Nelms, *Auburn University, United States*

D12.2 Fault Diagnostic Device for Photovoltaic Panels

W. Wang², A. Liu², H. Chung², R. Lau², J. Zhang³, A. Lo¹, ¹Chu Hai College of Higher Education, Hong Kong; ²City University of Hong Kong, Hong Kong; ³Sun Yat-sen University, China

D12.3 A Detailed Induction Machine Core Loss Model in the Arbitrary Reference Frame

Y. Liu, A. Bazzi, *University of Connecticut, United States*

D12.4 Novel Leakage Current Study Model Based on Finite Element Analysis for Photovoltaic Panels

W. Chen, L. Guo, Y. Duan, X. Yang, *Xi'an Jiaotong University, China*

D12.5 Magneto-Electro-Mechanical Modeling of Magnetic Actuation Systems

O. Ezra, M. Peretz, *Ben-Gurion University of the Negev, Israel*

D12.6 Rapid Control Prototyping for Server Power Supply with High-Resolution PWM

Y. Yonezawa², T. Sasaki², H. Hosoyama¹, H. Nakao², A. Manabe¹, J. Kaneko², Y. Nakashima², T. Maruyama³, ¹Fujitsu Advanced Technologies Ltd., Japan; ²Fujitsu Laboratories Ltd., Japan; ³Tohoku Institute of Technology, Japan

D12.7 A Novel Stability Analysis Approach Based on Describing Function Method Using for DC-DC Converters

J. Shang¹, H. Li¹, X. You¹, T. Zheng¹, S. Wang², ¹Beijing Jiaotong University, China; ²State Grid Beijing Changping Electric Power Supply, China

D12.8 Use of Primary-Side Information to Perform Online Estimation of the Secondary-Side Information and Mutual Inductance in Wireless Inductive Link

J. Chow, H. Chung, *City University of Hong Kong, Hong Kong*

D12.9 Production Code Generation for Server Power Supply Controller

T. Sasaki², H. Hosoyama¹, Y. Yonezawa², A. Manabe¹, K. Huang³, X. Liu³, J. Chen³, J. Kaneko², Y. Nakashima², ¹Fujitsu Advanced Technologies Ltd., Japan; ²Fujitsu Laboratories Ltd., Japan; ³Nanjing Fujitsu Nanda Software Technology Co., Ltd., China

D12.10 Stability Modeling of HEV/EV Electric Drives as a Small-Scale Distributed Power System

J. Kikuchi, *Ford Motor Company, United States*

D12.11 Generic Modeling of a Self-Commutated Multilevel VSC HVDC System for Power System Stability Studies

C. Hahn¹, M. Burkhardt¹, A. Semerow¹, M. Luther¹, O. Ruhle², ¹Friedrich-Alexander-University of Erlangen-Nuremberg, Germany; ²Siemens AG, Germany

D12.12 Topology Design of Isolated Multiport Converters for Smart DC Distribution Systems

Y. Tong¹, J. Jatskevich¹, A. Davoudi², ¹University of British Columbia, Canada; ²University of Texas at Arlington, United States

D12.13 A New Analytical EMC Model of Power Electronics Converters Based on Quadripole System: Application to Demonstrate the Mode Decoupling Condition

A. Ales², J. Schanen², J. Roudet², D. Moussaoui¹, ¹Ecole Militaire Polytechnique, Algeria; ²Grenoble Institute of Technology, France

D12.14 Generalized Small Signal Modeling of Coupled Inductor, Based High Gain, High Efficiency DC-DC Converters

M. Das, V. Agarwal, *Indian Institute of Technology Bombay, India*

D12.15D FEA Based Squirrel Cage Rotor Model for Design Tradeoffs and Performance Analysis

A. Kabir², R. Mikail¹, S. Englebretson¹, I. Husain², ¹ABB Corporate Research, United States; ²North Carolina State University, United States

D12.16 Reliability Modeling of Capacitor Bank for Modular Multilevel Converter Based on Markov State-Space Model

V. Najmi, J. Wang, R. Burgos, D. Boroyevich, Virginia Polytechnic Institute and State University, United States

D12.17 A New Modeling Approach for Modular Multilevel Converter (MMC) in D-Q Frame

V. Najmi, N. Nazir, R. Burgos, Virginia Polytechnic Institute and State University, United States

D12.18 Advanced Controller Design for a Series-Series Compensated Inductive Power Transfer Charging Infrastructure Using Asymmetrical Clamped Mode Control

K. Aditya, S. Williamson, University of Ontario-Institute of Technology, Canada

D12.19 DQ Reference Frame Modeling and Control of Single-Phase Active Power Decoupling Circuits

Y. Tang, Z. Qin, F. Blaabjerg, P. Loh, Aalborg University, Denmark

D12.20 Instantaneous Thermal Modeling of the DC-Link Capacitor in Photovoltaic Systems

Y. Yang, K. Ma, H. Wang, F. Blaabjerg, Aalborg University, Denmark

D12.21 A Novel Dynamic Modeling Method for Wireless Power Transfer Systems

H. Li, J. Li, L. Huang, K. Wang, X. Yang, Xi'an Jiaotong University, China

D12.22 Model Predictive Control of H-Bridge Inverter Based on Discrete-Time Model of Equivalent Circuit

X. Wu, G. Xiao, Y. Lu, D. Lu, F. Chen, Xi'an Jiaotong University, China

D12.23 Real-Time Simulation Based Performance Analysis of Active Filters for Oil Drilling Rigs

S. Kanukollu, K. Al Hosani, N. Al Sayari, A. Beig, petroleum institute, U.A.E.

D12.24 D-Q Impedance Specification for Balanced Three-Phase AC Distributed Power System

B. Wen², D. Boroyevich², R. Burgos², P. Mattavelli¹, Z. Shen², ¹Università di Padova, Italy; ²Virginia Polytechnic Institute and State University, United States

D12.25 Combinational-Logic-Based Traction Inverter Fault Diagnosis

A. Ulatowski, A. Bazzi, University of Connecticut, United States

D12.26 A Comprehensive Analysis of Magnet Defect Faults in Permanent Magnet Synchronous Motors

M. Zafarani, T. Goktas, B. Akin, University of Texas at Dallas, United States

Session D13: Control

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

Ali Davoudi, University of Texas at Arlington

Pietro Scalia, Texas Instruments

D13.1 Improving Light Load Efficiency in a Series Capacitor Buck Converter by Uneven Phase Interleaving

P. Shenoy, M. Amaro, Texas Instruments Inc., United States

D13.2 Active Power Sharing in Input-Series-Input-Parallel Output-Series Connected DC/DC Converters

Y. Lian, G. Adam, D. Holliday, S. Finney, University of Strathclyde, United Kingdom

D13.3 State-Feedback-with-PI Control for NPC Three-Level Inverter

X. Liu, X. Lin, Z. Liang, Y. Kang, Huazhong University of Science and Technology, China

D13.4 DC Symmetrical Component Method for Analysis and Control of Bipolar LVDC Grid

Y. Gu², Y. Chi¹, Y. Li¹, W. Sun¹, W. Li², X. He², ¹China Electric Power Research Institute, China; ²Zhejiang University, China

D13.6 Autonomous Hierarchical Control of DC Microgrids with Constant-Power Loads

M. Srinivasan, A. Kwasinski, University of Texas at Austin, United States

D13.7 Small-Signal Modeling for Digital Predictive Current Mode Control in CCM

S. He, R. Nelms, J. Hung, Auburn University, United States

D13.8 Cross-Coupling and Decoupling Techniques in the Current Control of Grid-Connected Voltage Source Converter

S. Zhou, J. Liu, L. Zhou, H. She, Xi'an Jiaotong University, China

- D13.10 A Predictive Control Scheme for a Dual Output Indirect Matrix Converter**
O. Gulbudak, E. Santi, *University of South Carolina, United States*
- D13.11 Dithered Multi-Bit Sigma-Delta Modulator Based DPWM for DC-DC Converters**
J. Mooney¹, M. Halton², P. Iordanov², V. O'Brien², ¹*Athlone Institute of Technology, Ireland*; ²*University of Limerick, Ireland*
- D13.12 A Simple DQ Current Controller for Single-Phase Grid-Connected Inverters**
M. Ebrahimi, S. Khajehoddin, *University of Alberta, Canada*
- D13.13 A Predictive Nearest Level Control of Modular Multilevel Converter**
F. Zhang, G. Joos, *McGill University, Canada*
- D13.14 750-kW Interleaved Buck Converter DC Supply Control Implementation in a Low-Cost FPGA**
Y. Liu, C. Farnell, S. Ahmed, J. Balda, A. Mantooth, *University of Arkansas, United States*
- D13.15 Space Vector Modulation for Single-Phase Transformerless Three-Leg Unified Power Quality Conditioner**
Y. Lu, G. Xiao, X. Wu, D. Lu, *Xi'an Jiaotong University, China*
- D13.16 A Novel Synchronization Method Designed for Single-Phase Distorted Grid**
Y. Lu, G. Xiao, L. Zang, X. Wu, F. Chen, *Xi'an Jiaotong University, China*
- D13.17 Control Strategy for Com-Leg in Single-Phase Transformerless Three-Leg Unified Power Quality Conditioner**
D. Lu, G. Xiao, Y. Lu, F. Chen, *Xi'an Jiaotong University, China*
- D13.18 Multiphase Current Controlled Buck Converter with Energy Recycling Output Impedance Correction Circuit (OICC): Adaptive Voltage Positioning (AVP) and Dynamic Voltage Scaling (DVS) Application**
V. Svikovic, J. Cortes, P. Alou, J. Oliver, O. García, J. Cobos, *Universidad Politécnica de Madrid, Spain*
- D13.19 Simultaneous PWM Control to Operate the Three-Phase Dual Active Bridge Converter Under Soft Switching in the Whole Load Range**
J. Huang, Y. Wang, Z. Li, Y. Jiang, W. Lei, *Xi'an Jiaotong University, China*

- D13.20 Design-Oriented Stability Criteria of a v^2 Control Compensated with Inductor Current of a Boost Converter for Shipboard Power Systems**
J. Cortés², J. Jiménez¹, S. Jayasuriya¹, P. Alou², C. Nwankpa¹, J. Cobos², ¹*Drexel University, United States*; ²*Universidad Politécnica de Madrid, Spain*
- D13.21 Modeling and Circulating Current Control of MMC**
L. Herrera, X. Yao, J. Wang, *Ohio State University, United States*
- D13.22 Active Damping of LLCL-Filter Resonance Based on LC-Trap Voltage and Capacitor Current Feedback**
M. Huang, X. Wang, P. Loh, F. Blaabjerg, *Aalborg University, Denmark*
- D13.23 Droop-Free Team-Oriented Control for AC Distribution Systems**
V. Nasirian², Q. Shafiee¹, J. Guerrero¹, F. Lewis², A. Davoudi², ¹*Aalborg University, Denmark*; ²*University of Texas at Arlington, United States*

Session D14: Manufacturing, Quality, and Business Issues

Thursday, March 19, 11:30 a.m. – 1:30 p.m.
BALLROOM AB

CHAIRS:

Bulent Sarlioglu, *University of Wisconsin – Madison*

- D14.1 Advanced Power Cycling Test for Power Module with on-Line on-State VCE Measurement**
U. Choi¹, I. Trintis¹, F. Blaabjerg¹, S. Jørgensen², M. Svarre², ¹*Aalborg University, Denmark*; ²*GRUNDFOS Holding A/S, Denmark*
- D14.2 Nanosilver Preform Assisted Die Attach for High Temperature Applications**
S. Seal, M. Glover, A. Mantooth, *University of Arkansas, United States*
- D14.4 Tackling Reliability of Power Module**
W. He², A. Vass-Varnai¹, J. Wilson¹, ¹*Mechanical Analysis Division, United States*; ²*Mentor Graphics Corp, United States*

Session D15: Renewable Grid

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

Babak Nahidmobarakeh, *University of Lorraine*

Chris Siegl, *Fairchild Semiconductor*

D15.1 Evaluation and Testing of Voltage-Controlled Grid-Connected Inverter for High Penetration of Renewable Energy

Y. Wang², J. Zhao², J. Dai², H. Liu², S. Ushiki¹,
M. Ohshima¹, ¹*Origin Electric Co., Ltd., Japan*;
²*Shanghai University of Electric Power, China*

D15.3 Operation Schemes of Interconnected DC Microgrids Through an Isolated Bi-Directional DC-DC Converter

M. Lee, W. Choi, H. Kim, B. Cho, *Seoul National University, Korea, South*

D15.4 A Single-Stage Grid-Connected Flyback Inverter with Power Decoupling Function

Z. Chen, M. Li, Q. Wu, Y. Xu, *Nanjing University of Aeronautics and Astronautics, China*

D15.6 Impact Evaluation of Series DC Arc Faults in DC Microgrids

X. Yao, L. Herrera, J. Wang, *Ohio State University, United States*

D15.7 Design of LLCL-Filter for Grid-Connected Converter to Improve Stability and Robustness

M. Huang, X. Wang, P. Loh, F. Blaabjerg, *Aalborg University, Denmark*

D15.8 Multi-Agent-Based Distributed State of Charge Balancing Control for Distributed Energy Storage Units in AC Microgrids

C. Li¹, T. Dragicevic¹, J. Vasquez¹, J. Guerrero¹,
E. Coelho², ¹*Aalborg University, Denmark*;
²*Universidade Federal de Uberlandia, Brazil*

Session D16: Renewable Wind II

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

Ali Mehrizi, *Washington State University*

Huai Wang, *Aalborg University*

D16.1 Harmonic Compensation for Variable Speed DFIG Wind Turbines Using Multiple Reference Frame Theory

J. Li, K. Corzine, *Clemson University, United States*

D16.2 Virtual Synchronous Control of Grid-Connected DFIG-Based Wind Turbines

Y. Zhao, J. Chai, X. Sun, *Tsinghua University, China*

D16.3 Closed-Loop Control on PMSG Torque in Direct-Drive Wind Power Generation System Without Speed Sensor

S. Yang¹, L. Guo¹, L. Chang², X. Zhang¹,
Z. Xie¹, ¹*Hefei University of Technology, China*;
²*University of New Brunswick, Canada*

D16.4 Virtual Inductance Self-Demagnetization Based LVRT Control Strategy for Doubly Fed WTs

S. Yang¹, Y. Chen¹, L. Chang², Z. Xie¹, X. Zhang¹, ¹*Hefei University of Technology, China*;
²*University of New Brunswick, Canada*

D16.5 Controller Design for TCSC Using Observed-State Feedback Method to Damp SSR in DFIG-Based Wind Farms

H. Mohammadpour, J. Siegers, E. Santi, *University of South Carolina, United States*

Session D17: Renewable Circuits II

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

Akshay Kumar Rathore, *National University of Singapore*

Huai Wang, *Aalborg University*

D17.2 Analysis and Design of Coupled Inductor for Interleaved Multiphase Three-Level DC-DC Converters

M. Mu², F. Lee², Y. Jiao², S. Lu¹, ¹*Tsinghua University, China*; ²*Virginia Polytechnic Institute and State University, United States*

D17.3 Power Flow Control of a Dual-Input Interleaved Buck/Boost Converter with Galvanic Isolation for Renewable Energy Systems

M. Mira, Z. Zhang, A. Knott, M. Andersen, *Danmarks Tekniske Universitet, Denmark*

D17.5 Application of Wavelet Transform-Based Discharging/Charging Voltage Signal Denoising for Advanced Data-Driven SOC Estimator

J. Kim¹, B. Cho², ¹*Chosun University, Korea, South*; ²*Seoul National University, Korea, South*

D17.6 Asymmetrical Duty-Cycle Control of a Novel Multi-Port CLL Resonant Converter

K. Colak, E. Asa, M. Bojarski, D. Czarkowski, *New York University, United States*

D17.7 A Modular Multilevel Converter with Half-Bridge Submodules for Hybrid Energy Storage Systems Integrating Battery and UltraCapacitor

F. Guo, R. Sharma, *NEC Laboratories America, Inc., United States*

D17.8 Sequence Impedance Measurement of Three-Phase Inverters Using a Parallel Structure

W. Cao, Y. Ma, X. Zhang, F. Wang, *University of Tennessee, United States*

D17.9 Modular Isolated DC-DC Converter with Multi-Limb Transformer for Interfacing of Renewable Energy Sources

R. Chattopadhyay, S. Bhattacharya, *North Carolina State University, United States*

Session D18: Renewable PV Systems

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

Ali Mehrizi, *Washington State University*

Liming Liu, *ABB*

D18.1 Enhancement of the Extracted Maximum Power of PV Array During Partial Shading Using Switched PV-Based System

A. Elserougi³, M. Diab¹, A. Abdel-Khalik¹, A. Massoud², S. Ahmed³, ¹*Alexandria University, Egypt*; ²*Qatar University, Qatar*; ³*Texas A&M University at Qatar, Qatar*

D18.2 Prediction of Bond Wire Fatigue of IGBTs in a PV Inverter Under Long-Term Operation

P. Diaz Reigosa, H. Wang, Y. Yang, F. Blaabjerg, *Aalborg university, Denmark*

D18.4 A New Modified Inc-Cond MPPT Technique and its Testing in a Whole PV Simulator Under PSC

G. Cipriani, V. Di Dio, F. Genduso, R. Miceli, D. La Cascia, *Università degli Studi di Palermo, Italy*

D18.6 Maximum Power Point Tracking of Grid Connected Photovoltaic System Employing Model Predictive Control

M. Shadmand¹, M. Mosa², R. Balog¹, H. Abu-Rub², ¹*Texas A&M University, United States*; ²*Texas A&M University at Qatar, Qatar*

D18.7 Control Strategies for Solar Panel Companion Inverters

P. Sahu, M. Manjrekar, *University of North Carolina at Charlotte, United States*

D18.8 Analysis of the Series-Connected Distributed Maximum Power Point Tracking PV System

C. Chen, Y. Chen, *National Taiwan University, Taiwan*

Session D19: Transportation Power Electronics

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

Farborz Musavi, *CUI*

Jing Xu, *ABB Inc*

D19.1 Research on Uninterrupted Power Supply Technology for Auxiliary Winding of Electric Locomotive When Passing Neutral Section

Y. Du, T. Zheng, W. Ran, R. Hao, X. You, Y. Liu, *Beijing Jiaotong University, China*

D19.2 A High Frequency, High Efficiency GaN HFET Based Inductive Power Transfer System

A. Cai, A. Pereira, R. Tanzania, Y. Tan, L. Siek, *Nanyang Technological University, Singapore*

D19.3 Design and Performance Evaluation of a Digitally Controlled 1 kW Three-Phase Interleaved ZVS Converter for Plug-in EV and HEV Battery Charger

M. Sucameli, *STMicroelectronics, Italy*

D19.4 A Bidirectional Series Resonant Matrix Converter Topology for Electric Vehicle DC Fast Charging

J. Sandoval, S. Essakiappan, P. Enjeti, *Texas A&M University, United States*

- D19.5 Hybrid Sinusoidal-Pulse Charging Strategy for Li-Ion Battery in Electric Vehicle Application**
S. Hu, X. Wang, R. Wang, J. Wu, X. He, *Zhejiang University, China*
- D19.6 Application of Bi-Directional Z-Source in UltraCapacitor-Battery Hybrid Energy Storage System for EV**
Z. Liang, S. Hu, Y. Liu, W. Li, X. He, *Zhejiang University, China*
- D19.7 Drive and Protection Methods for Very High Current Lateral GaN Power Transistors**
J. Roberts, G. Klowak, D. Chen, A. Mizan, *GaN Systems Inc., Canada*
- D19.8 A Hybrid Converter for Energy Management of EV Drives**
T. Hu¹, L. Xu², L. Qiu², Y. Li², X. Han¹,
¹Northeast Dianli University, China;
²Tsinghua University, China
- D19.9 A Study of the Self-Coupling Magnetic Resonance Coupled Wireless Power Transfer**
L. Tong¹, H. Zeng², F. Peng², ¹Fudan University, China; ²Michigan State University, United States
- D19.10 Implementation and Validation of DQ Current Control of a Bidirectional SiC Single-Phase AC-DC Converter**
A. Andhra Sridhar, N. Weise, *Marquette University, United States*
- D19.11 A Novel Digital Peak-Current-Mode Self-Sustained Oscillating Control (PCM-SSOC) Technique for a Dual-Active Bridge DC/DC Converter**
M. Pahlevani, A. Bakhshai, P. Jain, *Queen's University, Canada*
- D19.12 A Constant Resistance Analysis and Control of Cascaded Buck and Boost Converter for Wireless EV Chargers**
K. Colak, M. Bojarski, E. Asa, D. Czarkowski, *New York University, United States*
- D19.13 A Partial Power Processing of Battery/ Ultra-Capacitor Hybrid Energy Storage System for Electric Vehicles**
M. Badawy, Y. Sozer, *University of Akron, United States*

Session D20: Power Electronics Applications I

Thursday, March 19, 11:30 a.m. – 1:30 p.m.
BALLROOM AB

CHAIRS:

Pradeep Shenoy, *Texas Instruments*

Abhijit Pathak, *International Rectifier*

- D20.2 DSP Based Control and Soft Switched Mode Power Conversion Realizes Smart and Portable N-Channel RF Generator for Surgical Ablation**
S. Talebi, J. Evans, R. Beebe, T. Hartranft, D. Eckerson, S. McSoley, *Jabil Circuit, Inc., United States*
- D20.3 Used-Battery Management with Integrated Battery Building Block System**
Y. Li, Y. Han, *University of Wisconsin-Madison, United States*
- D20.4 The Influence of DC-Link Voltage Control on the Performance of Active Power Filter**
Y. Wang, Y. Xie, X. Liu, *South China University of Technology, China*
- D20.5 Design and Experimental Verification of High Boost Energy Recycle Converter for the Energy Conservation in the Development Process of Power Module**
Y. Kim¹, G. Park¹, J. Ahn², B. Lee²,
¹Dongahelcomm Corporation, Korea, South;
²Sungkyunkwan University, Korea, South
- D20.6 Two-Stage Power Supply Based on Double Resonant Tank LLC-DCX for Magnetic Levitation Control System Applications**
H. Ma¹, W. Liu¹, J. Wang¹, C. Zheng², G. Lu¹,
¹Southwest Jiaotong University, China; ²Virginia Polytechnic Institute and State University, United States
- D20.7 Laminated Busbar Design and Stray Parameter Analysis of Three-Level Converter Based on HVIGBT Series Connection**
H. Yu, Z. Zhao, T. Lu, L. Yuan, S. Ji, *Tsinghua University, China*
- D20.10 An Integrated High Efficiency Ultra-Low Power Single Chip DC/AC Inverter for Driving Liquid Crystal Electro-Optic Lenses**
X. Li, A. Huang, *North Carolina State University, United States*

D20.11 ITER VS Converter Control for Circulation Current and Commutation Failure

H. Jo, H. Cha, *Chungnam National University, Korea, South*

D20.12 New PWM Technique for Three-to-Five Phase Matrix Converter with High Efficiency and Low THD

M. Sayed³, T. Takeshita¹, A. Iqbal², ¹Nagoya Institute of Technology, Japan; ²Qatar University, Qatar; ³South Valley University, Egypt

D20.13 A Novel Phase Control of Semi Bridgeless Active Rectifier for Wireless Power Transfer Applications

E. Asa, K. Colak, M. Bojarski, D. Czarkowski, *New York University, United States*

D20.14 High-Performance Control of Paralleled Three-Phase Inverters for Residential Microgrid Architectures Based on Online Uninterruptable Power Systems

C. Zhang¹, J. Guerrero¹, J. Vasquez¹, E. Coelho¹, C. Seniger², ¹Aalborg University, Denmark; ²Leaneco A/S, Denmark

D20.15 Realizing an Integrated System for Residential Energy Harvesting and Management

Y. Zhang, J. Umhoza, H. Liu, F. Hossain, C. Farnell, A. Mantooth, *University of Arkansas, United States*

D20.16 A Strategy for Balancing Switching Losses of FB-PSZVS DC-DC Converters in Pulse and Sinusoidal Ripple Current Charging Applications

Y. Lee, S. Maxwell, S. Park, *University of Connecticut, United States*

D20.17 A Direct Voltage Unbalance Compensation Strategy for Islanded Microgrids

X. Zhao², X. Wu², L. Meng¹, J. Guerrero¹, J. Vasquez¹, ¹Aalborg University, Denmark; ²Northwestern Polytechnical University, China

Session D21: Power Electronics Applications II

Thursday, March 19, 11:30 a.m. – 1:30 p.m.

BALLROOM AB

CHAIRS:

Dimitri Torregrossa, *École polytechnique fédérale de Lausanne*

Abhijit Pathak, *International Rectifier*

D21.1 Improving the Cross Regulation of Multi-Output SRC by Adding the Magnetic Fence and Capacitance Compensation

Y. Qiao², F. Zheng², Y. Zhang², G. Peng², Y. Xie², D. Bai¹, ¹Academy of Space Information Technology, China; ²Xidian University, China

D21.2 Resonant Inverter Design for Stand-Alone Dynamic Active Piezoelectric Energy Harvesting

A. Stein, H. Hofmann, *University of Michigan, United States*

D21.3 A High Voltage Split Source Voltage Multiplier with Increased Output Voltage

L. Katzir, D. Shmilovitz, *Tel Aviv University, Israel*

D21.4 Biologically Inspired Coupling Pixilation for Position Independence in Capacitive Power Transfer Surfaces

J. Dai, D. Ludois, *University of Wisconsin-Madison, United States*

D21.5 A 60 mV-3 V Input Range Boost Converter with Amplitude-Regulated and Intermittently Operating Oscillator for Energy Harvesting

H. Gao¹, H. Nakamoto¹, H. Yamazaki¹, M. Kondou², ¹Fujitsu Laboratories Ltd., Japan; ²Fujitsu Ltd., Japan

D21.6 An Accurate Back to Front Design Methodology for PT Based Load Resonant Converters

Y. Yang¹, M. Radecker¹, K. Lang¹, W. Fischer², ¹Fraunhofer IZM, Germany; ²Technische Universität Dresden, Germany

D21.7 Three Dimensional Integration of Electromagnetic Interference Filter

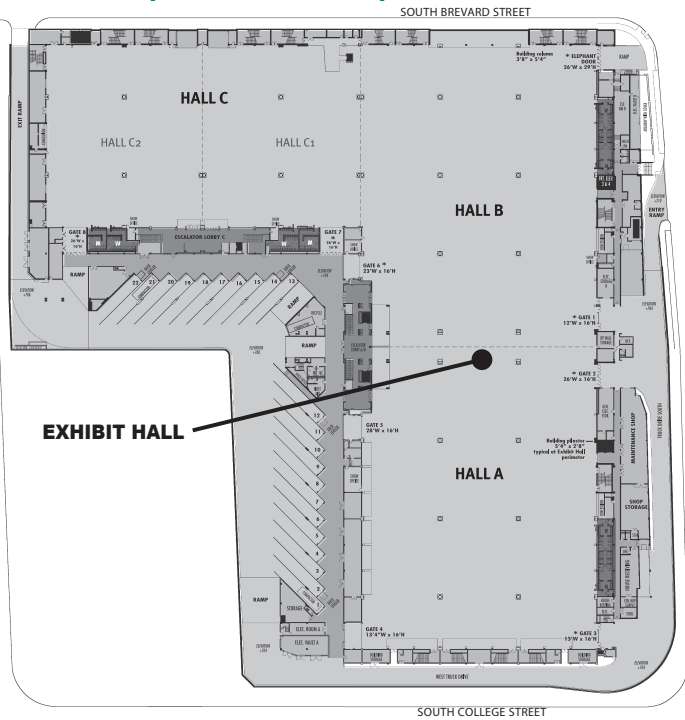
Y. Zhang, F. Zheng, Y. Xie, Y. Qiao, G. Peng, *Xidian University, China*

D21.8 Maximum Efficiency Control of Wireless Power Transfer via Magnetic Resonant Coupling Considering Dynamics of DC-DC Converter for Moving Electric Vehicles

K. Hata, T. Imura, Y. Hori, *University of Tokyo, Japan*

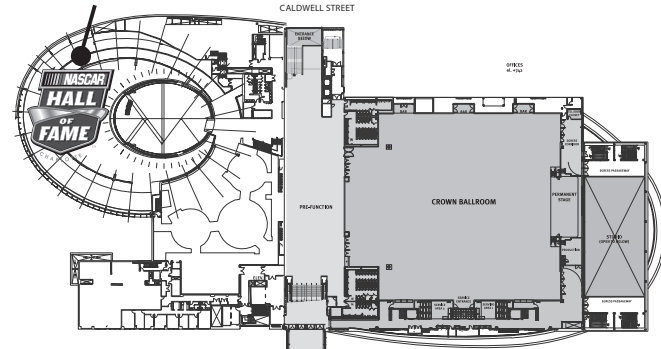
- D21.9 Wireless Electric Vehicle Charging via Capacitive Power Transfer Through a Conformal Bumper**
J. Dai, D. Ludois, *University of Wisconsin-Madison, United States*
- D21.10 High Power Factor Dimmable Self-Oscillating Electronic Ballast with Variable Inductor Control**
M. Menke³, M. da Silva³, A. Seidel³, M. Perdigão¹, J. Alonso², *¹Instituto Superior de Engenharia de Coimbra, Portugal; ²Universidad de Oviedo, Spain; ³Universidade Federal de Santa Maria, Brazil*
- D21.11 Fault Tolerable Li-Ion Battery Stack**
G. Liu, K. Shi, W. Zhang, D. Xu, *Zhejiang University, China*
- D21.12 Alternating Current Welding Using Four Quadrant Switches**
A. Navarro-Crespin, R. Casanueva, F. Azcondo, *Universidad de Cantabria, Spain*
- D21.13 Energy Bus-Based Equalization Scheme with Bidirectional Isolated Cuk Equalizer for Series Connected Battery Strings**
R. Ling¹, Q. Dan¹, L. Wang¹, D. Li², *¹Chongqing University, China; ²Vicor Corporation, United States*
- D21.14 Design Considerations of LLC Resonant Converter for Contactless Laptop Charger**
C. Zheng, B. Chen, L. Zhang, R. Chen, J. Lai, *Virginia Polytechnic Institute and State University, United States*
- D21.15 A Simple Approach to Current THD Prediction for Small-Scale Grid-Connected Inverters**
B. Cao, L. Chang, R. Shao, *University of New Brunswick, Canada*
- D21.16 An Energy Channelling LED Driver Technology to Achieve Flicker-Free Operation with True Single Stage Power Factor Correction**
P. Fang, Z. Hu, Y. Liu, *Queen's University, Canada*
- D21.17 Improvement of Waveform for High Frequency AC-Linked Matrix Converter with SVM Based on Virtual Indirect Control**
K. Koiwa¹, J. Itoh¹, M. Shioda², *¹Nagaoka University of Technology, Japan; ²San-Eisha Mfg Co., Ltd., Japan*
- D21.18 Quad Switch Push-Pull (QSPP) RF Amplifier with Direct, Simultaneous Modulation of Phase and Pulse-Position for Spread Spectrum Power Applications**
A. Avestruz, A. Chang, S. Leeb, *Massachusetts Institute of Technology, United States*

Level 1 (Exhibit Hall Level)

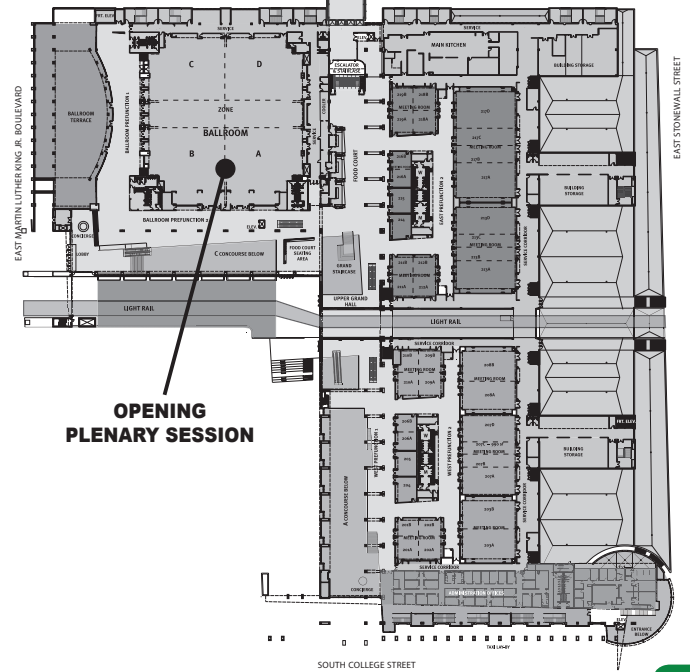
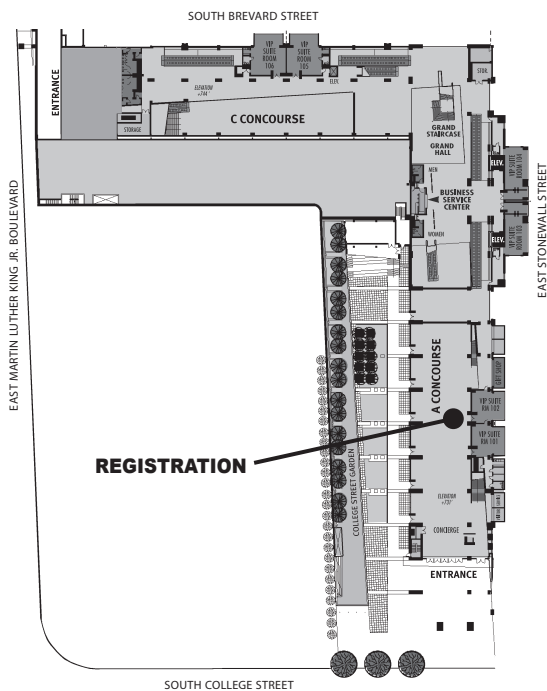


Level 3 (Ballroom & Meeting Room Level)

WEDNESDAY EVENING SOCIAL EVENT



Level 2 (Street Level/Registration)



OPENING PLENARY SESSION

2015 Exhibitor Directory



WELCOME TO THE 30th Annual APEC Conference and Exposition!

The 2015 APEC Exposition will provide conference attendees an exceptional opportunity to examine and touch the product offerings of the leading suppliers to the power electronics industry. The newest components, power supplies, design tools and services will be on display, and you can meet and talk to application experts at each booth. The exhibition is sold out again this year, so you will be sure to find something of interest in every corner of the hall.

For in-depth product details, the Exhibitor Seminars on Tuesday afternoon and Wednesday morning will offer product presentations and a question and answer forum for present and future products and services. Additional highlights of the conference include the Exhibit Hall Welcome Reception on Monday evening followed immediately at 8 p.m. by the 24th Annual MicroMouse Contest, then on Tuesday at 5 p.m. the Rap Sessions covering topics of interest in power electronics.

A thank you goes to our long-term APEC sponsors the IEEE Industrial Applications & Power Electronics Societies (IAS & PELS), and the Power Sources Manufacturers Association (PSMA) for their commitment and support of APEC 2015. In addition, a special thanks goes to our seven conference partners whose logos appear on the next page, who have provided additional financial support to make your conference experience even better. *Please enjoy!*

APEC 2015

Our Partners

Diamond



Platinum



Gold



Silver



APEC 2015 Exposition

The Exposition will open on Monday, March 16 when the Plenary Session concludes.

Exhibit Hall Hours

Monday, March 16 5:00 p.m. – 8:00 p.m.
*hall will open upon conclusion of the Plenary

Tuesday, March 17 12:00 p.m. – 5:00 p.m.

Wednesday, March 18 10:00 a.m. – 2:00 p.m.

Exhibit Hall Functions

Exhibitors' Reception

A Welcoming Reception will be held in the Exhibit Hall on Monday, March 16, from 5:00 p.m. until 8:00 p.m. Registered spouses and guests are welcome.

Exhibit Hall Lunch and Breaks

Lunch will be served in the Exhibit Hall on Tuesday from 12:00 – 1:30 pm and on Wednesday from 12:00 p.m. – 2:00 p.m. free of charge to all who have access to the exhibit hall.

On Tuesday afternoon from 2:30 p.m. – 3:30 p.m., we will be having an ice cream social in the Exhibit hall.

The Wednesday morning coffee break will be served in the Exhibit Hall from 10:00 a.m. to 11:00 a.m.

Exposition & Giveaway

During all three days of the Exhibition we will be giving away over \$5000 in prizes. At registration everyone (exhibits only registrants and exhibitors included) will be issued a raffle ticket that you will put in a drop box upon entering the Exhibit Hall. This will be good for all three days of raffles during the exhibition but you must be present to win.

Exposition Minimum Age

Entrance to the APEC Exhibit Hall is restricted to those 18 years of age and older.

Exhibitor Seminars

Held in conference rooms 213A, 213BC, 213D, 217A, 217BC, 217D and 218/19 located on the upstairs (Ballroom) level.

Tuesday, March 17

Session One. 1:30 p.m. – 2:00 p.m.
 Session Two. 2:15 p.m. – 2:45 p.m.
 Session Three 3:00 p.m. – 3:30 p.m.
 Session Four 3:45 p.m. – 4:15 p.m.

Wednesday, March 18

Session Five. 10:30 a.m. – 11:00 a.m.
 Session Six 11:15 a.m. – 11:45 a.m.

Exhibitor Seminars

Exhibitor Seminar – Session 1

Tuesday, March 17, 1:30 p.m. – 2:00 p.m.

Cirasys

ROOM 218/219

Higher Performance Buck and Boost Converter Solutions From Nonlinear Control Methods

SPEAKER: Paul Nichols

While research and emphasis has been focused at improving components, circuit design, and complex topologies, the control method itself has received comparably little attention (relying on historic PID and Type III controls) even though it is the very foundation of the converter and power supply. Cirasys, Inc. has developed entirely new control methods designed specifically for power electronics that employ nonlinear feedback linearization techniques that have seen great success in high performance aircraft and robotics.

These new control alternatives give even simple converter designs greater performance and entirely new capabilities, such as inherent stability, larger bandwidth, faster transient response, and a simpler design process. Cirasys will be demonstrating for the first time publicly a buck converter that operates independently of capacitive load, and a boost converter that has much higher bandwidth, speed, and can perform an internal envelope tracking function that provides greater energy efficiency for a downstream system utilizing varying voltage. These new control methods have been implemented in analog and digital, can be applied to any power level, and can be used in DC-DC or AC/DC variants.

Coilcraft

ROOM 213A

Get the Power You Deserve from Your Inductor

SPEAKER: Leonard Crane

As power magnetics technology continues to advance, taking full advantage of the “latest and greatest” components requires a precise evaluation of inductor performance under specific application conditions of current, ripple, frequency and ambient temperature. This presentation takes a new look at inductor specifications and demonstrates how to achieve the best combination of small size and high performance, optimizing the results to meet the needs of any specific design.

DEWETRON GmbH

ROOM 217B/C

Dewetron's Power Analyzer

SPEAKER: Bernhard Grasel

The Dewetron Power Analyzer combines multiple measurement instruments like a Power Analyzer, a scope, a data logger and a spectrum analyzer.

Due to its unique design and technique it's possible to connect any number and type of sensor (voltage up to 1600V, current, digital, counter, CAN, video and a lot more).

This allows comprehensive analysis for all type of applications. The Power Analyzer function allows to measure almost every inverter-motor combination (DC, 1- to 7-phase AC motors at different frequencies) and multiple power measurements with just one device. The power quality library covers a number of analysis: FFT, harmonics, higher frequencies, interharmonics, flicker, flicker emission, symmetrical components, etc.

GMW Associates

ROOM 213BC

Current & Voltage Transducers for accurate power measurements in high power Variable Speed Motor Drives

SPEAKER: Ian Walker

Accurate voltage, current and power measurements on high power Variable Speed Motor Drives as used in electric vehicles is quite difficult in practice. There can be three or more phases from the Drive to the Motor with voltages up to 1000V peak and rises times as short as 0.1us for a dV/dt of 10MV/sec. Capacitive coupling from this high dV/dt results in high levels of noise on ground shields and nearby signal lines. The drive currents can be up to 1000A with variable frequency from dc to about 500Hz. Magnetic fields from the current in one drive phase cable can inductively couple into "loops" formed by multiple ground points in the measurement circuit for another phase effectively generating cross-talk between the measurement phases. The high voltages and high currents are also hazardous to test personnel from the potential for electric shock by direct contact or electric arcs generated by direct inter-phase contact or poor contacts at cable connection points.

Electrically isolated Current and Voltage Transducers located directly at the measurement points can effectively reduce these noise and crosstalk effects and long signal leads enable physical separation of the Drive and Motor under test from the measurement instrumentation. Current Transducers with appropriate ratios can generate a current output signal of, for example,

1000mA with accurate amplitude and phase for a 1000A primary current. The small gauge signal cable can be a shielded twisted pair carrying 1000mA peak, dramatically reducing the external magnetic field and crosstalk effects. Similarly a Voltage Transducer can have a 10V differential output signal on a shielded, twisted pair for a 1000V voltage difference, dramatically reducing capacitive coupling of high frequency noise.

This presentation will cover some of the available high accuracy Current and Voltage Transducers and installation techniques for reducing noise transferred to the data logging system or power analyzer.

Hoffmann & Co Elektrokohle AG

ROOM 217D

Aluminium Graphite: A Revolutionary Thermal Management Solution in High Reliability Applications

SPEAKER: Dr. Sandra Reisinger

Hoffmann is a world leader in the automotive and rail sectors. With our new product, Aluminium Graphite (ALG), we are set to change the playing field in thermal management for power electronics. ALG combines a low coefficient of thermal expansion (CTE) with a high thermal conductivity, making it an ideal candidate for systems that are subject to active or passive thermal cycles. By using ALG, there is a marked improvement in the reliability and life-time of components and systems. This presentation will point out the unique properties and characteristics of ALG, its fabrication process, and possible applications. These include heat sinks or heat spreaders, such as flanges for RF power amplifiers and base plates for power modules. Hoffmann can deliver customized designs and platings as the fabrication and machining of all parts is conducted in-house.

TowerJazz

ROOM 217A

Smart Lighting System in Bulb enabled by 700V Ultra High Density Logic Platform

SPEAKER: Dr. Shye Shapira

Modern lighting systems contain a multitude of functions: multistage efficient energy conversion from grid to LED, RF communication, and control and processing functions. These allow adjustment to the dimming as well as color and response to changing conditions such as the time of day or presence of individuals in a room. Traditionally lighting systems have been implemented in several separate subsystems located at various places in an office or home space. Now, many of these functions are integrated into a single bulb or other lighting fixture comprising a single "Lighting System in a Bulb."

The current solutions however are still costly and require several boards and at times, dozens of components.

TowerJazz presents a platform which enables a full revolution of the lighting system in a bulb, by enabling most system functions to be included in one component. When fully implemented, this allows reduction of the total lighting system cost along with a drastic reduction of its footprint.

The features of this platform will be described along with their impact at the lighting system level.

Venable

ROOM 213D

Stability Analysis of a Digital Controller Based Power Supply using the Venable Mixed Signal Analyzer.

SPEAKER: Manfred Trent

This seminar will demonstrate frequency response analysis of mixed signal measurements to obtain loop gain of a system that incorporates a digital controller. It will illustrate the gathering of all relevant transfer function data, from both digital and analog portions of a power supply, through the application of a single sweep on a closed loop system. Comparison and commonality of digital vs. analog feedback compensation will also be discussed. The advantages of the Venable mixed signal method will be shown.

Exhibitor Seminar – Session 2

Tuesday, March 17, 2:15 p.m. – 2:45 p.m.

CogniPower

ROOM 217A

Compound Converter Topology Can Take Many Forms

SPEAKER: Tom Lawson

Compound Converters are a family of AC/DC topologies that perform both PFC and agile output regulation where the majority of power passes through only a single stage of power conversion. The principles involved can be applied to a wide variety of applications, providing performance, efficiency and cost benefits for power converters from tens to thousands of Watts.

Discussed here are flyback, forward, quasi-resonant, and DC/DC forms. Topologies that reuse the transformer secondary winding as the supplemental inductor enable smaller size and lower-cost for PFC in power converters below 65 W. Many of these topologies are particularly suited to take advantage of GaN switching.

Freescale Semiconductor, Inc.

ROOM 217D

Efficient Thermal Management for Motor Control

SPEAKER: Tom Zemites

Introducing a temperature dependent current limit for motor drivers. This thermal management scheme ensures high efficient operation by reducing switching losses when motor is experiencing heavy loads or binding. It enables continuous motor operation in critical applications and/or harsh environments.

Gecko-Simulations

ROOM 217B/C

Optimally Design PE Systems with GeckoCIRCUITS & GeckoMAGNETICS

SPEAKER: Jonas Muehlethaler

Gecko-Simulations is developing software tools in the field of multi-domain numerical simulation and design of power electronic systems. In this exhibitor seminar, we are presenting how to optimally design PE Systems with GeckoCIRCUITS & GeckoMAGNETICS.

GeckoCIRCUITS is a widely spread circuit simulator for modeling your power electronics systems. Besides its fast circuit simulation capability, GeckoCIRCUITS combines control modelling and thermal simulations in an easy-to-use software package. Furthermore, it includes GeckoMAGNETICS, a software tool that enables fast, accurate, and user-friendly modeling and optimal design of inductive power components, such as Inductors and Transformers. It works for a wide power range and for all type of core materials and many winding types (including Litz and Foil Windings).

Magnetics

ROOM 213BC

XFlux Designs for High Current Applications

SPEAKER: Jacob Hughes

Discussion will be focused on high current applications and their solutions using Magnetics XFlux material. Speaker will also discuss other available options, For example, different sizes, permeabilities, and shapes of XFlux.

Powerex, Inc.

ROOM 213A

Powerex Technology Update: Featuring 7th Generation, Three Level and SiC Devices

SPEAKER: Eric Motto

Powerex is pleased to introduce the latest developments in high power semiconductor modules designed to meet industry demands for higher efficiency, higher reliability and lower system costs. This presentation will feature three new products:

- (1) Modules with industry standard outlines using high efficiency 7th generation IGBT and free wheel diode chips along with a novel structure having reduced weight and increased thermal cycling durability.
- (2) Low internal inductance modules designed for efficient implementation of type-T and type-I three level topologies in high power inverter applications.
- (3) Modules utilizing SiC power devices to achieve the highest efficiency in demanding applications

SIMPLIS Technologies

ROOM 213D

SIMPLIS – Verilog HDL Co-simulation and SIMetrix/SIMPLIS 8.0 New Features

SPEAKER: Ronald Wong and Christopher Bridge

SIMPLIS VH, the new SIMPLIS Verilog-HDL co-simulation module, enables the fast, industry-verified SIMPLIS analog simulation engine to run in parallel with a Verilog-HDL simulator. SIMPLIS VH enables users to analyze the interaction between a behavioral or gate-level digital IC design and the actual power supply application circuit. Designers interested in exploring new digital control algorithms can use behavioral Verilog-HDL syntax to get their ideas to the testing stage without having to delve into gate-level design. For final design verification, the designer can use the synthesizable Verilog-HDL code, before submitting to layout, to test the silicon's performance against the original application circuit specifications.

ZES ZIMMER

ROOM 218/219

New PWM and VFD Power Measuring Methods with DualPath

SPEAKER: Robert Emerson

The new LMG670 architecture with DualPath makes possible simultaneous and precise measurement of low,

torque-relevant fundamental frequencies and higher PWM frequencies with harmonics. The only way to truly measure efficiency: dual A/D conversion and analog and digital signal processing filters per input channel. Come learn about the right methods to eliminate errors and delays of previous approaches. Get accurate results in the shortest time.

Exhibitor Seminar – Session 3

Tuesday, March 17, 3:00 p.m. – 3:30 p.m.

Ferroxcube USA, Inc.

ROOM 213BC

New and Evolving Ferrite Power Materials

SPEAKER: Lowell Bosley

Ferroxcube continues to evolve its leading power ferrite materials as well as formulate new power material concepts to provide the switching power supply industry design engineers with leading edge ferrite power materials for high frequency transformer or inductor design. With a focus on switching frequency, operating temperature, or saturation flux density, Ferroxcube continues to provide a wide variety of power materials to fit each niche of power supply designers' desires. Additional information will include how to apply performance factory plots to determine the optimum power ferrite material for chosen frequency or temperature applications.

Integrated Engineering Software

ROOM 217D

An Example of Field and Power Electronic Co-Simulation: Wireless Power Transfer

SPEAKER: Dr. Matthew Wismayer

Development of many electric or magnetic application requires a coordination of field analysis to characterize the device and circuit or system analysis to characterize how the device behaves in the final application. This talk will illustrate how FARADAY and CASPOC can work together in development of Wireless Power Transfer. FARADAY can produce the required inductive coupling information about a configuration. By using BEM FARADAY is able to overcome the inherent weakness of FEM (or FEA) for the open region modeling often required for inductive coupling. A new Coils and Windings interface in the newest release of FARADAY makes this analysis even easier than before. CASPOC is used for modeling proposed circuitry for the device.

NH Research

ROOM 213D

Lowering Risk & Speeding Development by Using Flexible Test Hardware & Test Software

SPEAKER: Martin Weiss

Testing early and with the right tools significantly reduces the total project cost, risk of project schedule slips, and potential field failures due to a design or manufacturing related issue.

The project cost, timeline, and project risk can only be reduced when the right tool is available or can be easily created by using flexible hardware and software tools.

Flexible tools also enable an engineering or a manufacturing department to quickly change from one product or application to the next new project while simultaneously reducing capital expenditures.

It is for these and additional reasons that NH Research Inc. (NHR) designs and manufactures our hardware and software tools with flexibility-of-use in mind.

During this presentation, NH Research will demonstrate through customer examples how flexibility in both hardware and software tools make them easy to create the right tool.

Our products are cover a wide range of industries including: aerospace; rail; automotive; grid; Military; and beyond.

Consider attending to learn how flexible hardware and software tools will make your departments more efficient, able to test earlier, improve test coverage, and lower total project risk.

ON Semiconductor

ROOM 213A

Innovations in Ultra-High Density AC/DC Power Supply Designs

SPEAKER: Tim Kaske

End users are always looking for smaller and lighter AC/DC power supplies. For developers, this presents a design challenge of balancing performance and cost. New products and solutions are now enabling ultra-high density AC/DC solutions which were not previously possible. ON Semiconductor provides a complete system level solution utilizing our market leading products to enable these solutions. The company will be introducing the industry's first current-mode LLC controller, which when combined with our latest PFC controller, synchronous rectification controller, and Gallium Nitride switches, demonstrates ultra-high power density.

Power Electronics Industry Collaborative.

ROOM 217B/C

Power Matters – How the Power Electronics Industry Collaborative is Working to Shape the Future of the Power Electronics Industry in the United States

SPEAKER: Keith Evans

Development of a stronger, more competitive U.S. power electronics ecosystem requires engaged collaboration from a variety of industry stakeholders. The Power Electronics Industry Collaborative (PEIC) is accelerating U.S. power electronics by convening industry, government, national laboratories, academia, and trade organizations to pursue common goals, including industry analyses, investment, and workforce development. The PEIC is a nonprofit, industry driven membership-based consortium comprised of OEMs, suppliers, researchers, and other stakeholders working to advance the U.S. power electronics industry.

During this session, PEIC President, Keith Evans, will describe the PEIC and share opportunities to engage with the organization. The session will include both a presentation and open dialogue, during which participants will discuss how the PEIC can best support their respective organization, and the broader power electronics industry. Additionally, participants will be invited to provide input to an industry analysis the PEIC is conducting through a \$500,000, two-year grant award from the National Institute of Standards and Technology (NIST) under the Advanced Manufacturing Technology Consortia (AMTech) Program.

Stellar Industries Corp.

ROOM 218/219

Direct Bond Copper Substrates for High Power and High Thermal Applications

SPEAKER: Jason Greenspan

Stellar will discuss Direct Bond Copper(DBC) substrate construction. How do we make DBC substrates? Where are they commonly used? We'll also touch on available materials, plating options, size limitations, Cu thicknesses, special features, etc.

Teledyne Lecroy

ROOM 217A

Three-phase Electrical and Mechanical Motor Drive Power Analysis Using an 8 Channel, 12-bit, 1GHz Oscilloscope

SPEAKER: Kenneth Johnson

Variable frequency motor drives combine complex embedded control systems and algorithms, high voltage isolated power electronics circuits, and mechanical signal sensing. The complete system design is highly interactive, yet today debug and validation is typically performed with two or three separate instruments, none of which solve the complete debug and validation challenge or combine the data set into one easily understandable view/table.

In this seminar we will demonstrate how Teledyne LeCroy's 8 channel, 12-bit oscilloscope with 1 GHz bandwidth and three-phase power and motor mechanical analysis provides capability to monitor more signals at high resolution and bandwidth so as to permit acquisition of all of the following types of signals in one system.

Exhibitor Seminar – Session 4

Tuesday, March 17, 3:45 p.m. – 4:15 p.m.

Dino-Lite Scopes (BigC)

ROOM 217B/C

Dino-Lite Digital Microscope: EDGE Series

SPEAKER: Connie Pedregon

Overview of handheld USB-powered digital microscopes for inspection and documentation of surfaces and small parts. The portable microscopes are able to easily capture images and videos, and also have software capabilities including measurement, annotation, crosshair, and gridline functions. Magnification ranges available include 10x-220x, 500x-550x, and 700x-900x. Features such as adjustable built-in polarizer allow for reduction of glare while inspecting reflective objects. Our latest EDGE series microscopes contain an enhanced sensor for improved image quality and have features such as Enhanced Depth of Field (EDOF), Extended Dynamic Range (EDR), and Automatic Magnification Reading (AMR). Various accessories such as a multitude of stands and our wifi adapter allow for increased stability and portability while gathering results.

Ducati Capacitors / Iconopower

ROOM 217A

New High-Temperature, High Capacity DC-Link PP Film Capacitors

SPEAKER: Roberto Defant

After a brief comparison of commercially available Metallized Film technologies/materials including their respective strong and weak points a short but comprehensive approach to the correct dimensioning of Metallized Polypropylene Power Capacitors will be presented by Ducati, with a particular focus on the factors currently limiting their field of application; successively the test results of new, improved Polypropylene films will be presented and applied to Power Capacitor dimensioning.

Global Power Technologies Group

ROOM 217D

SiC Power Module, Subsystem and their Applications

SPEAKER: Dr. Timothy J. Han

Silicon Carbide (SiC) is an emerging technology that offers high temperature capability and improved efficiency to a variety of power conversion system applications. At this time SiC Schottky Barrier Diodes (SBDs) and MOSFETs are available for commercial use. This seminar provides practical applications of SiC power devices using hybrid power modules, and full SiC power modules. The power conversion performances are demonstrated with Silicon IGBT/MOSFET technologies versus SiC MOSFETs/SBDs in the On-board Vehicle Charger. Test data presented is measured in the same system, at the same points of operation, using the conventional Si and hybrid Si/SiC power modules.

We also present the emerging application areas of the SiC power devices like photovoltaic inverter, electric vehicles, industrial motor drivers and medical applications.

Keysight Technologies

ROOM 213D

Keysight Test Solutions Improve Power Circuit Design Success

SPEAKERS: Mike Hawes, Ryo Takeda, & Michael Hoffman

In this session Keysight Technologies will highlight its wide range of measurement equipment that can help you test, characterize, and debug your power-related circuit designs. Keysight's B1506A power semiconduc-

tor device analyzer can perform complete power diode, MOSFET and IGBT datasheet characterization up to 1500 A and 3 kV. It can also measure capacitance and gate charge up to 3 kV and calculate device power loss. Keysight's InfiniVision X-Series oscilloscopes can automatically characterize linear and switch mode power supplies with measurements including input AC power quality, current harmonics, switching loss, output ripple, efficiency, and more. In addition, using the built-in waveform generator these scopes can also perform frequency response measurements such as power supply rejection ratio (PSRR) and Control Loop Response (Bode). Finally, Keysight's new IntegraVision power analyzer can help R&D engineers test and visualize power conversion device performance for efficiency, inrush current and other critical power measurements.

Taiwan National Program for Intelligent Electronics

ROOM 218/219

Strengthening Modern Electronics Industry through the National Program for Intelligent Electronics in Taiwan

SPEAKER: Dr. Jeng-Long Chiang

Taiwan National Program for Intelligent Electronics (NPiE) promotes technological innovation of modern electronics for medical, green, car, and conventional 3C (computer, communication, consumer electronics) applications. The NPiE integrates R&D capabilities of government agencies, universities, and the industry to develop core IC technologies, cultivate interdisciplinary talents, and explore new MG+4C markets. It is expected that, through the NPiE, Taiwan's IC industry will steadily contribute to the global high-tech community and the future. This time at APEC will be the first time that Taiwan's advanced technology and innovative products on green and power electronics, achieved by Industrial Technology Research Institute (ITRI) and the academia under NPiE, are demonstrated on this global stage. In this session, NPiE's executive framework, achievements, current status and collaboration opportunity will be presented. It will also be the best platform for bridging you (your company) and potential partners in Taiwan.

Semtech Corporation

ROOM 213BC

Greener, Smarter, Smaller Power Solutions

SPEAKER: Andy Khayat

Power Management solutions for today's power hungry applications must meet a wide variety of performance aspects from high efficiency, to intelligent control, to ultra-small size. This seminar session will focus on

optimizing techniques to reduce shutdown and standby state current consumption to achieve the highest efficiency possible.

Würth Electronics Midcom Inc.

ROOM 213A

REDEXPERT & STS

SPEAKER: Oliver Opitz & Swaroop Vaidyanath

Looking for magnetics design help? Re-learn how to design in magnetics for your latest switchmode power supply using REDEXPERT for non-isolated designs or STS for isolated flyback designs. These two newest design tools released by Würth Electronics bring a brand new twist to the industry.

REDEXPERT selects from a huge library of over 2,000 power inductors to save design time in finding the power inductor with lowest total losses. The AC and DC losses are based on hard switching measurements for different duty cycles, resulting in an overall accuracy of up to 99%. STS takes the radical approach of starting with your power supply design requirements and doing a reverse design on each transformer in the database to select parts that meet your needs and are in stock. Design your board using the same platform and source them all from the same supplier.

Exhibitor Seminar – Session 5

Wednesday, March 18, 10:30 a.m.- 11:00 a.m.

Adaptive Power Systems, Inc.

ROOM 213D

Latest Advances in Programmable AC Power Source Designs

SPEAKER: Mitchel Orr

Understanding the capabilities and differences of linear and pulse-width modulated (PWM) AC power sources is helpful to design and test engineers. Recognizing the capabilities of each implementation allows them to determine which types meet their requirements best. A well-instrumented AC power source can deliver precisely managed power to fully characterize a unit under test. The AC power source may be used to present a range of voltages and currents to determine steady-state power needs. In addition, transients, harmonic waveforms and other voltage perturbations may be applied. These features support limit-testing and verification of operational extremes for a unit under test. Using the AC power source's built-in measurement features, loading characteristics of the unit under test can be analyzed

This paper will provide an overview of both linear power amplification and PWM Switch mode design evolution. Pros and cons of each approach and the implications of each implementation on power quality and specific types of loads will be compared side by side.

Efficient Power Conversion

ROOM 217A

GaN Transistors for Efficient Power Conversion

SPEAKER: Alex Lidow, Ph.D

Gallium nitride transistors are rapidly being designed into many power conversion and RF applications. This seminar will provide an update on the state-of-the art in GaN transistor technology, highlighting the latest generation of EPC enhancement-mode GaN products.

- Devices that offer a significant reduction in a key figure of merit for high power density DC-DC conversion.
- A family of monolithic half-bridge devices that increase efficiency and power density, while reducing end-product assembly costs.
- The extension of the eGaN product family to 450 V.

In addition, several applications currently using GaN transistors such as high power density DC-DC converters, high frequency envelope tracking, and wireless power transfer will be discussed.

Microchip Technology Inc.

ROOM 213A

Tradeoffs Between Analog and Digital Implementations for Power Supplies

SPEAKER: Fionn Sheerin and Tom Spohrer

Power supply control is changing dramatically with the increasingly available “digital” controllers. This can mean very different things in different contexts: some applications do not need any digital content, but can benefit from improved performance; some applications need digital interfaces, but are agnostic to control methods; some applications target “true” digital control, with digitally implemented transfer functions. The products available include a wide spectrum of microcontrollers, analog controllers and mixed-signal implementations. However, despite the hype, analog power supply control remains the mainstay in power conversion. The difficulties and costs associated with partial or full digital control implementations push many designers to continue with proven analog techniques.

The strengths, weaknesses and tradeoffs between control implementations are key to a successful power product design. Given the variety of options available with analog, digital and hybrid control methodologies, it is important for engineers to select the optimum control architecture for the design requirements. The best approach may be unfamiliar, but proper control selection can save time and improve the system capabilities.

Pacific Sowa Corporation

ROOM 213BC

Atmix's Soft Magnetic Powder

SPEAKER: Ota Arata

Introduction of the soft magnetic powder produced by Epson Atmix Corporation.

Taiwan Semiconductor Co.

ROOM 217D

New Generation Semiconductors for Improved Power Efficiency

SPEAKER: Mark Christopher

Taiwan Semiconductor is globally recognized as a leading supplier of discrete power electronics technology. Taiwan Semiconductor provides complete power control solutions and is continuously expanding its product portfolio. In this session, TSC will present information on new generation semiconductor solutions for:

- AC-DC Power Regulation
- LED Lighting Power Control
- Efficient Power Rectification
- High Voltage Switching

Vishay Technologies

ROOM 217BC

Adding Vishay Performance to Your Power Application Solar Main Inverter

SPEAKER: Mark Walsh

Come learn how Vishay Intertechnology's broad portfolio of components, leading technologies, and diverse market expertise can boost performance in your system. Using the example of a solar inverter application, Vishay will highlight its latest industry-leading power MOSFETs, diodes, and passives components.

Zipalog Inc.

ROOM 218/219

Mixed-Signal Integrated Circuit Verification for Power Electronics Systems

SPEAKER: Felicia James

Designing integrated circuits for today's complex power electronics systems poses numerous challenges to successfully address system requirements. Often system requirements for targeted power management integrated circuits encompass complex voltage supplies for multiple power domains with sophisticated control systems. The implementation of these IC's include analog, power, memory, and digital design elements with expectations of system monitoring and communication. In addition, market pressure predicates concurrent design between integrated circuit and system design teams. However, common integrated circuit design flows do not successfully bridge verification tasks across the multiple domains. Special challenges persist when considering power devices and analog in context with microcontrollers and software.

This session will consider best-practices and technologies to better predict the performance of integrated circuits within the context of the system. The focus will be on exploring methods to more explicitly evaluate the IC during the design phase within the system context. Topics will include tradeoff discussions on modeling techniques and simulation efficiency versus accuracy as well as challenges across domain boundaries. The session will also touch upon issues specific to delivering power management integrated circuits that can operate within various types of reliability and operating standards.

Exhibitor Seminar – Session 6

Wednesday, March 18, 11:15 a.m.-11:45 a.m.

Alpha

ROOM 217B/C

Ultra-Fast-Sintering with Alpha Argomax

SPEAKER: Julien Joguet or Gustavo Greca

We will present the company Alpha, we will introduce Alpha Argomax sinter technology and then will describe the processes used to Ultra Fast Sintering

Fairchild

ROOM 213D

High Voltage Design Enablement

SPEAKER: James Victory

Fairchild is developing novel design enablement concepts and techniques that designers can apply to discrete semiconductor technology for accurate, optimized, and streamline power system circuit design. The goal of design enablement is to facilitate design optimization that leads to first-time right silicon and fastest time-to-market. This type of design platform, often embodied within a process design kit, or PDK, is well known in the IC design world, but has been a foreign concept to discrete technologies. Fairchild will present the foundational component of their design enablement platform which includes physical, process and geometrically scalable SPICE models that enable flexible front end design and ultimately drive automated physical layout generation methodologies to navigate and be successful in all aspects of design.

International Rectifier Corporation

ROOM 213A

Get to Market Faster with IR's scalable Digital Power

SPEAKER: Ramesh Balasubramaniam

Everyone knows that companies generate profits by getting their products to the market faster. However, traditional analog power supply design techniques continue to be painstakingly slow and various digital power solutions available on the market remain complicated and just as slow. International Rectifier's flexible, scalable digital power solutions are wrapped with a system solution that speeds up the entire process at least 6 times faster! The system solution addresses the entire chain from schematic design, digital parameter (config file) generation, power rail optimization and system validation.

Mersen

ROOM 213BC

Safety and Reliability for Electrical Power

SPEAKER: Kian Sanjari

This session will demonstrate Mersen's commitment to develop industry-leading technologies to improve efficiency and reliability of power electronics equipment. The session will focus on three key topics of:

- Fast Acting Power Semi-Conductor Fuses providing most reliable fault current protection

- Air and Liquid Cooling Systems and Thermal management solutions to provide thermal protection for semiconductor components while enabling heat to dissipate. Efficient cooling is key to long term reliability and performance of power electronics.
- Laminated bus bars providing most efficient connection between various components, thus limiting parasitic inductance, improving ease of assembly and integration while minimizing wiring errors and costs.

Plexim

ROOM 217A

Multi-Domain Modeling with PLECS

SPEAKER: Kristofer Eberle

Power conversion systems comprise of several physical domains including electrical, magnetic, thermal, and often mechanical subsystems. To fully understand the behavior of the overall system, and therefore increase likelihood of a successful design, the characteristics of the individual domains and their effects on the power converters must be analyzed in simulation as early as possible. In addition to creating complete and accurate system models, it is also important to simulate real-world operating and fault conditions. For fast prototyping and performance prediction, computer-based circuit-simulation has been widely adopted in the engineering development process. Modeling such complex systems, while including switching power electronic converters, requires a powerful and robust simulation tool. Furthermore, the speed of the solver is critical to allow for developing and verifying multiple iterative enhancements based on insight gained through system simulation.

PLECS is a simulation tool developed for power electronics engineers that allows for very efficient and robust modeling of power conversion systems including multi-physical domains and associated control algorithms. In this presentation a 2MW grid-connected wind power generation system, designed in detail using PLECS, and the effects and interactions of multiple physical domains will be explored. The library components used to build the system are taken from PLECS' different physical domains, including from the electrical, magnetic, and mechanical, as well as signal processing and control systems categories. The results from transient simulations under realistic operating and fault scenarios will be demonstrated and discussed.

Power Electronic Measurements Ltd

ROOM 218/219

The Practicalities of Measuring Fast Switching/Transient Currents in Power Electronic Applications Using Rogowski Transducers

SPEAKER: Dr. Chris Hewson

It is essential to measure fast current transients accurately in power electronic applications, for example to determine switching loss in semi-conductors, to monitor stress in bond wires in large power devices or to determine the effects of stray inductance on a circuit. Rogowski current probes are an excellent tool for measuring such currents; they have good a high frequency bandwidth >20MHz, high slew rate capability, and utilise a small clip-around sensor coil allowing easy access to get into difficult to reach parts of the circuit. This presentation discusses the limits of these transducers when monitoring fast transient currents, these limits will be outlined using practical results from various commonly encountered power electronic circuit configurations.

The target audience for this presentation is practising engineers (design / field applications / consultants) in the field of power electronics, for example engineers developing or testing power converters or characterising semiconductor devices.

The talk will cover a number of key concepts that are important to the practising engineer who has to interpret Rogowski probe measurements of rapidly changing currents in power electronic circuits.

Zhejiang Keda Magnetolectricity Co., Ltd

ROOM 217D

New Generation of Alloy Powder Core Material in Power Inductor Design

SPEAKER: Alan Chik

Traditional alloy powder core materials like MPP, High Flux and Sendust have been used as PFC chokes, output chokes, or power inductors for high efficiency applications for more than decades, but many magnetic design engineers are still looking for alternative replacement of them due to price and power density issues.

The presentation covers the fairly new developed material called Nanodust™ (KAM/KAH) that offers a cost effective replacement of both MPP and High Flux by KDM. It is the first nano-technology soft magnetic material developed independently by a local China-based company and commercially available to the market. Also, newly developed materials named Super Sendust™ (KS-HF) and Low Cost Si-Fe (KW) that are absolutely good alternatives of Sendust are introduced as well. Technical performance, characteristic comparison with popular materials, and the manufacturing process (Nanodust™ only) are included in the presentation.

Exhibit Hall

EXHIBIT HALL FLOOR PLAN

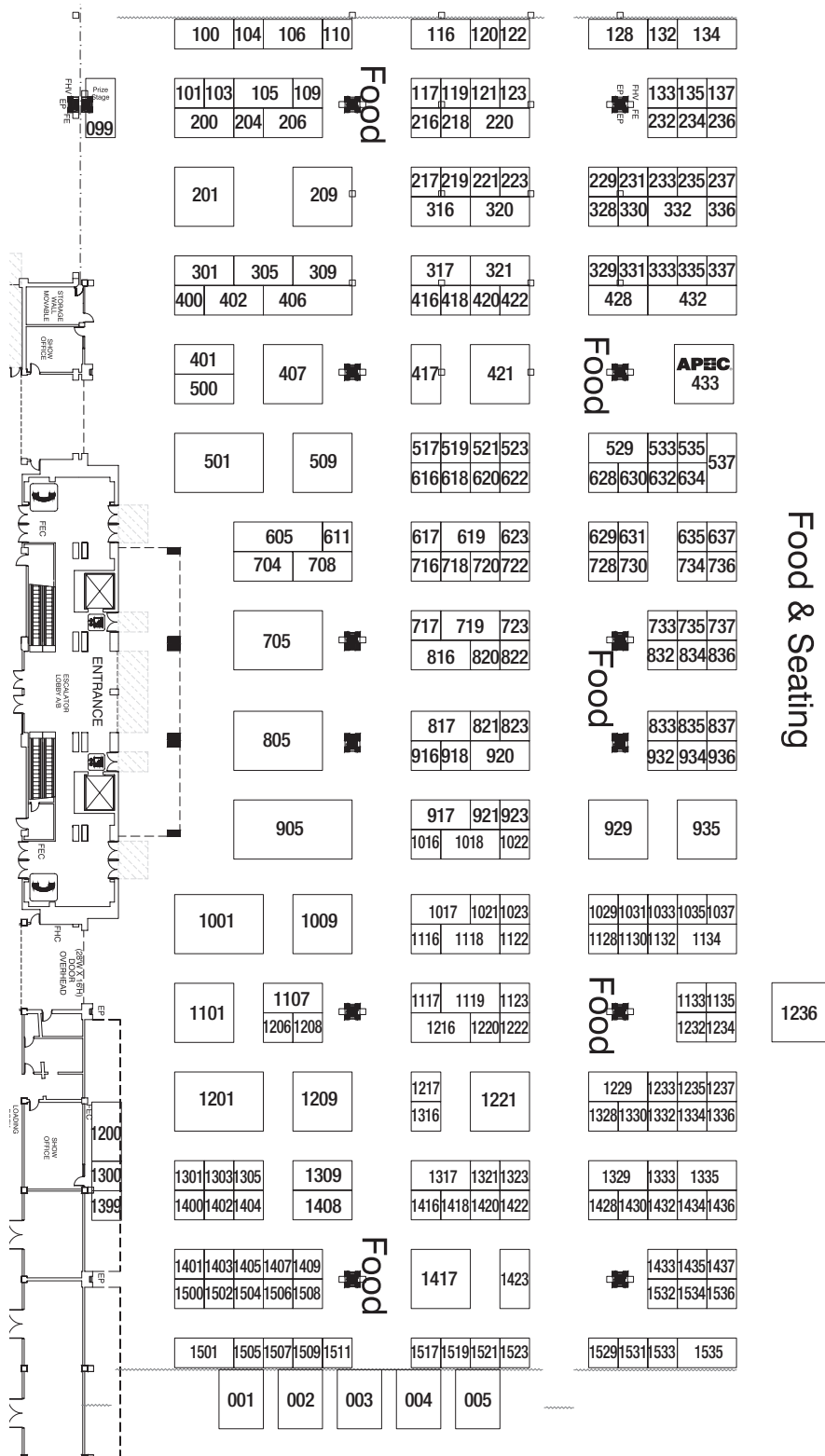


EXHIBIT HALL FLOOR PLAN

Exhibitor Listing

as of 2/06/15

Exhibitor	Booth #
ACME Electronics Corporation	1330
Acopian Power Supplies	320
Adaptive Power Systems	1430
Adelser	1423
Advanced Cooling Technologies, Inc.	1401
Advanced Test Equipment Rentals	1422
Agile Magnetics	1400
Agile Switch	1504
Allstar Magnetics	1037
Alpha	1232
Alpha & Omega Semiconductor	719
Alpha Wire	122
Alps Electric Co. Ltd.	1536
Altera Corporation	123
Amantys LTD	1321
Ametherm, Inc.	1023
Amphenol Interconnect Products	301
ANPEC Electronics	103
ANSYS, Inc.	1208
APEI	1409
APEC Show Management	433
Ascatron	117
Auxel FTG	637
AVX	321
Beijing Kejiaxin Electric Co., Ltd.	336
Bellwether Electronic Corp.	330
Bergquist Company The	216
BH Electronics, Inc.	1506
Bomatec International Corp.	135
Broxing SA	1432
CalRamic Technologies, LLC	328
Central Semiconductor Corp.	934
Ceramic Magnetics, Inc./Kolektor Magma	616
Chroma Systems Solutions, Inc.	1309
Cirasys, Inc.	1407
CogniPower	918
Coil Winding Specialist, Inc.	632
Coilcraft	1107
Coiltron, Inc.	1511
Component Distributors, Inc. (CDI)	1237
Core Technology Group, Inc.	921
Cornell Dubilier	400
Cosmo Ferrites Ltd.	1220

Exhibitor	Booth #
COTEK Electronic Ind. Co., Ltd	133
CPS Technologies	533
Cramer Coil & Transformer Co. Inc.	1519
Cree, Inc.	1417
CUI Inc	206
Daco Semiconductor	1403
Danfoss Silicon Power GmbH	309
Datatronics	723
Dau Thermal Solutions North America	1305
Dean Technology, Inc.	1301
Dearborn Electronics Inc.	106
Dexter Magentic Technologies	1508
Dino-Lite Scopes (BigC)	736
Ducati Capacitors	1505
EACO Capacitor	1323
EBG Resistors	1303
ECI	823
ECU Electronics Industrial Co., Ltd.	1333
EFC/WESCO	1021
Efficient Power Conversion Corporation (EPC)	1405
Egston System Electronics Eggenburg	537
Electrocube, Inc.	833
Electronic Concepts, Inc.	704
Electronic Systems Packaging	635
Elna Magnetics	622
Enargy Power Co. Ltd.	1437
Exar Corporation	428
Fairchild Semiconductor	905
Fair-Rite Products Corp.	329
Ferroxcube USA, Inc.	1016
FRAKO Capacitors	737
Freescale Semiconductor	1118
Fuji Electric Corp. of America	619
GAN Systems	1408
Gecko-Simulations	120
GENTEQ	519
Global Choice International LLC	119
Global Foundries	620
Global Power Technologies Group	718
GMW Associates	416
Gowanda Electronics	237
GRAPES- GRid-connected Advanced	

Exhibitor**Booth #**

Power Electronics	1402
Haraeus Materials Technology	1533
Hengdian Group DMEGC Magnetics Co., LTD	820
Heraeus Electronic Materials Division	1531
Hesse Mechatronics, Inc.	1221
Hoffmann	233
Holy Stone International	1332
HVR Advanced Power Components, Inc.	1122
IAS	1399
I.C.T. Power/ Innovation Plus	1507
ICE Components, Inc.	1206
Iconopower	1505
Illinois Capacitor Inc.	720
Indium Corporation	335
Infineon	509
Infolytica Corporation	422
INTEGRATED Engineering Software	517
Intepro Systems	836
International Rectifier	705
Intersil Corporation	500
Intertape Polymer Group	521
Isotek Corporation, Subsidiary of Isabellenhutte	218
Iwatsu Test Instruments	1134
JARO Thermal	128
JFE Steel Corporation	134
Jianghai Capacitor Co. LTD	1532
Johanson Dielectrics, Inc.	1035
John Deere Electronic Solutions	100
Kaschke Components GMBH	523
KDM Zhejiang Keda Magnetolectricity Co., Ltd.	932
KEMET	1229
Kendeil srl	1509
Keysight Technologies	432
KITAGAWA INDUSTRIES America, Inc.	631
Knowles Capacitors	1436
Leclanché Capacitors	1217
LEM USA, Inc.	232
LHV Power Corporation	1500
Linear Technology Corporation	201
Lodestone Pacific	822
LTEC Corporation	936
MagnaChip Semiconductor	634
Magna-Power Electronics	217
Magnet Applications, Inc.	1135
Magnetic Metals Corp.	1130
Magnetics	916

Exhibitor**Booth #**

Magsoft Corporation	923
Malico Inc.	236
Mangoldt Reactors	735
Mentor Graphics	337
Mentor Graphics – Mechanical Analysis	332
Mersen	1009
Mesago PCIM GmbH	219
Metallix Refining	834
Methode Power Solutions Group	605
MH&W	1022
Microchip Technology Inc.	200
Micrometals, Inc.	728
MK Magnetics Inc.	1119
Monolith Semiconductor Inc.	1534
Monolithic Power Systems, Inc.	421
MORNSUN America LLC	1233
Mouser Electronics, Inc.	316
MPS Industries, Inc.	1133
MTL Distribution	1328
NEC TOKIN America Inc.	1428
New England Wire Technologies	1123
NH Research, Inc.	1116
Niagara Thermal Products	234
Nichicon	535
NORWE, Inc.	628
NXP Semiconductors	1101
Oak Ridge National Laboratory	1517
Ohmite MFG	402
Okaya	1033
ON Semiconductor	407
Opal-RT	730
Pacific Sowa Corporation; C/O Epson Atmix Corporatopm	835
Panasonic	1501
Pancon Corporation	1416
Payton America	417
Pearson Electronics, Inc.	1029
PELS – IEEE	1300
Plexim	618
Power Electronic Measurements Ltd.	418
Power Electronics Industry Collaborative (PEIC)	1435
Power Integrations	116
Power Solutions Inc.	231
PowerELab Ltd.	204
Powerex, Inc.	817
Powersim Inc.	1316

Exhibitor**Booth #**

Powervation	529
POWRMOD DC to DC Converters	121
Precision Inc.	832
Prodrive Technologies	1521
PSMA	1200
QORVO	611
Qualtek	1535
RAF Tabtronics LLC	623
REMTEC, Inc.	331
Renco Electronics Inc.	406
Renesas Electronics	1404
Richardson RFPD	101
Ridley Engineering, Inc.	401
Rogers Corporation	317
ROHM	209
Rubadue Wire Company, Inc.	629
Samwha USA Inc.	235
SanRex Corporation	104
Sapa Extrusions North America	734
SBE, Inc.	1502
Schaffner Trencor LLC	1523
Scientific Test, Inc.	1132
Semikron, Inc.	920
Semtech	110
Shanghai Eatop Electronic Technology Co.	837
ShengYe Electrical Co. Ltd.	229
Shenzhen Poco Magnetic Co., Ltd.	1335
Shenzhen Zeassett Electronic Technology Co., Ltd	1334
Simplis Technologies	1017
Sonoscan, Inc.	1031
Sree Vishnu Magnetics Pvt. Ltd.	1434
Stellar Industries Corp.	132
STMicroelectronics, Inc.	805
Sumida America Components Inc.	1329
Taica North America Corporation	1234
Taiwan National Program for Intelligent Electronic	137

Exhibitor**Booth #**

Taiwan Semiconductor Inc.	223
Taiyo Kogyo Co., LTD.	1235
TDK Corporation	1201
Teledyne LeCroy	105
Texas Instruments	1001
The Allpower Source (Div. of Technology Dynamics)	1433
Thermik Corporation	1222
Toshiba America Electronic Components, Inc.	1209
TowerJazz	821
Transim Technology	708
Transphorm	1317
TSC Ferrite International	1420
TT electronics	1018
Typhoon HIL, Inc.	109
United Chemi-Con Inc.	816
United Silicon Carbide, Inc.	305
University of Texas – Dallas	333
VAC Sales USA LLC	917
Venable Instruments, Inc.	1117
Vicor Corporation	929
Viking Tech America Corporation	221
Vincotech GmbH	716
Vishay Intertechnology, Inc.	501
Voltage Multipliers	717
Wakefield-Vette Thermal Solutions	722
Wolverine Tube Inc. – MicroCool Division	1336
Würth Electronics Midcom Inc.	1216
X-FAB Semiconductor Foundries	733
Xitron Technologies Inc.	1128
Yokogawa Corporation of America	420
Yole Development	617
ZES Zimmer	1418
Zhejiang Guidu Power Electronic Co Ltd.	1529
Zhuzhou CSR Times Electric Co., Ltd	935
Zipalog	630
ZMDI (Zentrum Mikroelektronik Dresden)	220

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Power Systems Design: Empowering Global Innovation

2015 APEC Exhibitor Company Descriptions

ACME Electronics Corporation . . . Booth 1330

No. 2, Fugian Zast Road
Zengjiang Street, Zast Square
Guangzhou-Zengcheng,
www.acme-ferrite.com.tw

ACME Electronics Corporation is a ISO/TS16949 and ISO14001 certified manufacturer of soft ferrite products and sapphire ingots for use in the computer, telecommunications, automotive, lighting, LCD TV, LED and other related electronics industries. It is a subsidiary of USI Corporation, a public listed company in Taiwan.

Acopian Power Supplies Booth 320

P.O. Box 638
Easton, PA 18044
www.acopian.com

Acopian manufactures millions of reliable AC-DC and DC-DC power supplies that are shipped within 3 days. Products include Programmable, Switching, Linear, Rack Mount, Wall Mount, DIN Rail Mount, Redundant Systems, High Voltage & Custom Power Supplies. We offer every voltage from 1 volt to 30kV & up to 2400 watts. MADE IN THE USA

Adaptive Power Systems Booth 1430

17711 Mitchel North
Irvine, CA 92614
www.adaptivepower.com

Adaptive Power Systems (APS) designs and manufactures a complete and extensive line of AC and DC power equipment to meet world-wide applications. Products include frequency changers, programmable AC and DC power supplies and electronic loads. Markets served include production test, household appliance and consumer product manufacturing, defense, commercial aviation, telecommunications, industrial manufacturing and compliance test agencies.

Adelser Booth 1423

2200 Gateway Centers Blvd.
Suite 213
Morrisville, NC 27560
www.adelser.com

Adelser is a power assembly manufacturer. With more than 40 years experience, our company designs and provides high quality assemblies, from a few kw's to 100's of kw's, using IGBT's, thyristors, diodes... We provide standard assemblies from our database, or we can provide a solution, with your specific requests.

Advanced Cooling Technologies, Inc. Booth 1401

1046 New Holland Avenue
Lancaster, PA 17601
www.1-act.com

Advanced Cooling Technologies, Inc. (ACT) is a premier thermal management solutions company. Under our ISO9001 and AS9100 certifications, we design and manufacture products for diverse applications including satellite thermal control, commercial/military electronics cooling and temperature calibration. In addition, our responsive, customer-focused team provides innovative engineering and advanced research and development services for clients worldwide.

Advanced Test Equipment Rentals Booth 1422

10401 Roselle St.
San Diego, CA 92121
www.atecorp.com

Advanced Test Equipment Rentals (ATEC) supplies complete testing solutions for EMC, Electrical, Power Quality, Environmental and other similar testing applications for the Defense, Aerospace, Automotive, Utility, Telecom and many more industries. Our friendly and knowledgeable team, along with the largest stock inventory of rental equipment, is available to support all your needs.

Agile Magnetics Booth 1400

24 Chenell Drive
Concord, NH 03301
www.agilemagco.com

Agile is an AS9100 certified advanced manufacturer of a very broad array of magnetics for the power industry. We are steeped in magnetics knowledge and world class manufacturing practices. Winding capabilities include Universal, Litz, sheet copper, and standard magnet wire winds. We offer advanced potting impregnation for isolation/thermal transfer.

Agile Switch Booth 1504

1650 Arch St.
#1905
Philadelphia, PA 19103
www.AgileSwitch.com

AgileSwitch designs, develops and markets IGBT Gate Drive Boards and Power Stacks that significantly improve the performance, efficiency and lifetime of power inverters/converters for renewable energy generation and high efficiency electric motor applications.

Allstar Magnetics Booth 1037

6205 NE 63rd St.
Vancouver, WA 98661
www.allstarmagnetics.com

Allstar Magnetics, LLC is a value added magnetic and inductive components distributor. We offer a full line of ferrite cores and hardware, permanent magnet materials, and wound assemblies. Value added services include custom gapping, CNC machining, grinding, coating, custom winding, and testing.

Alpha Booth 1232

300 Atrium Drive
Somerset, NJ 08873
www.alpha.alent.com

Alpha, a business unit of Alent plc, is the global leader in the development, manufacturing and sales of innovative specialty materials used in a wide range of industry segments, including electronics assembly, power electronics, die attach, LED lighting, photovoltaics, semiconductor packaging, automotive and others.

Alpha & Omega Semiconductor ... Booth 719

475 Oakmead Pkwy
Sunnyvale, CA 94085
www.aosmd.com

Alpha and Omega Semiconductor Limited (AOS) is a designer, developer and global supplier of a broad range of power semiconductors, including a wide portfolio of Power MOSFET, IGBT and Power IC products. Target applications include portable computers, tablets, smart phones, flat panel TVs, LED lighting, and consumer and industrial motor controls.

Alpha Wire Booth 122

711 Lidgerwood Avenue
Elizabeth, NJ 07207
www.alphawire.com

Alpha Wire has engineered wire and cable that excel in taming even the most challenging design applications for over 90 years. Our broad offering of wire, cable, & tubing products allows you to quickly design critical interconnections for signals and power, and includes the ability to create custom cables.

Alps Electric Co. Ltd. Booth 1536

3151 Jay Street S-100
Santa Clara, CA 95054
<http://www.alpsgd.com/eng/>

We are a leading global manufacturer of electronic devices, supplying some 40,000 different components to around 2,000 companies that produce automobiles, home appliances, mobile devices and industrial machinery all over the world. Our products may not always be directly visible to their users, but they do play vital roles in many items used by people everyday. Read on to learn more about Alps Electric and the electronic devices we make. www.alps.com

Altera Corporation Booth 123

101 Innovation Drive
San Jose, CA 95134
www.altera.com

Altera® is the pioneer of programmable logic solutions, enabling designers of electronic systems to rapidly and cost effectively innovate, differentiate, and win in their markets. Altera offers FPGAs, SoCs, CPLDs and complementary technologies, such as power management, as well as software tools, IP, and customer support to provide high-value solutions to customers worldwide. Visit Altera at www.altera.com.

Amantys LTD Booth 1321

Platinum Building
St. John's Innovation Park, Cowley Road
Cambridge, CB40WS
www.amantys.com

Innovative products for low and medium voltage power, applying digital techniques for the "intelligent control of power" in wind, solar, traction and HVDC applications. Our Amantys Power Drive™ IGBT drivers (1200V to 6500V) monitor and log key parameters with Amantys Power Insight™ to increase system availability and fibre optic lifetime.

Ametherm, Inc. Booth 1023

3111 N. Deer Run Road
Suite #4
Carson City, NV 89701
www.amphenol-aipc.com

For 20 years, Ametherm Inc has been dedicated to providing reliable inrush current limiters and sensing thermistors for a variety of applications in the Power, Audio, and Medical Equipment markets. Ametherm is proud to manufacture all of its products in the USA at the companies' Carson City, Nevada facility.

Amphenol Interconnect Products . Booth 301

20 Valley Street
Endicott, NY 13760
www.anpec.com.tw

Amphenol Interconnect Products is a total solution provider for Power Products. We bring a high level of expertise in design and manufacturing to the market place. With a global footprint Amphenol provides supply localization along with increased flexibility. Products include Bus Bars, Power Cables and Power Interconnects.

ANPEC Electronics . Booth 103

9890 Irvine Center Drive
Irvine, CA 92618
www.anpec.com.tw

ANPEC is an IC company located in Taiwan that is dedicated in designing power IC, mixed signal IC, and power discrete products for a wide variety of power applications.

The main product categories include the power management IC such Switching Regulators and PMIC products, Battery Management, Audio Amplifier and CODEC IC, LCD Controller/Driver IC, Motor Drive and Hall Effect IC, as well as discrete power MOSFET. These products are offered in a wide variety of applications such as computer, communication, consumer as well as other markets needing power IC products.

ANSYS, Inc. . Booth 1208

225 West Station Square Drive
Suite 200
Pittsburgh, PA 15219
aaa.ansys.com

ANSYS simulation software enables engineers to accurately and quickly design power electronic and electrically controlled systems.

APEC Show Management . Booth 433

2025 M Street, NW, Suite 800
Washington, DC 20036
www.apec-conf.org

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APEI . Booth 1409

535 W. Research Center Blvd.
Fayetteville, AR 72701
www.apei.com

APEI's designs, develops, and manufactures electronic solutions that enable tomorrow's technology today. Through the use of wide bandgap materials, APEI delivers product lines and engineering solutions that perform

like no other. We offer Wireless Telemetry, Packaging, Switched-Mode Power Converters, and Motor Drives for high performance / extreme environment applications.

Ascatron . Booth 117

Isafjordsgatan 22B
Electrum 207
Kista, SE 164 40
www.ascatron.com

Ascatron provides silicon carbide (SiC) epitaxial material and device design solutions for power semiconductors.

- Custom designed SiC epitaxy wafers for development, qualification and volume production.
- Support customer product development with device technology, design and prototyping.
- Complete material production line with process technology for integration in customer fab.

Auxel FTG . Booth 637

33 Hartford Avenue
Suite 201, PO Box 143
Granby, CT 06035
www.auxelftg.com

AuxelFTG is a global manufacturer of interconnection and power distribution products for applications in the fields of Low Voltage Electricity, Power Electronics and Electronics. With over 50 years' experience, AuxelFTG offers a wide range of innovative, reliable, safe and cost-optimized solutions. Our product range includes custom designed Laminated Bus Bars.

AVX . Booth 321

1 AVX Boulevard
Fountain Inn, SC 29644
www.avx.com

AVX is the leading manufacturer of passive and interconnect solutions for all power applications, ranging from switchmode capacitors to RF devices. Technologies include ceramic, high voltage, tantalum, niobium and film capacitors; medium and high power DC capacitors and pulse supercapacitors, with circuit protection devices including MLVs, fuses and EMI filters.

Beijing Kejiixin Electric Co., Ltd. . Booth 336

181 Fshi Road
Shijingshan District, 100041
www.kejiixin.com

Beijing Kejiixin Electric Group Co. Ltd. is a professional designer and manufacturer of metallized film capacitors for military and civil application such as electric vehicle inverters, industry induction heaters, electric welding machines, solar and wind power, energy storage, high-energy physics, laser power source and radar system.

Bellwether Electronic Corp. Booth 330

9F-1, No.1071, Zhong Zheng Rd.

Taoyuan City, 33045

www.bellwether-corp.com

Bellwether Electronic Corporation produces precise, high-quality and competitive electronic connectors. Bellwether has an excellent Research and Development team, strict quality-control system and fine management. Our goal is innovation, speed and customer's satisfaction.

Bergquist Company The. Booth 216

18930 West 78th Street

Chanhassen, MN 55317

www.bergquistcompany.com

The Bergquist Company is the world leader in the development and manufacturing of thermally conductive interface materials. With some of the best-known brands in the business, Bergquist provides solutions for top electronics companies worldwide. Additionally, Bergquist developed Thermal Clad metal core printed circuit boards for complete thermal management systems in surface mount and High Power LED applications.

BH Electronics, Inc. Booth 1506

12219 Wood Lake Drive

Burnsville, MN 55337

www.bhelectronics.com

BH Electronics is a world leader for the design / manufacturing of extremely reliable custom/standard discrete magnetic components. Areas of specialties include: high power, high frequency and high temperature applications. With manufacturing facilities in USA, Mexico and China, BHE is positioned to deliver high quality products at a competitive price.

Bomatec International Corp. Booth 135

Unit 6, 400 Finchdene Square

Toronto, ON M1X 1E2

www.bomatec.ch

NdFeB, SmCo, AlNiCo, Ferrite and other permanent magnets for motors and sensors. Nanocrystalline and amorphous tape wound cores for current sensors, common mode chokes, transformers, residual-current circuit breakers, Low cost due to iron based material. High permeability up to 600,000. Hi magnetic saturation up to 1.56T. Very low ion loss of 2.2W/kg at 1kH/0.5T. 20 to 50 microns thickness

Broxing SA Booth 1432

World Trade Center

Lugano-Agno, CH 6992

www.broxing.com

The Swiss company >BROXING< SA is world leader in high-current contact elements. for PCBs and for IMS. These PowerClamps series handle currents up to 1000 Amps, using pressfit, THT and SMT technologies. Main

applications are in the e-mobility, photovoltaic, defence, aerospace, transport and industrial field.

CalRamic Technologies, LLC Booth 328

Mfg. Facility

5462 Louie Lane

Reno, NV 89511

www.calramic.com

Manufacturers of High Voltage Ceramic Capacitors, 500VDC to 20KVDC in a variety of configurations and styles. High Voltage Multilayer, Radial Leaded, Surface Mount, for Commercial, Analytical, Military, and Space Level applications in NPO, X7R, and others. High Voltage Disc Capacitors in a variety of dielectrics for the same applications listed above. Custom configurations as well. US Based manufacturing company, and a partner company of Voltage Multipliers Inc.

Central Semiconductor Corp. Booth 934

145 Adams Avenue

Hauppauge, NY 11788

www.centalsemi.com

Central Semiconductor is a manufacturer of innovative discrete semiconductors since 1974. Products include standard and custom small signal and power transistors, MOSFETs, silicon carbide devices, diodes, rectifiers, protection devices, current limiting diodes, bridge rectifiers, and thyristors. Devices available in standard surface mount, through-hole and custom packages. Bare die also available.

Ceramic Magnetics, Inc./**Kolektor Magma Booth 616**

16 Law Drive

Fairfield, NJ 7004

www.cmi-ferrite.com

Ceramic Magnetics (CMI) offers a wide variety of MnZn and NiZn ferrites, specializing in custom machined cores as well as standard shapes. Our engineering and manufacturing capabilities enable CMI to develop proof of concept prototypes and then seamlessly ramp to full-scale production.

Chroma Systems Solutions, Inc. . . Booth 1309

19772 Pauling

Foothill Ranch, CA 92610

www.chromausa.com

Chroma is the world leading provider of automated test systems and power test instrumentation including AC/DC Power Sources, Electronic Loads, Power Meters, and Hipot testers for diverse bench-top, R&D and design verification of EV/PHEV, Solar, LED, Battery, Medical, and Power Supply applications. Visit us at booth #1309 or www.ChromaUSA.com.

Cirasys, Inc. Booth 1407

17217 Waterview Pkwy.
Suite 1.202C
Dallas, TX
www.cirasys.com

Cirasys superior performance converters use nonlinear control methods instead of traditional PID/Type III controls, giving their converters inherent stability, faster response, greater bandwidths, and new features such as built-in envelope tracking for higher efficiency. For buck, boost & buck-boost topologies, DC-DC or AC/DC variants, any power level, digital or analog.

CogniPower Booth 918

3217 Phoenixville Pike
Malvern, PA 19355
www.cognipower.com

CogniPower has developed improved controls for switched mode power converters. These controls enable inherently stable power conversion with exceptional speed, agility, and efficiency. CogniPower control loops can run 50 times faster than conventional controls, making them an excellent match for next-generation switches. Controls are scalable from mW to kW.

Coil Winding Specialist, Inc. Booth 632

353 West Grove Ave
Orange, CA 92865
www.coilws.com

Coil Winding Specialist or CWS started as a design center for custom inductors, chokes, coils and transformers in the early 1980's. Its original objective was to provide custom designs for engineers in need of inductive and transformer products in a hurry.

Coilcraft Booth 1107

1102 Silver Lake Road
Cary, IL 60013
www.colicraft.com

Coilcraft is a leading global supplier of magnetic components including, power magnetics, filters and high performance RF chip inductors. Bring your magnetics questions and see what's new:

- XAL/XFL high-performance molded power inductors
- High-isolation transformers
- New planar magnetics
- Coupled inductors
- AEC-Q200 magnetics for automotive

Coiltron, Inc. Booth 1511

6755 SW Sandburg Street
Tigard, OR 97223
www.coiltron.com

Our expertise in design/manufacture of magnetics, satisfying customer's needs, design issues, and deadlines, is why Coiltron has built long standing relationships with a wide range of world recognized names.

We take pride in our long history of customer satisfaction.

Coiltron makes the parts that power the world's greatest devices

Component Distributors, Inc. (CDI) Booth 1237

2601 Blake Street, Suite 450
Denver, CO 80205
www.cdiweb.com

Component Distributors, Inc. delivers technical solutions that are easy to find and easy to buy. CDI is a value-added distributor of power electronics, including power supplies, power ICs, passive components, batteries, thermal management and design services. CDI distributes globally and provides local customer service and application support across the Americas.

Core Technology Group, Inc. Booth 921

140 Independence Lane
Chalfont, PA 18914
www.coretechgroup.com

Core Technology Group, Inc., a Test and Measurement Design and Manufacturing company, brings you the SA and RA Series, Swept Frequency Network/Impedance Analyzers, that give you the power to make high quality frequency domain and impedance measurements on your electronic, mechanical, electro-chemical, micro and nanotech systems, at a very low cost.

Cornell Dubilier Booth 400

140 Technology Place
Liberty, SC 29657
www.cde.com

Cornell Dubilier is a North American capacitor manufacturer with three ISO 9001 certified facilities and a sales liaison office in Shenzhen, China. Its principal market is power electronics and it is the largest aluminum electrolytic screw terminal capacitor supplier in the US. Major capacitor types are aluminum electrolytic, polypropylene film, polyester film, mica, pulse, snubber, motor-run, motor-start and high voltage capacitors.

Cosmo Ferrites Ltd Booth 1220

Cosmo Ferrites Limited (CFR), leading and reputed soft ferrite core manufacturer based in India. CFR aim's to be the market leader in Soft Ferrite business by becoming preferred supplier through technological, operational & service excellence. Our product range serves applications in Lighting, Power, Automotive and Solar Industry.

COTEK Electronic Ind. Co., Ltd. . . . Booth 133

No. 33, Sec. 2, Renhe Rd.
Daxi Township
Taoyuan County, 33548
www.cotek.com.tw

Cotek Electronics Industries, a Taiwanese based company for almost three decades, is committed to providing innovative products for your applications. In Kepco's partnership with Cotek, we offer a wide range of power supply products: AC/DC, Din Rail, Medical Approved, and Dual Output Smart Battery Chargers. Please visit us at Booth 133.

CPS Technologies Booth 533

111 South Worcester Street
Norton, MA 2766
www.alsic.com

CPS Technologies Corporation is the worldwide leader in the design and high-volume production of AlSiC (aluminum silicon carbide) for high thermal conductivity and device compatible thermal expansion. AlSiC thermal management components manufactured by CPS include Hermetic electronic packages, Heat sinks, Microprocessor & Flip chip heat spreader lids, Thermal substrates, IGBT base plates, Cooler baseplates, Pin Fin baseplates for Hybrid Electric Vehicles (HEV), and many others!

Cramer Coil & Transformer Co. Inc. Booth 1519

401 N. Progress Drive
Saukville, WI 53080
www.cramerco.com

Cramer Coil & Transformer is dedicated to supplying repeatable, high quality, cost effective magnetics solutions. Our state-of-the-art design capabilities and safety agency expertise allows for the efficient generation of custom high frequency wire wound and planar magnetic designs for the most demanding switch mode power supply applications.

Cree, Inc. Booth 1417

4600 Silicon Drive
Durham, NC 27703
www.cree.com/power

Cree is the world's leader in silicon carbide power semiconductors. Cree's devices excel where low switching loss is required allowing systems to achieve ultra-high efficiency and high switching frequency to reduce system size, weight and cost. Cree products include zero recovery rectifiers (Z-Rec™) with breakdown voltages of 600V, 650V, 1200V and 1700V. With our first to market introduction of SiC MOSFETs (Z-FET™) we deliver the lowest possible Rds(on) and capacitance for the highest possible switchin

CUI Inc Booth 206

20050 SW 112th Ave.
Tualatin, OR 97062
www.cui.com

CUI is a technology company focused on the development and distribution of electronic components. At the leading edge of power supply design, the organization supports customers as they strive to improve the energy efficiency and environmental credentials of their application.

Daco Semiconductor Booth 1403

No. 28-4, Cheng-Tien Road
Taipei City,
www.dacosemi.com.tw

Daco is a pioneer manufacturer of wafer fabrication & diode assembly in Taiwan specializing in Rectifier Diode, Schottky, Thyristor, Silicon Carbide and diversified device from small signal to power modules up to 1000 amperes, and has been dedicating to the development toward green energy solution and following customer's vision with innovative products and quality service.

Danfoss Silicon Power GmbH Booth 309

Husumer Strasse 251
Flensburg, 24941
www.powermodules.danfoss.com

Danfoss Silicon Power designs and manufactures customer specified power modules for power conversion OEMs serving the automotive, industrial, medical and renewable energy market spaces. Danfoss' capabilities range from custom circuit topologies in standard packaging to custom packages and interconnects for the automotive industry. Danfoss' quality system is certified to ISO/TS-16949.

Datatronics Booth 723

28151 Highway 74
Romoland, CA 92585
www.datatronics.com

Datatronics designs and manufactures the broadest line of wirewound magnetic devices for customers worldwide. Products include SMPS transformers, SMD and thru-hole inductors, common mode chokes, gate drive transformers, current sense transformers and pul

**Dau Thermal Solutions
North America Booth 1305**

1657 East Park Drive
Macedon, NY 14502
www.dauusa.com

World leader in the design, and manufacturing of thermal management solutions for the power electronics industry: copper/aluminum liquid and air-cooled heat sinks, hybrid heat sinks, heat pipes, heat pipe heat exchangers, heat frames and ruggedized electronic chassis.

Dean Technology, Inc. Booth 1301

3227 Skylane Drive
Carrollton, TX 75006
www.hvca.com

Dean Technology specializes in the manufacture of high voltage components, assemblies and power supplies. Its three product lines (HVCA, CKE, and HVPSI) provide high voltage diodes, bridge rectifiers, ceramic capacitors, MOVs, selenium suppressors, silicon carbide varistors, high voltage power supplies, multipliers, test equipment, and custom components and assemblies.

Dearborn Electronics Inc. Booth 106

1221 N. Highway 17-92
Longwood, FL 32750
www.Dearbornelectronics.com

Dearborn Electronics, Inc. an Exxelia Group, designer and manufacturer of innovative electronic and electromechanical solutions. For over 50 years, Exxelia Group has been focusing its business on the design and manufacture of innovative high-tech solutions offering the highest levels of reliability: capacitors, filters, precision mechanics, position sensor and slip rings, and wound magnetic components. These products are manufactured to meet the requirements of space, aeronautics, defence, rail, medical, manufacturing, energy and telecommunications sectors.

Dexter Magentic Technologies . . . Booth 1508

1050 Morse Avenue
Elk Grove Village, IL 60007
www.dextermag.com

Dexter Magnetic Technologies was founded as Permag Corporation in 1951 as the FIRST global magnetic materials distributor.

Since then, Dexter Magnetic Technologies has become your essential magnetic partner. The company's growing supply chain offers the most diverse offerings of current magnetic materials. Our experienced engineers and support staff can help you choose the correct "off-the-shelf" components, or assist in a custom, cost effective solution to your needs.

Learn more about Dexter and its magnet products at www.dextermag.com.

Dino-Lite Scopes (BigC) Booth 736

20655 S. Western Av. Ste. 116
Torrance, CA 90501
www.dinolite.us

Dino-Lite portable digital microscopes and eyepiece cameras provide high-quality microscopy video interfacing to PC and MAC with clear and steady imaging. Most models provide 10x-200x along with a multitude of software features. The included DinoCapture software makes it easy to take snapshots, record videos, manipulate images, save and email discoveries.

Ducati Capacitors Booth 1505

www.ducatienergia.it

DUCATI Energia produces AC & DC capacitors for power factor correction and power electronics applications with high current and harmonic distortion including inverter, filtering, switching, high power lighting, traction and railways, welding, PFC with high voltage and high harmonic applications. Presenting New High-Temperature, High Capacity DC-Link PP Film Capacitors

EACO Capacitor Booth 1323

www.eaco.com

EACO is a professional manufacturer of power electronic film capacitors. We have snubber capacitors. DC-link capacitors, AC-filter capacitors etc. We are committed to offering our customers reliable and high quality products with fast delivery of 2 weeks at a competitive price.

EBG Resistors Booth 1303

460 Spruce Street
P.O. Box 519
Middletown, PA 17057
www.ebgusa.com

EBG RESISTORS LLC is a leading manufacturing resource of standardized and customized precision, high voltage (to 100kV), high power (to 1700W) Non-Inductive Thick Film resistors. Producing highly reliable resistors for; regen, dynamic breaking, motor drives, aerospace, medical, and numerous commercial applications, focusing on innovative resistors for today's engineer.

ECI Booth 823

53 Main Line Drive
POB 1536
Westfield, MA 1086
www.eciworld.com

Since 1947 we have been manufacturing electromagnetic components (transformers, coils, inductors, chokes, antenna's and planar magnetics) for a variety of OEM's in the military/aerospace, commercial, industrial and automotive markets. With facilities in the USA and Europe, we are able to meet almost any of our global customer's service requirements.

ECU Electronics Industrial Co., Ltd. Booth 1333

No. 41 TianZhi Rd., Huadian Building
Hefei, 230088
www.ecu.com.cn

ECU Electronics Industrial Co. Ltd (ECU) has been committed to providing integrated professional power solutions since its establishment in 1992, focusing on research, manufacturing and marketing of AC – DC converters and DC-DC converters. Our products have UL/CE/TUV/CCC certification, exported to worldwide, eg. USA, Europe, Australia, etc.

EFC/WESCO Booth 1021

41 Interstate Lane
Waterbury, CT 6705
www.filmcapacitors.com

EFC/Wesco is a North American based, ISO 9001-2008 Certified manufacturer of standard and custom film capacitors. We are a leading supplier for the power electronics, instrumentation, and surge suppression markets. Products include Metallized and Film/Foil caps, RC Networks, EMI Suppression caps and now introducing DC-Link caps.

Efficient Power Conversion Corporation (EPC) Booth 1405

909 N. Sepulveda
Suite 230
El Segundo, CA 90245
www.epc-co.com

Efficient Power Conversion (EPC) is the leading provider of gallium nitride (GaN)-based power management technology and is doing more than just improving efficiency of electrical power. In booth 1405, EPC will be showcasing GaN-based applications including wireless power, high-speed mobile communications, low cost satellites, and high power density DC/DC converters.

Egston System Electronics Eggenburg Booth 537

Grafenberger Str. 37
Eggenburg, 3730
www.egston.com

EGSTON is a medium-sized company in Lower Austria and a high quality manufacturer of Inductive component parts, Cable systems, Power Supply units and Chargers and Power Electronics.

There are production plants in the Czech Republic, China and India.

- Global distribution
- ISO 9001 ISO/TS 16949 certification
- Employees: 1.110
- Turnover in 2013: EUR 44,9 Mio.

Electrocube, Inc. Booth 833

3366 Pomona Blvd.
Pomona, CA 91768
www.electrocube.com

Electrocube is a design manufacturer of power electronic passive components with proven integrity and industry know-how for over 54 years; including Film Capacitors, RC networks, EMI Filters, Foil Transformers, Audi-optimized Capacitors, and TRUs. Products in service worldwide in land, sea, air and space, in commercial, industrial, and military applications. ISO9001 and AS9100C quality certified. Approved supplier to Boeing, GE, Honeywell, Raytheon, Eaton, and others.

Electronic Concepts, Inc. Booth 704

526 Industrial Way West
Eatontown, NJ 7724
www.ecicaps.com

Electronic Concepts is the recognized leader in film capacitor design and manufacture. Our vertical integration and innovative design capability offers the flexibility to meet your most demanding requirements and applications. Our latest development is on film capacitors operating at 125°C, 150°C and 175°C.

Electronic Systems Packaging Booth 635

1175 W. Victoria Street
Rancho Dominguez, CA 90220
www.espbus.com

Electronic Systems Packaging is a manufacturer of laminated bus bars, IGBTs, linear motor tracks and magnet rotor assemblies to commercial and military industries. With over 30 years of experience, ESP can provide prototypes and high volume production at a competitive cost. ESP has manufacturing facilities in California and in Beijing, China.

Elna Magnetics Booth 622

203 Malden Turnpike
Saugerties, NY 12477
www.elnamagnetics.com

Elna Magnetics is an authorized distributor and full service manufacturer of quality magnetic components in standard and non-standard core shapes for the electronics industry. Our custom machining services provides prototyping or large production runs, as well as high quality assembly and bonding techniques. We also are an authorized distributor for Magdev permanent magnets.

Powerful products for a Powerful Market.

Enargy Power Co. Ltd. Booth 1437

2303 Camino Ramon
San Ramon, CA 94583
www.enargycorp.com

Enargy Power is a leading supplier of power conversion solutions in Shenzhen, China. It carries an incredibly broad range of DC-DC converters and AC-DC power supplies, with over 2,000 models in product line. Currently Enargy Power manufactures both standard and customized high density and high power multiple output modules.

Exar Corporation Booth 428

48720 Kato Road
Fremont, CA 94538
www.EXAR.com

Exar Corporation designs, develops and markets high performance integrated circuits and system solutions for the industrial and embedded systems communications, high-end consumer and infrastructure markets. Exar's broad product portfolio includes analog, display, LED lighting, mixed-signal, power management, connectivity, data management and video processing solutions. Exar has locations worldwide providing real-time customer support. For more information, visit www.exar.com.

Fairchild Semiconductor Booth 905

3030 Orchard Pkwy
San Jose, CA 95134
www.fairchildsemi.com

Fairchild manufactures a complete portfolio of low- to high-power solutions for delivering an amazing design experience to engineers building mobile, industrial, cloud, automotive, lighting, and computing systems. Visit us at APEC 2015 and learn how, together with our customers, we are making the world a cleaner and smarter place.

Fair-Rite Products Corp. Booth 329

1 Commercial Row
P.O. Box 288
Wallkill, NY 12589
www.fair-rite.com

For over fifty years Fair-Rite Products Corp. has been the first choice in cost effective ferrite components. We offer a comprehensive product line that includes a wide range of materials and geometries for EMI Suppression, Power Applications, and RFID Antennas. We place the highest value on quality, engineering, service, and continual improvement. Fair-Rite Products Corp. supplies a wide variety of standard catalog ferrite parts to thousands of customers worldwide.

Ferroxcube USA, Inc. Booth 1016

1200 Golden Key Circle
Suite 233
El Paso, TX 79925
www.ferroxcube.com

Leading in soft ferrite technology building on our Philips magnetic components heritage, FERROXCUBE can offer customers the highest level of support in the development of their new innovative designs. Our competencies cover soft ferrite products, materials, and accessories. All are developed to meet today's demanding high-frequency, low-loss and environmental requirements.

FRAKO Capacitors Booth 737

1200 Golden Key Circle
Suite 233
El Paso, TX 79925
www.Frako.com

Since 1928 FRAKO has been the world's premier producer of AC Power Factor Capacitors & Harmonic Filter Capacitors.

Triple safety protection, high current capability and high ambient temperature ratings are combined to deliver dependable performance under extreme conditions. UL/CSA/IEC approvals; 240-800V; 50/60Hz; 1-30 kvar. Capacitors, Power Quality Controller, Capacitor Modules

Freescale Semiconductor Booth 1118

6501 William Cannon Drive West
Austin, TX 78735
www.freescale.com

Freescale is a global semiconductor company enabling the Internet of Tomorrow. We develop solutions to provide secure efficient connections, safer and greener automobiles, and add intelligence to everyday items. As a leader in processing and sensing solutions, we are driving a more innovative and connected world for the future.

Fuji Electric Corp. of America Booth 619

50 Northfield Avenue
Edison, NJ 8837
www.americas.fijielectric.com

Fuji Electric Corporation of America is dedicated to provide quality products with superior customer service. Our extensive product line includes, IGBT Modules and IPM (Intelligent Power Modules) for industrial application, IGBT modules for automotive application, Power MOSFET, Super junction MOSFET, Fast-recovery diodes.

GAN Systems Booth 1408

1145 Innovation Dr. Suite 101
#501
Ottawa, ON K2K 3G8
www.gansystems.com

GaN Systems is the first place systems designers go to realize all the benefits of gallium nitride in their power conversion and control applications. We develop the most complete range of gallium nitride power switching transistors for a wide variety of markets. Our unique Island Technology® addresses today's challenges of cost, performance, and manufacturability resulting in devices that are smaller and more efficient than other GaN design approaches.

Gecko-Simulations Booth 120

Physikstrasse 3
Zurich,
www.gecko-simulations.com

Gecko-Simulations AG is developing tools in the field of multi-domain numerical simulation and design of power electronic systems. Our aim is to be a leading company in the field of virtual prototyping – thus helping to get your power electronics product from idea to hardware in a way that is faster, cheaper, and smarter. Gecko-Simulations currently offers the circuit simulator GeckoCIRCUITS and the magnetic design tool GeckoMAGNETICS.

GENTEQ Booth 519

1265 Peter Cooper Drive
El Paso, TX 79936
www.genteqcapacitors.com

Global Choice International LLC Booth 119

1699 Wall Street
Suite 119A
Mount Prospect, IL 60056
www.globalchoice.me

We produce and export various SMD or normal coil, inductor, current /voltage transformer, relay used for

electric controller system PCB, UPS ect. Such as electric meter, equipment PCB. In the meantime, we also produce metal parts and plastic parts as user's need. If you give us your specific requirements, such as technical data and outside dimension ect, We can supply sample for your test. OEM is

acceptable.

Global Foundries Booth 620

2600 Great America Way
Santa Clara, CA 95128
www.globalfoundries.com

GLOBALFOUNDRIES is the world's first full-service semiconductor foundry with a truly global footprint. Launched in March 2009, the company has quickly achieved scale as the second largest foundry in the world, providing a unique combination of advanced technology and manufacturing to more than 160 customers. With operations in Singapore, Germany and the United States, GLOBALFOUNDRIES is the only foundry that offers the flexibility and security of manufacturing centers spanning three continents. GLOBALFOUNDRIES is owned by Mubadala Development Company

Global Power Technologies Group Booth 718

20692 Prism Place
Lake Forest, CA 92630
www.gptechgroup.com

GPTG Silicon Carbide (SiC) technologies "makes low cost SiC products" for the commercial Power and Energy market. GPTG is a vertically integrated SiC semiconductor company. Under this structure, SiC technology is expected to be fully and economical for Power Design Engineers. With GPTG's portfolio of SiC Discrete products like Mosfet and Schottky Diodes. GPTG also makes SiC modules and also SiC sub- Systems to Reduce size. GPTG is also a low cost provider of SiC Epitaxial wafers in 100 MM, 150 MM, and coming soon 200MM.

GMW Associates Booth 416

955 Industrial Road
San Carlos, CA 94070
www.gmw.com

Current sensors and transducers from uA to kA and dc to 2GHz for development, test, QA, power measurement and OEM. Magnetic field sensors for current and position indication. Transducers and instruments for magnetic field measurement with application to field mapping, quality control and non-contact machine condition monitoring.

Gowanda Electronics Booth 237

One Magnetics Parkway
Gowanda, NY 14070
www.gowanda.com

Gowanda Electronics is a US-based manufacturer of power & RF inductors, transformers and application-specific magnetics. Capabilities: custom-molding/winding/prototyping, Class 100,000 cleanrooms, environmental test lab, ISO13485/AS9100/ISO9001 standards. Markets: communications, medical, military-aerospace, space, test equipment. Products from TTE Filters (RF & microwave filters) and Instec Filters (EMI/RFI filters) also featured. Affiliates of gowandaholdings.com.

**GRAPES- GRid-connected
Advanced Power Electronics Booth 1402**

2055 South Innovation Way – NCREPT
Fayetteville, AR 72701
www.grapes.uark.edu

GRAPES is an NSF Industry/University Cooperative Research Center focused on accelerating the adoption and insertion of power electronics into the electric grid. Our university-based researchers partner with component manufacturers, equipment providers and power users to research industry-relevant topics and produce exceptional students to join the power industry.

Heraeus Materials Technology . . . Booth 1533

1901 U.S. Highway 130
North Brunswick, NJ 08902
www.hst-us.com

**Hengdian Group DMEGC
Magnetics Co., LTD Booth 820**

c/o ASL Technologies Inc.
14568 Rutledge Sq.
San Diego, CA 92128
www.chinaDMEGC.com

DMEGC is China's #1 leading soft magnetism producer with more than 40,000 Ton out put and more than 20 factories. Its own R&D design center provide cutting edge new materials. Material including Mn-Zn, Ni-Zn, Iron Power and Alloy power series with shapefor all ranges to support application in power, telecoms, LAN, Automotive, medical and etc. The best volume, quality and cost ratio bring value customers all over the world. Please contact us for more information.

**Heraeus Electronic
Materials Division Booth 1531**

One Summit Square
Suite 403
Langhorne, PA 19047
www.thickfilm.net

Heraeus Electronics is a material supplier for the power electronics industry. We provide high current carrying thick film pastes to make your own power electronic circuits as well as roll clad strips combining the properties of two or more metals to provide a reliable bond between casing and hybrid.

Hesse Mechatronics, Inc. Booth 1221

225 Hammond Ave.
Fremont, CA 94539
www.hesse-mechatronics.us

Hesse Mechatronics manufactures heavy and fine wire and ribbon bonders for power electronics and other microelectronics applications. Wire types include aluminum, gold and copper in both round wire and ribbon including HCR™ (High Current Ribbon). Our industry lead in ultrasonics is applied to our wire bond quality monitoring PiQC System.

Hoffmann Booth 233

Au 62
Bad Goisern, 4822
www.aluminium-graphite.com

Hoffmann is a world leader in the development and production of carbon and graphite materials and components. Aluminium Graphite (ALG) is our new, cutting-edge product for the power electronics industry. This composite material is an ideal thermal management solution in high reliability applications.

Holy Stone International Booth 1332

41700 Ivy Street
Suite D
Murrieta, CA 92562
www.holystonecaps.com

Holy Stone Enterprise Co., Ltd is a leading manufacturer of multilayer ceramic capacitors. Core competency product lines include: smt and through hole X and Y safety certified, high voltage, and high capacitance devices. 0201 to 3640 sizes up to 100uf and 8KVDC in NPO, X5R, X6S, and X7R temperature coefficients.

**HVR Advanced Power
Components, Inc. Booth 1122**

1307 Military Road
Tonawanda, NY 14217
www.hvrpc.com

HVR provides cost-effective engineered solutions for high-stress resistor applications. Application areas include: Industrial, T&D, Research, Transportation, and Medical. Our solid composition resistors inherently provide high voltage solutions, non-inductance and high peak power. We will utilize our decades of experience and unique materials approach to engineer a low-cost application-specific solution.

IAS Booth 1399

445 Hoes Lane
Piscataway, NJ 08854
www.ias.ieee.org

I.C.T. Power/ Innovation Plus Booth 1507

1220 Corporate Drive
Burlington, ON L7L 5R6
www.ictpowerusa.com

I.C.T. Power – a leader in power conversion solutions for over 20 years. Our technical salesforce facilitate solutions based on both standard and custom power electronic components. Products include power semiconductor & assemblies, semiconductor clamps, power film and electrolytic capacitors, thermal management, resistors, fuses, reactors, filters and laminated bus bars.

ICE Components, Inc. Booth 1206

1165 Allgood Road
Suite 20
Marietta, GA 30062
www.icecomponents.com

ICE Components, Inc. is a leading manufacturer of standard and custom magnetic components and current sensors for use in both high and low power applications. Our broad line includes many best in class products. Stop by our booth to learn more.

Iconopower Booth 1505

1051 Ages Drive
Ottawa, Ontario K1G 6L3
www.iconopower.com

One of the largest stocking distributors of Power Electronic Components in North America – Power Semiconductors (Diode, SCR & IGBT), AC & DC Power Electronic Capacitors manufactured by Ducati Capacitors, Thermal Management Products & Clamps and customized assemblies. Providing quality products and innovative solutions worldwide for four decades.

Illinois Capacitor Inc. Booth 720

3757 W. Touhy Avenue
Lincolnwood, IL 60712
www.illcap.com

Illinois Capacitor is a leading manufacturer of capacitors for electronic applications. Offering leading-edge aluminum electrolytic, EDLC/supercapacitors, film and other high/medium power film capacitors with many packages and termination options. New for APEC 2015: custom supercapacitor modules, DC Link modules and aluminum polymers with the highest voltage and capacitance ranges anywhere.

Indium Corporation Booth 335

34 Robinson Road
Clinton, NY 13323
www.indium.com

Indium Corporation is a premier materials manufacturer and supplier to the global electronics, semiconductor, solar, thin-film, and thermal management markets. Products include solders and fluxes; brazes; thermal interface materials; sputtering targets; indium, gallium, germanium, and tin metals and inorganic compounds; and NanoFoil®. Founded in 1934, Indium has global technical support and factories located in China, Malaysia, Singapore, South Korea, the United Kingdom, and the USA.

Infineon Booth 509

640 N. McCarthy Blvd.
Milpitas, CA 95035
www.infineon.com

Infineon Technologies is a world leader in semiconductors offering products and system solutions addressing three central challenges to modern society: energy efficiency, mobility, and security. Explore our wide portfolio of high-end products for switched mode power supply, motor control, MOSFETs and more. For more information visit: www.infineon.com

Infolytica Corporation Booth 422

300 Leo-Pariseau, Suite 2222
Montreal, QC
www.infolytica.com

Infolytica Corporation is the developer of MagNet 2D/3D, the leading electromagnetic field simulation software, and ElecNet 2D/3D for electric fields. Some typical design applications include transformers, motors, DC-DC converters, sensors/NDT and much more.

INTEGRATED Engineering Software Booth 517

220-1821 Wellington Avenue
Winnipeg, MB R3H0G4
www.integratedsoft.com

Since 1984, INTEGRATED Engineering Software has offered an innovative, world-class suite of complete solutions for engineering and scientific designs involving multiple disciplines – creating simulation software programs that analyze a full spectrum of physical problems. INTEGRATED Engineering Software is a leading developer of complete solutions for engineering and scientific designs. Visit www.integratedsoft.com to learn more.

Intepro Systems Booth 836

14712-A Franklin Ave.
Tustin, CA 92780
www.inteproATE.com

Intepro Systems Power Electronics ATE has provided an open hardware and software architecture that virtually eliminates obsolescence risks for the military and aerospace battery, power supply, and power component testing. Intepro Systems also provides card level loads, high power stand-alone loads, and cost effective AC sources.

International Rectifier Booth 705

101 N. Sepulveda
El Segundo, CA 90245
www.irf.com

International Rectifier, an Infineon Technologies company, offers analog and mixed signal ICs, advanced circuit devices, integrated power systems and components. Leading manufacturers of computers, appliances, lighting, automobiles, satellites, aircraft and defense systems rely on IR's energy-efficient power management solutions to power their next-generation products. For more information, go to www.irf.com.

Intersil Corporation Booth 500

1001 Murphy Ranch Road
Milpitas, CA 95035
www.intersil.com

Intersil Corporation is a leading provider of innovative power management and precision analog solutions. With a deep IP portfolio and a rich history of innovation, Intersil is the trusted partner to leading companies in the industrial and infrastructure, mobile computing, automotive and aerospace markets. Learn more at www.intersil.com.

Intertape Polymer Group Booth 521

100 Paramount Drive
Suite 300
Sarasota, FL 34232
WWW.ITAPE.COM

Intertape Polymer Corporation is one of the largest pressure sensitive tape manufacturers in the world. In addition, a broad selection of heat shrink and stretch films, coated fabrics and films complement the pressure sensitive tapes offering. Our products touch many industries including electrical and electronics manufacturers, as well as fulfillment, industrial manufacturers, water retention, food processing plants, steel and other metal working facilities, etc.

**Isotek Corporation,
Subsidiary of Isabellenhutte Booth 218**

1199 G.A.R. Highway
Swansea, MA 2777
www.isotekcorp.com

Isotek (Swansea, MA) is a subsidiary of Isabellenhutte (Dillenburg, Germany). Isotek supplies low ohmic, high current sensing and high power dynamic braking resistors to the industrial, automotive and energy markets.

Iwatsu Test Instruments Booth 1134

1-7-41 Kugayama
Suginami-ku
Tokyo, 168-8511
http://www.iti.iwatsu.co.jp/index_e.html

Power electronics and it's managements nowadays such as inverters for train, PV(photovoltaic), EV(electrical vehicle), etc. we manufacture a wide range of electronic testing equipment and systems such as semiconductor curvetracers, magnetic property analyzers, highvoltage isolated probes to cover various types of demands from industries and research for energy- efficient power managements.

JARO Thermal Booth 128

6600 Park of Commerce Blvd
Boca Raton, FL 33487
www.jarothermal.com

In a world where the internal temperatures of electronics continue to rise, Jaro Thermal responds with a broad range of innovative, cutting-edge cooling technologies, designed to extend the life of electronic components across many different industries and applications.

JFE Steel Corporation Booth 134

Hibiya Kokusai Bldg. 2-3
Uchisaiwai-cho, 2chome, Chiyoda-ku
Tokyo,
<http://www.jfe-steel.co.jp/en/index.html>

JFE Steel Corporation will exhibit Super Core which is the highest grade, non-oriented magnetic steel sheets available.

Super Core is ideal for applications in high-frequency reactors, transformers and so on. If you are interested in our material, please stop by our booth.

Jianghai Capacitor Co. LTD Booth 1532

3929 Palisades Blvd.
Ypsilanti, MI 48197
www.jianghai.com

Johanson Dielectrics, Inc. Booth 1035

4001 Calle Tecate
Camarillo, CA 93012
<http://www.johansondielectrics.com/>

Johanson Dielectrics specializes in application-specific ceramic capacitor solutions for high voltage and high power applications. Our broad capacitor offering includes: High voltage, low inductance, high temperature, planar, discoidal, safety certified, switchmode, numerous leaded configurations and custom form factors as well as X2Y EMI filters. Contact Johanson for your challenging capacitor requirements.

John Deere Electronic Solutions. . . Booth 100

1441 44th Street N
Fargo, ND 58102
JohnDeere.com/JDES

John Deere Electronic Solutions (JDES) differentiates John Deere's global business and focuses on innovation critical to the enterprise's success. JDES provides custom and off-the-shelf electronics and power electronics for original equipment manufacturers worldwide. We develop solutions that provide reliable and rugged electronic components and systems for demanding industries.

Kaschke Components GMBH Booth 523

Rudolf-Winkel-Strasse 6
Goettingen, 37079
www.kaschke.de

Kaschke Components is one of the leading designer and manufacturer of soft magnetic materials and inductive components, located in Germany. Kaschke offers customised inductive solutions with a focus on renewable energies, smart grids and energy efficiency. The portfolio varies from tiny high frequency antenna coils up to high performance-low loss power chokes for 60KW inverters.

KDM Zhejiang Keda Magnetolectricity Co., Ltd. Booth 932

525 Quyuan Road North
Wukang Town, Deqing County
Zhejiang Prov.,
www.kdm-mag.com

China's leading alloy powder core manufacturer that specializes in Sendust (KS), Super Sendust (KS-HF), Si-Fe (KSF), Neu Flux or Super Si-Fe (KNF), Low Cost Si-Fe (KW), Nanodust (KAM, KAM-AF, KAH), MPP (KM), and High Flux (KH).

KEMET Booth 1229

2835 Kemet Way
Simpsonville, SC 18045
www.kemet.com

KEMET Electronics Corporation is a leading global supplier of electronic components. We offer our customers the broadest selection of capacitor technologies in the industry across, along with an expanding range of electromechanical devices, electromagnetic compatibility solutions and supercapacitors. Our vision is to be the preferred supplier of electronic component solutions for customers demanding the highest standards of quality, delivery and service.

Kendeil srl Booth 1509

www.kendeil.com

Kendeil is a leading producer of power electronic capacitors for wind and solar inverter applications, industrial motor drives, UPS, chargers and aluminum foil for electrolytic capacitors. Products made by advanced technology meet the highest international standards in performances and quality. Plants locations in Italy, France and India, with worldwide netsale.

Keysight Technologies. Booth 432

5301 Stevens Creek Blvd.
Santa Clara, CA 95051
www.keysight.com

Keysight Technologies (NYSE:KEYS) is a global electronic measurement technology and market leader dedicated to transforming its customers' measurement experience. This includes innovations that facilitate the design of electrical power conversion systems and enable the efficient use of power. The business had revenues of \$2.9 billion in fiscal year 2014.

KITAGAWA INDUSTRIES**America, Inc. Booth 631**

2325 Paragon Drive
Ste 10
San Jose, CA 95131
www.intermark-usa.com

KITAGAWA INDUSTRIES America, Inc. (formally Intermark USA, Inc.) is a leading provider of EMI solution products, thermal solution products, shock/vibration management products as well as plastic components. We cover a variety of electronic applications and industries including consumer products, telecom, LEDs, medical devices, power supplies, wireless devices, and automotive industry.

Knowles Capacitors Booth 1436

Old Stoke Road, Arminghall
Norwich, Norfolk,
www.knowlescapacitors.com

At Knowles Capacitors we make Multilayer, High Reliability, Single Layer and Precision Variable Capacitors, EMI Filters and Thin Film Devices. Our business was formed by combining Dielectric Laboratories, Novacap, Syfer and Voltronics, each well-established specialty capacitor makers with a combined history of over 175 years, into a single organization. Products include High-Voltage (10kV) MLCC's, HV EMI filters, High Current EMI filters, Custom thin film for GAN applications.

Leclanché Capacitors Booth 1217

Avenue De Grandson 48
Yuerdon, 1400
www.ftcap.de www.Lcap.ch

Manufacturers of power capacitors since 1919, we produce both electrolytic and film capacitors at factories in Germany and Switzerland.

We offer a large range of standard power capacitors. When standard does not fit the needs, then we are happy to suggest custom designs.

LEM USA, Inc. Booth 232

11665 W. Bradley Road
Milwaukee, WI 53224
www.lem.com

LHV Power Corporation Booth 1500

10221 Buena Vista Ave
Santee, CA 92071
www.LHVpower.com

LHV Power/Current Ways are world renowned designer and manufacturer of both low and high voltage power supply and battery charger solutions. With both USA and Asia based manufacturing capabilities, we provide quality products at competitive pricing along with the best customer service. We are an ISO 9001:2008 certified global manufacturer.

Linear Technology Corporation . . . Booth 201

1630 McCarthy Blvd.
Milpitas, CA 95035
www.linear.com

Linear Technology offers a broad line of high performance analog integrated circuits providing an essential bridge between analog and the digital electronics in communications, networking, industrial, automotive, computer, medical, instrumentation, consumer, and

military and aerospace systems. Linear Technology produces power management, data conversion, signal conditioning, RF and interface ICs, μ Module subsystems, and wireless sensor network products.

Lodestone Pacific Booth 822

4769 E.Wesley Drive
Anaheim, CA 92807
www.lodestonepacific.com

Lodestone Pacific manufactures Toroid Mounts, Headers, Bobbin and Anti Static Trays for the magnetics industry in its China factory. Lodestone Pacific also manufactures high reliability, high Q and variable shielded coilforms and is an authorized distributor for Fair-rite Products EMI/RFI ferrites, Micrometals iron powder cores, Arnold powder and tape wound cores, and P. Leo transformer tapes.

LTEC Corporation Booth 936

2880 Zanker Road, #203
San Jose, CA 95134
www.ltecusa.com

LTEC is the first and largest circuits, systems, and intellectual property analysis firm in Japan with over 30-year experience, 110+ engineers and local offices in North America and Asia. Today's globalized, highly competitive environment increases the vulnerability of intellectual property. LTEC can help protect your IP. This is our mission.

MagnaChip Semiconductor Booth 634

424, Teheran-ro
Gangnam-gu
Seoul, 135-738
www.magnachip.com

MagnaChip is a Korea-based manufacturer and designer of analog and mixed-signal semiconductor products. We have one of the broadest and deepest analog and mixed-signal semiconductor technology platforms in the industry with our 30-year operating history. MagnaChip has over 3000 patents in our portfolio and extensive engineering and manufacturing process expertise.

Magna-Power Electronics Booth 217

39 Royal Road
Flemington, NJ 8822
www.magna-power.com

Magna-Power Electronics designs and manufactures robust programmable DC power products in the USA that set industry standards for quality, size, and control. The company's experience in power electronics is reflected in its 1.5 kW to 2000 kW+ product line, quality service, and reputation for excellence.

Magnet Applications, Inc. Booth 1135

12 Industrial Drive
Du Bois, PA 15801
www.magnetapplications.com

Magnet Applications has the ability to build magnetizing fixtures, manufacture magnets, and supply machined components from our in house facilities offers a rapid prototype service. We're capable of running both ferrite and rare earth compounds from a few hundred pieces per month to more than 2 million pieces per month.

Magnetic Metals Corp Booth 1130

1900 Hayes Ave
Camden, NJ 08105
www.magneticmetals.com

Magnetic Metals, a U.S. based manufacturer, offers tape wound toroidal and cut cores, laminations for transformers and precision motors, valued added contract manufacturing services and a wide range of GFCI, ALCI and AFCI components. Established in 1942, Magnetic Metals is AS9100 and ISO9001 certified to service industrial, commercial, and defense clients worldwide.

Magnetics Booth 916

110 Delta Drive
Pittsburgh, PA 15238
www.mag-inc.com

Magnetics is a leading manufacturer of high performance soft magnetic materials including MPP, High Flux, Kool Mu®, XFLUX® and AmoFlux® powder cores, ferrite cores, and nickel-iron alloy tape wound cores. AmoFlux is a new amorphous powder core material that is ideal for power factor correction (PFC) and output chokes.

Magsoft Corporation Booth 923

1 Fairchild Square
Clifton Park, NY 12065
www.magsoft-flux.com

Thinking green? Take control of your design, adopt Magsoft's suite of CAE tools: Flux, GOT-It, PORTUNUS, InCa3D and SPEED. Design, analyze and optimize your devices and systems: motors, actuators, bus bars, electrical connections, power conversion and distribution equipment. You have ideas, we have solutions! Not just tools!

Malico Inc. Booth 236

5, Ming-Lung Road
Yangmei, 32663
www.malico.com

Malico Inc. is a leading edge material forming and thermal management company. Established in 1986, Malico has developed a unique hybrid casting process that can manufacture traditional casting parts without voids and reduce secondary machining cost. Our matured Cu-Cu and Al-Al brazing technologies can ensure no leakage, even micro leakage, for all cold plates and liquid cooling parts. For more information, visit www.malico.com

Mangoldt Reactors Booth 735

USA Technical Sales Office
W62 N248 Washington Ave.
Cedarburg, WI 53012
www.mangoldt.com

Mangoldt is the world's premier producer of UL / IEC reactors (inductors) for use in harmonic filters, alternative energy filters and capacitor banks. Mangoldt Reactors offer precise inductance, accurate design and improve the performance of power quality filters. Fast reactor quotes for: Harmonic filters, Capacitor banks, Active filters, Converters, Grid-Tie inverter, Current limiting, Inrush and Air core.

Mentor Graphics Booth 337

8005 SW Boeckman Rd
Wilsonville, OR 97070
www.mentor.com/sm

Mentor Graphics is a world leader in electronic hardware and software design solutions, providing products, consulting services, and support for electronic, semiconductor, and systems companies. The System Level Engineering Division provides upfront modeling and analysis solutions that flow seamlessly to design implementation, significantly enhancing productivity and reducing cost and risk.

Mentor Graphics – Mechanical Analysis Booth 332

8005 SW Boeckman Road
Wilsonville, OR 97070
www.mentor.com/mechanical

Mentor Graphics – Mechanical Analysis provides accurate, fast MicReD® test solutions for evaluating lifetime, quality and thermal properties of high power semiconductors (IGBTs & MOSFETs). MicReD® Power Tester 1500A combines power cycling and failure-in-progress diagnosis (Thermal Characterization – T3Ster® technology). Mentor Graphics also supplies world-leading Electronics Cooling simulation software – FloTHERM®.

Mersen Booth 1009

374 Merrimac Street
Newburyport, MA 1950
www.ep-us.mersen.com

Mersen integrates its extensive expertise in cooling and heatsink technology, laminated bus bar design and semiconductor fuses in your power electronics applications to make them safe, reliable and profitable. With industrial operations in major economic regions of the globe, Mersen's engineering teams provide local customer support with innovative best-fit solutions!

Mesago PCIM GmbH Booth 219

Rotebuehlstrabe 83-85
Stuttgart, 70178
www.pcim-europe.com

PCIM Europe is the international leading exhibition and conference for power electronics, intelligent motion, renewable energy and energy management. Recent trends and developments offer solutions for pressing problems of the industry.

Metallix Refining Booth 834

59 Avenue at the Commons
Shrewsbury, NJ 07702
www.metallixrefining.com

Metallix Refining is a Precious Metals Recycling Company that is dedicated to exceeding expectations. We strive to make the precious metals recycling process seamless; from scheduling your pick up through out the final precious metal purchase.

Methode Power Solutions Group . . Booth 605

1700 Hicks Road
Rolling Meadows, IL 60008
www.methode.com

Methode designs and manufactures range of power solutions across many industries, including Data/Telecom, Aerospace/Defense, Transportation/Construction, Renewable and Industry/Commercial Inverters. Methode's power building blocks: simple to multi-layer ed bus bars, thermal management, power connectors & cables. They can be engineered with third party components, to provide sub-assemblies/ assemblies, such as the SmartPower Stack.

MH&W Booth 1022

575 Corporate Drive
Mahwah, NJ 07430
www.mhw-intl.com

MH&W supplies the most technological advanced magnetic cores; Ferrite, Powder and Tape wound for EMI suppression, Signal processing and Power Conversion

with High Temperature/High Frequency/High Reliability applications. Tailored cores, bobbins , clamps as well as machining, gapping and grinding services are available. Make MH&W your one stop for magnetics.

Microchip Technology Inc. Booth 200

2355 W. Chandler Blvd.
Chandler, AZ 85224
www.microchip.com

Microchip Technology Inc. is a leading provider of microcontroller and analog semiconductors, providing low-risk product development, lower total system cost and faster time to market for thousands of diverse customer applications worldwide. Headquartered in Chandler, Arizona, Microchip offers outstanding technical support along with dependable delivery and quality.

Micrometals, Inc. Booth 728

5615 E. La Palma Avenue
Anaheim, CA 92807
www.micrometals.com

Micrometals, Inc. and Micrometals Arnold division offer the widest selection of shapes, sizes and materials of powder cores available. The product range recently expanded with the introduction of 147 and 160 perm Sendust (MS) material in toroid geometries up to 100mm. Custom parts welcome and sizes larger than catalog parts available.

MK Magnetics Inc Booth 1119

17030 Muskrat Avenue
Adelanto, CA 92301
www.mkmagnetics.com

Leading manufacturer of magnetic cores made with various tape ribbon including: amorphous (Metglas), nanocrystalline, silicon-steel, nickel and cobalt alloys, Cut C-cores, E-cores and toroids. Applications: inverters, filter chokes, transformers, etc. Markets: smart grid, energy storage, renewable energy, medical, aerospace/military, industrial, high energy, R&D, etc. ISO 9001:2008, RoHS, ITAR, DFARS.

Monolith Semiconductor Inc. Booth 1534

1000 Heritage Center Circle
Round Rock, TX 78664
<http://www.monolithsemi.com>

Monolith Semiconductor is a supplier of high-performance 900V and 1.2KV discrete Silicon Carbide MOSFETs and diodes. Monolith Semi's SiC devices are manufactured on an automotive-qualified 150mm CMOS line and share the quality and manufacturing systems for highest quality. Monolith is also open to design and manufacture custom SiC devices for customers.

Monolithic Power Systems, Inc. . . . Booth 421

79 Great Oaks Blvd.
San Jose, CA 95119
www.monolithicpower.com

MPS leads in high-performance power solutions. Founded in 1997, MPS pioneered integrated power semiconductor solutions and delivery architectures. MPS provides innovative power solutions in Cloud Computing, Telecom, Industrial, Automotive, and Consumer Market Segments. MPS has offices in the US, China, Taiwan, Korea, Japan, and Europe.

MORNSUN America LLC Booth 1233

13 Country Club Lane
Suite C
Milford, MA 01757
www.mornsunamerica.com

Mornsun America LLC, a leading manufacturer of DC-DC, AC-DC converter, isolation amplifier; LED driver and RS232/CAN/485 transceivers, as well as EMC components.

Mornsun's products are widely used in industrial, automation, instrumentation, power systems, IGBT/ SiC gate drivers, Renewable energy, medical and automotive devices and other commercial applications.

Mouser Electronics, Inc. Booth 316

1000 N. Main Street
Mansfield, TX 76063
www.mouser.com

Mouser Electronics is the global authorized distributor with the newest semiconductors and electronic components, including the latest power electronics components. With over 500 manufacturers on its linecard, Mouser caters to design engineers and buyers, and offers fast, same day shipping. To learn more, visit www.mouser.com

MPS Industries, Inc. Booth 1133

19210 S. Vermont Ave
Bldg. D Suite 405
Gardena, CA 90248
www.mpsind.com

MPS Industries is a leading manufacturer of magnetic components with a broad product line of standard and custom transformers, inductors, common mode chokes, and current sensors. Our U.S. based engineering team is highly experienced in a wide variety of power applications and industries.

MTL Distribution Booth 1328

23167 Temescal Canyon Road
Corona, CA 92883
www.mtldistribution.com

With 26 years of experience, MTL is an authorized distributor of magnetic cores and associated hardware for Magnetics Inc and powder iron toroid cores for Micrometals-Arnold. We also provide value-added custom machining services for clients with special requests or short lead time requirements. Our friendly staff is dedicated to providing the highest quality service with flexible pricing and delivery options to help meet our customer's needs.

NEC TOKIN America Inc. Booth 1428

2460 North First Street
Suite 220
San Jose, CA 95131
www.nec-tokin.com

We manufacture higher performance capacitors and Inductors for today's compact and sophisticated mobile computers and Smartphones.

NEC TOKIN:

- Material-based device creation company
- Japan-oriented manufacturing
- Solution-providing company
- Devices Thru Material Innovation – Solutions for tomorrow

New England Wire Technologies Booth 1123

130 North Main Street
Lisbon, NH 3585
www.newenglandwire.com

New England Wire Technologies is a privately held, employee owned manufacturing company whose technical staff expertly assists in design, development and testing of specialty wire and cable products to meet exacting customer specifications for applications in medical, automotive, communications, computer, industrial electronics, robotics and high-energy physics industries.

NH Research, Inc. Booth 1116

16601 Hale Avenue
Irvine, CA 92606
www.nhresearch.com

NH Research designs and manufactures diagnostic test equipment used to functionally test several types of electronic power devices such as EV/HEV batteries, DC power supplies, converters, telecom rectifiers, chargers, adapters, inverters and UPSs. NHR test equipment consists of power instruments such as AC and DC programmable loads as well as automated test systems controlled through a full-featured test executive on a PC. Applications include production test, engineering characterization, agency certification/qualification, and depot repair.

Niagara Thermal Products **Booth 234**

3315 Haseley Drive
Niagara Falls, NY 14304
www.niagarathermal.com

Building upon more than 30 years of design and manufacturing experience in high performance heat exchangers, cold plates, heat sinks and heat transfer fin, Niagara Thermal Products has continued to evolve into a leading supplier of custom thermal solutions for a diverse array of markets and applications.

Nichicon **Booth 535**

927 E. State Parkway
Schaumburg, IL 60173
www.nichicon.com

Nichicon is a world leader in the manufacture of Aluminum Electrolytic Capacitors, Film Capacitors, Functional Polymer Capacitors and EDLC capacitors. We are your source for all your power conversion capacitor needs. Stop by our booth to discuss your project with our professional team and register for a free capacitor design kit.

NORWE, Inc **Booth 628**

P.O. Box 2511
2813 Carrington Street NW
North Canton, OH
www.norwe.com

NORWE is a leading manufacturer of Standard and Custom designed thermoplastic Bobbins for Ferrites & Laminations, SMD components and accessories. All Products comply with the RoHS Directive 2011/65/EU (Lead-Free). NORWE is certified according to DIN EN ISO 9001:2008, DIN EN ISO 14001:2009 and UL 746D.

NXP Semiconductors **Booth 1101**

1109 McKay Drive
San Jose, CA 95131
www.nxp.com

The electronics industry is being driven by four mega trends that are helping shape our society: Security, Connectivity, Mobility and Energy Efficiency. Connecting to these trends and enabling Secure Connections for a Smarter World, NXP Semiconductors (NASDAQ: NXP) creates solutions for the Connected Car, Security, Portable & Wearable and the Internet of Things.

Oak Ridge National Laboratory **Booth 1517**

www.ornl.gov

Oak Ridge National Laboratory's Power Electronics and Electric Machinery Group provides advanced technology applications for R&D. Areas of expertise include:

transportation, grid, and renewable energies with a main focus on electric drive technologies. Our team and its laboratories foster collaborations using innovative analysis, simulation and modeling, and testing.

Ohmite MFG **Booth 402**

85 W. Algonquin Rd.
Suite 230
Arlington Heights, IL 60005
www.ohmite.com

Ohmite Manufacturing Company has been a leading provider of resistors for high current, high voltage and high energy applications for 90 years. Ohmite's full complement of products includes wirewound, wire element, thick film, and ceramic composition constructions. Ohmite also has a complete line of Heatsinks for thermal applications.

Okaya **Booth 1033**

52 Marks Road, Suite 1
Valparaiso, IN 46383
www.okaya.com

Okaya Electric offers a wide range of Electrical Noise and Surge Suppression Components including: Single/Three Phase Filters, Snubber Capacitors, Line Capacitors, Spark Quenchers, and Electrostatic/Lightning Surge Absorbers.

ON Semiconductor **Booth 407**

5005 East McDowell Road
Mail Drop A100
Phoenix, AZ 85008
www.onsemi.com

ON Semiconductor is driving energy efficient innovations, empowering customers to reduce global energy use. The company offers a comprehensive portfolio of energy efficient power and signal management, logic, discrete, and custom solutions to help design engineers solve their unique design challenges.

Opal-RT **Booth 730**

1751 Richardson, Suite 2525
Montreal, QB H3K 1G6
www.opal-rt.com/

OPAL-RT TECHNOLOGIES is the leading developer of open Real-Time Digital Simulators and Hardware-in-the-Loop testing equipment for electrical, electro-mechanical and power electronic systems. OPAL-RT simulators are used by engineers and researchers at leading manufacturers, utilities, universities and research centres around the world. The company's core software, RT-LAB, enables users to rapidly develop models suitable for Real-Time Simulation, while minimizing initial investment and their cost of ownership.

**Pacific Sowa Corporation;
C/O Epson Atmix Corporatopm. . . . Booth 835**

10 Anson Rd.
#13-11 International Plaza
www.pacificsowa.co.jp

Sales and Customer support representative of EPSON
ATMIX's Magnetic Powders.

Panasonic Booth 1501

1 Kotari-yakemachi
Nagaokakyo, Kyoto,
http://www.semicon.panasonic.co.jp/en/

Panasonic provides ENELEAD, the "Total solution of power devices", which supports from power system design to purchasing of components, allowing you to select a suitable small, high-efficiency power device, to easily perform a design and evaluation of power systems by using web-based tools, and to purchase peripheral components.

Pancon Corporation Booth 1416

1205 McConville Rd.
Lynchburg, VA 24502
www.paktron.com

Designs and manufactures in USA, Multilayer Polymer (MLP) Film Capacitors that provide improved stability, both electrically and mechanically, compared to multilayer ceramics and features "non-shorting" operation and does not crack like large ceramic chip capacitors. Paktron is also the manufacturer of the Quencharc® RC Network.

Payton America Booth 417

1805 S. Powerline Road
Suite 109
Deerfield Beach, FL 33442
www.paytongroup.com

Payton Group International is the world leader in the design and manufacturing of PLANAR TRANSFORMERS and INDUCTORS. Custom designs using standard parts with no NRE, samples in few weeks from few watts to 20KWatts in a single unit. We provide fast designs for most SMPS applications. Our design team and our ISO/TS facilities in Florida, Israel and China can handle commercial and military applications.

Pearson Electronics, Inc. Booth 1029

4009 Transport St.
Palo Alto, CA 94303
www.pearsonelectronics.com

Pearson Electronics is the original and leading manufacturer of Wide Band Current Transformers used for accurate AC current measurements. Pearson Current Transformers can measure transients, harmonics, pulse,

sine-wave and other complex current wave shapes. A typical model has 1% accuracy and a 3 dB bandwidth from 1 Hz to 20 MHz. We meet both OEM and custom requirements.

PELS - IEEE Booth 1300

445 Hoes Lane
Piscataway, NJ 08855
www.ieee-pels.org

Plexim Booth 618

5 Upland Rd.
Ste. 4
Cambridge, MA 2140
www.plexim.com

Plexim's electrical engineering software PLECS is a simulation package for designing multi-physical domain power conversion systems and their associated controls that yields robust and fast results. Available in two versions, PLECS Blockset works in the MATLAB/Simulink environment while PLECS Standalone is an independent solution. Plexim also now offers a processor-in-the-loop (PIL) tool for developing and testing embedded controls and web-based simulation (WBS) for educational and marketing purposes.

**Power Electronic
Measurements Ltd. Booth 418**

Gloucester House, Wellington Street
Long Eaton, Nottingham,
www.pemuk.com

PEM Ltd design, manufacture and sell state of the art, wide-bandwidth, flexible, clip-around, current sensors based on Rogowski Technology. Ideal for the latest semiconductor or power electronics development and hf and current pulse measurements, the sensors cover frequencies from 0.01Hz to 30MHz and currents from 10A to 1,000,000A.

**Power Electronics Industry
Collaborative (PEIC) Booth 1435**

P.O. Box 159
Grand Ledge, MI 48837
www.peic-us.org

The Power Electronics Industry Collaborative (PEIC) is a national, industry driven membership-based consortium comprised of OEMs, suppliers, researchers, and other stakeholders working to advance the U.S. power electronics industry. The PEIC's vision is to position the United States as a global center of power electronics research, design, and manufacturing.

Power Integrations Booth 116

5245 Hellyer Avenue
2504 Biel-Bienne
San Jose, CA 95138
www.power.com

Power Integrations supplies high-performance components for high-voltage power-conversion systems. Our ICs and diodes enable compact, energy-efficient AC-DC PSUs for products including mobile devices, TVs, PCs, appliances, meters, LED lights. SCALE™ IGBT drivers enhance the efficiency, reliability and cost of applications including motor drives, renewables, electric vehicles and HV DC transmission.

Power Solutions Inc. Booth 231

6555 Sugarloaf Parkway Suite 307-159
Duluth, GA 30097
www.psl-powersolutions.com

PSL Power Solutions Inc. is our North American Sales division created in 2012. The original business known as Power Semi-Conductors was started in 1972. In 2015 we are a leading power / sub assembly, sub system, heat sink and cold plate solutions manufacturer supported by high quality supply partners

PowerELab Ltd. Booth 204

RM521-522, BLK 9, Enterprise Place
5 Science Park West Ave., HK Science Park, Shatin
Hong Kong,
www.powerelab.com

PowerELab provides design services for many power electronics products, e.g.AC-DC power supply, 80+ server, 80+ ATX, LED driver, electronic ballast, EV charger, DC-AC inverter, battery charger, medical power supply, DC-DC converter, etc. patent licensing, consultancy and training. We also developed a free on-line power supply design tool PowerEsim.

Powerex, Inc. Booth 817

173 Pavilion Lane
Youngwood, PA 15697
www.pwr.com

Powerex (www.pwr.com) is a leading supplier of discrete devices, modules and integrated high power semiconductor solutions. Its broad product line includes IGBTs, HVIGBTs, SiC Modules, IPMs, rectifiers, thyristors, custom modules and assemblies.

Powersim Inc. Booth 1316

2275 Research Blvd.
Suite 500
Rockville, MD 20850
www.powersimtech.com

Powersim is specialized in simulation and design tools for research and product development in power supplies, motor drives, and power conversion and control systems. With its comprehensive simulation and design capabilities, our flagship product PSIM offers a complete solution for research and development in various power electronics applications.

Powervation Booth 529

2665 N. First St.
Ste. 206
San Jose, CA 95134
www.powervation.com

Powervation (www.powervation.com), the Intelligent Digital Power™ Company, delivers breakthrough intelligent digital IC solutions for designers of cloud and enterprise computing, communications, and high-performance power systems. The company's digital DC/DC controllers with Auto-Control® technology, provides intelligent adaptive compensation, delivering significant benefits in performance, efficiency, reliability and breakthrough design simplicity.

POWRMOD DC to DC Converters . . Booth 121

P.O. Box 775
Yaphank, NY 11980
www.powermod.com

Precision Inc. Booth 832

1700 Freeway Boulevard
Minneapolis, MN 55430
www.precision-inc.com

Precision, Inc. is a manufacturer of Inductors, Transformers, Coils and other Power Magnetics Products. Precision Provides Engineering Assistance, Custom Designs and Prototypes. Clean Room Production with ISO 9001 and ISO 13485. Recent Designs Include GaN Ready Magnetics. Products Manufactured and Shipped from Plants on a Global Basis.

Prodrive Technologies Booth 1521

Science Park
Son, NB 56gzEM
www.prodrive-technologies.com

Prodrive Technologies develops, manufactures and sustains electronic and mechatronic solutions. We offer custom and off-the-shelf products such as gate drivers, power stacks, power supplies, any kind of converter and even complete power cabinets optimized for your application. We have the experience and know-how to provide the most reliable, cost-effective solutions.

PSMA Booth 1200

PO Box 418
Mendham, NJ 07945
www.pσμα.com

QORVO Booth 611

7628 Thorndike Rd.
Greensboro, NC 27409
www.qorvo.com

Qorvo, formed by the merger of RFMD and TriQuint, and a global leader in the design and manufacture of GaN and compound semiconductor components for RF, is now expanding its GaN leadership into Power Conversion with a family of 650V GaN Power Switches that enable breakthrough efficiency and density.

Qualtek Booth 1535

7610 Jenther Drive
Mentor, OH 44060
www.qualtekusa.com

Qualtek Electronics Corp. was established in 1980 and is known for its persistent commitment to quality and technology. Products range from a full line of high reliability and low cost switch mode power supplies to a full offering of AC and DC fans, all with worldwide safety approvals.

RAF Tabtronics LLC Booth 623

200 Lexington Ave.
Deland, FL 32724
www.RAFTabtronics.com

Since 1973, RAF Tabtronics LLC has been creating advanced electromagnetic technologies and cost-effective customized solutions for the world's leading power electronics and high-technology companies. We design and manufacture innovative ultra-high powerdensity, high-efficiency components and value-added assemblies which provide significant competitive advantage to our customers. RAF Tabtronics LLC, Technology to the Global Power.

REMTEC, Inc. Booth 331

100 Morse Street
Norwood, MA 02062
www.remtec.com

REMTEC is your one-stop provider for ceramic packaging solutions. We use PCTF®, DBC and Other Advanced Technologies to Design and Produce Cost-Effective Custom and Semi-Custom Packaging Solutions – Metallized Substrates, Packages and Components – Applications in Power Electronics, Renewable Energy, Commercial, Industrial and Military Industries, Optoelectronics and RF/MW.

Renco Electronics Inc. Booth 406

595 International Place
Rockledge, FL 32955
www.rencousa.com

Manufacture and Worldwide distribution of Transformers, Inductors and Chokes; along with our large standard product selection we will engineer the right product for you, build to print or cross to another manufacture and provide samples for evaluation. YOU DESIGN, WE ENGINEER, TOGETHER WE SUCCEED!

Renesas Electronics Booth 1404

2801 Scott Blvd.
Santa Clara, CA 95050
www.am-renesas.com

Renesas Electronics is a major supplier of high-performance MCUs, Analog ICs, and Power Semiconductors, including world-class IGBTs, a wide range of Li+ fuel-gauge ICs, and power management ICs. Renesas Electronics provides solutions, software, and other services that add value for our automotive and industrial customers. www.renesas.com

Richardson RFPD Booth 101

40W267 Keslinger Road
PO Box 307
Lafox, IL 60147
www.richardsonrfpd.com

Richardson RFPD / Arrow RF & Power, an Arrow Electronics company, is a global leader in the RF and wireless communications, power conversion and renewable energy markets. It brings relationships with many of the industry's top radio frequency and power component suppliers. Whether it's designing components or engineering complete solutions, Richardson RFPD's worldwide design centers and technical sales team provide comprehensive support for customers' go-to-market strategy, from prototype to production.

Ridley Engineering, Inc. Booth 401

3547 53rd Avenue West
Suite 347
Bradenton, FL 34210
www.ridleyengineering.com

For over 25 years, Ridley Engineering has provided the industry with the finest design products and educational courses worldwide. Products include Power 4-5-6 design software, the AP300 frequency response analyzer, four-day lab workshops, and consulting services. Our 2012 APEC booth features an interactive display of our products.

Rogers Corporation Booth 317

One technology Dr.
Rogers, CT 6263
www.rogerscorp.com

Rogers Corporation is a global technology leader in specialty materials and components that enable high performance and reliability of power electronics, mass transit, automotive and sustainable energy. Rogers' Power Electronics Solutions Division will be exhibiting the RO-LINX laminated busbars, PowerCircuit Materials and curamik Ceramic Substrates and Micro-Channel Coolers.

ROHM Booth 209

2323 Owen Street
Santa Clara, CA 95054
www.rohm.com

ROHM Semiconductor leverages the latest technologies and expertise garnered through years as an industry leader to deliver a broad portfolio of innovative, high reliability products for the power market from gate drivers, LDOs, switching regulators, and power management ICs to power diodes/transistors/passives, IGBTs, and even breakthrough power SiC devices.

Rubadue Wire Company, Inc. Booth 629

1301 N. 17th Avenue
Greeley, CO 80631
www.rubadue.com

Rubadue Wire manufactures wire and cable products for multiple industries around the globe. Specializing in high temperature, high dielectric products for electronics used in various applications. We were the first to design and manufacture Triple Insulated Wire. Currently offering size ranges from 4 AWG to 44 AWG with insulations and dimensions suited to your requirements.

Samwha USA Inc. Booth 235

2555 Melksee Street
San Diego, CA 92154
http://.samwha.com

Manufacturer of ROHS and REACH compliant and ISO/ TS 16949 certified capacitors and modules, inductors and cores for all electric devices and modules. Value-creating corporation for mankind and environment

SanRex Corporation Booth 104

50 Seaview Blvd.
Port Washington, NY 11050
www.sanrex.com

Since 1947, SanRex, as a pioneer of semiconductor devices for electrical power, has had considerable success in efforts geared towards new technology. SanRex's line of Power Semiconductors maximizes efficiency and improves product performance.

Sapa Extrusions North America . . . Booth 734

9600 W. Bryn Mawr Ave.
Rosemont, IL 60018
www.sapagroup.com

Sapa Thermal Management-Worldwide Partner in Thermal Solutions: For over 30 years, we have been supplying thermal aluminum extrusions and fabrications, specializing in high-fin ratio heat sinks (19:1), cold plates and motor housing. With over 75 extrusion presses ranging from 2' to 20', we offer both manufacturing and thermal engineering at our facilities in North America, Europe and Asia.

SBE, Inc. Booth 1502

81 Parker Road
Barre, VT 05641
www.sbelectronics.com

SBE Inc. is a leading developer and manufacturer of AC and DC film capacitor solutions for transportation, alternative energy, laser, medical and UPS network applications. SBE has been manufacturing capacitors for over 50 years and has produced over a billion capacitors. The company's engineering, product development & manufacturing are located in Barre, VT.

Schaffner Trenco LLC Booth 1523

2550 Brookpark Rd
Cleveland, OH 44134
www.schaffner-trenco.com

Schaffner is a market leader in the design and manufacture of power conditioning, filtering and distribution equipment. Product scope includes basic EMC filters up to large power magnetic devices along with custom engineered solutions. Schaffner serves many markets including VS Drives, Transportation, Renewable Energy, Metals and Power Generation/ Backup Systems.

Scientific Test, Inc. Booth 1132

1110 E. Collins Blvd. Ste. 130
Richardson, TX 75081
www.scitest.com

STI is a manufacturer of test equipment for power semiconductor devices. In business for over 30 years, we provide ATE as well as Curve Tracer instruments. From incoming inspection and QC, to the device characterization lab and on to the production floor, Scientific Test, Inc. is "Your Discrete Test Source".

Semikron, Inc. Booth 920

11 Executive Drive
Hudson, NH 3051
www.semikron.com

SEMIKRON is a global manufacturer of electronic power unit components and systems (approx. 2kW to 10MW). The product portfolio ranges from chips, semiconductor discretes, IGBT, diode and thyristor modules, customized solutions and integrated electronic power unit systems.

Semtech Booth 110

200 Flynn Rd
Camarillo, CA 93012
www.semtech.com

Semtech Corporation is a leading supplier of power, analog and mixed-signal semiconductors for high-end consumer, computing, communications and industrial equipment. Products are designed to benefit the engineering and global community. For more information, visit www.semtech.com.

Shanghai Eatop Electronic Technology Co... Booth 837

158 Tangming Rd.
Songjiang District Shanghai, China 201617

Eagtop designs & manufactures reactors, resistors, Liquid cold plate, film capacitor, crowbar resistor and Laminated Busbar. The customers like ABB, Gamesa, Vestas, Schneider, Converteam, Thyssenkrupp, Siemens and Emerson have already co-operated with us.

ShengYe Electrical Co. Ltd. Booth 229

Shunde, Foshan, Guangdong,
<http://www.shengye.com/dl/en/>

Shenzhen Poco Magnetic Co., Ltd. Booth 1335

Guangdang,
www.pocomagnetic.com

One-Stop magnetic material (powder core) and component application solution provider.

Shenzhen Zeasset Electronic Technology Co., Ltd Booth 1334

B1 Building Anle Industrial Park
Hangcheng Road, Banan District
Shenzhen,
www.zste.com

ZEASSET is a professional high tech manufacturer specialized in R&D marketing of large size & high volts aluminum electrolytic capacitor & super capacitor. Obtained the certification of ISO9001&ISO14001, and have as many as 20 self-owned patents. Have over 80 different automated equipments, 20 professional technical engineers, 6000 sq meters workshops.

Simplis Technologies Booth 1017

P.O. Box 40084
Portland, OR
www.simplistechnologies.com

SIMPLIS Technologies is the creator of SIMPLIS, the leading simulation engine for switched mode power supply design. In partnership with SIMetrix Technologies Ltd we develop and market the SIMetrix/SIMPLIS software products which provides unmatched capabilities for the power electronics designer.

Sonoscan, Inc Booth 1031

2149 E. Pratt Blvd.
Elk Grove Village, IL 60007
www.sonoscan.com

Sonoscan is a leader and innovator in Acoustic Micro Imaging (AMI) technology. Sonoscan manufactures acoustic microscope systems and provides laboratory services to nondestructively inspect and analyze products. Our C-SAM microscopes provide unmatched accuracy for the inspection of products for hidden internal defects in SMT devices, ceramic capacitors and resistors, hybrids, MEMs, etc.

Sree Vishnu Magnetics Pvt. Ltd.. Booth 1434

9/1, Thiruvalluvar Salai
Kannivakkam Village, Guduvancherry
Chennai, TN 603 202
www.sveindia.com

High Power Inductors and Transformers Manufacturer, with 25 years experience. Design and Development with Computational Electromagnetic Modeling, Thermal Analysis and CAD Models. Tool Design, Tool Room, Molding, Test Equipments from Agilent, Weinker, Kikusui. UL, IEC and RoHS. Serving Customers in USA, Europe. Specialists in Custom Designs. Flexible Volumes.

Stellar Industries Corp. Booth 132

50 Howe Avenue
Millbury, MA 01527
www.stellarind.com

Stellar's custom products include precision lapped and polished electronic grade ceramics composed of Alumina, Beryllium Oxide, Aluminum Nitride, and other specialty dielectrics. Stellar also provides custom/design specific metallization services on these ceramics using a variety of thick film, thin film, refractory, plated, and Direct Bond Copper technologies.

STMicroelectronics, Inc. Booth 805

30 Corporate Drive
Suite 300
Burlington, MA 1803
www.st.com
STMicroelectronics, Inc.

ST is a major supplier of high-performance ICs and power discretes for power-supply, power-management, motor-control and lighting applications. As a global leader in semiconductors serving customers across sense and power and automotive products and embedded solutions, ST is found everywhere microelectronics make positive and innovative contributions to people's life.

Sumida America Components Inc. . Booth 1329

1251 N. Plum Grove Road
Suite 150
Schaumburg, IL 60173
www.sumida.com

Sumida is a leading global supplier of electronic components and modules including high performance RF magnetics such as chip inductors, RF transformers and air cores. Our offerings also include power solutions such as transformers for dc/dc convertors, switched mode power supplies and common mode chokes. Our extensive power inductor selection includes 1,000's of solutions to address every need whether it be standard or custom.

**Taiwan National Program
for Intelligent Electronic Booth 137**

R611, Delta Bldg. No. 101
Section 2, Kuang Fu Roa
Hsinchu,
www.twnpie.org

Taiwan National Program for Intelligent Electronics (NPiE) promotes technological innovation of modern electronics for medical, green, car, and conventional 3C applications. It integrates R&D capabilities of government, academia, and industry to develop core IC technologies, cultivate interdisciplinary talents, and steadily contribute to Taiwan semiconductor industry and the global high-tech community.

**Taica North America
Corporation Booth 1234**

3080 Olcott Street, Suite A220
Santa Clara, CA 95054
www.taica-na.com

Taica manufactures Alpha-GEL silicone products for Thermal Interface, Anti-EMI, Anti-vibration, and Shock-absorbing applications. Taica Alpha-GEL products are extremely stable in harsh environments, and can be used between -40C to +200C. They also provide

excellent cushioning & vibration damping performance. Industries include: Electronics, Automotive, Medical Devices, Consumer Products, Aerospace, and others. Taica product info: www.taica.co.jp/gel-english/products.

Taiwan Semiconductor Inc. Booth 223

3191 W. Temple Ave
Suite 105
Pomona, CA 91768
<http://www.taiwansemi.com/>

Taiwan Semiconductor is a global supplier of discrete power semiconductor products. TSC provides power control solutions for all electronic applications including power conversion, lighting, and motor control. TSC's expanding product portfolio includes AC-DC bridge rectifiers, diodes, Power MOSFETS, ESD protection, DIACs, TRIACs, IGBTs, and lighting power control ICs.

Taiyo Kogyo Co., LTD Booth 1235

TOC Bldg. 11F-58, 7-22-17
Shinagawa-ku, Tokyo,
www.taiyo-technology.jp/english.html

Taiyo Kogyo manufactures Heavy Copper/High Current PCB (HPCPB) used in low impedance power conversion, eliminating wires, dissipating heat efficiently. HPCPB combines signal with power on same layer, and embeds busbars such as with IGBT or MOSFET signal driver signal with the capacitor bank power lines, handled by same multilayer PCB.

TDK Corporation Booth 1201

475 Half Day Road
Suite 300
Lincolnshire, IL 60069
www.tdk.com

TDK offers a complete range of innovative solutions for the power electronics industry. From TDK-Lambda brand of stand-alone AC/DC power supplies and board mounted DC/DC power modules to our line of TDK and EPCOS passive electronic components including MLCCs, aluminum and electrolytic capacitors, ferrites, inductors, wireless power products and more.

Teledyne LeCroy Booth 105

700 Chestnut Ridge Road
Chestnut Ridge, NY 10977
teledynelecroy.com

Teledyne LeCroy offers high-performance oscilloscopes, serial data analyzers and protocol test solutions that drive product innovation. Teledyne LeCroy's 50-year heritage of technical innovation is the foundation for its recognized leadership in "WaveShape Analysis" – capturing, viewing and measuring the high-speed signals that drive today's information and communications technologies.

Texas Instruments Booth 1001

12500 TI Blvd MS 8680
Dallas, TX 75243
www.ti.com

Texas Instruments will feature several innovative power management applications, including demonstrations and information on power supply control LED lighting, digital power, digital sign control, point of load and DC/DC control solutions.

**The Allpower Source
(Div. of Technology Dynamics) . . . Booth 1433**

100 School Street
Bergenfield, NJ 07621
www.theallpower.com

We will be exhibiting the following unique and high power components for the power conversion industry at extremely competitive prices. Included are Circuit Breakers, Shock Isolators, High Current Heat Sink Extrusions, EMI Filters, Nanocrystalline Cores, Custom Rubber Items, Variable Transformers, Shunts, Unique Fans, Power Resistors, and Super Caps

Thermik Corporation Booth 1222

3304 US Hwy 70 E.
New Bern, NC 28560
www.thermik.com

Manufacturer of over-heating/over-temperature protection products, including snap action, re-settable, bimetal thermal protectors (thermostats) temperature limiting switches and PTC Thermistor temperature sensors for electrical and electronic equipment.

**Toshiba America
Electronic Components, Inc. Booth 1209**

9740 Irvine Boulevard
Irvine, CA 92618
www.toshiba.com/taec

Toshiba offers power semiconductors for computing, consumer, and industrial applications that require high reliability, power efficiency and a compact design. Low and high voltage MOSFETs, superjunction MOSFETs (DTMOS), single and multi-chip DC-DC converters, IGBTs, bipolar transistors, diodes, regulators, intelligent power device (IPDs), transistor Couplers and IC couplers will be featured.

TowerJazz Booth 821

2350 Mission College Blvd.
#500
Santa Clara, CA 95054
www.TowerJazz.com

TowerJazz offers a leading BCD process platform and a customizable LDMOS (5V to 80V) process, providing design optimization and the smallest die size with the highest efficiency at any given breakdown voltage. TowerJazz also offers an unrivaled 700V power platform to address the rapidly emerging, energy saving LED lighting market.

Transim Technology Booth 708

433 NW 4th Avenue
Suite 200
Portland, OR 97209
www.transim.com

Transim Technology Corporation is the global leader in delivering innovative cloud application engineering solutions for the electronics industry. Our solutions combine advanced technology platform with industry-leading engineering and software expertise. The company headquarters is in Portland, OR with several global satellite offices. For more information, visit www.transim.com.

Transphorm Booth 1317

115 Castilian Drive
Goleta, CA 93117
www.transphormusa.com

Transphorm is the first company to offer complete solutions to inefficient electric power conversion powered from the ac line using GaN diode and HEMT devices. Transphorm designs and supplies application specific products based upon its high voltage (600 v), superior performing EZ GaNTM technology.

TSC Ferrite International Booth 1420

www.tscinternational.com

Last US Manufacturer of Power Ferrites. Low Loss Power Materials, Temperature Stable Material, Perms of 2,000 – 5,000, 7,000 and 10,000. Large Sizes, 800+ tooled parts. Custom and semi-custom cores. Testing services, Innovative solutions. Iron Powder toroids, E-cores, bobbins and threaded cores. Global supplier, RoHS, REACH Compliant, Socially Accountable Manufacturer

TT electronics Booth 1018

4200 Bonita Place
Fullerton, CA 92835
www.ttelectronics.com

TT electronics is a focused, global electronics group supplying leading manufacturers in the defence, aerospace, medical, transportation and industrial electronics markets. The TT electronics technology portfolio is one of the most comprehensive in the industry, supplying passive components and discrete semiconductors from brands including AB, BI Technologies, IRC, Optek, Semelab and Welwyn Components.

Typhoon HIL, Inc. Booth 109

35 Medford St.
Suite 305
Somerville, MA 02143
www.typhoon-hil.ch

Typhoon HIL, Inc. is a technology leader for ultra-high fidelity Hardware-in-the-Loop (HIL) real-time emulators for power electronics. The company was founded in 2008, and since then, we have been creating products distinguished by leading edge technology, unrivaled performance, ease of use, and affordability.

United Chemi-Con Inc. Booth 816

9801 West Higgins Road
Rosemont, IL 60018
www.chemi-con.com

Passive Components. World's Largest Aluminum Electrolytic Capacitor manufacturer including Screw terminals, snap-in, radial, SMD and Polymer and Hybrid. We are also the largest etched aluminum foil raw material supplier to that market. UCC also produces Super-Capacitors, MLCC's, Film Capacitors and Metal Oxide Varistors. Thanks so much.

United Silicon Carbide, Inc. Booth 305

7 Deer Park Drive
Suite E
Monmouth Junction, NJ 8852
www.unitedsic.com

United Silicon Carbide, Inc manufactures silicon carbide (SiC) Power Devices, specializing in JFETs, BJTs, and Schottky Diodes for power electronics. USCI designs, fabricates, and tests all of our devices in our manufacturing facility located just north of Princeton, along New Jersey's Einstein Alley.

University of Texas – Dallas Booth 333

800 W Campbell Road, EC33
Richardson, TX 75080
www.utdallas.edu/research/REVT

The Renewable Energy and Vehicular Technology (REVT) lab at the University of Texas at Dallas is a center of higher education and research with over 25 researchers who are actively working on a range of projects related to affordable, sustainable, and cutting edge solutions for energy, water, and healthcare.

VAC Sales USA LLC Booth 917

2935 Dolphin Drive
Suite 102
Elizabethtown, KY 42701
www.vacuumschmelze.com

Vacuumschmelze GmbH (VAC Sales USA) is a leading global manufacturer of magnetic materials and inductive components made from these alloys. Our Vitroperm nanocrystalline magnetic cores uniquely combine high permeability with low loss. Our products include tape wound cores, common mode chokes, closed loop current sensors, current transformers, gate drive transformers and power transformers.

Venable Instruments, Inc. Booth 1117

8656 Hwy 71 West
Cuesta Centre, E Bldg
Austin, TX 78735
www.venable.biz

For over 35-years Venable Instruments is the industry leader offering a broad range of tools for design/testing of feedback control loops and impedance measurements. Venable specializes in frequency response analyzers, impedance measurement, analysis software for gain/phase plotting and design tools to synthesize stable loop compensation. Loop design application includes analog and digital power supplies, motion control, PFC, and inverters. Impedance measurement applications include discrete components, source/load impedance, batteries, and distributed power.

Vicor Corporation Booth 929

25 Frontage Road
Andover, MA 1810
www.vicorpower.com

Headquartered in Andover, Massachusetts, Vicor Corporation designs, manufactures and markets innovative, high-performance modular power components, from bricks to semiconductor-centric solutions, to enable customers to efficiently convert and manage power from the power source to the point of load.

Viking Tech America Corporation . Booth 221

70, Kuanfu N. Rd.
HsinChu Industrial Park, Hukou
HsinChu 303,
www.vikingamerica.com

Viking Tech Corporation has been manufacturing Passive Components since 1997, offering Thick/Thin Film Resistors, Thin Film Inductors and Ceramic Capacitors with exceptional quality and service. Our main products include Thin Film Resistors, Power Resistors, Low Ohm Resistors, Current Sensing Resistors, RF Inductors, Chip Beads, Common Mode Filters and Power Inductors.

Vincotech GmbH Booth 716

Biberger Strasse
Unterhaching
82008 Germany

Vincotech – an affiliated company within the Mitsubishi Electric Corporation – develops and manufactures high-quality electronic power components for Motion Control, Renewable Energy, and Power Supply applications. Vincotech delivers off-the-shelf products and customized solutions in 23 standard housings to satisfy every demand. To learn more about Vincotech, please visit www.vincotech.com.

Vishay Intertechnology, Inc. Booth 501

63 Lancaster Avenue
Malvern, PA 19355
www.vishay.com

Vishay Intertechnology is one of the world's largest manufacturers of discrete semiconductors and passive electronic components. These components are used in virtually all types of electronic devices and equipment, in the industrial, computing, automotive, consumer, telecommunications, military, aerospace, power supplies, and medical markets. Vishay can be found at www.vishay.com.

Voltage Multipliers Booth 717

8711 W. Roosevelt Avenue
Visalia, CA 93291
www.voltagemultipliers.com

VMI designs and produces high voltage diodes, optocouplers, power supplies, and assemblies. Using the latest technology and state-of-the-art equipment, our data-driven manufacturing practices, dedicated teams, and reliable processes come together to make the most reliable products available on the market.

VMI delivers standard and custom solutions to our customers.

Wakefield-Vette Thermal Solutions Booth 722

121 Jasmine Court
Driftwood, TX 78619
www.vettecorp.com

Wakefield-Vette Thermal Solutions a Global supplier that specializes in solving thermal challenges at the component, system and facility level. Wakefield-Vette owns and operates their own manufacturing facilities around the world. Our specialty includes cooling board level components to complex liquid cooling assemblies along with passive and active thermal management solutions. Products include, aluminum and copper heat sinks, cold plates, fans, heat pipes and hybrid assemblies.

Wolverine Tube Inc. – MicroCool Division Booth 1336

2100 Market Street NE
Decatur, AL 35601
www.microcooling.com

Wolverine Tube has been in business for 99 years providing “innovative thermal solutions” to the automotive and HVAC industries with enhanced copper tube. The MicroCool® Division has leveraged the company's proprietary MDT technology to produce novel cold plates and integrated base plates for optimal liquid cooling solutions for the Electronics Industry.

Würth Electronics Midcom Inc. . . Booth 1216

121 Airport Drive
P.O. Box 1330
Watertown, SD 57201
www.we-online.com

Würth Electronics Midcom globally leads the design and manufacture of custom transformers and magnetics. A standard line of products also include inductors, ferrites, chokes, capacitors, LEDs, terminal blocks, wire-to-board, board-to-board and Input/Output connectors. Two new, and unique, online design tools will release at APEC: Red Expert and Smart Transformer Selector.

X-FAB Semiconductor Foundries . . Booth 733

275 Saratoga Ave.
Santa Clara, CA 95050
www.xfab.com

As the leading foundry group for analog/mixed-signal semiconductor applications, X-FAB manufactures wafers in geometries ranging from 1.0 to 0.13 micrometer on CMOS and special BCD, SOI and MEMS processes in five fabs worldwide. Its comprehensive design ecosystem includes services and tools for developing diversified power/HV, MEMS, opto and analog products – all backed by X-FAB's more than 20 years of solid analog/mixed-signal foundry expertise.

Xitron Technologies Inc. Booth 1128

5959 Cornerstone Court West
Suite 100
San Diego, CA 92121
www.xitrontech.com

XiTRON Technologies is the premier source of precision power testing and measuring equipment for industrial and consumer product development, manufacturing, and ENERGY STAR testing. Solutions include Power Analyzers, Phase Angle Voltmeters, DC & Temperature Calibrators, Ohmmeters, and more. Please stop by our booth and let us solve your testing needs.

**Yokogawa Corporation
of America Booth 420**

2 Dart Road
Newnan, GA 30265
www.tmi.yokogawa.com

For nearly 100 years, Yokogawa has offered a variety of precision instruments to test power supplies,

converters, motor drives, inverters and other power electronics circuits and systems. Visit Booth 420 and allow our Precision Makers demonstrate the latest advancements and solutions in electric signal and power measurements- from high-end precision Power Analyzers to multi-function ScopeCorders.

Yole Développement Booth 617

75 Cours Emile Zola
Villeurbanne 69100
France
www.yole.fr / www.i-micronews.com

Founded in 1998, Yole Développement (Yole) has grown to become a group of companies providing marketing, technology and strategy consulting, media in addition to corporate finance services. With a strong focus on emerging applications using silicon and/or micro manufacturing, Yole has expanded to include more than 50 collaborators worldwide covering MEMS, Compound Semi., LED, Image Sensors, Optoelectronics, Microfluidics & Medical, Photovoltaics, Advanced Packaging, Manufacturing and Power Electronics. We support industrial companies, investors and R&D organizations worldwide to help them understand markets and follow technology trends to develop their business.

ZES Zimmer Booth 1418

4808 Santa Monica Ave.
San Diego, CA 92107
www.zes.com

Precision Power Measurement is our defining statement. ZES ZIMMER builds precision instruments and systems

for measuring electrical power, energy, harmonics, and flicker. Established in 1980, count on our German quality and craftsmanship for your power measuring needs: from low power to megawatts, DC to 10 MHz, sinusoidal to distorted and PWM wave forms and low power factor. Our customers are found across a wide variety of power applications in areas of R&D, QC and regulatory compliance. Come see our technology revolution: DualPath. www.zes.com

**Zhejiang Guidu Power
Electronic Co Ltd. Booth 1529**

www.zjguidu.com

**Zhuzhou CSR Times
Electric Co., Ltd Booth 935**

Shidai Road
Shifeng District
Zhuzhou, Hunan
www.timeselectric.cn

Is a \$2 billion global drive & control system company that also designs and manufactures power electronics by providing its customers power semiconductors, laminated bus bars, capacitors, thermal management and voltage & current sensors. We have extensive power electronics knowledge and capabilities bringing over 50 years of experience in this field.

Zipalog Booth 630

850 Central Pkwy E
Suite #160
Plano, TX 75074
zipalog.com

Zipalog provides verification services and solutions for analog integrated circuit design. The executive team has more than 40 years of experience in analog, mixed-signal, and power management integrated circuit design and electronic design automation. Zipalog's solutions accelerate analog design with visualization and smart verification within a system context.

**ZMDI (Zentrum
Mikroelektronik Dresden) Booth 220**

Grenzstrasse 28
Dresden, 1109
www.zdmi.com

Zentrum Mikroelektronik Dresden AG (ZMDI) offers a world-class portfolio of analog and mixed-signal semiconductors solutions for automotive, industrial, medical, mobile sensing, information technology and consumer applications. We enable our customers to create the most energy-efficient products in sensing, power management and lighting. ZMDI power controllers optimize FPGA and telecommunications applications.

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SAVE-THE-DATE

March 20-24, 2016

APEC®

The Premier Global
Event in Applied
Power Electronics™

2016

**LONG BEACH CONVENTION
& ENTERTAINMENT CENTER**

**LONG
BEACH**
California

March 20-24, 2016

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