

APEC®

The Premier Global
Event in Applied
Power Electronics™

2016

LONG BEACH CONVENTION
& ENTERTAINMENT CENTER

LONG
BEACH
California

March 20-24, 2016

Applied Power Electronics Conference and Exposition

APEC® 2016 Sponsors



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For the latest news and information, access to on-line conference and hotel information download the **APEC2016 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"**.



APEC 2016

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Foreword

It is my utmost pleasure to welcome you to the 2016 IEEE Applied Power Electronics Conference and Exposition (APEC 2016), at the Long Beach Convention Center, in Long Beach, California.

As the **Premier Event in Applied Power Electronics**, APEC provides a unique opportunity to power electronics professionals from academia, national laboratories, and industry for exchange of technical knowledge, networking, and exposure to the vibrant indigenous culture.

The APEC 2016 organizing committee has been working wholeheartedly to compose this excellent technical conference for you. Thanks to their dedication and countless hours of work as well as APEC's sponsors: IEEE Industry Applications Society (IAS), IEEE Power Electronics Society (PELS), and Power Sources Manufacturers Association (PSMA).

Like its predecessors, APEC 2016 offers a unique technical program for the power electronics community. We have a record breaking and unique conference and exposition planned for you to experience, with a comprehensive program remarkably attractive to the academic researchers, students, educators, industry, government agencies, and general public. The technical presentation papers are selected from an all-time record high 1212 digests submitted from 45 countries from across the globe. The exposition hits its record high participation with 263 exhibitors and 398 booths. The exhibitors will showcase their state-of-the-art technologies, products, and solutions on applied power electronics. Furthermore, this year in our progressively popular industry sessions we have 119 accepted presentations in 20 sessions.

The Professional Educational Seminars, offered by internationally renowned experts, start on Sunday, March 20th. Each of the 21 three-and-a-half hour educational seminars, selected from the record-high 52 submissions, 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 world-class speakers from industry and academia covering the key power electronics technologies, components, and innovations affecting our industry and the society.

This year, the 30th micro mouse competition will include teams from Japan, Taiwan, Singapore, China, United

Kingdom and the United States. The increasingly popular rap sessions include three moderated debates on **Future of Semiconductor Technology Development**, **Power Electronics for Internet of Things**, and **Advanced Refueling Technologies for Electric Vehicles**. This year APEC sponsors have provided 43 travel grants to assist students' participation in this unique conference. In addition, the APEC Mobile App provides access to an interactive directory and map of the exhibitors on their mobile device.

The Wednesday night social event "Surfin' Safari" will be at the Pacific Ballroom – Long Beach Convention Center. The APEC social event provides you with the opportunity to let loose, enjoy great food and network with your colleagues. This year we are thrilled to have live entertainment from California's premiere Beach Boy's cover band, The Beach Toys!

With three convenient local airports, average high temperature of 68°F (20 °C) in March, an enjoyable voyage away from Catalina Island and a convenient trip from Disneyland and Universal Studios Hollywood, Long Beach is a prime location for APEC. In addition to conference outstanding program, I hope you and your families will enjoy your stay at Long Beach and its superlative attractions such as the Ports O' Call Village, Point Vicente Lighthouse, Regal Queen Mary, the Shoreline Village, the Aquarium of the Pacific, its extensive museums, and many elite dining destinations.

I would like to take this opportunity to reiterate my appreciation to APEC attendees, exhibitors, reviewers, volunteers, sponsors, organizing committee members, and steering committee members. We are passionately looking forward to meeting you at APEC 2016, wish you a heartfelt welcome to APEC, and hope that you will have a memorable experience.

Warmest Regards,



Alireza Khaligh

General Chair

2016 IEEE Applied Power Electronics Conference
and Exposition

APEC 2016

Conference Committee & Management

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Power Sources Manufacturers Association

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Jonathan Kimball

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Missouri University of Science & Technology

Kevin Parmenter

PSMA
Excelsys Technologies Ltd.

Russell Spyker

IAS
Wright Patterson AFB

Schedule-at-a-Glance

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

**KEY: S = Professional
Education Seminars**

R = Rap Sessions

**IS = Industry Sessions
D = Dialogue Sessions**

T = Technical Sessions

SUNDAY, MARCH 20, 2016

Registration	8:00 a.m. – 5:00 p.m.	LBCC – EXHIBIT HALLS B/C
Speaker Breakfast	8:00 a.m. – 9:00 a.m.	LBCC – ROOM 201B
S01: Exceeding 99% Efficiency for PFC and Isolated DC-DC Converters. GaN Versus Silicon	9:30 a.m. – 1:00 p.m.	LBCC – ROOM 104A
S02: The Invisible Schematic: Non-Idealities in Circuit Elements and System Components.	9:30 a.m. – 1:00 p.m.	LBCC – ROOM 104B
S03: Getting from 48 V to Load Voltage: Improving Low Voltage DC-DC Converter Performance with GaN Transistors.	9:30 a.m. – 1:00 p.m.	LBCC – ROOM 102AB
S04: A Comprehensive Introduction to Implementing a Fully Digital Power-Factor-Correction Boost Converter	9:30 a.m. – 1:00 p.m.	LBCC – ROOM 104C
S05: Basic Power Electronics Design Tutorial	9:30 a.m. – 1:00 p.m.	LBCC – ROOM 101A
S06: Solid-State Transformers – Key Design Challenges, Applicability, and Future Concepts	9:30 a.m. – 1:00 p.m.	LBCC – ROOM 103AB
S07: Photovoltaic Modeling and Why It Matters for Power Electronics	9:30 a.m. – 1:00 p.m.	LBCC – ROOM 101B
S08: Stability and Damping of Grid-Connected Voltage-Source Converters.	2:30 p.m. – 6:00 p.m.	LBCC – ROOM 102AB
S09: PMBus™: Review and New Capabilities.	2:30 p.m. – 6:00 p.m.	LBCC – ROOM 104A
S10: Wide Bandgap Device Characterization	2:30 p.m. – 6:00 p.m.	LBCC – ROOM 104B
S11: High Performance Digital Control for Power Converters	2:30 p.m. – 6:00 p.m.	LBCC – ROOM 104C
S12: Non-linear Thermal Topics in Semiconductors and Electronics.	2:30 p.m. – 6:00 p.m.	LBCC – ROOM 101A
S13: Power Architectures, Protection and Control of DC Microgrids	2:30 p.m. – 6:00 p.m.	LBCC – ROOM 103AB
S14: Soft Switching Three-Phase Converters or Inverters	2:30 p.m. – 6:00 p.m.	LBCC – ROOM 101B

MONDAY, MARCH 21, 2016

Speaker Breakfast	7:00 a.m. – 8:00 a.m.	LBCC – ROOM 201B
Registration	7:30 a.m. – 5:00 p.m.	LBCC – EXHIBIT HALLS B/C
Spouse and Guest Breakfast	8:00 a.m. – 9:00 a.m.	HYATT REGENCY – PACIFIC ROOM
Spouse and Guest Hospitality Room Open	8:00 a.m. – 11:00 a.m.	HYATT REGENCY – PACIFIC ROOM
S15: Introduction to Fast Analytical Techniques: Application to Small-Signal Modeling	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 104A
S16: Reliability of Power Electronic Systems.	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 102AB
S17: Addressing Challenges in High Power and High Voltage Designs with IGBTs	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 101A
S18: A State-Space Design Approach to Digital Feedback Control of DC/DC Converters.	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 101B
S19: How to Go from Si to SiC Components in the Design of Converters Including Safety & EMC	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 103AB
S20: Principles and Practices of Digital Current Regulation for AC Systems	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 104B

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

S21: Latest Technologies of LLC Converters for High Current, Fast Response, and Wide Input Voltage Range Applications.	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 104C
Spouse and Guest Tour “Docent Estate Tour at the Huntington” departs (<i>Registration Required</i>)	10:00 a.m.	HYATT REGENCY – PACIFIC ROOM
Opening Plenary Session.	1:30 p.m. – 5:00 p.m.	LBCC – GRAND BALLROOM
Exhibit Hall Welcome Reception	5:00 p.m. – 8:00 p.m.	LBCC – EXHIBIT HALLS A/B/C
MicroMouse Contest	8:00 p.m. – 10:00 p.m.	LBCC – HALL A

TUESDAY, MARCH 22, 2016

Speaker Breakfast.	7:00 a.m. – 8:00 a.m.	LBCC – GRAND BALLROOM
Registration	7:30 a.m. – 5:00 p.m.	LBCC – EXHIBIT HALLS B/C
Spouse and Guest Breakfast.	8:00 a.m. – 9:00 a.m.	HYATT REGENCY – PACIFIC ROOM
Spouse and Guest Hospitality Room Open	8:00 a.m. – 11:00 a.m.	HYATT REGENCY – PACIFIC ROOM
IS01: Aiding Design Excellence	8:30 a.m. – 11:55 a.m.	LBCC – ROOM 201A
IS02: 3D Power Packaging	8:30 a.m. – 11:55 a.m.	LBCC – ROOM 201B
IS03: Smart Products for the Smart Grid	8:30 a.m. – 11:55 a.m.	LBCC – ROOM 202AB
IS04: Wide Bandgap Semiconductors.	8:30 a.m. – 11:55 a.m.	LBCC – ROOM 203AB
T01: Three-Phase AC-DC Converters.	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 101A
T02: High Frequency and Fast-Response DC-DC Converters.	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 104A
T03: Microgrids and Hybrid Systems	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 104B
T04: Control Strategies for Inverters and Motor Drives	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 103C
T05: Si Devices and Power Module Packaging.	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 101B
T06: DC-DC Converter Control.	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 102AB
T07: Solar Energy Systems	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 104C
T08: Advanced Converter for Power Systems Used in Transportation	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 103AB
T09: Gate Drives, Failure Analysis, and Protection	8:30 a.m. – 12:00 p.m.	LBCC – ROOM 102C
Spouse and Guest Tour “Tour the Stars” departs (<i>Registration Required</i>)	9:30 a.m.	HYATT REGENCY – PACIFIC ROOM
Exhibit Hall Open	12:00 p.m. – 5:00 p.m.	LBCC – EXHIBIT HALLS A/B/C
Exhibitor Seminars – Session #1 (Concurrent Sessions).	1:30 p.m. – 2:00 p.m.	See Page 181
Exhibitor Seminars – Session #2 (Concurrent Sessions).	2:15 p.m. – 2:45 p.m.	See Page 191
Exhibitor Seminars – Session #3 (Concurrent Sessions).	3:00 p.m. – 3:30 p.m.	See Page 195
Exhibitor Seminars – Session #4 (Concurrent Sessions).	3:45 p.m. – 4:15 p.m.	See Page 199
R1: Future of Semiconductor Technology Development	5:00 p.m. – 6:30 p.m.	LBCC – ROOM 104A
R2: Power Electronics for Internet of Things: Will it happen?	5:00 p.m. – 6:30 p.m.	LBCC – ROOM 104B
R3: Advanced Refueling Technologies for EVs	5:00 p.m. – 6:30 p.m.	LBCC – ROOM 104C

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Speaker Breakfast	7:00 a.m. – 8:00 a.m.	LBCC – GRAND BALLROOM
Registration	8:00 a.m. – 3:00 p.m.	LBCC – EXHIBIT HALLS B/C
Spouse and Guest Breakfast	8:00 a.m. – 9:00 a.m.	HYATT REGENCY – PACIFIC ROOM
Spouse and Guest Hospitality Room Open	8:00 a.m. – 11:00 a.m. –	HYATT REGENCY – PACIFIC ROOM
IS05: Thermal Management	8:30 a.m. – 10:10 a.m.	LBCC – ROOM 201A
IS06: Modeling and Simulation	8:30 a.m. – 10:10 a.m.	LBCC – ROOM 201B
IS07: Very Low Power Applications	8:30 a.m. – 10:10 a.m.	LBCC – ROOM 202AB
IS08: Alternative Energy in High Penetration Areas	8:30 a.m. – 10:10 a.m.	LBCC – ROOM 203AB
T10: Control of AC-DC Converters	8:30 a.m. – 10:10 a.m.	LBCC – ROOM 102AB
T11: GaN-based DC-DC Converters	8:30 a.m. – 10:10 a.m.	LBCC – ROOM 104A
T12: Electric Machines	8:30 a.m. – 10:10 a.m.	LBCC – ROOM 101A
T13: Advances in Magnetics	8:30 a.m. – 10:10 a.m.	LBCC – ROOM 101B
T14: System Design and Layout for Improved Performance.	8:30 a.m. – 10:10 a.m.	LBCC – ROOM 102C
T15: Modeling of AC Energy Converters and Systems.	8:30 a.m. – 10:10 a.m.	LBCC – ROOM 104B
T16: Manufacturing, Test, and Reliability	8:30 a.m. – 10:10 a.m.	LBCC – ROOM 103C
T17: Soft-Switching Converters in Renewable Energy Systems	8:30 a.m. – 10:10 a.m.	LBCC – ROOM 104C
T18: Solid State Lighting	8:30 a.m. – 10:10 a.m.	LBCC – ROOM 103AB
Exhibit Hall Open	10:00 a.m. – 2:00 p.m.	LBCC – EXHIBIT HALLS A/B/C
Exhibitor Seminars – Session #5 (Concurrent Sessions).	10:30 a.m. – 11:00 a.m.	See page 202
Exhibitor Seminars – Session #6 (Concurrent Sessions).	11:15 a.m. – 11:45 a.m.	See page 205
IS09: High Frequency Magnetics; Black Magic, Art or Science?	2:00 p.m. – 5:25 p.m.	LBCC – ROOM 201A
IS10: From the Board to the Datacenter	2:00 p.m. – 5:25 p.m.	LBCC – ROOM 201B
IS11: Medium Voltage Applications	2:00 p.m. – 5:25 p.m.	LBCC – ROOM 202AB
IS12: Transportation Power Electronics	2:00 p.m. – 5:25 p.m.	LBCC – ROOM 203AB
T19: Resonant and Soft Switching DC-DC Converters	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 101A
T20: Control Applications and Modulation Schemes	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 102C
T21: Advances in Wide BandGap Devices.	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 104A
T22: Motor Drive Design and Inverter Topologies	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 101B
T23: Modeling of Magnetic Circuits and Systems	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 102AB
T24: Inverter/Converter Control	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 103C
T25: Topics in Renewable Energy Systems I	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 104B
T26: Electric Vehicle Charging Systems	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 104C
T27: Utility Interface & Inverter Applications	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 103AB
“Surfin’ Safari” Evening Social Event (Ticket Required)	7:00 p.m. – 10:00 p.m.	LBCC – PACIFIC BALLROOM

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Speaker Breakfast	7:00 a.m. – 8:00 a.m.	LBCC – GRAND BALLROOM
Dialogue Presenter Breakfast	7:00 a.m. – 8:00 a.m.	LBCC – EXHIBIT HALLS A/B
Registration	8:00 a.m. – 12:00 p.m.	LBCC – CONCOURSE LOBBY
Spouse and Guest Breakfast	8:00 a.m. – 9:00 a.m.	HYATT REGENCY – PACIFIC ROOM
Spouse and Guest Hospitality Room Open	8:00 a.m. – 11:00 a.m.	HYATT REGENCY – PACIFIC ROOM
IS13: Safety and Compliance	8:30 a.m. – 11:30 a.m.	LBCC – ROOM 201A
IS14a: Topics in Power Integration	8:30 a.m. – 10:10 a.m.	LBCC – ROOM 201B
IS14b: Power Electronics Industry in North America	10:40 a.m. – 11:30 a.m.	LBCC – ROOM 201B
IS15: Power Electronics Applications	8:30 a.m. – 11:30 a.m.	LBCC – ROOM 202AB
IS16: Power Semiconductors Enabling Next Generation Applications	8:30 a.m. – 11:30 a.m.	LBCC – ROOM 203AB
T28: Isolated DC-DC Converters	8:30 a.m. – 11:20 a.m.	LBCC – ROOM 104A
T29: Multilevel Converters	8:30 a.m. – 11:20 a.m.	LBCC – ROOM 101A
T30: Multilevel and Matrix Converters for Motor Drives	8:30 a.m. – 11:20 a.m.	LBCC – ROOM 102C
T31: System Design Techniques for Reduced EMI	8:30 a.m. – 11:20 a.m.	LBCC – ROOM 101B
T32: Modeling of DC Energy Converters and Systems	8:30 a.m. – 11:20 a.m.	LBCC – ROOM 102AB
T33: Gate Drive Techniques	8:30 a.m. – 11:20 a.m.	LBCC – ROOM 103C
T34: Energy Storage Systems	8:30 a.m. – 11:20 a.m.	LBCC – ROOM 104B
T35: Topics on Inductive and Capacitive Wireless Power Transfer	8:30 a.m. – 11:20 a.m.	LBCC – ROOM 104C
T36: Wireless Power Transfer	8:30 a.m. – 11:20 a.m.	LBCC – ROOM 103AB
D01: AC-DC Converters	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
D02: DC-DC Converters I	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
D03: DC-DC Converters II	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
D04: Utility Interface	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
D05: Motor Drives and Inverters: Modeling and Control I	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
D06: Motor Drives and Inverters: Modeling and Control II	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
D07: Motor Drives and Inverters: Topologies	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
D08: Advanced Components and Devices	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
D09: System Design Considerations for Power Electronics	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
D10: Modeling and Simulation	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
D11: Control I	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
D12: Control II	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
D13: Renewable Energy Systems I	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
D14: Renewable Energy Systems II	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
D15: Transportation Power Electronics	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A

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D16:	Power Topologies, Distribution, and Control	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
D17:	Emerging and Renewable Power	11:30 a.m. – 1:30 p.m.	LBCC – EXHIBIT HALL A
IS17:	Market Analysis	2:00 p.m. – 5:00 p.m.	LBCC – ROOM 201A
IS18:	LED Lighting.	2:00 p.m. – 3:15 p.m.	LBCC – ROOM 201B
IS19a:	ElectroMagnetic Compatibility	2:00 p.m. – 3:15 p.m.	LBCC – ROOM 202AB
IS19b:	Capacitors for Power Applications	4:10 p.m. – 5:25 p.m.	LBCC – ROOM 202AB
IS20:	Active Devices	2:00 p.m. – 5:00 p.m.	LBCC – ROOM 203AB
T37:	Single-Phase AC-DC Converters	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 102AB
T38:	Non-Isolated DC-DC Converters	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 101A
T39:	Inverter Applications and Technologies.	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 101B
T40:	Modeling, Modulation and Control of Motor Drive.	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 102C
T41:	Gate Drivers and Integrated Packaging	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 103C
T42:	Component Modeling.	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 103AB
T43:	Grid and Utility Interface	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 104A
T44:	Topics in Renewable Energy Systems II	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 104B
T45:	Envelope Tracking and Resonant Conversion	2:00 p.m. – 5:30 p.m.	LBCC – ROOM 104C



General Information

Conference Location

Long Beach Convention & Entertainment Center

300 E Ocean Blvd
Long Beach, CA 90802
Phone: (562) 436-3636

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

- > **Hyatt Regency Long Beach**
200 South Pine Avenue
Long Beach, CA 90802
Phone: (562) 491-1234
- > **Renaissance Long Beach Hotel**
111 E. Ocean Blvd
Long Beach, CA 90802
Phone: (562) 437-5900
- > **Courtyard Long Beach Downtown**
500 East First Street
Long Beach, CA 90802
Phone: (562) 435-8511
- > **Hilton Long Beach Hotel & Exec Center**
701 W. Ocean Blvd
Long Beach, CA 90831
Phone: (562) 983-3400

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APEC: Applied Power
Electronics Conference



APEC – Applied Power
Electronics Conference

Ground Transportation

Area Airports

- > **Long Beach Airport – LGB**
 - > Hotel direction: 7 mile(s) S
 - > Alternate transportation: Super Shuttle; Private Shuttle service available only. Fee is 74.00 USD for up to 9 passengers – reservation required.
 - > Bus service, fee: 1.25 USD (one way)
 - > Estimated taxi fare: 23.00 USD (one way)
- > **Los Angeles International Airport – LAX**
 - > Hotel direction: 24 mile(s) NW
 - > Alternate transportation: Super Shuttle; fee: 17 USD (one way); reservation required
 - > Bus service, fee: 1.75+ USD (one way)
 - > Estimated taxi fare: 70.00-80.00 USD (one way)
- > **John Wayne Airport-Orange County – SNA**
 - > Hotel direction: 24 mile(s) SE
 - > Alternate transportation: Super Shuttle; fee: 37 USD (one way); reservation required
 - > Estimated taxi fare: 75.00 USD (one way)

Parking

- > **Long Beach Convention Center**
Parking is \$10 per car per entry to any of the Center's lots.
- > **Hilton Long Beach**
\$18/day self-parking; \$22/day valet
- > **Hyatt Long Beach**
\$24/day self-parking or valet
- > **Renaissance Long Beach**
\$20/day self-parking; \$26/day valet
- > **Courtyard Long Beach**
\$19/day self-parking; \$24/day valet

Getting Around Town

- > **Passport Shuttle**
Downtown Long Beach's Passport Shuttle is designed to provide a direct connection between Pine Avenue retail and restaurant district and Long Beach Convention Center, Aquarium of the Pacific, Queensway Bay and Shoreline Village waterfront destinations. Shuttles run between these locations as often as every 15 minutes, every day.

Conference Registration

In order to participate in the 2016 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 Long Beach Convention & Entertainment Center (Exhibit Halls B/C).

Saturday, March 19 4:00 p.m. – 7:00 p.m.
Sunday, March 20 8:00 a.m. – 5:00 p.m.
Monday, March 21. 7:30 a.m. – 5:00 p.m.
Tuesday, March 22 7:30 a.m. – 5:00 p.m.
Wednesday, March 23. 8:00 a.m. – 3:00 p.m.
Thursday, March 24* 8:00 a.m. – 12:00 p.m.
(*Concourse Lobby)

Information for Presenters

Professional Education Seminar Presenters: 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 201B at the Long Beach Convention & Entertainment Center at 8:00 a.m. on Sunday and at 7:00 a.m. on Monday.** After breakfast, you will receive brief instructions from the Professional Education Seminar Chairs.

Industry Sessions and Oral Technical Session Presenters: must attend a mandatory speaker breakfast on the morning of your presentation. Breakfast will be held at **7:00 a.m. each day, Tuesday-Thursday, in the Grand Ballroom at the Long Beach Convention & Entertainment Center.** The Program Chair will host this breakfast at which you will be given your speaker ribbon and provided instructions. Immediately after breakfast you will be able to review your previously uploaded presentation with your session chair.

Dialogue Session Presenters: must attend a mandatory speaker breakfast in **Hall A at the Long Beach Convention & Entertainment Center at 7:00 a.m. on Thursday.** 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.

Speaker Ready Room: available to Professional Education Seminar, Industry Session and Oral Technical Session presenters should you need to review your presentation in advance of your session or make any edits. **The speaker ready room is located in room 203C** and is open during the following times:

Sunday, March 20 8:00 a.m. – 5:00 p.m.
Monday, March 21. 7:30 a.m. – 5:00 p.m.
Tuesday, March 22 7:30 a.m. – 5:00 p.m.
Wednesday, March 23. 7:30 a.m. – 5:00 p.m.
Thursday, March 24 7:30 a.m. – 12:00 p.m.

Purchasing of Conference Proceedings and Seminar Workbooks

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

Conference registrants can purchase extra copies of the Conference Proceedings and Seminar Workbooks on USB through Early Registration. APEC reserves the right to limit quantities of APEC Proceedings or Seminar Workbooks sold to any one person or institution.

Conference Proceedings & Seminars on USB Payment Policy

For payments at the conference, APEC can accept credit cards (Master Card, Visa or American Express), or checks or money orders (payable in U.S dollars and drawn on an U.S. bank). Checks and money orders returned unpaid will be assessed and an additional handling charge of \$50.

A LIMITED NUMBER of copies of the Conference Proceedings and Seminar Workbooks may be available for sale at the Conference Registration Center, starting at noon on Wednesday, March 23.

	On-site
Conference Proceedings (USB Only)	\$180
Seminar Workbook (USB only)	\$180

Publications purchased can be picked up at the registration desk.

- > **PURCHASING THROUGH THE IEEE**
Post conference APEC Proceedings may be purchased through the IEEE.
- > **IEEE Single Copy Sales**
44S Hoes Lane
Piscataway, New Jersey 08854 USA
P: (800) 678-4333 (USA & Canada)
or
(732) 981-0060
Web site: <http://shop.ieee.org/ieeestore/>

Important Rules, Notices, & Conference Policies

Registration Cancellation & Refund Policy

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.

Accepted credit cards: Master Card, Visa and American Express.

Please do not send cash. Checks and money orders returned unpaid or credit card payments for which payment was refused will be assessed an additional handling charge of \$50.

Registrations must be submitted by March 18, after March 18 you must 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 26, 2016. All refunds will be processed after the conclusion of the conference and will be subject to a \$50 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.

Badges Required for Admission

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.

Recording & Photography at APEC

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.

No Recruiting! No Recruiters!

IEEE Policy #10.1.24 prohibits recruiting at IEEE sponsored conferences. Consequently, recruiters and recruiting advertisements will not be permitted in the APEC 2016 hotel space, meeting facilities or Exhibit Hall.

Distributing Commercial Material at APEC

Rules For Non-Exhibitors

Distribution of commercial material in the APEC 2016 hotel space (including directly to the hotel rooms of APEC participants), meeting space and Exhibit Halls by people or organizations not participating in the Exposition is prohibited.

APEC reserves the right to remove without notice any materials not in compliance with this policy.

Rules For Exhibitors

Exhibitors may only distribute commercial materials in their booth, at Exhibitor Seminars they are conducting and at press conferences they are holding. APEC reserves the right to remove without notice any materials not in compliance with this policy.

Conference Highlights

Plenary Session

APEC 2016 Plenary is designed to cover the history of power, the current needs in energy efficiency and the future possibilities. Topics include: The Challenges of VHF Power Conversion; The Future of Power Electronic Design; Breaking Speed Limits with GaN Power ICs; Residential Nanogrids With Battery Storage – Is This Our Future?; The Future of Magnetic Design for Power Electronics; and finally, Why Do Power Supplies Fail? – A Real-World Analysis. Come see where power technology has been, and where it is headed.

Professional Education Seminars

This year APEC will offer 21 Professional Education Seminars to take place on Sunday, March 20 and Monday, March 21. Seminars cover a wide range of topics including device evaluation, circuit design, control techniques, system interactions, industry standards, etc.

Technical Sessions

APEC professionals like you participated in a rigorous peer review process and have carefully picked over 500 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 through Thursday afternoon. Papers with a more specialized focus are available for discussion with authors at the dialogue session 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.

Industry Sessions

At APEC 2016, the Industry Sessions track continues to expand. This year we've increased from 15 sessions to 20, facilitating the presentation of even 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 other-

Privacy Policy

Information Provided During Registration

Contact information, which includes your name, affiliation, and mailing address, may be provided upon request to any partners and/or supporting publication participating in the APEC 2016 Exposition.

In addition APEC may use the information you provide to contact you with information about APEC 2016 or any future APEC.

No other use will be made of the information you provide. Your information will not be sold, distributed, leased or provided to any other person or organization except as described above.

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.



wise be present at an industry conference. While many of these sessions are technical in nature, some also target business-oriented people such as purchasing agents, electronic system designers, regulatory engineers, 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.

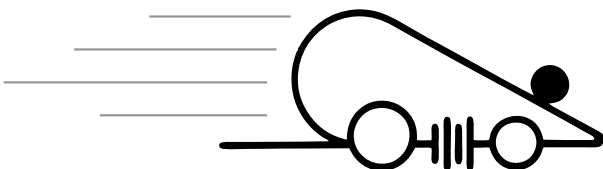
Exhibitor Seminars & Exposition

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 Long Beach Convention & Entertainment Center, in the back of Exhibit Hall A, on the evening of Monday, March 21 starting at 8:00 p.m. **All are welcome!**



Conference Social Event

Enjoy an evening with your toes in the sand and an umbrella drink in hand! The APEC social event is sure to provide the perfect venue for you and your colleagues to relax, unwind and enjoy live entertainment from California's premiere Beach Boy's cover band, The Beach Toys! Join us for this once in a lifetime event on **Wednesday, March 23 - 7:00 p.m. to 10:00 p.m. in the Pacific Ballroom at the Long Beach Convention & Entertainment Center.**

Young Professionals & Students Reception (All Young Professionals and Students Welcome)

Sponsored by IEEE Power Electronics Society and Industrial Applications Society

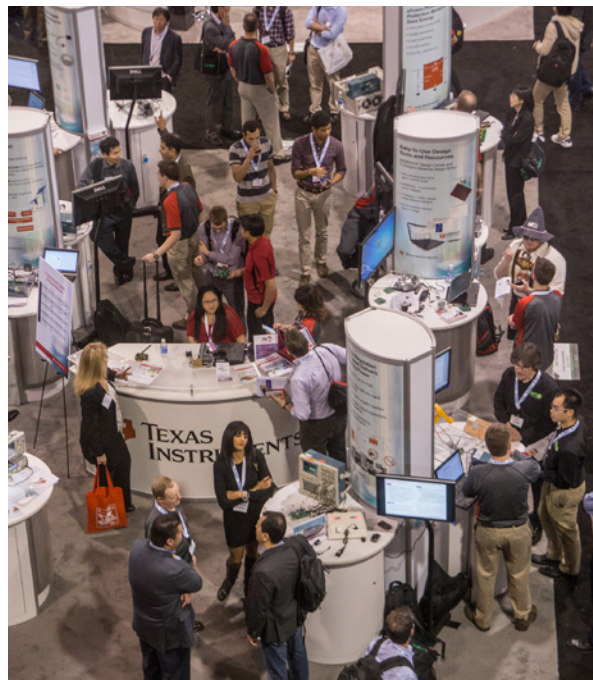
Location:

Cafe Sevilla, 140 Pine Ave, Long Beach, CA 90802

Tuesday, March 22nd - 6:30 p.m. to 9:00 p.m.

Want to mingle, learn and have fun with best minds of IEEE? IAS and PELS give you this opportunity to learn from the life journey of the biggest leaders at APEC at this free networking event.

An evening filled with meeting new people, learning about the best practices in industry and academia, and having loads of fun with drinks and snacks. So make sure you don't miss this wonderful chance to make new friends and meet new people.



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 21 – Thursday, March 24
8:00 a.m. – 11:00 a.m.

PACIFIC ROOM, HYATT REGENCY LONG BEACH

> Spouse and Guest Breakfast

Monday, March 21 – Thursday, March 24
8:00 a.m. – 9:00 a.m.

PACIFIC ROOM, HYATT REGENCY LONG BEACH



Optional Tours

> Docent Estate Tour At The Huntington

Monday, March 21

\$95/per person

10:00 a.m. – 4:30 p.m. (6.5 hour tour)

The Huntington houses an extensive art collection with a focus in 18th and 19th-century European art and 17th to mid-20th-century American art. The property also includes The Huntington Library and approximately 120 acres of specialized botanical landscaped gardens, most notably the “Japanese Garden”, the “Desert Garden”, and the “Chinese Garden.” You will enjoy a delightful lunch at the Café, which overlooks the gardens.

INCLUSIONS: Round-trip motor coach transportation

LUNCH AT CAFÉ (Choice of entrée, beverage and dessert)

> TOUR THE STARS!

Tuesday, March 22

\$85/per person

9:30 a.m. – 4:30 p.m. (7 hour tour)

This is by far the best LA and Hollywood tour around! You will see all the familiar sights like the Hollywood sign, the Stars Walk of Fame, Rodeo Drive and even some stars homes. Your tour guide will even show you the “local” spots where the famous like to go. You will be given a lunch envelope with \$15 cash for lunch at the famous Los Angeles Farmers Market. Snacks and water will be provided on the bus. We promise you won’t be disappointed!

The Los Angeles Farmers Market first opened in July 1934, it is also a historic Los Angeles landmark and tourist attraction. The Farmers Market features more than 100 restaurants, grocers, and tourist shops, and is located just south of CBS Television City. Unlike most farmers’ markets, which are held only at intervals, the Farmers’ Market of Los Angeles is a permanent installation and is open seven days a week. The dozens of vendors serve many kinds of food, both American cuisine from local farmers and restaurants and Los Angeles’ variety of local ethnic foods.

INCLUSIONS: Round trip motor coach transportation

On-board tour guide

\$15 cash for lunch at eatery of your choice at Los Angeles Farmer’s Market

Snacks and water on the bus

Sponsor Meetings

APEC Meetings

WEDNESDAY, MARCH 23, 2016

APEC 2016 Organizing/Steering Committee Luncheon	11:30 a.m. – 1:00 p.m.	LBCC – BOGARTS
APEC 2016 Steering Committee Meeting	1:00 p.m. – 2:30 p.m.	LBCC – BOGARTS

IAS Meetings

TUESDAY, MARCH 22, 2016

PELS / IAS Joint Vehicle and Transportation Systems Meeting (TC4)	3:00 p.m. – 4:00 p.m.	HYATT REGENCY – HARBOR AB
IEEE IAS/PELS Young Professional Reception	6:30 p.m. – 10:00 p.m.	OFFSITE – CAFE SEVILLA

PELS Meetings

SATURDAY, MARCH 19, 2016

PSMA/PELS Workshop on High Frequency Magnetics	7:30 a.m. – 5:00 p.m.	LBCC – ROOM 202
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SUNDAY, MARCH 20, 2016

IEEE International Future Energy Challenge (IFEC) Workshop.	9:00 a.m. – 5:30 p.m.	HYATT REGENCY – REGENCY A
IEEE Smart Village Operations Steering Committee Meeting (Committee Members only)	9:00 a.m. – 5:00 p.m.	HYATT REGENCY – SEAVIEW C
International Technology Roadmap on Wide Band Gap Steering Committee.	12:00 p.m. – 2:00 p.m.	HYATT REGENCY – HARBOR AB
PELS Industry Advisory Board and Magazine Advisory Dinner (Private Dining)	7:30 p.m. – 10:00 p.m.	OFFSITE – L'OPERA RESTAURANT

MONDAY, MARCH 21, 2016

PELS Membership Committee Meeting	8:30 a.m. – 11:30 a.m.	HYATT REGENCY – SEAVIEW A
ETTC Electronics Transformers Technical Committee.	9:00 a.m. – 12:00 p.m.	HYATT REGENCY – HARBOR AB
PELS TC2.8 – Technical Subcommittee, IWIPP2017 & ICDCM2017 Planning	10:00 a.m. – 12:00 p.m.	HYATT REGENCY – SHORELINE B
Chapter Chair Forum.	11:30 a.m. – 1:00 p.m.	HYATT REGENCY – SEAVIEW A

TUESDAY, MARCH 22, 2016

PELS Southern Conference Steering Committee (SPEC).	9:00 a.m. – 10:00 a.m.	HYATT REGENCY – SEAVIEW A
PELS Standards Committee Meeting.	9:00 a.m. – 10:30 a.m.	HYATT REGENCY – SEAVIEW B
PELS Digital Media Meeting.	9:00 a.m. – 10:00 a.m.	HYATT REGENCY – SHORELINE AB
IEMDC Steering Committee.	9:30 a.m. – 11:30 a.m.	HYATT REGENCY – HARBOR AB
PELS Exec & CPSS Team Meeting	10:00 a.m. – TBD.	HYATT REGENCY – SHORELINE
PELS TC6 – High Performance and Emerging Technologies	10:30 am – 12:00 p.m.	HYATT REGENCY – SEAVIEW A
PELS Fellows Committee (Members only)	12:00 p.m. – 1:00 p.m.	HYATT REGENCY – HARBOR AB
PELS TC1 – Power and Control Core Technologies.	12:00 p.m. – 2:00 p.m.	HYATT REGENCY – SEAVIEW B
Transportation Electrification Community	1:30 p.m. – 2:30 p.m.	HYATT REGENCY – HARBOR AB
PELS TC2 – Power Conversion Systems and Components.	2:00 p.m. – 3:30 p.m.	HYATT REGENCY – SHORELINE AB
PELS / IAS Joint Vehicle and Transportation Systems Meeting (TC4)	3:00 p.m. – 4:00 p.m.	HYATT REGENCY – HARBOR AB
PEDG Steering Committee	3:30 p.m. – 4:30 p.m.	HYATT REGENCY – SEAVIEW B
PELS TC7 – Communication Energy Systems.	4:00 p.m. – 5:30 p.m.	HYATT REGENCY – SHORELINE AB
PELS TC3 – Motor Drives and Actuators.	5:30 p.m. – 6:30 p.m.	HYATT REGENCY – HARBOR AB
IEEE IAS/PELS Young Professional Reception.	6:30 p.m. – 9:00 p.m.	OFFSITE – CAFE SEVILLA
PELS TC5 – Sustainable Energy Technical Committee.	6:30 p.m. – 7:30 p.m.	HYATT REGENCY – SEAVIEW B

WEDNESDAY, MARCH 23, 2016

ECCE 2015/2016/2017 Organizing Committee8:00 a.m. – 9:00 a.m.HYATT REGENCY – HARBOR AB
IEEE PELS Women In Engineering Breakfast8:00 a.m. – 9:00 a.m.HYATT REGENCY – REGENCY C
PELS Exec Team Meeting9:00 a.m. – 10:00 a.m.HYATT REGENCY – HARBOR AB
Smart Village Development Committee9:00 a.m. – 2:00 p.m.HYATT REGENCY – SHORELINE AB
PELS FinCom Meeting10:00 a.m. – 11:00 a.m.HYATT REGENCY – HARBOR AB
PELS Editorial Board – IEEE Transactions on Power Electronics11:30 a.m. – 1:30 p.m.HYATT REGENCY – REGENCY A
PELS Technical Operations & Products Committee Meeting1:30 p.m. – 5:30 p.m.HYATT REGENCY – REGENCY BC

THURSDAY, MARCH 24, 2016

PELS Conferences Committee Breakfast8:00 a.m. – 9:00 a.m.HYATT REGENCY – REGENCY C
PELS Conferences Committee Meeting9:00 a.m. – 12:00 p.m.HYATT REGENCY – REGENCY A
eT&D Steering Committee Meeting12:00 p.m. – 1:30 p.m.HYATT REGENCY – SEAVIEW A
PELS JESTPE Editorial Board Meeting2:00 p.m. – 4:00 p.m.HYATT REGENCY – REGENCY A
Humanitarian PE Adhoc.2:00 p.m. – 3:30 p.m.HYATT REGENCY – SEAVIEW A
PELS Constitution and Bylaws Committee3:00 p.m. – 4:30 p.m.HYATT REGENCY – SEAVIEW C
PELS Administrative Committee Dinner6:00 p.m. – 9:30 p.m.OFFSITE – THE QUEEN MARY

FRIDAY, MARCH 25, 2016

PELS Administrative Committee Breakfast (<i>Companions Welcome</i>)8:00 a.m. – 9:00 a.m.HYATT REGENCY – POOLSIDE
PELS Administrative Committee Meeting.9:00 a.m. – 3:00 p.m.HYATT REGENCY – SHORELINE
PELS Administrative Committee Lunch (<i>Companions Welcome</i>)11:30 a.m. – 12:30 p.m.HYATT REGENCY – POOLSIDE

PSMA Meeting**SATURDAY, MARCH 19, 2016**

PSMA/PELS Workshop on High Frequency Magnetics7:30 a.m. – 5:00 p.m.LBCC – ROOM 202
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MONDAY, MARCH 21, 2016

PSMA Annual Meeting – followed by March BoD Meeting7:30 a.m. – 1:00 p.m.LBCC – ROOM 202
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TUESDAY, MARCH 22, 2016

PSMA Energy Harvesting Committee Meeting8:00 a.m. – 10:00 a.m.HYATT REGENCY – REGENCY E
PSMA Semiconductor Committee Meeting8:00 a.m. – 10:00 a.m.HYATT REGENCY – REGENCY F
PSMA Safety & Compliance Committee Meeting10:00 a.m. – 12:00 p.m.HYATT REGENCY – REGENCY E
PSMA Power Technology Roadmap Committee Meeting12:00 p.m. – 2:00 p.m.HYATT REGENCY – REGENCY E
PSMA Marketing Committee Meeting12:00 p.m. – 2:00 p.m.HYATT REGENCY – REGENCY F
PSMA Packaging Committee Meeting2:00 p.m. – 4:00 p.m.HYATT REGENCY – REGENCY E

WEDNESDAY, MARCH 23, 2016

PSMA Energy Efficiency Committee Meeting.8:00 a.m. – 10:00 a.m.HYATT REGENCY – REGENCY E
PSMA Capacitor Committee Meeting8:00 a.m. – 10:00 a.m.HYATT REGENCY – REGENCY F
PSMA Magnetics Committee Meeting10:00 a.m. – 12:00 noon.HYATT REGENCY – REGENCY E
PSMA Transportation Committee Meeting10:00 a.m. – 12:00 noon.HYATT REGENCY – REGENCY F
PSMA Industry-Education Committee Meeting12:00 p.m. – 1:00 p.m.HYATT REGENCY – REGENCY E
PSMA Alternative Energy Committee Meeting1:00 p.m. – 3:00 p.m.HYATT REGENCY – REGENCY E

Sunday

March 20, 2016

8:00 a.m. – 9:00 a.m.

Speaker Breakfast

ROOM 201B

8:00 a.m. – 5:00 p.m.

Registration

EXHIBIT HALLS B/C

9:30 a.m. – 1:00 p.m.

Professional Education Seminars

(for detailed information see page 124)

S01: Exceeding 99% Efficiency for PFC and Isolated DC-DC Converters. GaN Versus Silicon

Ionel Jitaru, Rompower Energy Systems Inc.,
United States
ROOM 104A

S02: The Invisible Schematic: Non-Idealities in Circuit Elements and System Components

Ernest Wittenbreder, Technical Witts, Inc.,
United States
ROOM 104B

S03: Getting from 48 V to Load Voltage: Improving Low Voltage DC-DC Converter Performance with GaN Transistors

Alex Lidow¹, David Reusch¹, John Glaser¹,
¹Efficient Power Conversion Corporation,
United States
ROOM 102AB

S04: A Comprehensive Introduction to Implementing a Fully Digital Power-Factor-Correction Boost Converter

Alex Dumais¹, Joel Steenis¹,
¹Microchip Technology, United States
ROOM 104C

S05: Basic Switching Power Supply Design

Marty Brown, Sierra Energy Management Systems,
LLC, United States
ROOM 101A

S06: Solid-State Transformers – Key Design Challenges, Applicability, and Future Concepts

Johann Walter Kolar¹, Jonas Emanuel Huber¹,
¹Power Electronic Systems Laboratory,
ETH Zurich, Switzerland
ROOM 103AB

S07: Photovoltaic Modeling and Why It Matters for Power Electronics

Katherine A. Kim¹, Jeehoon Jung¹, ¹Ulsan National
Institute of Science and Technology (UNIST),
Korea, South
ROOM 101B

2:30 p.m. – 6:00 p.m.

Professional Education Seminars

(for detailed information see page 124)

S08: Stability and Damping of Grid-Connected Voltage-Source Converters

Frede Blaabjerg¹, Xiongfei Wang¹,
¹Aalborg University, Denmark
ROOM 102AB

S09: PMBus™: Review and New Capabilities

Robert White, Embedded Power Labs,
United States
ROOM 104A

S10: Wide Bandgap Device Characterization

Fred Wang¹, Zheyu Zhang¹, Edward Jones¹,
¹University of Tennessee, United States
ROOM 104B

SUNDAY

SUNDAY

- S11: High Performance Digital Control**
Hamish Laird, *ELMG Digital Power, New Zealand*
ROOM 104C
- S12: Non-linear Thermal Topics in Semiconductors and Electronics**
Roger Stout, *ON Semiconductor, United States*
ROOM 101A
- S13: Power Architectures, Protection and Control of DC Microgrids**
Tomislav Dragičević¹, Josep M. Guerrero¹,
Lexuan Meng¹, Xiaonan Lu², Juan C. Vasquez³,
¹Aalborg University, Denmark, ²Argonne National
Laboratory, United States, ³Virginia Polytechnic Inst.
& State Univ. / CPES, United States
ROOM 103AB
- S14: Soft Switching Three-Phase Converters or Inverters**
Mark Dehong Xu¹, Rui Li², ¹Zhejiang University,
China, ²Shanghai Jiaotong University, China
ROOM 101B



Monday

March 21, 2016

7:00 a.m. – 8:00 a.m.

Speaker Breakfast

ROOM 201B

7:30 a.m. – 5:00 p.m.

Registration

EXHIBIT HALLS B/C

8:00 a.m. – 9:00 a.m.

Spouse and Guest Breakfast

PACIFIC ROOM – HYATT REGENCY

8:00 a.m. – 11:00 a.m.

Spouse and Guest Hospitality Room Open

PACIFIC ROOM – HYATT REGENCY

8:30 a.m. – 12:00 p.m.

Professional Education Seminars

(for detailed information see page 124)

- S15: Introduction to Fast Analytical Techniques: Application to Small-Signal Modeling**
Christophe Basso, *ON Semiconductor, France*
ROOM 104A
- S16: Reliability of Power Electronic Systems**
Frede Blaabjerg¹, Francesco Iannuzzo¹, Huai Wang¹,
Ke Ma¹, ¹Aalborg University, Denmark
ROOM 102AB
- S17: Addressing Challenges in High Power and High Voltage Designs with IGBTs**
Vittorio Crisafulli¹, Dhaval Dalal², Tomas Krecek³,
Dominic Li², ¹ON Semiconductor, Germany,
²ON Semiconductor, United States,
³ON Semiconductor, Czech Rep.
ROOM 101A

S18: A State-Space Design Approach to Digital Feedback Control of DC/DC Converters
Dorin Neacsu, *Technical University of Iasi, Romania, Romania*
ROOM 101B

S19: How to Go From Si to SiC Components in the Design of Converters Including Safety and EMC
Supratim Basu¹, Tore M. Undeland², ¹Bose Research, India, ²Norwegian University of Science and Technology, Norway
ROOM 103AB

S20: Principles and Practices of Digital Current Regulation for AC Systems
Grahame Holmes, *RMIT, Australia*
ROOM 104B

S21: Latest Technologies of LLC Converters for High Current, Fast Response, and Wide Input Voltage Range Applications
Yan-Fei Liu, *Queen's University, Canada*
ROOM 104C

10:00 a.m.

Spouse and Guest Tour “Docent Estate Tour at the Huntington” departs

PACIFIC ROOM – HYATT REGENCY



1:30 p.m. – 5:00 p.m.

Opening Plenary Session

(for detailed information see page xx)

GRAND BALLROOM

1:30 p.m. – 2:00 p.m.

The Challenges of VHF Power Conversion

Tony Sagneri, *Finsix corp*

2:00 p.m. – 2:30 p.m.

The Future of Power Electronic Design

Michael Harrison, *Enphase Energy*

2:30 p.m. – 3:00 p.m.

Breaking Speed Limits with GaN Power ICs

Dan Kinzer, *Navitas Semiconductor*

3:00 p.m. – 3:30 p.m.

Break

3:30 p.m. – 4:00 p.m.

Residential Nanogrids With Battery Storage – Is This Our Future?

Antonio Ginart, *SonnenBatterie*

4:00 p.m. – 4:30 p.m.

The Future of Magnetic Design for Power Electronics

Ray Ridley, *Ridley Engineering*

4:30 p.m. – 5:00 p.m.

Why Do Power Supplies Fail? – A Real-World Analysis

David Hill, *Power Clinic*

5:00 p.m. – 8:00 p.m.

Exhibit Hall Welcome Reception

EXHIBIT HALLS A/B/C

8:00 p.m. – 10:00 p.m.

MicroMouse Contest

BACK OF EXHIBIT HALL A



Tuesday

March 22, 2016

7:00 a.m. – 8:00 a.m.

Speaker Breakfast

GRAND BALLROOM

7:30 a.m. – 5:00 p.m.

Registration

EXHIBIT HALLS B/C

8:00 a.m. – 9:00 a.m.

Spouse and Guest Breakfast

PACIFIC ROOM – HYATT REGENCY

8:00 a.m. – 11:00 a.m.

Spouse and Guest Hospitality Room Open

PACIFIC ROOM – HYATT REGENCY

8:30 a.m. – 11:55 a.m.

IS01: Aiding Design Excellence

ROOM 201A

SESSION CHAIRS:

Ada Cheng, *AdaClock*

Paul Greenland, *eIQ Energy*

8:30 a.m. – 8:55 a.m.

IS01.1: The Role of Patents in Great Designs: Maximize Rewards to Assignee and Inventor

Louis Burgyan, Yuji Kakizaki, *LTEC, United States*

8:55 a.m. – 9:20 a.m.

IS01.2: Developing a Power Engineering Career

Marty Brown, *Sierra Energy Management Systems, United States*

9:20 a.m. – 9:45 a.m.

IS01.3: Fundamentals of Electrical Power Measurements

Yusuf Chitalwala, *Yokogawa Corporation of America, United States*

9:45 a.m. – 10:10 a.m.

IS01.4: Today's Power Conversion Devices Require a New Generation of Test and Measurement Technology

Tom Neville, *Tektronix, United States*

10:40 a.m. – 11:05 a.m.

IS01.5: Online Power Design Tools: Past, Present and Future

Surinder Singh, Vinay Jayaram, Jeff Perry, *Texas Instruments, United States*

11:05 a.m. – 11:30 a.m.

IS01.6: Part Selection Efficiency & Optimization Aiding Design Excellence

Randall Restle, *Digi-Key Electronics, United States*

11:30 a.m. – 11:55 a.m.

IS01.7: Manufacturing and Reliability Perspective for Design Excellence

Aurora Craciun, *Celestica, United States*

8:30 a.m. – 11:55 a.m.

IS02: 3D Power Packaging

ROOM 201B

SESSION CHAIRS:

Brian Narveson, *Narveson Innovative Consulting*

Ernie Parker, *Crane Aerospace & Electronics*

8:30 a.m. – 8:55 a.m.

IS02.1: Additive Manufacturing Technology for Power Electronics Applications

Madhu Chinthavali, *Oakridge National Laboratory, United States*

8:55 a.m. – 9:20 a.m.

IS02.2: Some Progress in Cooling and 3D Packaging for EV/HEV Inverters

Yunqi Zheng, *iPowerPak, United States*

9:20 a.m. – 9:45 a.m.

IS02.3: Embedded Power from POL to Off-Line Applications

Fred Lee, *CPES, Virginia Tech, United States*

9:45 a.m. – 10:10 a.m.

IS02.4: Unmet Challenges of Embedded Components for 3D Packaging

Arnold Alderman, *Anagenesis, Inc., United States*

10:40 a.m. – 11:05 a.m.

IS02.5: Interconnect Reliability — Considerations in Dense Power Packages

Rick Fishbune, *IBM, United States*

TUESDAY

TUESDAY

11:05 a.m. – 11:30 a.m.

IS02.6: Integrated Magnetics for PwrSiP and PwrSoc

Paul McCloskey, *Tyndall National Institute, Ireland*

11:30 a.m. – 11:55 a.m.

IS02.7: Liquid Cooled Transformer Based Power Converters with 3D Printed Micro-Channel Heat Sink

Ernie Parker, Frank Fan Wang, *Crane A&E, United States*

8:30 a.m. – 11:55 a.m.

IS03: Smart Products for the Smart Grid

ROOM 202AB

SESSION CHAIRS:

Edward Herbert, *Independent Consultant*

Dusty Becker, *Independent*

8:30 a.m. – 8:55 a.m.

IS03.1: Virtual Power Plants (VPP)

Alexis Kwasinski, *University of Pittsburgh, United States*

8:55 a.m. – 9:20 a.m.

IS03.2: IIoT in Multi-Utility Smart Grid for Community & Smart City

Bharat Shah, Satyam Bheemarasetti, Ravi Prasad Patruni, *NeoSilica, United States*

9:20 a.m. – 9:45 a.m.

IS03.3: SmartMeters-Beyond Billing

Marshall Parsons, *Grid Edge Solutions Advanced Technologies, United States*

9:45 a.m. – 10:10 a.m.

IS03.4: DC Line Interactive Uninterruptible Power Supply (UPS) with Load Leveling

Robert Cuzner¹, Ahmad Hamidi², Adel Nasiri²,
¹University of Wisconsin, Madison, *United States*,
²University of Wisconsin-Milwaukee, *United States*

10:40 a.m. – 11:05 a.m.

IS03.5: Advanced Control of PV Grid Connected Converters Through the Implementation of the Synchronous Power Controller Concept

Pedro Rodriguez, *Abengoa, Spain*

11:05 a.m. – 11:30 a.m.

IS03.6: Voltage and VAR Regulation

John Berdner, *Enphase Energy, United States*

11:30 a.m. – 11:55 a.m.

IS03.7: Fault Tolerance and Healing

Alexis Kwasinski, *University of Pittsburgh, United States*

8:30 a.m. – 11:55 a.m.

IS04: Wide Bandgap Semiconductors

ROOM 203AB

SESSION CHAIRS:

Dennis Stephens, *Continental Automotive Systems*

Odile Ronat, *International Rectifier HiRel*

8:30 a.m. – 8:55 a.m.

IS04.1: SiC Solution for Industrial Auxiliary Power Supplies

Mitch Van Ochten, *ROHM Semiconductor, United States*

8:55 a.m. – 9:20 a.m.

IS04.2: An Industry First: Silicon Carbide Based Intelligent Power Module

Nitesh Satheesh, Adam Fender, Albert Charpentier, *AgileSwitch, LLC, United States*

9:20 a.m. – 9:45 a.m.

IS04.3: Ultra-Wide-Bandgap Semiconductors for Generation-After-Next Power Electronics

Robert Kaplar¹, Andrew Armstrong¹, Arthur Fischer¹, Albert Baca¹, Andrew Allerman¹, Daniel Mauch¹, Fred Zutavern¹, Michael King¹, Jack Flicker¹, Robert Brocato¹, Lee Rashkin¹, Jarod Delhotal¹, Lu Fang¹, Isik Kizilyalli², Ozgur Aktas², Jason Neely¹, ¹Sandia National Labs, *United States*, ²Avogy Inc., *United States*

9:45 a.m. – 10:10 a.m.

IS04.4: Application-Relevant Qualification of Emerging Semiconductor Power Devices

Sandeep Bahl, Grant Smith, *Texas Instruments, United States*

10:40 a.m. – 11:05 a.m.

IS04.5: Introducing eGaN® IC Targeting Highly Resonant Wireless Power

Michael de Rooij, *Efficient Power Conversion, United States*

11:05 a.m. – 11:30 a.m.

IS04.6: Scaling Power Electronic Converter SWaP Based on WBG and UWBG Device Characteristics

Jason Neely, Jarod Delhotal, Robert Kaplar, Jack Flicker, Lee Rashkin, *Sandia National Labs, United States*

11:30 a.m. – 11:55 a.m.

IS04.7: GaN Takes Server Power Supplies' Power Density to New Heights

Jason Cuadra, *Transphorm, Inc., United States*

8:30 a.m. – 12:00 p.m.

T01: Three-Phase AC-DC Converters

ROOM 101A

Track: AC-DC Converters

SESSION CHAIRS:

Gerry Moschopoulos, *Western University, Canada*

Patrick Wheeler, *University of Nottingham*

8:30 a.m. – 8:50 a.m.

T01.1: Hardware Implementation and Characterization of SiC-Based Hybrid Three-Phase Rectifier Employing Third Harmonic Injection

Markus Makoschitz¹, Michael Hartmann², Hans Ertl¹, ¹*Technische Universität Wien, Austria*, ²*Schneider Electric SE, Austria*

8:50 a.m. – 9:10 a.m.

T01.2: Voltage Oriented Control of the Three-Level Vienna Rectifier Using Vector Control Method

Jeevan Adhikari, Prasanna IV, Sanjib Kumar Panda, *National University of Singapore, Singapore*

9:10 a.m. – 9:30 a.m.

T01.3: Compensation of Neutral Point Deviation in 3-Level NPC Converter Under Unbalanced Grid Conditions

Kyungsub Jung, Yongsug Suh, *Chungbuk National University, Korea, South*

9:30 a.m. – 9:50 a.m.

T01.4: High Power Factor Modular Polyphase AC/DC Converters with Galvanic Isolation Based on Resistor Emulators

Javier Sebastián, Ignacio Castro, Diego G. Lamar, Aitor Vázquez, Kevin Martín, *Universidad de Oviedo, Spain*

9:50 a.m. – 10:10 a.m.

T01.5: Reduced Duty-Cycle Loss and Output Inductor Current Ripple in a ZVS Switched Three-Phase Isolated PWM Rectifier

Jahangir Afsharian¹, Dewei David Xu¹, Tao Zhao², Bing Gong³, Zhihua Yang³, ¹*Ryerson University, Canada*, ²*Hefei University of Technology, China*, ³*Murata Power Solution, Canada*

10:40 a.m. – 11:00 a.m.

T01.6: Analysis, Design, and Evaluation of Three-Phase Three-Wire Isolated AC-DC Converter Implemented with Three Single-Phase Converter Modules

Laszlo Huber, Misha Kumar, Milan Jovanovic, Dinggang Ping, Gang Liu, *Delta Electronics Shanghai Co., Ltd., China*

11:00 a.m. – 11:20 a.m.

T01.7: Startup Procedure for Three-Phase Three-Wire Isolated AC-DC Converter Implemented with Three Single-Phase Converter Modules

Misha Kumar, Laszlo Huber, Milan Jovanovic, Dinggang Ping, Gang Liu, *Delta Electronics Shanghai Co., Ltd., China*

11:20 a.m. – 11:40 a.m.

T01.8: Control of a Single-Stage Three-Phase Boost Power Factor Correction Rectifier

Ayan Mallik, Bryan Faulkner, Alireza Khaligh, *University of Maryland, United States*

11:40 a.m. – 12:00 p.m.

T01.9: A Bidirectional Single-Stage Three-Phase Rectifier with High-Frequency Isolation and Power Factor Correction

Bruno Ricardo de Almeida, Demercil de Souza Oliveira Junior, Paulo Peixoto Praça, *Universidade Federal do Ceará, Brazil*

8:30 a.m. – 12:00 p.m.

T02: High Frequency and Fast-Response DC-DC Converters

ROOM 104A

Track: DC-DC Converters

SESSION CHAIRS:

Olivier Trescases, *University of Toronto*

Jeff Nilles, *Texas Instruments*

8:30 a.m. – 8:50 a.m.

T02.1: A 5 MHz, 12 V, 10 A, Monolithically Integrated Two-Phase Series Capacitor Buck Converter

Pradeep S. Shenoy, Orlando Lazaro, Ramanathan Ramani, Mike Amaro, Wlodek Wiktor, Joseph Khayat, Brian Lynch, *Texas Instruments Inc., United States*

8:50 a.m. – 9:10 a.m.

T02.2: A 10-MHz Isolated Class-Phi2 Synchronous Resonant DC-DC Converter

Yuan Zhou, Zhiliang Zhang, Xuewen Zou, Zhou Dong, Xiaoyong Ren, *Nanjing University of Aeronautics and Astronautics, China*

9:10 a.m. – 9:30 a.m.

T02.3: 865 MHz Switching-Speed Step-Down DC-DC Power Converter for Envelope Tracking

Vivek Mehrotra, Andrea Arias, Joshua Bergman, Charles Neft, Miguel Urteaga, Berinder Brar, *Teledyne Scientific Company, United States*

9:30 a.m. – 9:50 a.m.

T02.4: Current Parking Regulator for Zero Droop/Overshoot Load Transient Response

Sudhir Kudva, William Dally, Thomas Greer III, Carl Thomas Gray, *Nvidia Corporation, United States*

9:50 a.m. – 10:10 a.m.

T02.5: A 5MHz, 24V-to-1.2V, AO2T Current Mode Buck Converter with One-Cycle Transient Response and Sensorless Current Detection for Medical Meters

Xugang Ke¹, Joseph Sankman², Dongsheng Ma¹,
¹University of Texas at Dallas, United States,
²Texas Instruments Inc., United States

10:40 a.m. – 11:00 a.m.

T02.6: Capacitively-Aided Switching Technique for High-Frequency Isolated Bus Converters

Seungbum Lim, Alex Hanson, Juan Santiago-González, David Perreault, *Massachusetts Institute of Technology, United States*

11:00 a.m. – 11:20 a.m.

T02.7: A 10 MHz, 48-to-5V Synchronous Converter with Dead Time Enabled 125 Ps Resolution Zero-Voltage Switching

Alexander Barner¹, Jürgen Wittmann², Thoralf Rosahl¹, Bernhard Wicht², ¹Robert Bosch GmbH, Germany, ²Hochschule Reutlingen, Germany

11:20 a.m. – 11:40 a.m.

T02.8: Plug-and-Play Electronic Capacitor for VRM Applications

Or Kirshenboim, Alon Cervera, Bar Halivni, Eli Abramov, Mor Mordechai Peretz, *Ben-Gurion University of the Negev, Israel*

11:40 a.m. – 12:00 p.m.

T02.9: Adaptive Voltage Positioning (AVP) Design of Multi-Phase Constant on-Time I² Control for Voltage Regulators with Ramp Compensations

Kuang-Yao Cheng, Yipeng Su, *Texas Instruments Inc., United States*

8:30 a.m. – 12:00 p.m.

T03: Microgrids and Hybrid Systems

ROOM 104B

Track: Power Electronics for Utility Interface

SESSION CHAIRS:

Yunwei Li, *University of Alberta*

Josep Guerrero, *Aalborg University in Denmark*

8:30 a.m. – 8:50 a.m.

T03.1: Reactive Power Support Capabilities of Nonsynchronous Interconnection Systems in Microgrid Applications

Yong-Duk Lee, Sung-Yeul Park, *University of Connecticut, United States*

8:50 a.m. – 9:10 a.m.

T03.2: Zero Standby Power High Efficiency Hot Plugging Outlet for 380VDC Power Delivery System

Kai Tan, Chang Peng, Pengkun Liu, Xiaoqing Song, Alex. Q Huang, *North Carolina State University, United States*

9:10 a.m. – 9:30 a.m.

T03.3: Design of Control System for Smooth Mode Transfer in Smart Microgrid Application

Mingzhi Gao¹, Canhui Zhang¹, Maohang Qiu¹, Min Chen¹, Aron Levy², ¹Zhejiang University, China, ²Technology Dynamics Inc., United States

9:30 a.m. – 9:50 a.m.

T03.4: Resonance Propagation Modeling and Analysis of AC Filters in a Large-Scale Microgrid

Yusi Liu, Chris Farnell, Alan Mantooth, Juan Carlos Balda, Roy McCann, Cheng Deng, *University of Arkansas, United States*

9:50 a.m. – 10:10 a.m.

T03.5: A New Bidirectional DC-DC Converter for Fuel Cell, Solar Cell and Battery Systems

Ankur Patel, *Vicor Corporation, United States*

10:40 a.m. – 11:00 a.m.

T03.6: A Multiport Isolated DC-DC Converter

Yan-Kim Tran, Drazen Dujic, *École Polytechnique Fédérale de Lausanne, Switzerland*

11:00 a.m. – 11:20 a.m.

T03.7: A Seamless Transfer Control Method with High Load Sharing Performance for Modular ESS

Jung-Hoon Ahn¹, Won-Yong Sung¹, Chang-Yeol Oh¹, Byoung-Kuk Lee¹, Yun-Sung Kim²,
¹*Sungkyunkwan University, Korea, South*,
²*Dongahelcomm Corporation, Korea, South*

11:20 a.m. – 11:40 a.m.

T03.8: A Plug-and-Play Ripple Mitigation Approach for DC-Links in Hybrid Systems

Sinan Li, Albert Ting Leung Lee, Siew-Chong Tan, Shu Yuen Ron Hui, *University of Hong Kong, Hong Kong*

11:40 a.m. – 12:00 p.m.

T03.9: Active Control of Low Frequency Common Mode Voltage to Connect AC Utility and 380 V DC Grid

Fang Chen, Rolando Burgos, Dushan Boroyevich, Xuning Zhang, *Virginia Polytechnic Institute and State University, United States*

8:30 a.m. – 12:00 p.m.

T04: Control Strategies for Inverters and Motor Drives

ROOM 103C

Track: Motor Drives and Inverters

SESSION CHAIRS:

Bilal Akin, *University of Texas, Dallas*

Babak Nahid-Mobarakeh, *University of Lorraine*

8:30 a.m. – 8:50 a.m.

T04.1: A Three-Level Space Vector Modulation Scheme for Paralleled Two Converters to Reduce Zero-Sequence Circulating Current and Common Mode Voltage

Zhongyi Quan, Yunwei Li, *University of Alberta, Canada*

8:50 a.m. – 9:10 a.m.

T04.2: Nonlinearity Analysis and Linear Modulation Method for Two Level Voltage Source Inverter with Low Switching to Operating Frequency Ratio

Yongjae Lee, Jung-Ik Ha, *Seoul National University, Korea, South*

9:10 a.m. – 9:30 a.m.

T04.3: Synchronization Strategies in Cascaded H-Bridge Multi Level Inverters for Carrier Based Sinusoidal PWM Techniques

Saroj Kumar Sahoo, Tanmoy Bhattacharya, *Indian Institute of Technology Kharagpur, India*

9:30 a.m. – 9:50 a.m.

T04.4: Design and Implementation of a Sinusoidal Flux Controller for Core Loss Measurements

Burak Tekgun, Ali Boynuegri, Asif Chowdhury, Yilmaz Sozer, *University of Akron, United States*

9:50 a.m. – 10:10 a.m.

T04.5: Implementation of Deadbeat-Direct Torque and Flux Control for Synchronous Reluctance Machines to Minimize Loss Each Switching Period

Michael Saur¹, Francisco Ramos¹, Aday Perez¹, Dieter Gerling¹, Robert Lorenz², ¹*Universität der Bundeswehr München, Germany*, ²*University of Wisconsin-Madison, United States*

10:40 a.m. – 11:00 a.m.

T04.6: Addressing the Unbalance Loading Issue in Multi-Drive Systems with a DC-Link Modulation Scheme for Harmonic Reduction

Yongheng Yang¹, Pooya Davari¹, Firuz Zare², Frede Blaabjerg¹, ¹*Aalborg University, Denmark*, ²*Danfoss Power Electronics A/S, Denmark*

11:00 a.m. – 11:20 a.m.

T04.7: Input Current Interharmonics in Adjustable Speed Drives Caused by Fixed-Frequency Modulation Techniques

Hamid Soltani¹, Pooya Davari¹, Poh Chiang Loh¹, Frede Blaabjerg¹, Firuz Zare², ¹*Aalborg University, Denmark*, ²*Danfoss Power Electronics A/S, Denmark*

11:20 a.m. – 11:40 a.m.

T04.8: Low-Frequency Voltage Ripples in the Flying Capacitors of the Nested Neutral-Point-Clamped Converter

Amer Ghias¹, Josep Pou², Salvador Ceballos³, Vassilios Agelidis², ¹*University of Sharjah, U.A.E.*, ²*University of New South Wales, Australia*, ³*TECNALIA, Spain*

11:40 a.m. – 12:00 p.m.

T04.9: DC Bus Capacitor Discharge of Permanent Magnet Synchronous Machine Drive Systems for Hybrid Electric Vehicles

Ziwei Ke¹, Julia Zhang¹, Michael Degner², ¹*Oregon State University, United States*, ²*Ford Motor Company, United States*

8:30 a.m. – 12:00 p.m.

T05: Si Devices and Power Module Packaging

ROOM 101B

Track: Devices and Components

SESSION CHAIRS:

Iulian Nistor, *Corporate Research, ABB Inc.*

Brian Rowden, *GE Global Research*

T05.1: Coss Hysteresis in Advanced Superjunction MOSFETs

8:30 a.m. – 8:50 a.m.

Jeff Fedison, Michael Harrison, *Enphase Energy, Inc., United States*

T05.2: Compact Electrothermal Models for Unbalanced Parallel Conducting Si-IGBTs

8:50 a.m. – 9:10 a.m.

Roozbeh Bonyadi, Olayiwola Alatise, Ji Hu, Zarina Davletzhanova, Yeganeh Bonyadi, Jose Ortiz-Gonzalez, Li Ran, Philip Mawby, *University of Warwick, United Kingdom*

T05.3: General 3D Lumped Thermal Model with Various Boundary Conditions for High Power IGBT Modules

9:10 a.m. – 9:30 a.m.

Amir Sajjad Bahman, Ke Ma, Frede Blaabjerg, *Aalborg University, Denmark*

T05.4: Improved 6.5kV FREEMD-Pair Based on SiC JFET and Si IGBT

9:30 a.m. – 9:50 a.m.

Xiaoqing Song, Alex. Q Huang, Chang Peng, Liqi Zhang, *North Carolina State University, United States*

T05.5: On the Comparative Assessment of 1.7 kV, 300 a Full SiC-MOSFET and Si-IGBT Power Modules

9:50 a.m. – 10:10 a.m.

Muhammad Nawaz, Kalle Iives, *ABB Corporate Research, Sweden*

T05.6: Suppression of Reverse Recovery Ringing 3.3kV/450A Si/SiC Hybrid in Low Internal Inductance Package Next High Power Density Dual, nHPD2

10:40 a.m. – 11:00 a.m.

Katsuaki Saito¹, Daisuke Kawase², Masamitsu Inaba², Keiichi Yamamoto², Katsunori Azuma², Seiichi Hayakawa², *¹Hitachi Europe Ltd., United Kingdom, ²Hitachi Power Semiconductor Device, Ltd.,*

11:00 a.m. – 11:20 a.m.

T05.7: New Layout Concepts in MW-Scale IGBT Modules for Higher Robustness During Normal and Abnormal Operations

Paula Diaz Reigosa, Francesco Iannuzzo, Stig Munk-Nielsen, Frede Blaabjerg, *Aalborg University, Denmark*

11:20 a.m. – 11:40 a.m.

T05.8: Design, Package, and Hardware Verification of a High Voltage Current Switch

Ankan De, Adam Morgan, Vishnu Mahadeva Iyer, Haotao Ke, Xin Zhao, Kasunaidu Vechalapu, Subhashish Bhattacharya, Douglas C. Hopkins, *North Carolina State University, United States*

11:40 a.m. – 12:00 p.m.

T05.9: Investigation of Short Circuit in a IGBT Power Module with Three-Level Neutral Point Clamped Type 2 (NPC2, T-NPC, Mixed Voltage) Topology

Kevin Lenz, Vladan Jerinic, Reiner Hinken, *Danfoss Silicon Power, Germany*

8:30 a.m. – 12:00 p.m.

T06: DC-DC Converter Control

ROOM 102AB

Track: Control

SESSION CHAIRS:

Sombuddha Chakraborty, *Texas Instruments*

Rafael Pena Alzola, *University of British Columbia*

8:30 a.m. – 8:50 a.m.

T06.1: Closed-Loop Design and Time-Optimal Control for a Series-Capacitor Buck Converter

Timur Veksler, Ofer Ezra, Yevgeny Bezdenezhnykh, Mor Mordechai Peretz, *Ben-Gurion University of the Negev, Israel*

8:50 a.m. – 9:10 a.m.

T06.2: Unified Constant On/Off-Time Hybrid Compensation for Fast Recovery in Digitally Current-Mode Controlled Point-of-Load Converters

K Hariharan, Santanu Kapat, Siddhartha Mukhopadhyay, *Indian Institute of Technology Kharagpur, India*

9:10 a.m. – 9:30 a.m.

T06.3: Digital Implementation of Adaptive Synchronous Rectifier (SR) Driving Scheme for LLC Resonant Converters

Chao Fei, Virginia Fred C. Lee, Qiang Li,
Virginia Polytechnic Institute and State University, United States

9:30 a.m. – 9:50 a.m.

T06.4: Digital Synchronous Rectification Controller for LLC Resonant Converters

Maryam S. Amouzandeh¹, Behzad MahdaviKhah¹, Aleksandar Prodic¹, Brent McDonald²,¹*University of Toronto, Canada*, ²*Texas Instruments Inc., United States*

9:50 a.m. – 10:10 a.m.

T06.5: A Novel Adaptive Synchronous Rectification Method for Digitally Controlled LLC Converters

Fan Wang¹, Brent McDonald¹, Jeff Langham¹, Bo Fan², ¹*Texas Instruments Inc., United States*, ²*Texas Instruments Inc., China*

10:40 a.m. – 11:00 a.m.

T06.6: Influence of the ADC Zero Bin on the Performance of an Integrated DC-DC Converter

Sanna Vesti, Matteo Agostinelli, Heorhii Koltsov, Stefano Marsili, *Infineon Technologies Austria AG, Austria*

11:00 a.m. – 11:20 a.m.

T06.7: Improved Current-Mode Control with Single-Cycle Load Transient

Virginia Li, Pei-Hsin Liu, Qiang Li, Fred C. Lee,
Virginia Polytechnic Institute and State University, United States

11:20 a.m. – 11:40 a.m.

T06.8: A Mixed-Signal Ripple-Based Controller for a 16 V, 10 MHz Integrated Buck Converter

Sergii Tkachov, Matteo Agostinelli, *Infineon Technologies Austria AG, Austria*

11:40 a.m. – 12:00 p.m.

T06.9: New Control Concept for Soft-Switching Flyback Converters with Very High Switching Frequency

Alexander Connaughton¹, Klaus Krischan¹, Kenneth Kin Leong², Annette Muetze¹, ¹*Technische Universität Graz, Austria*, ²*Infineon Technologies AG, Austria*

8:30 a.m. – 12:00 p.m.

T07: Solar Energy Systems

ROOM 104C

Track: Renewable Energy Systems

SESSION CHAIRS:

Babak Fahimi, *University of Texas, Dallas*

Morgan Kiani, *Texas Christian University*

8:30 a.m. – 8:50 a.m.

T07.1: Analysis, Modeling and Control of an Interleaved Isolated Boost Series Resonant Converter for Microinverter Applications

Luciano Garcia-Rodriguez¹, Cheng Deng¹, Juan Carlos Balda¹, Andres Escobar-Mejia²,
¹*University of Arkansas, United States*, ²*Universidad Tecnologica de Pereira, Colombia*

8:50 a.m. – 9:10 a.m.

T07.2: Benchmarking of Constant Power Generation Strategies for Single-Phase Grid-Connected Photovoltaic Systems

Ariya Sangwongwanich, Yongheng Yang, Frede Blaabjerg, Huai Wang, *Aalborg University, Denmark*

9:10 a.m. – 9:30 a.m.

T07.3: Advanced Slip Mode Frequency Shift Islanding Detection Method for Single Phase Grid Connected PV Inverters

Bahador Mohammadpour, Majid Pahlevani, Sajjad Makhdoomi Kaviri, Paveen Jain,
Queen's University, Canada

9:30 a.m. – 9:50 a.m.

T07.4: Direct MPPT Control of PWM Converters for Extreme Transient PV Applications

Ignacio Galiano Zurbriggen, Francisco Paz, Martin Ordonez, *University of British Columbia, Canada*

9:50 a.m. – 10:10 a.m.

T07.5: Feeding Partial Power Into Line Capacitors for Low Cost and Efficient MPPT of Photovoltaic Strings

Ali Elrayyah¹, Mohammed Badawey², Yilmaz Sozer², ¹*Qatar Environment and Energy Institute, Qatar*, ²*University of Akron, United States*

10:40 a.m. – 11:00 a.m.

T07.6: Single Phase Cascaded H5 Inverter with Leakage Current Elimination for Transformerless Photovoltaic System

Xiaoqiang Guo¹, Xiaoyu Jia¹, Zhigang Lu¹, Josep Maria Guerrero², ¹*Yanshan University, China*, ²*Aalborg University, Denmark*

11:00 a.m. – 11:20 a.m.

T07.7: Optimal Low Switching Frequency Pulse Width Modulation of Current-Fed Three-Level Inverter for Solar Integration

Gnana Sambandam Kulothungan, Akshay Kumar Rathore, Amarendra Edpuganti, Dipti Srinivasan, *National University of Singapore, Singapore*

11:20 a.m. – 11:40 a.m.

T07.8: Low Leakage Current Single-Phase PV Inverters with Universal Neutral-Point-Clamping Method

Liwei Zhou, Feng Gao, *Shandong University, China*

11:40 a.m. – 12:00 p.m.

T07.9: Modular Subpanel Photovoltaic Converter System: Analysis and Control

Yuan Li¹, Yue Zheng², Su Sheng², Brad Scandrett³, Brad Lehman², ¹*Sichuan University/Northeastern University, China*, ²*Northeastern University, United States*, ³*Powerfilm, United States*

8:30 a.m. – 12:00 p.m.

T08: Advanced Converter for Power Systems used in Transportation

ROOM 103AB

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.

T08.1: Integrated DC-DC Converter Design for Electric Vehicle Powertrains

Saeed Anwar, Weimin Zhang, Fred Wang, Daniel Jes Costinett, *University of Tennessee, United States*

8:50 a.m. – 9:10 a.m.

T08.2: A 1 MHz Bi-Directional Soft-Switching DC-DC Converter with Planar Coupled Inductor for Dual Voltage Automotive Systems

Chenhao Nan, Raja Ayyanar, *Arizona State University, United States*

9:10 a.m. – 9:30 a.m.

T08.3: A Bridgeless Totem-Pole Interleaved PFC Converter for Plug-in Electric Vehicles

Yichao Tang, Weisheng Ding, Alireza Khaligh, *University of Maryland, United States*

9:30 a.m. – 9:50 a.m.

T08.4: Stability Analysis of Hybrid AC/DC Power Systems for More Electric Aircraft

Mehdi Karbalaye Zadeh¹, Roghayeh Gavagsaz-Ghoachani², Babak Nahid-Mobarakkeh², Serge Pierfederici², Marta Molinas¹, ¹*Norwegian University of Science and Technology, Norway*, ²*Université de Lorraine, France*

9:50 a.m. – 10:10 a.m.

T08.5: On the Concept of the Multi-Source Inverter

Lea Dorn-Gomba, Pierre Magne, Clement Barthelmebs, Ali Emadi, *McMaster University, Canada*

10:40 a.m. – 11:00 a.m.

T08.6: Time-Domain Analysis of a Wide-DC-Range Series Resonant Dual-Active-Bridge Bidirectional Converter with a New Passive Auxiliary Circuit

Alireza Safaei, Praveen Jain, Alireza Bakhshai, *Queen's University, Canada*

11:00 a.m. – 11:20 a.m.

T08.7: A New High Capacity Compact Power Modules for High Power EV/HEV Inverters

Seiichiro Inokuchi, *Mitsubishi Electric Corporation, Japan*
Shoji Saito¹, Arata Izuka¹, Yuki Hata¹, Shinji Hatae¹, Toshiya Nakano², Eric R. Motto², ¹*Mitsubishi Electric Corporation, Japan*, ²*Powerex, Inc., United States*

11:20 a.m. – 11:40 a.m.

T08.8: Modular Pet, Two-Phase Air-Cooled Converter Cell Design and Performance Evaluation with 1.7kV IGBTs for MV Applications

Frederick Kieferndorf, Uwe Drofenik, Francesco Agostini, Francisco Canales, *ABB Switzerland Ltd, Switzerland*

11:40 a.m. – 12:00 p.m.

T08.9: A Phase Shift Full Bridge Based Reconfigurable PEV Onboard Charger with Extended ZVS Range and Zero Duty Cycle Loss

Haoyu Wang, *ShanghaiTech University, China*

8:30 a.m. – 12:00 p.m.

T09: Gate Drives, Failure Analysis, and Protection

ROOM 102C

Track: Power Electronics Applications

SESSION CHAIRS:

Zhiliang Zhang, *Nanjing University of Aeronautics and Astronautics*

Indumini Ranmuthu, *Texas Instruments*

8:30 a.m. – 8:50 a.m.

T09.1: Series Arc Fault Detection Method Based on Statistical Analysis for DC Microgrids

Gab-Su Seo¹, Jung-Ik Ha¹, Bo-Hyung Cho¹, Kyu-Chan Lee², ¹Seoul National University, Korea, South, ²Smart Power Supply Co., Ltd., Korea, South

8:50 a.m. – 9:10 a.m.

T09.2: Arc Welding Inverter with Embedded Digital Active EMI Controller

Junpeng Ji, Wenjie Chen, Xu Yang, *Xi'an Jiaotong University, China*

9:10 a.m. – 9:30 a.m.

T09.3: A Thermo-Sensitive Electrical Parameter with Maximum dIC/dt During Turn-Off for High Power Trench/Field-Stop IGBT Modules

Yuxiang Chen¹, Haoze Luo¹, Wuhua Li¹, Xiangning He¹, Jun Ma², Guodong Chen², Ye Tian², Enxing Yang², ¹Zhejiang University, China, ²Shanghai Electric, China

9:30 a.m. – 9:50 a.m.

T09.4: A Software Frequency Response Analysis Method to Monitor Degradation of Power MOSFETs in Basic Single-Switch Converters

Serkan Dusmez¹, Manish Bhardwaj², Lei Sun¹, Bilal Akin¹, ¹University of Texas at Dallas, United States, ²Texas Instruments Inc., United States

9:50 a.m. – 10:10 a.m.

T09.5: A New Capacitance Estimation Method of Supercapacitor Bank Using a Bank Impedance and Current Injection

Junwon Lee, Hyunsik Jo, Hanju Cha, *Chungnam National University, Korea, South*

10:40 a.m. – 11:00 a.m.

T09.6: Gate Driver Design for 1.7kV SiC MOSFET Module with Rogowski Current Sensor for Shortcircuit Protection

Jun Wang, Zhiyu Shen, Christina Dimarino, Rolando Burgos, Dushan Boroyevich, *Virginia Polytechnic Institute and State University, United States*

11:00 a.m. – 11:20 a.m.

T09.7: 2 MHz High-Density Integrated Power Supply for Gate Driver in High-Temperature Applications

Remi Perrin¹, Bruno Allard¹, Cyril Buttay¹, Nicolas Quentin¹, Wenli Zhang², Rolando Burgos², Dushan Boroyevich², Philippe Preciat³, Donatien Martineau³, ¹Université Claude Bernard Lyon 1, France, ²Virginia Polytechnic Institute and State University, United States, ³Labinal Power Systems, France

11:20 a.m. – 11:40 a.m.

T09.8: Design Consideration of Gate Driver Circuits and PCB Parasitic Parameters of Paralleled E-Mode GaN HEMTs in Zero-Voltage-Switching Applications

Juncheng Lu¹, Alan Brown², Matt McAmmond², Di Chen³, Julian Styles³, Hua Bai¹, ¹Kettering University, United States, ²Hella Corporate Center USA Inc., United States, ³GaN Systems Inc., Canada

11:40 a.m. – 12:00 p.m.

T09.9: A Gate Driver of SiC MOSFET for Suppressing the Negative Voltage Spikes in a Bridge Circuit

Qi Zhou, Feng Gao, *Shandong University, China*

9:30 a.m.

Spouse and Guest Tour “Tour the Stars” departs

PACIFIC ROOM – HYATT REGENCY

12:00 p.m. – 5:00 p.m.

Exhibit Hall Open

EXHIBIT HALLS A/B/C

.....
1:30 p.m. -2:00 p.m.

Exhibitor Seminars – Session #1

(for detailed information see page 188)

COILCRAFT

New Power Inductors for High Frequency DC-DC Converters

ROOM 101A

DINO-LITE SCOPES (BIGC)

Dino-Lite Digital Microscope: Edge Series

ROOM 101B

HYDRO-QUÉBEC RESEARCH INSTITUTE (IREQ)

Simulating Power Electronics Converters Using MATLAB/SimPowerSystems. The Right Balance between Performance and Fidelity

ROOM 102AB

INFINEON TECHNOLOGIES

MOSFET Driver IC Solutions from Infineon Technologies

ROOM 103AB

LEM USA

New ASIC based Open Loop Transducers

ROOM 201A

NXP SEMICONDUCTORS USA, INC.

Introducing new Motor Drivers featuring Functional Safety and Higher Torque

ROOM 201B

STMICROELECTRONICS

Silicon Carbide MOSFET Benefits in Automotive Applications

ROOM 202AB

TEXAS INSTRUMENTS

Big Batteries: take a walk on the high side with TI's 100-V FET driver

ROOM 203AB

.....
2:15 p.m. -2:45 p.m.

Exhibitor Seminars – Session #2

AAVID THERMALLOY LLC

Aavid Thermalloy Expands Capabilities & Products with Niagara Acquisition

ROOM 101A

COGNIPOWER

The Practical Side of Faster, Smaller, More Efficient Power Converters

ROOM 101B

MAGNETICS

Large XFLUX® and Block Structures for High Current Applications

ROOM 102AB

NH RESEARCH, INC.

Testing Vehicle Power & V2G Applications

ROOM 103AB

POWEREX, INC.

New DIPIPM™s Featuring More Integration and Lower Cost

ROOM 201A

SIMPLIS TECHNOLOGIES

Designing Digitally Controlled Systems with SIMPLIS

ROOM 201B

MOUSER ELECTRONICS

An Integrated Filter and Power Converter Electric Vehicle Powertrain Solution

ROOM 203AB

VISHAY INTERTECHNOLOGY

Performance Components for Power Applications

ROOM 202AB

.....
3:00 p.m. -3:30 p.m.

Exhibitor Seminars – Session #3

AGILESWITCH, LLC

An Industry First – Silicon Carbide based Intelligent Power Module

ROOM 101A

FAIR-RITE PRODUCTS CORP.

Low loss 67 Material for High Frequency Power Applications

ROOM 101B

MAGSOFT CORORATION

Fast computation of Inductance, Capacitance, Current Density in conductor arrangements

ROOM 102AB

MONOLITHIC POWER SYSTEMS (MPS)

High Performance PMSM Servo System Using MPS e.Motion Technology

ROOM 103AB

ON SEMICONDUCTOR

Energy Efficient Innovations

ROOM 201A

TYPHOON HIL, INC.
**Ultra-high Fidelity Hardware-in-the-loop
Simulation for Power Electronics and
Microgrid**

ROOM 201B

WÜRTH ELEKTRONIK EISOS
**8 Simple Design Tips – How to Design in a
Power Inductor**

ROOM 203AB

ZES ZIMMER INC.
**New AC power measuring advancements:
Power Supplies, Drives, PWM, Harmonics,
Waveforms and more**

ROOM 202AB

5:00 p.m. – 6:30 p.m.

Rap Sessions

(for detailed information see page 146)

**Rap Session 1: Future of Semiconductor
Technology Development**

ROOM 104A

**Rap Session 2: Power Electronics for
Internet of Things: Will it happen?**

ROOM 104B

**Rap Session 3: Advanced Refueling
Technologies for EVs**

ROOM 104C

3:45 p.m. – 4:15 p.m.

Exhibitor Seminars – Session #4

FAIRCHILD SEMICONDUCTOR
**1200V Smart Power Module for Low-Power
Industrial Motor Drive Applications**

ROOM 101A

INTERSIL
**Digital Power Design Featuring Intersil's
ChargeMode and Hybrid Digital Controllers**

ROOM 101B

KEMET ELECTRONICS CORPORATION
Capacitor Modeling and Simulation

ROOM 102AB

SCHUNK HOFFMANN CARBON TECHNOLOGY
**Aluminium Graphite: The Optimal Thermal
Management Solution for High Reliability
Applications**

ROOM 103AB

SYNOPTIS
**Accurate Modeling and Simulation of
Contemporary Power Converters using
Saber**

ROOM 201A

TAIWAN SEMICONDUCTOR
**Improved Efficiency in LED Lighting
Control**

ROOM 201B

WURTH ELECTRONICS MIDCOM
Custom Flyback Transformers Made Easy

ROOM 203AB



Wednesday

March 23, 2016

7:00 a.m. – 8:00 a.m.

Speaker Breakfast

GRAND BALLROOM

8:00 a.m. – 3:00 p.m.

Registration

EXHIBIT HALLS B/C

8:00 a.m. – 9:00 a.m.

Spouse and Guest Breakfast

PACIFIC ROOM – HYATT REGENCY

8:00 a.m. – 11:00 a.m.

Spouse and Guest Hospitality Room Open

PACIFIC ROOM – HYATT REGENCY

8:30 a.m. – 10:10 a.m.

IS05: Thermal Management

ROOM 201A

SESSION CHAIRS:

Peter Resca, *Advanced Thermal Solutions, Inc.*

8:30 a.m. – 8:55 a.m.

IS05.1: Thermal Challenges and Solutions for Industrial Solid State Lighting Applications

Peter Resca, *Advanced Thermal Solutions, United States*

8:55 a.m. – 9:20 a.m.

IS05.2: Thermally Managing High Power Devices Using Heat Pipe Assemblies

Abdul Samad Jawed, *Cliff Weasner, Ahmed Zaghlol, Mersen, Canada*

9:20 a.m. – 9:45 a.m.

IS05.3: Using Web Based Tools for the Thermal Design of a Power Converter

Ahmed Zaghlol¹, Jeremy Howes², David Levett³, Greg Schendel⁴, ¹*Mersen, Canada*, ²*Tesla Energy, United States*, ³*Infineon, United States*, ⁴*Parker SSD Drives, United States*

9:45 a.m. – 10:10 a.m.

IS05.4: Reflowable Thermal Devices Protecting High-Power Automotive Electronics

Barry Brents, *TE Connectivity, United States*

8:30 a.m. – 10:10 a.m.

IS06: Modeling and Simulation

ROOM 201B

SESSION CHAIRS:

Cahit Gezgin, *Infineon Technologies*

Brian Thomas, *Independent Consultant*

8:30 a.m. – 8:55 a.m.

IS06.1: System-Level Crosstalk-Induced Efficiency Impact of CDC Converter: Simulation to Measurement Correlation

Joerg Goller, Jie Chen, Rajen Murugan, *Texas Instruments, Inc, United States*

8:55 a.m. – 9:20 a.m.

IS06.2: Switching Voltage Regulator Modeling Methodology for Simulation Based Power Delivery Design

Wei Xu, Jiangqi He, David Figueroa, *Intel Corporation, United States*

9:20 a.m. – 9:45 a.m.

IS06.3: CoolSPICE: a New Electrical and Thermal Circuit Simulator for Power Circuit Design with New Wide Bandgap Device Capabilities

Akin Akturk, Neil Goldsman, Zeynep Dilli, Simon Peggs, *CoolCAD Electronics LLC, United States*

9:45 a.m. – 10:10 a.m.

IS06.4: Power Converter System Stress and Mechanical Analysis Within an Integrated Design Environment

Rehan Iqbal, Carl Bycraft, *Mentor Graphics, United States*

WEDNESDAY

WEDNESDAY

8:30 a.m. – 10:10 a.m.

IS07: Very Low Power Applications

ROOM 202AB

SESSION CHAIRS:

Edward Stanford, *Power Deliver Consultants*

Nick Gruendler, *Celestica*

8:30 a.m. – 8:55 a.m.

IS07.1: Energy Harvesting Is Not Fiction Anymore

Lorandt Fölkel, *Würth Elektronik eiSos GmbH, Germany*

8:55 a.m. – 9:20 a.m.

IS07.2: A New Way to Power the World with High Efficiencies

Michael Freeman, *Semitrex, United States*

9:20 a.m. – 9:45 a.m.

IS07.3: System Architecture That Extends Battery Life

Matthew Tyler, *ON Semiconductor, United States*

9:45 a.m. – 10:10 a.m.

IS07.4: Primary Side Regulation in Flyback Converters Delivers Low Cost, High Reliability and Energy Efficiency

Ramanan Natarajan, Bing Lu, Brent McDonald, Vaibhav Desai, Peter Fundaro, *Texas Instruments, United States*

8:30 a.m. – 10:10 a.m.

IS08: Alternative Energy in High Penetration Areas

ROOM 203AB

SESSION CHAIRS:

Michael Harrison, *Enphase Energy*

Bharat Shah, *Independent Consultant*

8:30 a.m. – 8:55 a.m.

IS08.1: The Growth of Renewable Energy in California

David Hochschild, *California Energy Commission, United States*

8:55 a.m. – 9:20 a.m.

IS08.2: Shine and Drive: the Symbiotic Relationship Between Renewables, Electric Vehicles, and the Grid

Carla Peterman, *California Public Utilities Commission, United States*

9:20 a.m. – 9:45 a.m.

IS08.3: Modernizing the Grid and Enabling Distributed Energy Resources

Heather Sanders, *Southern California Edison, United States*

9:45 a.m. – 10:10 a.m.

IS08.4: Promoting Renewable Energy Technologies Through Research, Testing and Standards

Tim Zgonena, *Underwriters Laboratories, United States*

8:30 a.m. – 10:10 a.m.

T10: Control of AC-DC Converters

ROOM 102AB

Track: AC-DC Converters

SESSION CHAIRS:

Tsornng-Juu Liang, *National Cheng-Kung University (Taiwan)*

Laszlo Balogh, *Fairchild Semiconductor*

8:30 a.m. – 8:50 a.m.

T10.1: Interleaved Boost Based AC/DC Bidirectional Converter with Four Quadrant Power Control Based on One-Cycle Controller (OCC)

Snehal Bagawade, Praveen Jain, *Queen's University, Canada*

8:50 a.m. – 9:10 a.m.

T10.2: A New Control Scheme to Improve Load Transient Response of Single Phase PWM Rectifier with Auxiliary Current Injection Circuit

Naga Brahmendra Gorla, Sandeep Kolluri, Pritam Das, Sanjib Kumar Panda, *National University of Singapore, Singapore*

9:10 a.m. – 9:30 a.m.

T10.3: Active Capacitor with Ripple-Based Duty Cycle Modulation for AC-DC Applications

Ching-Chieh Yang, Yang-Lin Chen, Yaow-Ming Chen, *National Taiwan University, Taiwan*

9:30 a.m. – 9:50 a.m.

T10.4: Novel Approach to Current-Mode Control in DCM/CCM Boundary Boost PFC

Giovanni Gritti, Claudio Adragna, *STMicroelectronics, Italy*

9:50 a.m. – 10:10 a.m.

- T10.5: Reducing the Switching Frequency Variation Range for CRM Buck PFC Converter by Variable on-Time Control**
Xiaoping Wang, Kai Yao, Nanjing, Junfang Zhang,
Nanjing University of Science and Technology, China

8:30 a.m. – 10:10 a.m.

T11: GaN-based DC-DC Converters

ROOM 104A

Track: DC-DC Converters

SESSION CHAIRS:

Alexis Kwasinski, *University of Pittsburgh*
Regan Zane, *Utah State*

8:30 a.m. – 8:50 a.m.

- T11.1: High Efficiency 20-400 MHz PWM Converters Using Air-Core Inductors and Monolithic Power Stages in a Normally-Off GaN Process**
Alihossein Sepahvand, Yuanzhe Zhang,
Dragan Maksimovic, *University of Colorado Boulder, United States*

8:50 a.m. – 9:10 a.m.

- T11.2: Thermal Evaluation of Chip-Scale Packaged Gallium Nitride Transistors**
David Reusch, Johan Strydom, Alex Lidow,
Efficient Power Conversion Corporation, United States

9:10 a.m. – 9:30 a.m.

- T11.3: Over 300kHz GaN Device Based Resonant Bidirectional DCDC Converter with Integrated Magnetics**
Gang Liu¹, Dan Li¹, Yungtaek Jang², Jianqiu Zhang¹, ¹Fudan University, China, ²Delta Products Corporation, United States

9:30 a.m. – 9:50 a.m.

- T11.4: Effective Control & Software Techniques for High Efficiency GaN FET Based Flexible Electrical Power System for Cube-Satellites**
Ashish Shrivastav, Shikhar Singh, Anirudh Mahajan, Subhashish Bhattacharya,
North Carolina State University, United States

9:50 a.m. – 10:10 a.m.

- T11.5: A 98.8% Efficient Bidirectional Full-Bridge Isolated DC-DC GaN Converter**
Rakesh Ramachandran, Morten Nyman,
University of Southern Denmark, Denmark

8:30 a.m. – 10:10 a.m.

T12: Electric Machines

ROOM 101A

Track: Motor Drives and Inverters

SESSION CHAIRS:

Bilal Akin, *University of Texas, Dallas*
Bulent Sarlioglu, *University of Wisconsin – Madison*

8:30 a.m. – 8:50 a.m.

- T12.1: Comparison of Lateral- and Cylindrical-Stator Electrical Machines for High-Speed Direct-Drive Applications in Confined Spaces**
Arda Tüysüz, Johann Walter Kolar, *Eidgenössische Technische Hochschule Zürich, Switzerland*

8:50 a.m. – 9:10 a.m.

- T12.2: Novel Contactless Axial-Flux Permanent-Magnet Electromechanical Energy Harvester**
Michael Flankl¹, Arda Tüysüz¹, Ivan Subotic², Johann Walter Kolar¹, ¹Eidgenössische Technische Hochschule Zürich, Switzerland, ²Liverpool John Moores University, United Kingdom

9:10 a.m. – 9:30 a.m.

- T12.3: Design of Rare-Earth Free Five-Phase Outer-Rotor IPM Motor Drive for Electric Bicycle**
Md. Zakirul Islam, Seungdeog Choi,
University of Akron, United States

9:30 a.m. – 9:50 a.m.

- T12.4: Transverse Flux Machines with Rotary Transformer Concept for Wide Speed Operations Without Using Permanent Magnet Material**
Iftekhhar Hasan, Wasi Uddin, Yilmaz Sozer,
University of Akron, United States

9:50 a.m. – 10:10 a.m.

- T12.5: Field Oriented Modeling and Control of Six Phase, Open-Delta Winding, Interior Permanent Magnet Synchronous Machines Considering Current Unbalance and Zero Sequence Currents**
Murat Senol, Michael Schubert, Georges Engelmann, Rik De Doncker, Thorben Grosse, Kay Hameyer, *Rheinisch-Westfälische Technische Hochschule Aachen, Germany*

8:30 a.m. – 10:10 a.m.

T13: Advances in Magnetics

ROOM 101B

Track: Devices and Components

SESSION CHAIRS:

Matthew Wilkowsky, *Altera Corporation*

Charles Sullivan, *Dartmouth*

8:30 a.m. – 8:50 a.m.

T13.1: Passive Integration Using FMLF Technique for Integrated Boost Resonant Converters

Cheng Deng¹, Luciano Andres Garcia Rodriguez¹, Juan Zou², Juan Carlos Balda¹, ¹University of Arkansas, United States, ²Xiangtan University, China

8:50 a.m. – 9:10 a.m.

T13.2: Magnetic Characterization Technique and Materials Comparison for Very High Frequency IVR

Dongbin Hou, Fred C. Lee, Qiang Li, Virginia Polytechnic Institute and State University, United States

9:10 a.m. – 9:30 a.m.

T13.3: Large-Signal Power Circuit Characterization of on-Silicon Coupled Inductors for High Frequency Integrated Voltage Regulation

Santosh Kulkarni¹, Zoran Pavlovic¹, Satya Kubendran¹, Claudio Carretero², Ningning Wang¹, Cian O'Mathuna¹, ¹Tyndall National Institute / University College Cork, Ireland, ²Universidad de Zaragoza, Spain

9:30 a.m. – 9:50 a.m.

T13.4: Point-of-Load Inductor with High Swinging and Low Loss at Light Load

Ting Ge¹, Khai Ngo¹, Jim Moss², ¹Virginia Polytechnic Institute and State University, United States, ²Texas Instruments Inc., United States

9:50 a.m. – 10:10 a.m.

T13.5: Iron Loss Evaluation of Three-Phase Inductor for Three-Phase PWM Inverter

Hiroaki Matsumori¹, Toshihisa Shimizu¹, Koushi Takano², Ishii Hitoshi², ¹Tokyo Metropolitan University, Japan, ²Iwatsu Test Instrument Corporation, Japan

8:30 a.m. – 10:10 a.m.

T14: System Design and Layout for Improved Performance

ROOM 102C

Track: System Integration

SESSION CHAIRS:

Jeff Nilles, *Texas Instruments*

Ernie Parker, *Crane Aerospace & Electronics*

8:30 a.m. – 8:50 a.m.

T14.1: CMOS Gate Drive IC with Embedded Cross Talk Suppression Circuitry for SiC Devices

Jeffery Dix, Zheyu Zhang, Benjamin J. Blalock, University of Tennessee, United States

8:50 a.m. – 9:10 a.m.

T14.2: Optimal Design of a Voltage Regulator Based Resonant Switched-Capacitor Converter IC

Eli Abramov, Alon Cervera, Mor Mordechai Peretz, Ben-Gurion University of the Negev, Israel

9:10 a.m. – 9:30 a.m.

T14.3: Novel Highly Integrated Current Measurement Method for Drive Inverters

Niklas Langmaack, Guenter Tareilus, Markus Henke, Technische Universität Braunschweig, Germany

9:30 a.m. – 9:50 a.m.

T14.4: A Novel DBC Layout for Current Imbalance Mitigation in SiC MOSFET Multichip Power Modules

Helong Li, Stig Munk-Nielsen, Szymon Beczkowski, Xiongfei Wang, Aalborg University, Denmark

9:50 a.m. – 10:10 a.m.

T14.5: A Double-End Sourced Multi-Chip Improved Wire-Bonded SiC MOSFET Power Module Design

Miao Wang, Fang Luo, Longya Xu, Ohio State University, United States

8:30 a.m. – 10:10 a.m.

T15: Modeling of AC Energy Converters and Systems

ROOM 104B

Track: Modeling and Simulation

SESSION CHAIRS:

Jaber Abu Qahouq, *The University of Alabama*

Xiongfei Wang, *Aalborg University*

8:30 a.m. – 8:50 a.m.

T15.1: Comparing Extended Kalman Filter and Particle Filter for Estimating Field and Damper Bar Currents in Brushless Wound Field Synchronous Generator for Stator Winding Fault Detection and Diagnosis

Sivakumar Nadarajan¹, Sanjib Kumar Panda¹, Bicky Bhangu², Amit Kumar Gupta²,

¹National University of Singapore, Singapore,

²Rolls-Royce Singapore Pte. Ltd., Singapore

8:50 a.m. – 9:10 a.m.

T15.2: Analytical Determination of Conduction Power Losses for Active Neutral-Point-Clamped Multilevel Converter

Vahid Dargahi¹, Arash Khoshkbar Sadigh²,

Keith Corzine¹, ¹Clemson University, United States,

²Extron Electronics, United States

9:10 a.m. – 9:30 a.m.

T15.3: Multifrequency Small-Signal Model of Voltage Source Converters Connected to a Weak Grid for Stability Analysis

Xing Li, Hua Lin, *Huazhong University of Science and Technology, China*

9:30 a.m. – 9:50 a.m.

T15.4: A New Approach to Control the Modified LinVerter for High Frequency Applications

Peyman Farhang, Stefan Mátéfi-Tempfli, *University of Southern Denmark, Denmark*

9:50 a.m. – 10:10 a.m.

T15.5: Small-Signal Terminal Characteristics Modeling of Three-Phase Boost Rectifier with Variable Fundamental Frequency

Zeng Liu¹, Jinjun Liu¹, Dushan Boroyevich²,

¹Xi'an Jiaotong University, China, ²Virginia

Polytechnic Institute and State University, United States

8:30 a.m. – 10:10 a.m.

T16: Manufacturing, Test, and Reliability

ROOM 103C

Track: Manufacturing, Quality, and Business Issue

SESSION CHAIRS:

Jim Marinos, *Payton Group*

Brian Narveson, *Narveson Innovative Consulting*

8:30 a.m. – 8:50 a.m.

T16.1: Reliability Analysis of a High-Efficiency SiC Three-Phase Inverter for Motor Drive Applications

Juan Colmenares, Diane-Perle Sadik, Patrik Hilber, Hans-Peter Nee, *KTH Royal Institute of Technology, Sweden*

8:50 a.m. – 9:10 a.m.

T16.2: RCP Evaluation of Electrolytic Capacitor Degradation for SMPS Failure Prediction

Hiroshi Nakao¹, Yu Yonezawa¹, Yoshiyasu

Nakashima¹, Fujio Kurokawa²,

¹Fujitsu Laboratories LTD., Japan,

²Nagasaki University, Japan

9:10 a.m. – 9:30 a.m.

T16.3: Modular Test System Architecture for Device, Circuit and System Level Reliability Testing

Roland Sleik¹, Michael Glavanovics¹, Sascha Einspieler¹, Annette Muetze², Klaus Krischan²,

¹Kompetenzzentrum Automobil- und

Industrieelektronik GmbH, Austria,

²Technische Universität Graz, Austria

9:30 a.m. – 9:50 a.m.

T16.4: EMI Noise Cancellation by Optimizing Transformer Design Without Need for the Traditional Y-Capacitor

Yongjiang Bai¹, Wenjie Chen¹, Ruirui He¹,

Dan Zhang², Xu Yang¹, ¹Xi'an Jiaotong University,

China, ²Silergy Corp., China

9:50 a.m. – 10:10 a.m.

T16.5: Manufacturing, Assembly and Production Qualifications of High Density, High Reliability POL DC-DC Converters

Fariborz Musavi, *CUI Inc, United States*

8:30 a.m. – 10:10 a.m.

T17: Soft-Switching Converters in Renewable Energy Systems

ROOM 104C

Track: Renewable Energy Systems

SESSION CHAIRS:

Afridi Khurram, *University of Colorado Boulder*

Katherine Kim, *Ulsan NIST*

8:30 a.m. – 8:50 a.m.

T17.1: Power Flow Control and ZVS Analysis of Three Limb High Frequency Transformer Based Three-Port DAB

Ritwik Chattopadhyay, Subhashish Bhattacharya,
North Carolina State University, United States

8:50 a.m. – 9:10 a.m.

T17.2: A Novel Multi-Input Converter Using Soft-Switched Single-Switch Input Modules with Integrated Power Factor Correction Capability for Hybrid Renewable Energy Systems

Sanjida Moury¹, John Lam¹, Vineet Srivastava²,
Ron Church², ¹*York University, Canada*,
²*Cistel Technology, Canada*

9:10 a.m. – 9:30 a.m.

T17.3: Analysis and Design of Impulse Commutated ZCS Three-Phase Current-Fed Push-Pull DC/DC Converter

Radha Sree Krishna Moorthy, Akshay Kumar
Rathore, *National University of Singapore, Singapore*

9:30 a.m. – 9:50 a.m.

T17.4: ZCS Resonant Converter Based Parallel Balancing of Serially Connected Batteries String

Ilya Zeltser¹, Or Kirshenboim², Nadav Dahan²,
Mor Mordechai Peretz², ¹*Rafael Advanced Defense Systems Ltd., Israel*, ²*Ben-Gurion University of the Negev, Israel*

9:50 a.m. – 10:10 a.m.

T17.5: A Novel Topology of High Voltage and High Power Bidirectional ZCS DC-DC Converter Based on Serial Capacitors

Lejia Sun, Fang Zhuo, Feng Wang, Tianhua Zhu,
Xi'an Jiaotong University, China

8:30 a.m. – 10:10 a.m.

T18: Solid State Lighting

ROOM 103AB

Track: Power Electronics Applications

SESSION CHAIRS:

Jim Spangler, *Spangler Prototype Inc*

Nan Chen, *ABB*

8:30 a.m. – 8:50 a.m.

T18.1: Control Scheme for TRIAC Dimming High PF Single-Stage LED Driver with Adaptive Bleeder Circuit and Non-Linear Current Reference

Weizhong Ma, Xiaogao Xie, Yang Han, Hao Deng,
Hangzhou Dianzi University, China

8:50 a.m. – 9:10 a.m.

T18.2: Three Phase Converter with Galvanic Isolation Based on Loss-Free Resistors for HB-LED Lighting Applications

Ignacio Castro, Diego G. Lamar, Manuel Arias,
Javier Sebastián, Marta H. Hernando,
Universidad de Oviedo, Spain

9:10 a.m. – 9:30 a.m.

T18.3: A ZV-ZCS Electrolytic Capacitor-Less AC/DC Isolated LED Driver with Continuous Energy Regulation

John Lam, Nader El-Taweel, *York University, Canada*

9:30 a.m. – 9:50 a.m.

T18.4: High Efficiency and Power Density GaN-Based LED Driver

Eric Faraci, Michael Seeman, Bin Gu, Yogesh
Ramadass, Brohlin Brohlin, *Texas Instruments Inc., United States*

9:50 a.m. – 10:10 a.m.

T18.5: A Novel LED Drive System Based on Matrix Rectifier

Baoping Shi, Bo Zhou, Jiadan Wei, Xianhui Qin,
Yuanyu Yang, Bing Liu, *Nanjing University of Aeronautics and Astronautics, China*

10:00 a.m. – 2:00 p.m.

Exhibit Hall Open

EXHIBIT HALLS A/B/C

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

Exhibitor Seminars – Session #5

ADAPTIVE POWER SYSTEMS
Advanced Power Conversion Test Equipment
 ROOM 101A

EFFICIENT POWER CONVERSION CORPORATION (EPC)
GaN...Changing the Way We Live
 ROOM 101B

MERSEN
Safety and Reliability for Power Electronics
 ROOM 102AB

MICROCHIP TECHNOLOGY INC.
Brutes and Brains: When Adding Intelligence to Power Supplies Makes Sense
 ROOM 103AB

RENESAS ELECTRONICS AMERICA INC.
Lithium Ion Battery Charging and Fuel Gauging for better functionality
 ROOM 201B

SBE, INC.
High Performance Integrated DC Link Capacitor/Bus Structures and AC Filter Capacitors
 ROOM 202AB

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

Exhibitor Seminars – Session #6

PANEL:

Eaton, Power Systems Design, Vicor, GaN Systems
 Next Generation of Power Supplies
 ROOM 101A

ABC TRADING BEIJING CO. LTD.
BsT-x measuring system for soft magnetic materials under high excitation
 ROOM 101B

AMANTYS POWER ELECTRONICS LTD
Intelligent Gate Drives – Delivering the Silicon Squeeze
 ROOM 102AB

ANALOG DEVICES INC
Ultra Low Noise LDOs Maximize Signal Chain Performance
 ROOM 103AB

CUI INC
Software Defined Power®
 ROOM 201A

HITACHI POWER SEMICONDUCTOR DEVICE, LTD.
New Packaging Generation. The next standard for High Voltage (1.2kV-6.5kV) IGBTs
 ROOM 201B

SOFTWARE CRADLE CO., LTD.
Cooling Fan Design System with Automated Performance Prediction
 ROOM 202AB

2:00 p.m. – 5:25 p.m.

IS09: High Frequency Magnetics; Black Magic, Art or Science?

ROOM 201A

SESSION CHAIRS:

Edward Herbert, *Independent Consultant*

Stephen Carlsen, *Raytheon*

2:00 p.m. – 2:25 p.m.

IS09.1: High Frequency Magnetics: Black Magic, Art or Science? Magnetics Core Loss
Ray Ridley, Ridley Engineering Inc., United States

2:25 p.m. – 2:50 p.m.

IS09.2: Selecting Magnetics for High Frequency Converters Practical Hints and Suggestions for Getting Started
Len Crane, Coilcraft, United States

2:50 p.m. – 3:15 p.m.

IS09.3: The Future for SMPS Magnetics
Weyman Lundquist, West Coast Magnetics, United States

3:15 p.m. – 3:40 p.m.

IS09.4: Accurate Estimation of Losses of Power Inductor in Power Electronics Applications
Ranjith Bramanpalli, Würth Elektronik, Germany

4:10 p.m. – 4:35 p.m.

IS09.5: Litz Wire: a Practical Discussion of its Uses and Limitations in High Frequency Transformers
Kyle Jensen, Rubadue Wire Company, Inc., United States

4:35 p.m. – 5:00 p.m.

IS09.6: Powder Core Materials for Magnetic Components in GaN and SiC Power Devices

Christopher Oliver, *Micrometals, Inc., United States*

5:00 p.m. – 5:25 p.m.

IS09.7: EMI Conducted and Radiated Emissions

Mark Rine, *Vacuumschmelze GmbH & Co., Germany*

2:00 p.m. – 5:25 p.m.

IS10: From the Board to the Datacenter

ROOM 201B

SESSION CHAIRS:

Brian Zahnstecher, *PowerRox LLC*

Wisam Moussa, *Infineon Technologies*

2:00 p.m. – 2:25 p.m.

IS10.1: The Technology Behind the World's Smallest 12V, 10A Voltage Regulator

Pradeep Shenoy, *Texas Instruments, United States*

2:25 p.m. – 2:50 p.m.

IS10.2: Noise Characterization of Switching Buck Regulators for EMI Analysis

Chunlei Guo¹, Yaxiao Qin², Huaifeng Wang²,
Eric Braun², Jinghai Zhou², Jiangqi He¹,
David Figueroa¹, ¹*Intel Corporation, United States*,
²*Monolithic power systems, United States*

2:50 p.m. – 3:15 p.m.

IS10.3: 48V Power Delivery to Grantley Reference Board

Donghwi Kim, Jiangqi He, David Figueroa,
Intel, United States

3:15 p.m. – 3:40 p.m.

IS10.4: PMBus on Linux: PMBus Support Options for the Linux Platform

Michael Jones, *Linear Technology, United States*

4:10 p.m. – 4:35 p.m.

IS10.5: System Power Simplification Utilizing PMBus™ Zone Capabilities

Travis Summerlin, *Texas Instruments, United States*

4:35 p.m. – 5:00 p.m.

IS10.6: Power-Defined Software In The Data Center

Brian Zahnstecher, *PowerRox, United States*

5:00 p.m. – 5:25 p.m.

IS10.7: Data Center Market and Technology Trends in Power Electronics

Mattin Grao Txapartegi, Pierric Gueguen,
YOLE DEVELOPPEMENT, France

2:00 p.m. – 5:25 p.m.

IS11: Medium Voltage Applications

ROOM 202AB

SESSION CHAIRS:

River Tinh-Ho Li, *ABB (China) Limited*

Alex Craig, *Fairchild Semiconductor*

Nan Chen, *ABB*

2:00 p.m. – 2:25 p.m.

IS11.1: Power Semiconductors for Medium Voltage Drives

Uwe Jansen, *Infineon Technologies AG, Germany*

2:25 p.m. – 2:50 p.m.

IS11.2: Medium Voltage Drives Design Considerations in Demanding and Special Applications

Wim van der Merwe, *ABB (Switzerland) Ltd., Switzerland*

2:50 p.m. – 3:15 p.m.

IS11.3: Advanced Multilevel STATCOM for Flicker-Mitigation in MV Installations

Martin Pieschel, *Siemens AG, Germany*

3:15 p.m. – 3:40 p.m.

IS11.4: Practical Considerations in Measuring Power and Efficiency on PWM and Distorted Waveforms During Dynamic Operating Conditions

Ken Johnson, *Teledyne LeCroy, United States*

4:10 p.m. – 4:35 p.m.

IS11.5: Technologies for Efficient Simulation of Complex MV Power Converters

Min Luo, *Plexim GmbH, Switzerland*

4:35 p.m. – 5:00 p.m.

IS11.6: HVDC Transmission Lines – Market, Technology and Geographical Trends

Mattin Grao Txapartegi, Pierric Gueguen,
YOLE DEVELOPPEMENT, France

5:00 p.m. – 5:25 p.m.

IS11.7: High Power Low Inductance Module Building Blocks for Three-Level Inverters

John Donlon¹, Marco Honsberg², ¹Powerex, Inc., United States, ²Mitsubishi Electric Europe, Germany

2:00 p.m. – 5:25 p.m.

IS12: Transportation Power Electronics

ROOM 203AB

SESSION CHAIRS:

Ralph Taylor, *Delphi Electronics & Safety*

Fred Weber, *FTW LLC*

2:00 p.m. – 2:25 p.m.

IS12.1: More Electric and Electric Aircraft

Kaushik Rajashekara, *UT Dallas, United States*

2:25 p.m. – 2:50 p.m.

IS12.2: Overview of the Unique Requirements and Challenges for Power Electronics in Mining Equipment

Dustin Selvey, *Caterpillar, United States*

2:50 p.m. – 3:15 p.m.

IS12.3: Medium and Heavy-Duty Vehicle Duty Cycles for Electric Powertrains

Kenneth Kelly, Kevin Bennion, Eric Miller, Bob Prohaska, *National Renewable Energy Laboratory, United States*

3:15 p.m. – 3:40 p.m.

IS12.4: Fuel Cells for Material Handling Systems

Fernando Corral, *Plug Power, United States*

4:10 p.m. – 4:35 p.m.

IS12.5: Design and Implementation of a LLC-ZCS Converter for Hybrid/Electric Vehicles

Davide Giacomini, Cesare Bocchiola, *International Rectifier, Italy*

4:35 p.m. – 5:00 p.m.

IS12.6: EV-Grid Integration (EVGI) Control and System Implementation “ Research Overview

Mithat Kisacikoglu, *NREL, United States*

5:00 p.m. – 5:25 p.m.

IS12.7: Assessing the North American Supply Chain for Traction Drive Motors

Steven Boyd¹, Christopher Whaling², ¹Department of Energy, *Vehicle Technologies Office, United States*, ²Synthesis Partners, LLC, *United States*

2:00 p.m. – 5:30 p.m.

T19: Resonant and Soft Switching DC-DC Converters

ROOM 101A

Track: DC-DC Converters

SESSION CHAIRS:

Mahshid Amirabadi, *Northeastern University*

Mehdi Ferdowsi, *Missouri University of Science and Technology*

2:00 p.m. – 2:20 p.m.

T19.1: LLC Synchronous Rectification Using Coordinate Modulation

Mehdi Mohammadi, Navid Shafiei, Martin Ordonez, *University of British Columbia, Canada*

2:20 p.m. – 2:40 p.m.

T19.2: Low Parasitics Planar Transformer for LLC Resonant Battery Chargers

Mohammad Ali Saket¹, Navid Shafiei¹, Martin Ordonez¹, Marian Craciun², Chris Botting², ¹University of British Columbia, Canada, ²Delta-Q Technologies Corporation, Canada

2:40 p.m. – 3:00 p.m.

T19.3: New Symmetrical Bidirectional L3C Resonant DC-DC Converter with Wide Voltage Range

Minjae Kim, Shinyoung Noh, Sewan Choi, *Seoul National University of Science and Technology, Korea, South*

3:00 p.m. – 3:20 p.m.

T19.4: Influence of the Junction Capacitance of the Secondary Rectifier Diodes on Output Characteristics in Multi-Resonant Converters

Stefan Ditze¹, Thomas Heckel², Martin März¹, ¹Fraunhofer Institute for Integrated Systems and Device Technology, Germany, ²Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany

3:20 p.m. – 3:40 p.m.

T19.5: A Triple Active Bridge DC-DC Converter Capable of Achieving Full-Range ZVS

Ling Jiang, Daniel Jes Costinett, *University of Tennessee, United States*

4:10 p.m. – 4:30 p.m.

T19.6: A Novel High Gain Step-Up Resonant DC-DC Converter for Automotive Application

Fei Shang¹, Mahesh Krishnamurthy¹, Alexander Isurin², ¹Illinois Institute of Technology, *United States*, ²Vanner Inc., *United States*

4:30 p.m. – 4:50 p.m.

T19.7: Series Injection Enabled Full ZVS Light Load Operation of a 15kV SiC IGBT Based Dual Active Half Bridge Converter

Awneesh Tripathi, Sachin Madhusoodhanan, Krishna Mainali, Kasunaidu Vechalapu, Subhashish Bhattacharya, *North Carolina State University, United States*

4:50 p.m. – 5:10 p.m.

T19.8: Soft Switching for Half Bridge Current Doubler for High Voltage Point of Load Converter in Data Center Power Supplies

Yutian Cui¹, Weimin Zhang¹, Leon M. Tolbert², Daniel Jes Costinett¹, Fred Wang¹, Benjamin J. Blalock¹, ¹*University of Tennessee, United States*, ²*University of Tennessee / Oak Ridge National Laboratory, United States*

5:10 p.m. – 5:30 p.m.

T19.9: An Algorithm to Analyze Circulating Current for Multi-Phase Resonant Converter

Yang Chen¹, Zhiyuan Hu¹, Laili Wang¹, Tianshu Liu¹, Wenbo Liu¹, Yan-Fei Liu¹, Jahangir Afsharian², Zhihua Yang², Hongliang Wang¹, ¹*Queen's University, Canada*, ²*Murata Power Solutions, Canada*

2:00 p.m. – 5:30 p.m.

T20: Control Applications and Modulation Schemes

ROOM 102C

Track: Power Electronics for Utility Interface

SESSION CHAIRS:

Ali Khajehaddin, *University of Alberta*

Paul Bauer, *Delft University of Technology*

2:00 p.m. – 2:20 p.m.

T20.1: A Simple Active Damping Method for Active Power Filters

Huawei Yuan, Xinjian Jiang, *Tsinghua University, China*

2:20 p.m. – 2:40 p.m.

T20.2: Simultaneous Voltage and Current Compensation of the 3-Phase Electric Spring with Decomposed Voltage Control

Shuo Yan, Tianbo Yang, Chi Kwan Lee, Siew-Chong Tan, Shu Yuen Ron Hui, *University of Hong Kong, Hong Kong*

2:40 p.m. – 3:00 p.m.

T20.3: Self-Synchronization Operation of Global Synchronous Pulsewidth Modulation with Communication Fault Tolerant and Simplified Calculation Capabilities

Tao Xu, Feng Gao, *Shandong University, China*

3:00 p.m. – 3:20 p.m.

T20.4: Design Considerations and Predictive Direct Current Control of Active Regenerative Rectifiers for Harmonic and Current Ripple Reduction

Alberto Berzoy, Ahmed Abdelfatah Mohamed, Osama Mohammed, *Florida International University, United States*

3:20 p.m. – 3:40 p.m.

T20.5: A Robust Controller for Medium Voltage AC Collection Grid for Large Scale Photovoltaic Plants Based on Medium Frequency Transformers

Bahaa Hafez¹, Prasad Enjeti¹, Shehab Ahmed², ¹*Texas A&M University, United States*, ²*Texas A&M University at Qatar, Qatar*

4:10 p.m. – 4:30 p.m.

T20.6: Optimal Low Switching Frequency Pulse Width Modulation of Current-Fed Five-Level Inverter for Solar Integration

Gnana Sambandam Kulothungan, Akshay Kumar Rathore, Amarendra Edpuganti, Dipti Srinivasan, *National University of Singapore, Singapore*

4:30 p.m. – 4:50 p.m.

T20.7: Design and Implementation of Division-Summation Digital Controlled Multi-Function Inverter to Achieve APF, Active Power Injection and Rectification

Tsai-Fu Wu¹, Hui-Chung Hsieh², Li-Chun Lin¹, Chih-Hao Chang¹, ¹*National Tsing Hua University, Taiwan*, ²*National Chung Cheng University, Taiwan*

4:50 p.m. – 5:10 p.m.

T20.8: Operation and Analysis of an Improved Transformerless Unified Power Flow Controller

Yang Liu¹, Shuitao Yang², Fang Zheng Peng¹, ¹*Michigan State University, United States*, ²*Michigan State University & Ford Motor Company, United States*

5:10 p.m. – 5:30 p.m.

T20.9: Design Consideration of Converter Based Transmission Line Emulation

Bo Liu¹, Shuoting Zhang¹, Sheng Zheng¹, Yiwei Ma¹, Fred Wang¹, Leon M. Tolbert², ¹*University of Tennessee, United States*, ²*University of Tennessee / Oak Ridge National Laboratory, United States*

2:00 p.m. – 5:30 p.m.

T21: Advances in Wide BandGap Devices

ROOM 104A

Track: Devices and Components

SESSION CHAIRS:

Doug Hopkins, *North Carolina State University*

Alex Huang, *North Carolina State University*

T21.1: Short-Circuit Characterization of 10 kV 10A 4H-SiC Mosfet

Emanuel-Petre Eni, Szymon Beczkowski, Stig Munk-Nielsen, Tamas Kerekes, Remus Teodorescu, *Aalborg University, Denmark*

T21.2: Record-Low 10mOhm SiC MOSFETs in TO-247, Rated at 900V

Vipindas Pala, Gangyao Wang, Brett Hull, Scott Allen, Jeffrey Casady, John Palmour, *Wolfspeed/Cree, Inc., United States*

T21.3: Performance Evaluation of Multiple Si and SiC Solid State Devices for Circuit Breaker Application in 380VDC Delivery System

Kai Tan, Pengkun Liu, Xijun Ni, Chang Peng, Xiaoqing Song, Alex. Q Huang, *North Carolina State University, United States*

T21.4: Evaluation of High Voltage Cascode GaN HEMTs in Parallel Operation

He Li¹, Xuan Zhang¹, Lucheng Wen¹, John Alex Brothers¹, Chengcheng Yao¹, Ke Zhu¹, Jin Wang¹, Liming Liu², Jing Xu², Joonas Puukko, ¹*Ohio State University, United States*, ²*ABB Inc., United States*

T21.5: A New Driving Concept for Normally-on GaN Switches in Cascode Configuration

Bernhard Zojer, *Infineon Technologies Austria, Austria*

T21.6: Avoiding Divergent Oscillation of Cascode GaN Device Under High Current Turn-Off Condition

Weijing Du, Xiucheng Huang, Fred C. Lee, Qiang Li, Wenli Zhang, *Virginia Polytechnic Institute and State University, United States*

4:30 p.m. – 4:50 p.m.

T21.7: Temperature-Dependent Turn-on Loss Analysis for GaN HFETs

Edward A. Jones¹, Fred Wang¹, Daniel Jes Costinett¹, Zheyu Zhang¹, Ben Guo², ¹*University of Tennessee, United States*, ²*United Technologies Research Center, United States*

4:50 p.m. – 5:10 p.m.

T21.8: Analysis of Parasitic Elements of SiC Power Modules with Special Emphasis on Reliability Issues

Diane-Perle Sadik¹, Juan Colmenares¹, Hans-Peter Nee¹, Konstantin Kostov², Florian Giezendanner³, Per Ranstad³, ¹*KTH Royal Institute of Technology, Sweden*, ²*Acreo Swedish ICT AB, Sweden*, ³*Alstom Power Sweden AB, Sweden*

5:10 p.m. – 5:30 p.m.

T21.9: Static and Dynamic Characterization of GaN HEMT with Low Inductance Vertical Phase Leg Design for High Frequency High Power Applications

Nidhi Haryani, Xuning Zhang, Rolando Burgos, Dushan Boroyevich, *Virginia Polytechnic Institute and State University, United States*

2:00 p.m. – 5:30 p.m.

T22: Motor Drive Design and Inverter Topologies

ROOM 101B

Track: Motor Drives and Inverters

SESSION CHAIRS:

Yingying Kuai, *Caterpillar Inc.*

Jin Wang, *The Ohio State University*

2:00 p.m. – 2:20 p.m.

T22.1: A Family of Single-Phase Current Source Converters with Double Outputs

Louelson Costa¹, Maurício B. R. Correa¹, Montie Vitorino¹, Gutemberg Dos Santos¹, Darlan Fernandes², ¹*Universidade Federal de Campina Grande, Brazil*, ²*Universidade Federal da Paraíba, Brazil*

2:20 p.m. – 2:40 p.m.

T22.2: Multiple-Output Boost Resonant Inverter for High Efficiency and Cost-Effective Induction Heating Applications

Hector Sarnago, Oscar Lucia, José Miguel Burdío, *Universidad de Zaragoza, Spain*

2:40 p.m. – 3:00 p.m.

T22.3: Development of 2-kW Interleaved DC-Capacitor-Less Single-Phase Inverter System

Runruo Chen, Hulong Zeng, Deepak Gunasekaran, Yunting Liu, Fang Zheng Peng, *Michigan State University, United States*

3:00 p.m. – 3:20 p.m.

T22.4: Single Stage Transformer Isolated High Frequency AC Link Based Open End Drive

Srikant Gandikota, Ned Mohan, *University of Minnesota, United States*

3:20 p.m. – 3:40 p.m.

T22.5: A Quasi-Z-Source Integrated Multi-Port Power Converter with Reduced Capacitance for Switched Reluctance Motor Drives

Fan Yi, Wen Cai, *University of Texas at Dallas, United States*

4:10 p.m. – 4:30 p.m.

T22.6: A Fault-Tolerant Topology of T-Type NPC Inverter with Increased Thermal Overload Capability

Jiangbiao He¹, Lixiang Wei², Nabeel Demerdash¹, *¹Marquette University, United States, ²Rockwell Automation, United States*

4:30 p.m. – 4:50 p.m.

T22.7: A Novel Analysis and Design Method of Phase Lead Filters in Repetitive Controllers for Pulse-Width Modulated Inverters

Shunfeng Yang¹, Peng Wang¹, Yi Tang¹, Michael Zagrodnik², Xiaolei Hu¹, King-Jet Tseng¹, *¹Nanyang Technological University, Singapore, ²Rolls-Royce Singapore Pte. Ltd., Singapore*

4:50 p.m. – 5:10 p.m.

T22.8: Research on the Filter of Load Side Converter in BDFG Based Ship Shaft Power Generation System

Meilin Wang, Hua Lin, Hongbin Yang, Xingwei Wang, *Huazhong University of Science and Technology, China*

5:10 p.m. – 5:30 p.m.

T22.9: Investigation of Common Mode Current Related DC-Bus Overvoltage in Multiple Converter Systems

Jiangbiao He, Zoran Vrankovic, Patrick Ozimek, Craig Winterhalter, *Rockwell Automation, United States*

2:00 p.m. – 5:30 p.m.

T23: Modeling of Magnetic Circuits and Systems

ROOM 102AB

Track: Modeling and Simulation

SESSION CHAIRS:

Ed Herbert

Jin Ye, *San Francisco State University*

2:00 p.m. – 2:20 p.m.

T23.1: High Frequency AC Inductor Analysis and Design for Dual Active Bridge (DAB) Converters

Zhe Zhang, Michael A.E. Andersen, *Danmarks Tekniske Universitet, Denmark*

2:20 p.m. – 2:40 p.m.

T23.2: A Comprehensive Assessment of PM Motor Topology Impact on Magnet Defect Fault Signatures

Mohsen Zafarani, Taner Goktas, Bilal Akin, *University of Texas at Dallas, United States*

2:40 p.m. – 3:00 p.m.

T23.3: High Frequency Modeling for Transformer Common Mode Noise Coupling Path Based on Multiconductor Transmission Line Theory

Peipei Meng¹, Xiangming Zhang², *¹Wuhan University of Technology, China, ²Naval University of Engineering, China*

3:00 p.m. – 3:20 p.m.

T23.4: Leakage Flux Modeling of Multi-Winding Transformer Using Permeance Magnetic Circuit

Min Luo¹, Drazen Dujic¹, Jost Allmeling², *¹École Polytechnique Fédérale de Lausanne, Switzerland, ²Plexim, Switzerland*

3:20 p.m. – 3:40 p.m.

T23.5: Modeling Magnetic Devices Using SPICE: Application to Variable Inductors

Marcos Alonso¹, Gilberto Martínez², Marina Perdigo³, Marcelo Cosetin⁴, Ricardo N. do Prado⁴, *¹Universidad de Oviedo, Spain, ²Continental Automotive Singapore Pte Ltd, Mexico, ³Universidade de Coimbra, Portugal, ⁴Universidade Federal de Santa Maria, Brazil*

4:10 p.m. – 4:30 p.m.

T23.6: Investigation of a Thermal Model for a Permanent Magnet Assisted Synchronous Reluctance Motor

Joseph Herbert, Akm Ararat, Guo-Xiang Wang, Seungdeog Choi, *University of Akron, United States*

4:30 p.m. – 4:50 p.m.

T23.7: Design Procedure for Multi-Phase External Rotor Permanent Magnet Assisted Synchronous Reluctance Machines

Sai Sudheer Reddy Bonthu, Seungdeog Choi, *University of Akron, United States*

4:50 p.m. – 5:10 p.m.

T23.8: Applicability and Limitations of an M2Spice-Assisted “Planar-Magnetics-in-the-Circuit” Simulation Approach

Samantha Gunter¹, Minjie Chen¹, Stephanie Pavlick¹, Rose Abramson¹, Khurram K. Afridi², David Perreault¹, ¹*Massachusetts Institute of Technology, United States*, ²*University of Colorado Boulder, United States*

2:00 p.m. – 5:30 p.m.

T24: Inverter/Converter Control

ROOM 103C

Track: Control

SESSION CHAIRS:

Siavash Pakdelian, *UMass Lowell*

Behrooz Mirafzal, *Kansas State University*

2:00 p.m. – 2:20 p.m.

T24.1: Solution of Input Double-Line Frequency Ripple Rejection for High-Efficiency High-Power Density String Inverter in Photovoltaic Application

Xiaonan Zhao, Lanhua Zhang, Rachael Born, Jih-Sheng Jason Lai, *Virginia Polytechnic Institute and State University, United States*

2:20 p.m. – 2:40 p.m.

T24.2: Fractional-Order Phase Lead Compensation for Multi-Rate Repetitive Control on Three-Phase PWM DC/AC Inverter

Zhichao Liu¹, Bin Zhang¹, Keliang Zhou², ¹*University of South Carolina, United States*, ²*University of Glasgow, United Kingdom*

2:40 p.m. – 3:00 p.m.

T24.3: A Robust Modified Model Predictive Control (MMPC) Based on Lyapunov Function for Three-Phase Active-Front-End (AFE) Rectifier

M. Parvez¹, Saad Mekhilef¹, Nadia Mei Lin Tan², Hirofumi Akagi³, ¹*University of Malaya, Malaysia*, ²*Universiti Tenaga Nasional, Malaysia*, ³*Tokyo Institute of Technology, Japan*

3:00 p.m. – 3:20 p.m.

T24.4: Adaptive Reference Model Predictive Control for Power Electronics

Yun Yang, Siew-Chong Tan, Shu Yuen Ron Hui, *University of Hong Kong, Hong Kong*

3:20 p.m. – 3:40 p.m.

T24.5: Power Switch Lifetime Extension Strategies for Three-Phase Converters

Serkan Dusmez, Enes Ugur, Bilal Akin, *University of Texas at Dallas, United States*

4:10 p.m. – 4:30 p.m.

T24.6: Current Controller Modeling for an Interleaved Boost with Voltage Multiplier Cells for PV Applications

Alessandro Pevere, Urmimala Chatterjee, Johan Driesen, *Katholieke Universiteit Leuven, Belgium*

4:30 p.m. – 4:50 p.m.

T24.7: New Active Capacitor Voltage Balancing Method for Five-Level Stacked Multicell Converter

Arash Khoshkbar Sadigh¹, Vahid Dargahi², Keith Corzine², ¹*Extron Electronics, United States*, ²*Clemson University, United States*

4:50 p.m. – 5:10 p.m.

T24.8: Gate Signal Jitter Elimination and Noise Shaping Modulation for High-SNR Class-D Power Amplifiers

Mario Mauerer, Arda Tüysüz, Johann Walter Kolar, *Eidgenössische Technische Hochschule Zürich, Switzerland*

5:10 p.m. – 5:30 p.m.

T24.9: Analysis and Compensation of Inverter Nonlinearity for Three-Level T-Type Inverters

Hyeon-Sik Kim, Yong-Cheol Kwon, Seung-Jun Chee, Seung-Ki Sul, *Seoul National University, Korea, South*

2:00 p.m. – 5:30 p.m.

T25: Topics in Renewable Energy Systems I

ROOM 104B

Track: Renewable Energy Systems

SESSION CHAIRS:

Fei Gao, *University of Technology of Belfort-Montbéliard*

Kent Wanner, *John Deere*

T25.1: Front-End Isolated Quasi-Z-Source DC-DC Converter Modules in Series for Photovoltaic High-Voltage DC Applications

2:00 p.m. – 2:20 p.m.

Yushan Liu¹, Haitham Abu-Rub¹, Baoming Ge²,
¹Texas A&M University at Qatar, Qatar,
²Texas A&M University, United States

T25.2: Analysis of Non Detection Zone for Multiple Distributed PCS Based on Equivalent Single PCS Using Reactive Power Approach

2:20 p.m. – 2:40 p.m.

Byeong-Heon Kim, Seung-Ki Sul, *Seoul National University, Korea, South*

T25.3: Optimal Power Scheduling for a Grid-Connected Hybrid PV-Wind-Battery Microgrid System

2:40 p.m. – 3:00 p.m.

Adriana Luna¹, Nelson Diaz¹, Mehdi Savaghebi¹,
Juan C. Vásquez¹, Josep Maria Guerrero¹,
Kai Sun², Guoliang Chen³, Libing Sun³,
¹Aalborg University, Denmark, ²Tsinghua University,
China, ³Shanghai Solar Energy & Technology Co.,
Ltd., China

T25.4: High Efficiency Power Converter for a Doubly-Fed SOEC/SOFC System

3:00 p.m. – 3:20 p.m.

Kevin Tomas-Manez, Alexander Anthon, Zhe Zhang, *Danmarks Tekniske Universitet, Denmark*

T25.5: A Hierarchical Active Balancing Architecture for Li-Ion Batteries

3:20 p.m. – 3:40 p.m.

Han-Dong Gui¹, Zhiliang Zhang¹, Dong-Jie Gu¹,
Yang Yang¹, Zhouyu Lu¹, Yan-Fei Liu², ¹Nanjing
University of Aeronautics and Astronautics, China,
²Queen's University, Canada

4:10 p.m. – 4:30 p.m.

T25.6: A Series-DG Based Autonomous Islanding Microgrid

Beihua Liang¹, Yunwei Li², Jinwei He¹, Chengshan Wang¹, ¹Tianjin University, China, ²University of Alberta, Canada

4:30 p.m. – 4:50 p.m.

T25.7: An Enhanced Droop Control Scheme for Resilient Active Power Sharing in Paralleled Two-Stage PV Inverter Systems

Hongpeng Liu¹, Yongheng Yang², Xiongfei Wang²,
Poh Chiang Loh², Frede Blaabjerg², Wei Wang¹,
Dianguo Xu¹, ¹Harbin Institute of Technology,
China, ²Aalborg University, Denmark

4:50 p.m. – 5:10 p.m.

T25.8: Voltage Closed-Loop Virtual Synchronous Generator Control of Full Converter Wind Turbine for Grid-Connected and Stand-Alone Operation

Yiwei Ma¹, Liu Yang¹, Fred Wang¹, Leon M. Tolbert², ¹University of Tennessee, United States,
²University of Tennessee / Oak Ridge National Laboratory, United States

5:10 p.m. – 5:30 p.m.

T25.9: DC Voltage Ripple Quantification for a Flywheel-Battery Based Hybrid Energy Storage System

Christopher Lashway, Ahmed Elsayed, Osama Mohammed, *Florida International University, United States*

2:00 p.m. – 5:30 p.m.

T26: Electric Vehicle Charging Systems

ROOM 104C

Track: Transportation Power Electronics

SESSION CHAIRS:

Jim Spangler, *Spangler Prototype Inc*

Hadi Malek, *Ford*

2:00 p.m. – 2:20 p.m.

T26.1: Adaptive Loss Reduction Charging Strategy Considering Variation of Internal Impedance of Lithium-Ion Polymer Batteries in Electric Vehicle Charging Systems

Nari Kim, Jung-Hoon Ahn, Dong-Hee Kim,
Byoung-Kuk Lee, *Sungkyunkwan University, Korea, South*

2:20 p.m. – 2:40 p.m.

T26.2: A Pulse Width Modulated LLC Type Resonant Topology Adapted to Wide Output Voltage Range

Haoyu Wang, *ShanghaiTech University, China*

2:40 p.m. – 3:00 p.m.

T26.3: A Series Resonant Circuit for Voltage Equalization of Series Connected Energy Storage Devices

Yanqi Yu, Raed Saasaa, Wilson Eberle, *University of British Columbia, Canada*

3:00 p.m. – 3:20 p.m.

T26.4: Implementation of 3.3-kW GaN-Based DC-DC Converter for EV on-Board Charger with Series-Resonant Converter That Employs Combination of Variable-Frequency and Delay-Time Control

Yungtaek Jang¹, Milan Jovanovic¹, Juan Ruiz¹, Misha Kumar¹, Gang Liu², ¹*Delta Products Corporation, United States*, ²*Delta Electronics Shanghai Co., Ltd., China*

3:20 p.m. – 3:40 p.m.

T26.5: Dual Active Bridge-Based Full-Integrated Active Filter Auxiliary Power Module for Electrified Vehicle Applications with Single-Phase Onboard Chargers

Ruoyu Hou, Ali Emadi, *McMaster University, Canada*

4:10 p.m. – 4:30 p.m.

T26.6: All-SiC Inductively Coupled Charger with Integrated Plug-in and Boost Functionalities for PEV Applications

Madhu Chinthavali¹, Omer Onar¹, Steven Campbell¹, Leon M. Tolbert², ¹*Oak Ridge National Laboratory, United States*, ²*University of Tennessee / Oak Ridge National Laboratory, United States*

4:30 p.m. – 4:50 p.m.

T26.7: Switching Condition and Loss Modeling of GaN-Based Dual Active Bridge Converter for PHEV Charger

Lingxiao Xue¹, Dushan Boroyevich¹, Paolo Mattavelli², ¹*Virginia Polytechnic Institute and State University, United States*, ²*Università degli Studi di Padova, Italy*

4:50 p.m. – 5:10 p.m.

T26.8: Analysis of Cascaded Multi-Output-Port Converter for Wireless Plug-in Hybrid/on-Board EV Chargers

Erdem Asa¹, Kerim Colak², Dariusz Czarkowski¹, ¹*New York University, United States*, ²*Istanbul Ulasim A.S., Turkey*

5:10 p.m. – 5:30 p.m.

T26.9: Comparative Analysis of High Step-Down Ratio Isolated DC/DC Topologies in PEV Applications

Zhiqing Li, Haoyu Wang, *ShanghaiTech University, China*

2:00 p.m. – 5:30 p.m.

T27: Utility Interface & Inverter Applications

ROOM 103AB

Track: Power Electronics Applications

SESSION CHAIRS:

Akshay Kumar Rathore, *Concordia University*

Yichao Tang, *Texas Instruments*

2:00 p.m. – 2:20 p.m.

T27.1: DC to Single-Phase AC Voltage Source Inverter with Power Decoupling Circuit Based on Flying Capacitor Topology for PV System

Hiroki Watanabe, Keisuke Kusaka, Keita Furukawa, Koji Orikawa, Jun-Ichi Itoh, *Nagaoka University of Technology, Japan*

2:20 p.m. – 2:40 p.m.

T27.2: Gan FET and Hybrid Modulation Based Differential-Mode Inverter

Sudip Mazumder¹, Ankit Gupta², Shirish Raizada², Harshit Soni², Nikhil Kumar², Paromita Mazumder¹, Parijat Bhattacharjee¹, ¹*NextWatt LLC, United States*, ²*University of Illinois at Chicago, United States*

2:40 p.m. – 3:00 p.m.

T27.3: Thermal and Electrical Co-Design of a Modular High-Density Single-Phase Inverter Using Wide-Bandgap Devices

Steven Chung¹, Miad Nasr¹, David Guirguis¹, Masafumi Otsuka¹, Shahab Poshkouhi¹, David K.W. Li¹, Vishal Palaniappan¹, David Romero¹, Cristina Amon¹, Olivier Orr², Olivier Trescases¹, ¹*University of Toronto, Canada*, ²*Solantro Semiconductor, Canada*

3:00 p.m. – 3:20 p.m.

T27.4: Reactive Power Compensation with Improvement of Current Waveform Quality for Single-Phase Buck-Type Dynamic Capacitor

Xinwen Chen, Ke Dai, Huazhong, Chen Xu, Ziwei Dai, Li Peng, *Huazhong University of Science and Technology, China*

3:20 p.m. – 3:40 p.m.

T27.5: Circulating Current Reduction for a Division-Summation Digital Controlled Transformerless UPS

Tsai-Fu Wu¹, Ting-Hao Shiu¹, Po-Heng Lin¹, Li-Chun Lin¹, Jia-Wei Huang², ¹*National Tsing Hua University, Taiwan*, ²*Industrial Technology Research Institute, Taiwan*

4:10 p.m. – 4:30 p.m.

T27.6: A Multi-Function Three-Level Dynamic Voltage Corrector with Wide Correction Range and Short Circuit Fault Isolation

Jiankun Cao, Pengling Ding, Haichun Liu, Shaojun Xie, *Nanjing University of Aeronautics and Astronautics, China*

4:30 p.m. – 4:50 p.m.

T27.7: Effects and Analysis of Minimum Pulse Width Limitation on Adaptive DC Voltage Control of Grid Converters

Bo Sun, Ionut Trintis, Stig Munk-Nielsen, Josep Maria Guerrero, *Aalborg University, Denmark*

4:50 p.m. – 5:10 p.m.

T27.8: Improved Three-Phase Micro-Inverter Using Dynamic Dead Time Optimization and Phase-Skipping Control Techniques

Seyed Milad Tayebi, Xianmin Mu, Issa Batarseh, *University of Central Florida, United States*

5:10 p.m. – 5:30 p.m.

T27.9: Correcting Current Imbalances in Three-Phase Four-Wire Distribution Systems

Vinson Jones, Juan Carlos Balda, *University of Arkansas, United States*

7:00 p.m. – 10:00 p.m.

“Surfin’ Safari” Evening Social Event

PACIFIC BALLROOM

(located adjacent to the Long Beach Convention and Entertainment Center)



Thursday March 24, 2016

7:00 a.m. – 8:00 a.m.

Speaker Breakfast

GRAND BALLROOM

7:00 a.m. – 8:00 a.m.

Dialogue Presenter Breakfast

HALL A

8:00 a.m. – 12:00 p.m.

Registration

LOBBY LEVEL – LBCC

8:00 a.m. – 9:00 a.m.

Spouse and Guest Breakfast

PACIFIC ROOM – HYATT REGENCY

8:00 a.m. – 11:00 a.m.

Spouse and Guest Hospitality Room Open

PACIFIC ROOM – HYATT REGENCY

8:30 a.m. – 11:30 a.m.

IS13: Safety and Compliance

ROOM 201A

SESSION CHAIRS:

Kevin Parmenter, *Excelsys*

Jim Spangler, *Independent Consultant*

8:30 a.m. – 8:55 a.m.

IS13.1: Surges and Transients Can't Read Specifications – How to Meet Specifications and Protect Against Real-World Threats

Tim Patel, *Littelfuse, Inc., United States*

8:55 a.m. – 9:20 a.m.

IS13.2: Component Level Safety Certification in Systems-IEC60747-17/UL1577

Mark Cantrell, *Analog Devices, United States*

9:20 a.m. – 9:45 a.m.

IS13.3: Introduction to EMC and EMC Standards

Ghery Pettit, *Pettit EMC Consulting LLC, United States*

9:45 a.m. – 10:10 a.m.

IS13.4: Type Testing Primer for Power Converters and Transformers

Brian O'Connell, *Tamura Corp of America, United States*

10:40 a.m. – 11:05 a.m.

IS13.5: IEC 60601-1-2, 4th Edition

Darryl Ray, *Darryl Ray EMC Consulting, LLC, United States*

11:05 a.m. – 11:30 a.m.

IS13.6: Sources for Regulatory Information and Related Search Techniques – How to Find Safety and Compliance Information

Kevin Parmenter, Jim Spangler, *Excelsys Technologies Ltd., United States*

8:30 a.m. – 10:10 a.m.

IS14a: Topics in Power Integration

ROOM 201B

SESSION CHAIR:

Dave Hurst, *NextEnergy*

8:30 a.m. – 8:55 a.m.

IS14a.1: Floating High Voltage Switches Integrated with Standard Logic

Tom Simmonds, *TLSI, United States*

8:55 a.m. – 9:20 a.m.

IS14a.2: AC/DC to UHV: How Application Requirements Drive IC Technology Requirements

Don Disney, *GLOBALFOUNDRIES, Singapore*

9:20 a.m. – 9:45 a.m.

IS14a.3: Multi-Chip Power Module Layout & Design Using Q3D Extractor and PowerSynth

Andalib Nizam¹, Atanu Dutta¹, Tom Vrotsos¹, Alan Mantooth¹, Steven Pytel Jr.²,
¹University of Arkansas, ²ANSYS, Inc.

9:45 a.m. – 10:10 a.m.

IS14a.4: PowerSoC & PowerSiP Markets Are Preparing. Are You?

Alex Avron, *Point The Gap, France*

10:40 a.m. – 11:30 a.m.

IS14b: Power Electronics Industry in North America

ROOM 201B

SESSION CHAIR:

Dave Hurst, *NextEnergy*

10:40 a.m. – 11:05 a.m.

IS14b.1: Driving Collaboration for Power Electronics Technology Road Mapping Industry Survey

Dave Hurst, *NextEnergy, United States*

11:05 a.m. – 11:30 a.m.

IS14b.2: Driving Collaboration for Power Electronics Technology Roadmapping Review

Swad Komanduri, Dave Hurst, Roland Kibler, Dan Radomski, *NextEnergy, United States*

8:30 a.m. – 11:30 a.m.

IS15: Power Electronics Applications

ROOM 202AB

SESSION CHAIR:

Bill Peterson, *E&M Power*

8:30 a.m. – 8:55 a.m.

IS15.1: Direct Current Emulator Wideband Load / Source for Powersystem Simulation and Testing

William Peterson, *E&M Power, United States*

8:55 a.m. – 9:20 a.m.

IS15.2: Digital Power Conversion

Herman Vaneijkelenburg, *Adaptive Power Systems, United States*

9:20 a.m. – 9:45 a.m.

IS15.3: Latest Solutions to Meet Power Conversion Needs on the "More Electric Aircraft"

Kaz Furmanczyk, *Crane Aerospace & Electronics, United States*

9:45 a.m. – 10:10 a.m.

IS15.4: Drive System Loss Reduction by Allpole Sine Filters

Dennis Kampen, *BLOCK Transformatoren-Elektronik GmbH, Germany*

10:40 a.m. – 11:05 a.m.

IS15.5: Peak Current Controlled ZVS Full Bridge Converter with Digital Slope Compensation

Sabarish Kalyanaraman, Ramesh Kankanala, *Microchip Technology (India) Pvt Ltd, India*

11:05 a.m. – 11:30 a.m.

IS15.6: Protection of Wide Band Gap Semiconductor Devices Used in High Power/High Voltage Applications
Barry Kirkorian, *Mersen USA, United States*

8:30 a.m. – 11:30 a.m.

IS16: Power Semiconductors Enabling Next Generation Applications

ROOM 203AB

SESSION CHAIRS:

Carl Blake, *Independent Consultant*

John Palmour, *Wolfspeed*

8:30 a.m. – 8:55 a.m.

IS16.1: Outlook for Semiconductors & Power Discretes & Modules
Dale Ford, *IHS, United States*

8:55 a.m. – 9:20 a.m.

IS16.2: Silicon Carbide Devices for Energy Efficient Infrastructure
Ranbir Singh, *GeneSiC Semiconductor Inc., United States*

9:20 a.m. – 9:45 a.m.

IS16.3: GaN Vs. Silicon – Overcoming Barriers to the Rise of GaN
Joe Engle, Alex Lidow, *EPC, United States*

9:45 a.m. – 10:10 a.m.

IS16.4: Unlocking the Power of GaN
Dan Kinzer, *Navitas Semiconductor, United States*

10:40 a.m. – 11:05 a.m.

IS16.5: GaN in a Silicon World: Competition or Coexistence
Tim McDonald, *Infineon, United States*

11:05 a.m. – 11:30 a.m.

IS16.6: Advanced High Power-Density Thermal Packages & Mother-Boards Enable Ultimate Power GaN & SiC Performance & Efficiency
Courtney Furnival, Arnold Alderman, *Semiconductor Packaging Solutions, United States*

8:30 a.m. – 11:20 a.m.

T28: Isolated DC-DC Converters

ROOM 104A

Track: DC-DC Converters

SESSION CHAIRS:

Dragan Maksimovic, *University of Colorado, Boulder*

Zhong Ye, *Texas Instruments*

8:30 a.m. – 8:50 a.m.

T28.1: New Design Methodology for Megahertz-Frequency Resonant DC-DC Converters Using Impedance Control Network Architecture
Yushi Liu, Ashish Kumar, Jie Lu, Dragan Maksimovic, Khurram K. Afridi, *University of Colorado Boulder, United States*

8:50 a.m. – 9:10 a.m.

T28.2: Dual Voltage Regulations of Single Switch Flyback Converter Using Variable Switching Frequency
Jin-Woong Kim, Jung-Ik Ha, *Seoul National University, Korea, South*

9:10 a.m. – 9:30 a.m.

T28.3: On-Chip PLL-Based Methods for Synchronizing Active Switches Across the Isolation Boundary in DC-DC Converters
Shahab Poshtkouhi, Miad Fard, Olivier Trescases, *University of Toronto, Canada*

9:30 a.m. – 9:50 a.m.

T28.4: An Isolated Soft-Switching Buck-Boost Converter Utilizing Two Transformers and Embedded Bidirectional Switches on Secondary-Side for Wide Voltage Applications
Tingting Liu¹, Hongfei Wu¹, Yan Xing¹, Kai Sun², ¹*Nanjing University of Aeronautics and Astronautics, China*, ²*Tsinghua University, China*

9:50 a.m. – 10:10 a.m.

T28.5: Effect of Transformer Design on Operation of Fundamental Duty Modulation for Dual-Active-Bridge Converter
Woojin Choi, Moonhyun Lee, Bo-Hyung Cho, *Seoul National University, Korea, South*

THURSDAY

THURSDAY

10:40 a.m. – 11:00 a.m.

T28.6: A High Step-Up Bidirectional Isolated Dual-Active-Bridge Converter with Three-Level Voltage-Doubler Rectifier for Energy Storage Applications

Xiaohai Zhan¹, Hongfei Wu¹, Yan Xing¹, Hongjuan Ge¹, Xi Xiao², ¹Nanjing University of Aeronautics and Astronautics, China, ²Tsinghua University, China

11:00 a.m. – 11:20 a.m.

T28.7: Digitized Self-Oscillating Loop for Piezoelectric Transformer-Based Power Converters

Marzieh Ekhtiari, Thomas Andersen, Zhe Zhang, Michael A.E. Andersen, *Danmarks Tekniske Universitet, Denmark*

8:30 a.m. – 11:20 a.m.

T29: Multilevel Converters

ROOM 101A

Track: Power Electronics for Utility Interface

SESSION CHAIRS:

Maryam Saeedifard, *Georgia Tech*

Julia Zhang, *Oregon State University*

8:30 a.m. – 8:50 a.m.

T29.1: An Isolated Topology for Reactive Power Compensation with a Modularized Dynamic-Current Building-Block

Hao Chen¹, Anish Prasai², Deepak Divan¹, ¹Georgia Institute of Technology, United States, ²Varentec, United States

8:50 a.m. – 9:10 a.m.

T29.2: Design and Control of a Compact MMC Submodule Structure with Reduced Capacitor Size Using the Stacked Switched Capacitor Architecture

Yuan Tang¹, Minjie Chen², Li Ran¹, ¹University of Warwick, United Kingdom, ²Massachusetts Institute of Technology, United States

9:10 a.m. – 9:30 a.m.

T29.3: Fundamental Frequency Sorting Strategy for Capacitor Voltage Balance of Modular Multilevel Converters with Phase Disposition PWM

Kun Wang, Yan Deng, Wenyu Li, Hao Peng, Guipeng Chen, *Xiangning He, Zhejiang University, China*

9:30 a.m. – 9:50 a.m.

T29.4: Active Voltage Balancing Control for 10kV Three-Level Converter Using Series-Connected HV-IGBTs

Shiqi Ji¹, Ting Lu¹, Zhengming Zhao¹, Hualong Yu¹, Fred Wang², ¹Tsinghua University, China, ²University of Tennessee, United States

9:50 a.m. – 10:10 a.m.

T29.5: Average-Value Model of Modular Multilevel Converters Considering Capacitor Voltage

Heya Yang¹, Yuxiang Chen¹, Wuhua Li¹, Xiangning He¹, Wei Sun², Yongning Chi², Yan Li², ¹Zhejiang University, China, ²China Electric Power Research Institute, China

10:40 a.m. – 11:00 a.m.

T29.6: New Submodule Circuits for Modular Multilevel Current Source Converters with DC Fault Ride Through Capability

Xinyu Yu, Yingdong Wei, Qirong Jiang, *Tsinghua University, China*

11:00 a.m. – 11:20 a.m.

T29.7: Voltage and Power Balance Control Strategy for Three-Phase Modular Cascaded Solid Stated Transformer

Zhiyu Zhang, Hengyang Zhao, Shihang Fu, Jianjiang Shi, Xiangning He, *Zhejiang University, China*

8:30 a.m. – 11:20 a.m.

T30: Multilevel and Matrix Converters for Motor Drives

ROOM 102C

Track: Motor Drives and Inverters

SESSION CHAIRS:

SeonHwan Hwang, *Kyungnam University, Korea*

Xiaohu Liu, *GE*

8:30 a.m. – 8:50 a.m.

T30.1: New Flying-Capacitor-Based Multilevel Converter with Optimized Number of Switches and Capacitors Controlled with a New Logic-Form-Equation Based Active Voltage Balancing Technique

Vahid Dargahi¹, Arash Khoshkbar Sadigh², Keith Corzine¹, ¹Clemson University, United States, ²Extron Electronics, United States

8:50 a.m. – 9:10 a.m.

T30.2: New Low-Cost Five-Level Active Neutral-Point Clamped Converter

Hongliang Wang¹, Lei Kou¹, Yan-Fei Liu¹, Paresh Sen¹, Sucheng Liu², ¹Queen's University, Canada, ²Anhui University of Technology, China

9:10 a.m. – 9:30 a.m.

T30.3: Medium Voltage (≥ 2.3 kV) High Frequency Three-Phase Two-Level Converter Design and Demonstration Using 10 kV SiC MOSFETs for High Speed Motor Drive Applications

Sachin Madhusoodhanan, Krishna Mainali, Awneesh Tripathi, Kasunaidu Vechalapu, Subhashish Bhattacharya, North Carolina State University, United States

9:30 a.m. – 9:50 a.m.

T30.4: Novel Three Phase Multi-Level Inverter Topology with Symmetrical DC-Voltage Sources

Ahmed Salem, Emad M. Ahmed, Mahrous Ahmed, Mohamed Orabi, Aswan University, Egypt

9:50 a.m. – 10:10 a.m.

T30.5: A 2 kW, Single-Phase, 7-Level, GaN Inverter with an Active Energy Buffer Achieving 216 W/in³ Power Density and 97.6% Peak Efficiency

Yutian Lei, Christopher Barth, Shibin Qin, Wen Chuen Liu, Intae Moon, Andrew Stillwell, Derek Chou, Thomas Foulkes, Zichao Ye, Zitao Liao, Robert Pilawa-Podgurski, University of Illinois Urbana-Champaign, United States

10:40 a.m. – 11:00 a.m.

T30.6: Indirect Matrix Converter Based Open-End Winding AC Drives with Zero Common-Mode Voltage

Saurabh Tewari¹, Ranjan Gupta², Apurva Somani³, Ned Mohan¹, ¹University of Minnesota, United States, ²First Solar, Inc., United States, ³Dynapower Company LLC, United States

11:00 a.m. – 11:20 a.m.

T30.7: Precharging Strategy for Soft Startup Process of Modular Multilevel Converters Based on Various SM Circuits

Jiangchao Qin¹, Suman Debnath², Maryam Saeedifard³, ¹Arizona State University, United States, ²Oak Ridge National Laboratory, United States, ³Georgia Institute of Technology, United States

8:30 a.m. – 11:20 a.m.

T31: System Design Techniques for Reduced EMI

ROOM 101B

Track: System Integration

SESSION CHAIRS:

John Vigers, Allegro Microsystems

Doug Hopkins, North Carolina State University

8:30 a.m. – 8:50 a.m.

T31.1: Conducted EMI Analysis and Filter Design for MHz Active Clamp Flyback Front-End Converter

Xiucheng Huang, Junjie Feng, Fred C. Lee, Qiang Li, Yuchen Yang, Virginia Polytechnic Institute and State University, United States

8:50 a.m. – 9:10 a.m.

T31.2: EMC Investigation of a Very High Frequency Self-Oscillating Resonant Power Converter

Jeppe Arnsdorf Pedersen, Arnold Knott, Michael A.E. Andersen, Danmarks Tekniske Universitet, Denmark

9:10 a.m. – 9:30 a.m.

T31.3: Numerical Optimization of Passive Line Filter Components for Suppression of Electromagnetic Interference (EMI)

Carsten Henkenius¹, Norbert Fröhleke¹, Joachim Böcker¹, Heiko Figge², ¹Universität Paderborn, Germany, ²Delta Energy Systems Germany GmbH, Germany

9:30 a.m. – 9:50 a.m.

T31.4: Electromagnetic Noise Coupling and Mitigation for Fast Response on-Die Temperature Sensing in High Power Modules

Chengcheng Yao¹, Pengzhi Yang¹, Mingzhi Leng¹, He Li¹, Lixing Fu¹, Jin Wang¹, Ke Zou², Chingchi Chen², ¹Ohio State University, United States, ²Ford Motor Company, United States

9:50 a.m. – 10:10 a.m.

T31.5: Ultra-Low Inductance Vertical Phase Leg Design with EMI Noise Propagation Control for Enhancement Mode GaN Transistors

Xuning Zhang, Zhiyu Shen, Nidhi Haryani, Dushan Boroyevich, Rolando Burgos, Virginia Polytechnic Institute and State University, United States

10:40 a.m. – 11:00 a.m.

T31.6: Decoupling of Interaction Between WBG Converter and Motor Load for Switching Performance Improvement

Zheyu Zhang¹, Fred Wang¹, Leon M. Tolbert², Benjamin J. Blalock¹, Daniel Jes Costinett¹,
¹University of Tennessee, United States,
²University of Tennessee / Oak Ridge National Laboratory, United States

11:00 a.m. – 11:20 a.m.

T31.7: Control and Characterization of Electromagnetic Emissions in Wide Band Gap Based Converter Modules for Ungrounded Grid-Forming Applications

Robert Cuzner¹, Seyed Rasoul Hosseini¹, Andrew Lemmon², James Gafford³, Michael Mazzola³,
¹University of Wisconsin-Milwaukee, United States,
²University of Alabama, United States, ³Mississippi State University, United States

8:30 a.m. – 11:20 a.m.

T32: Modeling of DC Energy Converters and Systems

ROOM 102AB

Track: Modeling and Simulation

SESSION CHAIRS:

Santanu Kapat, *IIT Kharagpur*

Sombuddha Chakraborty, *Texas Instruments*

8:30 a.m. – 8:50 a.m.

T32.1: A Practical Switching Time Model for Synchronous Buck Converters

Yuan Rao, Surinder Singh, Taisuke Kazama,
Texas Instruments Inc., United States

8:50 a.m. – 9:10 a.m.

T32.2: Off-Line Identification of Digitally Controlled Power Converters Using an Analog Frequency Response Analyzer

Marco Meola¹, Anthony Kelly², ¹Zentrum Mikroelektronik Dresden AG, Germany,
²Altera Corporation, Ireland

9:10 a.m. – 9:30 a.m.

T32.3: Extended Wide-Load Range Model for Multi-Level DC-DC Converters and a Practical Dual-Mode Digital Controller

Nenad Vukadinovic¹, Aleksandar Prodic¹, Brett Miwa², Cory Arnold², Michael Baker²,
¹University of Toronto, Canada,
²Maxim Integrated, United States

9:30 a.m. – 9:50 a.m.

T32.4: Burst Mode Control and Switched-Capacitor Converters Losses

Michael Evzelman, Regan Zane,
Utah State University, United States

9:50 a.m. – 10:10 a.m.

T32.5: Equivalent Circuit Modeling of LLC Resonant Converter

Shuilin Tian, Fred C. Lee, Qiang Li, *Virginia Polytechnic Institute and State University, United States*

10:40 a.m. – 11:00 a.m.

T32.6: Small Signal Modeling of the Hysteretic Modulator with a Current Ripple Synthesizer

Yi Huang, Chun Cheung, *Intersil Corporation, United States*

11:00 a.m. – 11:20 a.m.

T32.7: A Black-Box Modeling Approach for DC Nanogrids

Airan Francés, Rafael Asensi, Oscar García, Roberto Prieto, Javier Uceda, *Universidad Politécnica de Madrid, Spain*

8:30 a.m. – 11:20 a.m.

T33: Gate Drive Techniques

ROOM 103C

Track: Control

SESSION CHAIRS:

Christopher Bridge, *SIMPLIS Technologies*

Martin Ordonez, *University of British Columbia*

8:30 a.m. – 8:50 a.m.

T33.1: Design and Evaluation of Isolated Gate Driver Power Supply for Medium Voltage Converter Applications

Krishna Mainali, Sachin Madhusoodhanan, Awneesh Tripathi, Kasunaidu Vechalapu, Ankan De, Subhashish Bhattacharya, *North Carolina State University, United States*

8:50 a.m. – 9:10 a.m.

T33.2: General-Purpose Clocked Gate Driver (CGD) IC with Programmable 63-Level Drivability to Reduce Ic Overshoot and Switching Loss of Various Power Transistors

Koutarou Miyazaki¹, Seiya Abe², Masanori Tsukuda², Ichiro Omura², Keiji Wada³, Makoto Takamiya¹, Takayasu Sakurai¹, ¹University of Tokyo, Japan, ²Kyushu Institute of Technology, Japan, ³Tokyo Metropolitan University, Japan

9:10 a.m. – 9:30 a.m.

T33.3: An Integrated SiC CMOS Gate Driver

Matthew Barlow¹, Shamim Ahmed,
Alan Mantooth, Matt Francis², ¹University of
Arkansas, United States, ²Ozark Integrated
Circuits, Inc., United States

9:30 a.m. – 9:50 a.m.

T33.4: Digital Active Gate Drives Using Sequential Optimization

Daniel Rogers¹, Boris Murmann²,
¹Oxford University, United Kingdom,
²Stanford University, United States

9:50 a.m. – 10:10 a.m.

T33.5: One Adaptive Turn-Off Method for PFC Converter with Voltage Spike Limitation

Qunfang Wu, Qin Wang, Lan Xiao, Jialin Xu,
Hongxu Li, Nanjing University of Aeronautics
and Astronautics, China

10:40 a.m. – 11:00 a.m.

T33.6: A Digital Implementation for PWM Phase-Frequency Synchronization in SMPS Systems

Luca Bizjak¹, Emanuele Bodano¹, Ante Gotovac²,
Sergii Tkachov³, ¹Infineon Technologies Austria
AG, Italy, ²Infineon Technologies Austria AG,
Croatia, ³Infineon Technologies Austria AG,
Ukraine

11:00 a.m. – 11:20 a.m.

T33.7: A High Accuracy and High Bandwidth Current Sense Circuit for Digitally Controlled DC-DC Buck Converters

David Stack¹, Anthony Kelly¹, Thomas Conway²,
¹Altera Corporation, Ireland, ²University of
Limerick, Ireland

8:30 a.m. – 11:20 a.m.

T34: Energy Storage Systems

ROOM 104B

Track: Renewable Energy Systems

SESSION CHAIRS:

Wei Qiao, University of Nebraska Lincoln

Yilmaz Sozer, University of Akron

8:30 a.m. – 8:50 a.m.

T34.1: Modular Multilevel Dual Active Bridge DC-DC Converter with ZVS and Fast DC Fault Recovery for Battery Energy Storage Systems

Yuxiang Shi, Rui Li, Hui Li, Florida State University,
United States

8:50 a.m. – 9:10 a.m.

T34.2: An Analytical Framework to Design a Dynamic Frequency Control Scheme for Microgrids Using Energy Storage

Ajit Renjit¹, Feng Guo², Ratnesh Sharma²,
¹Ohio State University, United States,
²NEC Laboratories America, Inc., United States

9:10 a.m. – 9:30 a.m.

T34.3: Comparative Evaluation of LiFePO4 Cell SOC Estimation Performance with ECM Structure and Noise Model/Data Rejection in the EKF for Transportation Application

Hyunjun Lee¹, Joung-hu Park¹, Jonghoon Kim²,
¹Soongsil University, Korea, South,
²Chosun University, Korea, South

9:30 a.m. – 9:50 a.m.

T34.4: A Power Sharing Scheme for Series Connected Offshore Wind Turbines in a Medium Voltage DC Collection Grid

Michael Daniel, Prasad Enjeti, Texas A&M
University, United States

9:50 a.m. – 10:10 a.m.

T34.5: Fault Ride-Through Performance Evaluation of an Interleaved Grid-Connected Converter Employing Low Switching Frequency

Lorand Bede¹, Ghanshyamsinh Gohil¹, Mihai
Ciobotaru², Tamas Kerekes¹, Remus Teodorescu¹,
Vassilios Agelidis², ¹Aalborg University, Denmark
²University of New South Wales, Australia

10:40 a.m. – 11:00 a.m.

T34.6: Analysis of Two Charging Modes of Battery Energy Storage System for a Stand-Alone Microgrid

Jongmin Jo, Hanju Cha, Chungnam National
University, Korea, South

11:00 a.m. – 11:20 a.m.

T34.7: Proposition and Experimental Verification of a Bi-Directional Isolated DC/DC Converter for Battery Charger-Discharger of Electric Vehicle

Ryota Kondo, Yusuke Higaki, Masaki Yamada,
Mitsubishi Electric Corporation, Japan

8:30 a.m. – 11:20 a.m.

T35: Topics on Inductive and Capacitive Wireless Power Transfer

ROOM 104C

Track: Transportation Power Electronics

SESSION CHAIRS:

Chris Mi, *San Diego State University*

Omer Onar, *Oak Ridge National Laboratory*

8:30 a.m. – 8:50 a.m.

T35.1: A CLLC-Compensated High Power and Large Air-Gap Capacitive Power Transfer System for Electric Vehicle Charging Applications

Fei Lu¹, Hua Zhang², Heath Hofmann¹, Chris Mi²,
¹*University of Michigan-Ann Arbor, United States*,
²*University of Michigan-Dearborn, United States*

8:50 a.m. – 9:10 a.m.

T35.2: A Large Air-Gap Capacitive Power Transfer System with a 4-Plate Capacitive Coupler Structure for Electric Vehicle Charging Applications

Hua Zhang¹, Fei Lu², Heath Hofmann², Weiguo Liu³, Chris Mi¹, ¹*University of Michigan-Dearborn, United States*, ²*University of Michigan-Ann Arbor, United States*, ³*Northwestern Polytechnical University, China*

9:10 a.m. – 9:30 a.m.

T35.3: Dynamic Wireless Power Transfer System for Electric Vehicles to Simplify Ground Facilities – Power Control and Efficiency Maximization on the Secondary Side -

Katsuhiro Hata, Takehiro Imura, Yoichi Hori,
University of Tokyo, Japan

9:30 a.m. – 9:50 a.m.

T35.4: Uniform-Gain Frequency Tracking of Wireless EV Charging for Improving Alignment Flexibility

Yabiao Gao¹, Antonio Ginart², Kathleen Farley³, Zion Tsz Ho Tse¹, ¹*University of Georgia, United States*, ²*Sonnenbatterie GmbH / University of Georgia, United States*, ³*Southern Company Services, Inc., United States*

9:50 a.m. – 10:10 a.m.

T35.5: Design and Optimization of a Multi-Coil System for Inductive Charging with Small Air Gap

Christopher Joffe, Andreas Roßkopf, Stefan Ehrlich, Christian Dobmeier, Martin März,
Fraunhofer Institute for Integrated Systems and Device Technology, Germany

10:40 a.m. – 11:00 a.m.

T35.6: Core Design for Better Misalignment Tolerance and Higher Range of Wireless Charging for HEV

Mostak Mohammad¹, Sangshin Kwak², Seungdeog Choi¹, ¹*University of Akron, United States*, ²*Chung-ang University, Korea, South*

11:00 a.m. – 11:20 a.m.

T35.7: A 25 kW Industrial Prototype Wireless Electric Vehicle Charger

Mariusz Bojarski¹, Erdem Asa², Kerim Colak³, Dariusz Czarkowski⁴, ¹*Hevo Power Inc., United States*, ²*New York University / Hevo Power Inc., United States*, ³*Istanbul Ulasim A.S., Turkey*, ⁴*New York University, United States*

8:30 a.m. – 11:20 a.m.

T36: Wireless Power Transfer

ROOM 103AB

Track: Power Electronics Applications

SESSION CHAIR:

Michael Masquelier, *WAVE*

Xiong Li, *Texas Instruments*

8:30 a.m. – 8:50 a.m.

T36.1: Full-Bridge Series Resonant Multi-Inverter Featuring New 900-V SiC Devices for Improved Induction Heating Appliances

Mario Pérez-Tarragona, Hector Sarnago, Oscar Lucia, José Miguel Burdío,
Universidad de Zaragoza, Spain

8:50 a.m. – 9:10 a.m.

T36.2: A Novel Phase Control of Single Switch Active Rectifier for Inductive Power Transfer Applications

Kerim Colak¹, Erdem Asa², Dariusz Czarkowski³, ¹*Istanbul Ulasim A.S., Turkey*, ²*New York University / Hevo Power Inc., United States*, ³*New York University, United States*

9:10 a.m. – 9:30 a.m.

T36.3: Optimal Shaped Dipole-Coil Design and Experimental Verification of Inductive Power Transfer System for Home Applications

Tan Duy Nguyen, Eunsoo Lee, Byeungguk Choi, Chuntaek Rim, *Korea Advanced Institute of Science and Technology, Korea, South*

9:30 a.m. – 9:50 a.m.

T36.4: A Novel Time-Sharing Current-Fed ZCS High Frequency Inverter-Applied Resonant DC-DC Converter for Inductive Power Transfer

Kyohei Konishi¹, Tomokazu Mishima¹,
Mutsuo Nakaoka², ¹Kobe University, Japan,
²University of Malaya, Malaysia

9:50 a.m. – 10:10 a.m.

T36.5: Optimization of Coils for Magnetically Coupled Resonant Wireless Power Transfer System Based on Maximum Output Power

Dan Jiang, Yong Yang, Fuxin Liu, Xinbo Ruan,
Xuling Chen, *Nanjing University of Aeronautics and Astronautics, China*

10:40 a.m. – 11:00 a.m.

T36.6: Online Regulation of Receiver-Side Power and Estimation of Mutual Inductance in Wireless Inductive Link Based on Transmitter-Side Electrical Information

Jeff Po Wa Chow, Henry Shu-Hung Chung,
Chun Sing Cheng, *City University of Hong Kong, Hong Kong*

11:00 a.m. – 11:20 a.m.

T36.7: Dynamic Period Switching of PRS-PWM with Run-Length Limiting Technique for Spurious and Ripple Reduction in Fast Response Wireless Power Transmission

Takahiro Moroto, Toru Kawajiri, Hiroki Ishikuro,
Keio University, Japan

11:30 a.m. – 1:30 p.m.

Dialogue Sessions

(for detailed information see page 150)

HALL A

2:00 p.m. – 5:00 p.m.

IS17: Market Analysis

ROOM 201A

SESSION CHAIRS:

Chris Jones, *Artesyn Embedded Technologies*

Greg Evans, *WeiComm*

2:00 p.m. – 2:25 p.m.

IS17.1: The New Competitive Environment for Power Semiconductors

Victoria Fodale, Michael Markides, *IHS Technology, United States*

2:25 p.m. – 2:50 p.m.

IS17.2: Discrete Vs. Integrated Power Solutions IHS Technology

Jonathan Liao, Richard Eden, Michael Markides,
IHS Global Inc., United States

2:50 p.m. – 3:15 p.m.

IS17.3: GaN on Si HEMT vs SJ Mosfet: Technology and Cost Comparison of Next Generation 600/650V Power Devices

Elena Barbarini, *System Plus Consulting, France*

3:15 p.m. – 3:40 p.m.

IS17.4: Market Forecasts for Silicon Carbide & Gallium Nitride Power Semiconductors IHS Technology

Jonathan Liao, Richard Eden, Michael Markides,
IHS Technology, United Kingdom

4:10 p.m. – 4:35 p.m.

IS17.5: Si IGBT and SiC: Which Repartition for Power Devices?

Pierric Gueguen, *Yole Développement, France*

4:35 p.m. – 5:00 p.m.

IS17.6: How Will the Battery Market Build on EV/HEV Adoption?

Pierric Gueguen, *Yole Développement, France*

2:00 p.m. – 3:15 p.m.

IS18: LED Lighting

ROOM 201B

SESSION CHAIRS:

Aung Thet Tu, *Independent Consultant*

Brian Johnson, *Texas Instruments*

2:00 p.m. – 2:25 p.m.

IS18.1: Damping Circuit for Dimmable Retrofit LED Lamps

Nagaraja Chikkegowda, *OSRAM, United States*

2:25 p.m. – 2:50 p.m.

IS18.2: Smart Lighting and the Future of Illumination Markets

Robert F. Karlicek Jr., *Rensselaer Polytechnic Institute, United States*

2:50 p.m. – 3:15 p.m.

IS18.3: The Challenges (and Surprises) of Closed-Loop LED Color and Color Temperature Control

Cary Eskow, *Avnet Electronics, United States*

2:00 p.m. – 3:15 p.m.

IS19a: ElectroMagnetic Compatibility

ROOM 202AB

SESSION CHAIRS:

Kevin Parmenter, *Excelsys*

Jim Spangler, *Independent Consultant*

2:00 p.m. – 2:25 p.m.

IS19a.1: The Behavior of Electro-Magnetic Radiation of Storage Inductor in DC-DC Converters

Ranjith Bramanpalli, *Würth Elektronik, Germany*

2:25 p.m. – 2:50 p.m.

IS19a.2: EMC Filter Solutions for Switch Mode Power Supplies

Nikila Kareesan, *SCHURTER, Inc., United States*

2:50 p.m. – 3:15 p.m.

IS19a.3: Inductor Noise in the Buck Converter GPU Circuit

David Yu, Andrew Chu, *ITG Electronics, Inc., China*

4:10 p.m. – 5:25 p.m.

IS19b: Capacitors for Power Applications

ROOM 202AB

SESSION CHAIRS:

Kevin Parmenter, *Excelsys*

Jim Spangler, *Independent Consultant*

4:10 p.m. – 4:35 p.m.

IS19b.1: New Component Technologies Enable More Robust and Reliable Power System Design

Chris Reynolds, *AVX, United States*

4:35 p.m. – 5:00 p.m.

IS19b.2: Non-Traditional Supercapacitor Topologies for Traditional Circuit Issues

Nihal Kularatna, *The University of Waikato, New Zealand*

5:00 p.m. – 5:25 p.m.

IS19b.3: Proposal of Precise SPICE Model of Conductive Polymer Aluminum Solid Capacitors

Shun Koyama, Tomoyuki Goutsu, *Nippon Chemi-Con Corporation, Japan*

2:00 p.m. – 5:00 p.m.

IS20: Active Devices

ROOM 203AB

SESSION CHAIRS:

Sal Akram, *Fairchild Semiconductor*

Kumar Gandharva, *Infineon*

2:00 p.m. – 2:25 p.m.

IS20.1: Advantages and Optimized Control of Reverse Conducting Diode Controlled RCDC IGBT's

David Levett, Tim Frank, *IFNA, United States*

2:25 p.m. – 2:50 p.m.

IS20.2: If It Ain't Broke Why Fix It? Design Improvements to the PrimePACK™ IGBT Module for Commercial, Construction and Agricultural Vehicle (CAV) Traction Drives

David Levett, Tim Frank, *IFNA, United States*

2:50 p.m. – 3:15 p.m.

IS20.3: Hybrid Si-SiC High Power Modules for Cost Effective High Voltage, High Current, High Frequency Switching

Eric Motto, John Donlon, Mike Rogers, *Powerex Inc., United States*

3:15 p.m. – 3:40 p.m.

IS20.4: A New High Power IGBT Module Package

Timothy Frank, David Levett, *Infineon Technologies, United States*

4:10 p.m. – 4:35 p.m.

IS20.5: Test Setup for Accelerated Lifetime Determination of IGBT Modules

Bram Geene, *Prodrive Technologies, Netherlands*

4:35 p.m. – 5:00 p.m.

IS20.6: HybridMOS: Product Development Contributing to Improved Energy Savings

HiroYuki Ogurisu, Mitch Van Ochten, *ROHM Semiconductor, United States*

2:00 p.m. – 5:30 p.m.

T37: Single-Phase AC-DC Converters

ROOM 102AB

Track: AC-DC Converters

SESSION CHAIRS:

Dusty Becker, *Emerson Network Power*

Pritam Das, *National University of Singapore*

2:00 p.m. – 2:20 p.m.

T37.1: A Flyback AC/DC Converter Using Power Semiconductor Filter for Input Power Factor Correction

Chung-Pui Tung, Henry Shu-Hung Chung,
City University of Hong Kong, Hong Kong

2:20 p.m. – 2:40 p.m.

T37.2: Reducing the Variation Range of the Switching Frequency for CRM Boost PFC Converter by Injecting 3rd Harmonic Into the Input Current

Yi Wang, Kai Yao, *Nanjing University of Science and Technology, China*

2:40 p.m. – 3:00 p.m.

T37.3: A Sustained Increase of Input Current Distortion in Active Input Current Shapers to Eliminate Electrolytic Capacitor for Designing AC to DC HB-LED Drivers for Retrofit Lamps Applications

Diego G. Lamar¹, Manuel Arias¹, Alberto Rodriguez¹, Javier Sebastian¹, Arturo Fernandez², Jose Villarejo³, ¹*Universidad de Oviedo, Spain*,
²*European Space Agency, Netherlands*,
³*Universidad de Cartagena, Spain*

3:00 p.m. – 3:20 p.m.

T37.4: Reduced Current Stress Bridgeless Cuk PFC Converter with New Voltage Multiplier Circuit

Yi-Hung Liao, *National Penghu University of Science and Technology, Taiwan*

3:20 p.m. – 3:40 p.m.

T37.5: Implementation of Multi-Level Bridgeless PFC Rectifiers for Mid-Power Single Phase Applications

Trong Tue Vu, George Young, *Eisergy Ltd., Ireland*

4:10 p.m. – 4:30 p.m.

T37.6: US Mains Stacked Very High Frequency Self-Oscillating Resonant Power Converter with Unified Rectifier

Jepppe Arnsdorf Pedersen, Mickey P. Madsen, Jakob D. Mønster, Thomas Andersen, Arnold Knott, Michael A.E. Andersen, *Danmarks Tekniske Universitet, Denmark*

4:30 p.m. – 4:50 p.m.

T37.7: Digital-Based Interleaving Control for GaN-Based MHz CRM Totem-Pole PFC

Zhengyang Liu, Zhengrong Huang, Fred C. Lee, Qiang Li, *Virginia Polytechnic Institute and State University, United States*

4:50 p.m. – 5:10 p.m.

T37.8: A Novel AC-to-DC Adaptor with Ultra-High Power Density and Efficiency

Yan-Cun Li, Fred C. Lee, Qiang Li, Xiucheng Huang, Zhengyang Liu, *Virginia Polytechnic Institute and State University, United States*

5:10 p.m. – 5:30 p.m.

T37.9: A Single-Stage Single-Phase Isolated AC-DC Converter Based on LLC Resonant Unit and T-Type Three-Level Unit for Battery Charging Applications

Yikai Gao, Wen Cai, Fan Yi, *University of Texas at Dallas, United States*

2:00 p.m. – 5:30 p.m.

T38: Non-Isolated DC-DC Converters

ROOM 101A

Track: DC-DC Converters

SESSION CHAIRS:

Pradeep Shenoy, *Texas Instruments*

Juan Rivas-Davila, *Stanford*

2:00 p.m. – 2:20 p.m.

T38.1: DC-DC Power Converter Controller for SOC Balancing of Paralleled Battery System

Jaber Abu Qahouq, Lin Zhang, Yuan Cao, Bharat Balasubramanian, *University of Alabama, United States*

2:20 p.m. – 2:40 p.m.

T38.2: Ultra-Step-Up DC-DC Converter with Integrated Autotransformer and Coupled Inductor

Yam Siwakoti, Frede Blaabjerg, Poh Chiang Loh, *Aalborg University, Denmark*

2:40 p.m. – 3:00 p.m.

T38.3: Optimal Dynamic Phase Add/Drop Mechanism in Multiphase DC-DC Buck Converters

Anandha Ruban T T¹, Preetam Tadeparthy¹, Sankaran Aniruddhan², Vikram Gakhar¹, Muthusubramanian Venkateswaran¹,
¹*Texas Instruments India Pvt. Ltd., India*,
²*Indian Institute of Technology Madras, India*

3:00 p.m. – 3:20 p.m.

T38.4: A Universal Self-Calibrating Dynamic Voltage and Frequency Scaling (DVFS) Scheme with Thermal Compensation for Energy Savings in FPGAs

Shuze Zhao¹, Ibrahim Ahmed¹, Carl Lamoureux¹, Ashraf Lotfi², Vaughn Betz¹, Olivier Trescases¹,

¹University of Toronto, Canada,

²Altera Corporation, United States

3:20 p.m. – 3:40 p.m.

T38.5: Morphing Switched-Capacitor Step-Down DC--DC Converters with Variable Conversion Ratio

Song Xiong, Ying Huang, Siew-Chong Tan, Shu Yuen Ron Hui, *University of Hong Kong, Hong Kong*

4:10 p.m. – 4:30 p.m.

T38.6: Compact Modular Switched-Capacitor DC/DC Converters with Exponential Voltage Gain

Ying Huang, Song Xiong, Siew-Chong Tan, Shu Yuen Ron Hui, *University of Hong Kong, Hong Kong*

4:30 p.m. – 4:50 p.m.

T38.7: Study and Implementation of a High Step-Up Voltage DC-DC Converter Using Coupled-Inductor and Cascode Techniques

Tsorng Juu Liang, Yung Ting Huang, Jian Hsing Lee, Lo Pang Yen Ting, *National Cheng Kung University, Taiwan*

4:50 p.m. – 5:10 p.m.

T38.8: 20 mV Input, 4.2 V Output Boost Converter with Methodology of Maximum Output Power for Thermoelectric Energy Harvesting

Taichi Ogawa, Takeshi Ueno, Takayuki Miyazaki, Tetsuro Itakura, *Toshiba Corporation, Japan*

5:10 p.m. – 5:30 p.m.

T38.9: Clarification of Relationship Between Current Ripple and Power Density in Bidirectional DC-DC Converter

Hoai Nam Le, Koji Orikawa, Jun-Ichi Itoh, *Nagaoka University of Technology, Japan*

2:00 p.m. – 5:30 p.m.

T39: Inverter Applications and Technologies

ROOM 101B

Track: Power Electronics for Utility Interface

SESSION CHAIRS:

Ali Khajehoddin, *University of Alberta*

Wen Cai, *University of Texas, Dallas*

2:00 p.m. – 2:20 p.m.

T39.1: Grid-Voltage Feedforward Based Control for Grid-Connected LCL-Filtered Inverter with High Robustness and Low Grid Current Distortion in Weak Grid

Jinming Xu, Qiang Qian, Shaojun Xie, Binfeng Zhang, *Nanjing University of Aeronautics and Astronautics, China*

2:20 p.m. – 2:40 p.m.

T39.2: Evaluation of PV Frequency-Watt Function for Fast Frequency Reserves

Jason Neely, Jay Johnson, Jarod Delhotal, Sigifredo Gonzalez, Matthew Lave, *Sandia National Laboratories, United States*

2:40 p.m. – 3:00 p.m.

T39.3: A Systematic Design Method and Verification for a Zero-Ripple Interface for PV/Battery-to-Grid Applications

Suvankar Biswas, Ned Mohan, William Robbins, *University of Minnesota, United States*

3:00 p.m. – 3:20 p.m.

T39.4: Grid-Voltage-Feedforward Active Damping for Grid-Connected Inverter with LCL Filter

Minghui Lu¹, Xiongfei Wang¹, Frede Blaabjerg¹, S.M. Muyeen², Ahmed Al-Durra², Siyu Leng², ¹Aalborg University, Denmark, ²Petroleum Institute, U.A.E.

3:20 p.m. – 3:40 p.m.

T39.5: A High Power Density Single-Phase Inverter Using Stacked Switched Capacitor Energy Buffer

Colin McHugh, Sreyam Sinha, Jeffrey Meyer, Saad Pervaiz, Jie Lu, Fan Zhang, Hua Chen, Hyeokjin Kim, Usama Anwar, Ashish Kumar, Alihossein Sepahvand, Scott Jensen, Beomseok Choi, Daniel Seltzer, Robert Erickson, Dragan Maksimovic, Khurram K. Afridi, *University of Colorado Boulder, United States*

4:10 p.m. – 4:30 p.m.

T39.6: A Novel Single-Stage Dual-Active Bridge Based Isolated DC-AC Converter

Shiladri Chakraborty, Souvik Chattopadhyay,
Indian Institute of Technology Kharagpur, India

4:30 p.m. – 4:50 p.m.

T39.7: Ultra-Low Ripple Inverters for Distributed Generation Applications

Ang Shen, Pourya Shamsi, Mehdi Ferdowsi,
Missouri University of Science and Technology, United States

4:50 p.m. – 5:10 p.m.

T39.8: A 15 kV SiC MOSFET Gate Drive with Power Over Fiber Based Isolated Power Supply and Comprehensive Protection Functions

Xuan Zhang¹, He Li¹, John Alex Brothers¹,
Jin Wang¹, Lixing Fu², Mico Perales³, John Wu³,
¹*Ohio State University, United States*
²*Texas Instruments Inc., United States*,
³*MH GoPower Co., Ltd., Taiwan*

5:10 p.m. – 5:30 p.m.

T39.9: A 15-kV Class Intelligent Universal Transformer for Utility Applications

Jih-Sheng Jason Lai¹, Wei-Han Lai², Seung-Ryul Moon¹, Lanhua Zhang¹, Arindam Maitra³, ¹*Virginia Polytechnic Institute and State University, United States*, ²*Enertronics, Inc., United States*, ³*Electric Power Research Institute, United States*

2:00 p.m. – 5:30 p.m.

T40: Modeling, Modulation and Control of Motor Drive

ROOM 102C

Track: Motor Drives and Inverters

SESSION CHAIRS:

Jin Wang, *The Ohio State University*

River-TinHo Li, *ABB*

2:00 p.m. – 2:20 p.m.

T40.1: Modulation Technique for Common Mode Voltage Reduction in a Matrix Converter Drive Operating with High Voltage Transfer Ratio

Varsha Padhee¹, Ashish Kumar Sahoo², Ned Mohan², ¹*Rockwell Automation, United States*,
²*University of Minnesota, United States*

2:20 p.m. – 2:40 p.m.

T40.2: Soft-Switched Discontinuous Pulse-Width Pulse-Density Modulation Scheme

Arash Rahnamaee, Alireza Mojab, Hossein Riazmontazer, Sudip Mazumder, Milos Zefran,
University of Illinois at Chicago, United States

2:40 p.m. – 3:00 p.m.

T40.3: A Novel Flux Estimator Based on SOGI with FLL for Induction Machine Drives

Rende Zhao¹, Zhen Xin², Poh Chiang Loh²,
Frede Blaabjerg², ¹*China University of Petroleum, China*, ²*Aalborg University, Denmark*

3:00 p.m. – 3:20 p.m.

T40.4: Performance Characterization of Random Pulse Width Modulation Algorithms in Industrial and Commercial Adjustable Speed Drives

Kevin Lee¹, Guangtong Shen², Wenxi Yao³,
Zhengyu Lu³, ¹*Eaton Corporation Plc, United States*, ²*Purdue University, United States*,
³*Zhejiang University, China*

3:20 p.m. – 3:40 p.m.

T40.5: Stability Analysis and Controller Synthesis for Digital Single-Loop Voltage-Controlled Inverters

Xiongfei Wang, Poh Chiang Loh, Frede Blaabjerg,
Aalborg University, Denmark

4:10 p.m. – 4:30 p.m.

T40.6: High Efficiency, Hybrid Selective Harmonic Elimination Phase-Shift PWM Technique for Cascaded H-Bridge Inverters to Improve Dynamic Response and Operate in Complete Normal Modulation Indices

Amirhossein Moeini, Zhao Hui, Shuo Wang,
University of Florida, United States

4:30 p.m. – 4:50 p.m.

T40.7: Implementation and Experimental Validation of Efficiency Improvement in PMSM Drives Through Switching Frequency Reduction

Parag Kshirsagar, Krishnan Ramu, *Virginia Polytechnic Institute and State University, United States*

4:50 p.m. – 5:10 p.m.

T40.8: Sensorless Speed Control of Symmetrical Triple-Star Nine-Phase Interior Permanent Magnet Machines

Olorunfemi Ojo, Medhi Ramezani, *Tennessee Technological University, United States*

5:10 p.m. – 5:30 p.m.

T40.9: Mitigation of Common-Mode Noise in Wide Band Gap Device Based Motor Drives

Sneha Narasimhan, Saurabh Tewari,
Eric Severson, Rohit Baranwal, Ned Mohan,
University of Minnesota, United States

2:00 p.m. – 5:30 p.m.

T41: Gate Drivers and Integrated Packaging

ROOM 103C

Track: Devices and Components

SESSION CHAIRS:

Qiang Li, *Virginia Tech*

Jean-Luc Schanen, *Ecole Nationale Supérieure de l'Energie*

2:00 p.m. – 2:20 p.m.

T41.1: A High-Efficient Driving Isolated Drive-by-Microwave Half-Bridge Gate Driver for a GaN Inverter

Shuichi Nagai, Yasufumi Kawai, Osamu Tabata,
Songbaek Choe, Noboru Negro, Tesuzo Ueda,
Panasonic Corporation, Japan

2:20 p.m. – 2:40 p.m.

T41.2: Sensing Gallium Nitride HEMT Junction Temperature Using Gate Drive Output Transient Properties

He Niu, Robert Lorenz, *University of Wisconsin-Madison, United States*

2:40 p.m. – 3:00 p.m.

T41.3: Design and Application of a 1200V Ultra-Fast Integrated Silicon Carbide MOSFET Module

Suxuan Guo, Liqi Zhang, Yang Lei, Xuan Li,
Wensong Yu, Alex. Q Huang, *North Carolina State University, United States*

3:00 p.m. – 3:20 p.m.

T41.4: Active Gate Charge Control Strategy for Series-Connected IGBTs

Fan Zhang¹, Xu Yang¹, Yu Ren¹, Ying Chen¹,
Ruifeng Gou², ¹*Xi'an Jiaotong University, China*,
²*Xi'an XD Power Systems Co., LTD, China*

3:20 p.m. – 3:40 p.m.

T41.5: A MV Intelligent Gate Driver for 15kV SiC IGBT and 10kV SiC MOSFET

Awneesh Tripathi, Krishna Mainali, Sachin
Madhusoodhanan, Akshat Yadav, Kasunaidu
Vechalapu, Subhashish Bhattacharya,
North Carolina State University, United States

4:10 p.m. – 4:30 p.m.

T41.6: Linear Temperature Sensors in High-Voltage GaN-HEMT Power Devices

Richard Reiner, Patrick Waltereit, Beatrix Weiss,
Matthias Wespel, Dirk Meder, Michael Mikulla,
Rüdiger Quay, Oliver Ambacher, *Fraunhofer
Institute for Applied Solid State Physics, Germany*

4:30 p.m. – 4:50 p.m.

T41.7: An Innovative Power Module with Power-System-in-Inductor Structure

Laili Wang¹, Doug Malcolm¹, Yan-Fei Liu²,
¹*Sumida Technology, Canada*, ²*Queen's University, Canada*

4:50 p.m. – 5:10 p.m.

T41.8: Thermal Analysis of a Magnetic Packaged Power Module

Laili Wang¹, Doug Malcolm¹, Wenbo Liu²,
Yan-Fei Liu², ¹*Sumida Technology, Canada*,
²*Queen's University, Canada*

5:10 p.m. – 5:30 p.m.

T41.9: Analysis of a Low-Inductance Packaging Layout for Full-SiC Power Module Embedding Split Damping

Yu Ren, Xu Yang, Fan Zhang, Linlin Tan,
Xiangjun Zeng, *Xi'an Jiaotong University, China*

2:00 p.m. – 5:30 p.m.

T42: Component Modeling

ROOM 103AB

Track: Modeling and Simulation

SESSION CHAIRS:

Sheldon Williamson, *University of Ontario Institute of Technology*

Abhijit Pathak, *Infineon/IR*

2:00 p.m. – 2:20 p.m.

T42.1: Comprehensive Parametric Analyses of Thermally Aged Power MOSFETs for Failure Precursor Identification and Lifetime Estimation Based on Gate Threshold Voltage

Serkan Dusmez, Bilal Akin, *University of Texas at Dallas, United States*

2:20 p.m. – 2:40 p.m.

T42.2: Modeling and Design Guidelines of High Density Power Inductor for Battery Power Unit

Zhigang Dang, Jaber Abu Qahouq, *University of Alabama, United States*

2:40 p.m. – 3:00 p.m.

T42.3: Degradation of Low Voltage Metal Oxide Varistors in Power Supplies

Dawood Talebi Khanmiri¹, Roy Ball²,
Jerry Mosesian², Brad Lehman¹, ¹*Northeastern University, United States*, ²*Mersen-USA, United States*

3:00 p.m. – 3:20 p.m.

T42.4: Characterization and Modeling of SiC MOSFET Body Diode

Kang Peng, Soheila Eskandari, Enrico Santi,
University of South Carolina, United States

3:20 p.m. – 3:40 p.m.

T42.5: A Simple Behavioral Electro-Thermal Model of GaN FETs for SPICE Circuit Simulation

Liyao Wu, Maryam Saeedifard, *Georgia Institute of Technology, United States*

4:10 p.m. – 4:30 p.m.

T42.6: Decomposition and Electro-Physical Model Creation of the CREE 1200V, 50A 3-Ph SiC Module

Adam Morgan, Yang Xu, Douglas C. Hopkins,
Iqbal Husain, Wensong Yu, *North Carolina State University, United States*

4:30 p.m. – 4:50 p.m.

T42.7: A Three-Legged MATLAB/Simulink Transformer Model Using a Fictitious Delta Winding

Thomas Nondahl, Jingbo Liu, Peter Schmidt,
Rockwell Automation, United States

4:50 p.m. – 5:10 p.m.

T42.8: A Lifetime Prediction Method for LEDs Considering Mission Profiles

Xiaohui Qu¹, Huai Wang², Xiaoqing Zhan³,
Frede Blaabjerg², Henry Shu-Hung Chung³,
¹*Southeast University, China*, ²*Aalborg University, Denmark*, ³*City University of Hong Kong, Hong Kong*

5:10 p.m. – 5:30 p.m.

T42.9: Enhanced Li-Ion Battery Modeling Using Recursive Parameters Correction

Jaegu Kim, Jung-Hoon Ahn, Byoung-Kuk Lee,
Sungkyunkwan University, Korea, South

2:00 p.m. – 5:30 p.m.

T43: Grid and Utility Interface

ROOM 104A

Track: Control

SESSION CHAIRS:

Manish Bhardwaj, *Texas Instruments*

Nan Chen, *ABB*

2:00 p.m. – 2:20 p.m.

T43.1: Robust Sensorless Control of Grid Connected Converters with LCL Line Filters Using Frequency Adaptive Observers as AC Voltage Estimators

Vlatko Miskovic¹, Vladimir Blasko², Thomas Jahns³, Robert Lorenz³, Haojiong Zhang¹,
¹*Danfoss Drives, United States*, ²*United Technologies Research Center, United States*,
³*University of Wisconsin-Madison, United States*

2:20 p.m. – 2:40 p.m.

T43.2: Active Stabilization of Direct Matrix Converter Input Side Filter Through Grid Current Control

Martin Leubner, Nico Remus, Marc Stübiger,
Wilfried Hofmann, *Technische Universität Dresden, Germany*

2:40 p.m. – 3:00 p.m.

T43.3: Impedance-Based Stability Analysis of Single-Phase Inverter Connected to Weak Grid with Voltage Feed-Forward Control

Jiangfeng Wang¹, Jianhui Yao¹, Haibing Hu¹,
Yan Xing¹, Xiaobin He², Kai Sun³, ¹*Nanjing University of Aeronautics and Astronautics, China*,
²*Shanghai Institute of Space Power-Sources, China*, ³*Tsinghua University, China*

3:00 p.m. – 3:20 p.m.

T43.4: New Configuration of Dynamic Voltage Restorer for Medium Voltage Application

Arash Khoshkbar Sadigh¹, Vahid Dargahi²,
Keith Corzine², ¹*Extron Electronics, United States*,
²*Clemson University, United States*

3:20 p.m. – 3:40 p.m.

T43.5: Studies on the Clustered Voltage Balancing Mechanism for Cascaded H-Bridge STATCOM

Daorong Lu¹, Haibing Hu¹, Yan Xing¹, Xiaobin He², Kai Sun³, Jianhui Yao¹, ¹*Nanjing University of Aeronautics and Astronautics, China*, ²*Shanghai Institute of Space Power-Sources, China*,
³*Tsinghua University, China*

4:10 p.m. – 4:30 p.m.

T43.6: Design of a Fast Response Time Single-Phase PLL with DC Offset Rejection Capability

Abhijit Kulkarni, Vinod John, *Indian Institute of Science, India*

4:30 p.m. – 4:50 p.m.

T43.7: Four New Applications of Second-Order Generalized Integrator Quadrature Signal Generator

Zhen Xin¹, Rende Zhao², Xiongfei Wang¹, Poh Chiang Loh¹, Frede Blaabjerg¹, ¹Aalborg University, Denmark, ²China University of Petroleum, China

4:50 p.m. – 5:10 p.m.

T43.8: Three-Phase Multiple Harmonic Sequence Detection Based on Generalized Delayed Signal Superposition

Yong Lu¹, Guochun Xiao¹, Xiongfei Wang², Frede Blaabjerg², ¹Xi'an Jiaotong University, China, ²Aalborg University, Denmark

5:10 p.m. – 5:30 p.m.

T43.9: Hybrid Modeling and Control of Single-Phase Grid-Connected NPC Inverters

Xingda Yan, Zhan Shu, Suleiman Sharkh, *University of Southampton, United Kingdom*

2:00 p.m. – 5:30 p.m.

T44: Topics in Renewable Energy Systems II

ROOM 104B

Track: Renewable Energy Systems

SESSION CHAIRS:

Akshay Kumar Rathore, *Concordia University*

Yichao Tang, *Texas Instruments*

2:00 p.m. – 2:20 p.m.

T44.1: Stability Criterion and Controller Parameter Design of Radial-Line Renewable Systems with Multiple Inverters

Wenchao Cao, Xuan Zhang, Yiwei Ma, Fred Wang, *University of Tennessee, United States*

2:20 p.m. – 2:40 p.m.

T44.2: Stability Analysis and Improvement of Solid State Transformer (SST)-Paralleled Inverters System Using Negative Impedance Feedback Control

Qing Ye, Hui Li, *Florida State University, United States*

2:40 p.m. – 3:00 p.m.

T44.3: Compensator-Less Structures for Droop Control of Single Phase Inverters in a Flexible Microgrid

Onkar Kulkarni, Suryanarayana Doolla, Baylon Fernandes, *Indian Institute of Technology Bombay, India*

3:00 p.m. – 3:20 p.m.

T44.4: Comparative Evaluation of the Loss and Thermal Performance of Advanced Three Level Inverter Topologies

Alexander Anthon¹, Zhe Zhang¹, Michael A.E. Andersen¹, Grahame Holmes², Brendan McGrath², Carlos Teixeira², ¹Danmarks Tekniske Universitet, Denmark, ²RMIT University, Australia

3:20 p.m. – 3:40 p.m.

T44.5: Dual Buck Inverter with Series Connected Diodes and Single Inductor

Liwei Zhou, Feng Gao, *Shandong University, China*

4:10 p.m. – 4:30 p.m.

T44.6: Magnetic Integration of the Harmonic Filter Inductor for Dual-Converter Fed Open-End Transformer Topology

Ghanshyamsinh Gohil, Lorand Bede, Remus Teodorescu, Tamas Kerekes, Frede Blaabjerg, *Aalborg University, Denmark*

4:30 p.m. – 4:50 p.m.

T44.7: Mechanism Analysis and Mitigation of Instability in Grid-Connected Voltage Source Inverter with LCL Filters Based on Terminal Impedance

Teng Liu, Zeng Liu, Jinjun Liu, Qingyun Dou, *Xi'an Jiaotong University, China*

4:50 p.m. – 5:10 p.m.

T44.8: Seven-Switch Five-Level Active Neutral-Point Clamped Converter and Optimal Modulation Strategy

Hongliang Wang¹, Lei Kou¹, Yan-Fei Liu¹, Paresen Sen¹, Sucheng Liu², ¹Queen's University, Canada, ²Anhui University of Technology, China

5:10 p.m. – 5:30 p.m.

T44.9: A Simple Variable Step Size Method for Maximum Power Point Tracking Using Commercial Current Mode Control DC-DC Regulators

Su Sheng, Brad Lehman, *Northeastern University, United States*

2:00 p.m. – 5:30 p.m.

T45: Envelope Tracking and Resonant Conversion

ROOM 104C

Track: Power Electronics Applications

SESSION CHAIRS:

Brian Zahnstecher, *PowerRox*

Davide Giacomini, *Infineon*

2:00 p.m. – 2:20 p.m.

T45.1: Envelope Tracking GaN Power Supply for 4G Cell Phone Base Stations

Yuanzhe Zhang¹, Johan Strydom², Michael de Rooij², Dragan Maksimovic¹, ¹*University of Colorado Boulder, United States*, ²*Efficient Power Conversion Corporation, United States*

2:20 p.m. – 2:40 p.m.

T45.2: Envelope Tracking Power Supply for Volume-Sensitive Low-Power Applications Based on a Resonant Switched-Capacitor Converter

Alon Cervera, Mor Mordechai Peretz, *Ben-Gurion University of the Negev, Israel*

2:40 p.m. – 3:00 p.m.

T45.3: A Passive-Impedance-Matching Concept for Multi-Phase Resonant Converter

Hongliang Wang, Yang Chen, Yan-Fei Liu, *Queen's University, Canada*

3:00 p.m. – 3:20 p.m.

T45.4: LLC Converter with Auxiliary Switch for Hold Up Mode Operation

Yang Chen¹, Hongliang Wang¹, Yan-Fei Liu¹, Jahangir Afsharian², Zhihua Yang¹, ¹*Queen's University, Canada*, ²*Murata Power Solutions, Canada*

3:20 p.m. – 3:40 p.m.

T45.5: A Common Capacitor Multi-Phase LLC Resonant Converter

Hongliang Wang¹, Yang Chen¹, Zhiyuan Hu¹, Laili Wang¹, Yajie Qiu¹, Wenbo Liu¹, Yan-Fei Liu¹, Jahangir Afsharian², Zhihua Yang², ¹*Queen's University, Canada*, ²*Murata Power Solutions, Canada*

4:10 p.m. – 4:30 p.m.

T45.6: LLC Resonant Converter Design for Bendable Power Converter

Kwun Yuan Godwin Ho, M.H. Bryan Pong, Shu Yuen Ron Hui, *University of Hong Kong, Hong Kong*

4:30 p.m. – 4:50 p.m.

T45.7: Design Consideration of MHz Active Clamp Flyback Converter with GaN Devices for Low Power Adapter Application

Xiucheng Huang, Junjie Feng, Weijing Du, Fred C. Lee, Qiang Li, *Virginia Polytechnic Institute and State University, United States*

4:50 p.m. – 5:10 p.m.

T45.8: A New Capacitor Voltage Balancing Control for Hybrid Modular Multilevel Converter with Cascaded Full Bridge

Mahendra B. Ghat, Anshuman Shukla, Richa Mishra, *Indian Institute of Technology Bombay, India*

5:10 p.m. – 5:30 p.m.

T45.9: Sensorless Scheduling of the Modular Multilevel Series-Parallel Converter: Enabling a Flexible, Efficient, Modular Battery

Stefan Goetz¹, Zhongxi Li², Angel Peterchev¹, Xinyu Liang³, Chengduo Zhang³, Srdjan Lukic³, ¹*Duke University, United States*, ²*Tsinghua University, China*, ³*North Carolina State University, United States*



Professional Education Seminars

APEC strives to offer seminars with a practical mix of theory and application for the professional working in power electronics. APEC 2016 features 21 professional education seminars with a broad range of topics.

Sunday, March 20

9:30 a.m. – 1:00 p.m.

S01: Exceeding 99% Efficiency for PFC and Isolated DC-DC Converters, GaN Versus Silicon

Track: Control

Ionel Dan Jitaru
ROOM 104A

The new developments in semiconductor technology such as GaN and SiC may enable us to exceed the 99% efficiency power conversion for PFC and isolated DC-DC Converters. To reach that goal we have to start by reevaluating of the most suitable topologies in power conversion. Soft switching topologies have become popular in many applications in the last thirty years. Though we have more than 30 years tradition in soft switching topologies some of these topologies, have added too much complexity and their practical use becomes questionable with the availability of more ideal components.

A portion of the seminar describes the latest soft switching topologies which are addressing the soft switching both in primary and the secondary side.

Well known topologies are presented in the light of latest improvements, as well as new topologies which were recently derived.

A detailed power dissipation analysis in several applications will highlight the need for magnetic optimization. In spite of the significant progress in the semiconductor industry, the magnetics lags behind. The seminar will describe the impact of the parasitic elements in the magnetics in optimizing the performance of the power converters. In the quest for 99% efficiency the magnetics and the packaging become key factors in efficiency optimization.

The seminar will present the impact of Intelligent Power Processing in optimizing the efficiency and even in converting a traditional hard switching topology into a soft switching topology.

The presentation will be highlighted with many design examples and experimental results such as 99%+ efficiency PFC with power densities above 450W/in³, and 99% efficiency isolated DC-DC Converter.

S02: The Invisible Schematic: Non-Idealities in Circuit Elements and System Components

Track: System Design

Ernest H. Wittenbreder
ROOM 104B

The performance of a power electronics circuit is almost always different in some ways than the expected performance of the circuit that appears in the schematic capture for printed circuit board (PCB) layout. Often the captured schematic is more akin to a graphical representation of the bill of materials than to the circuit that behaves like a circuit consistent with the observed behavior. Almost all electronic components differ from their ideal electrical characteristics in some way. Each electronic component element is a circuit consisting of the ideal component plus invisible (non-ideal) elements, usually referred to as parasitic elements or intrinsic elements. In many cases there are components that exist in the circuit that do not appear in the captured schematic that can significantly affect the circuit behavior. These components may or may not be associated with circuit elements in the captured schematic, but may relate to the printed circuit board and/or the physical environment in which the power electronics product operates.

This seminar seeks to help design engineers become better aware of the invisible components or non-idealities in a power electronics circuit, to recognize the ways the invisible components effect circuit behavior, and to suggest methods for dealing with the problems that relate to behavior that results from invisible circuit elements.

This seminar is intended for beginner, intermediate, and advanced level power supply engineers who want a better awareness and understanding of the invisible circuit and associated design issues.

S03: Getting from 48 V to Load Voltage: Improving Low Voltage DC-DC Converter Performance with GaN Transistors

Track: Power Semiconductors

Alex Lidow, David Reusch, John Glaser
ROOM 102AB

Gallium Nitride (GaN) power semiconductors are being adopted in an increasing number of power conversion applications. The technology is rapidly developing and product experience in the field is expanding. This tutorial will begin with a discussion of the state-of-the art in GaN technology, including an overview of GaN technology, GaN transistor structures and the latest electrical performance.

The tutorial will continue with design basics fundamental to GaN transistors including drivers, layout, paralleling, dead-time management, and thermal considerations. Following the design basics will be design examples with a focus on 48 VIN to 1 VOUT network and telecom power supplies. Different architectures will be compared and the benefits of GaN transistors will be quantified over Si MOSFETs for various approaches to get 48 VIN to load.

The tutorial concludes with a look into future of this relatively young technology and its potential to improve performance in existing applications and enable new applications not possible with aging silicon MOSFETs. Beyond the discrete transistor, the extension of GaN technology to fully integrated circuits will be discussed, furthering the potential of GaN to raise the bar in power conversion performance.

S04: A Comprehensive Introduction to Implementing a Fully Digital Power-Factor-Correction Boost Converter

Track: Digital Control

Alex Dumais, Joel Steenis
ROOM 104C

The purpose of this presentation is to provide an in-depth introduction to power factor correction (PFC) circuits, using a digital implementation. The presenters will cover all the necessary steps to develop the control system for a fully digital Boost PFC operating in continuous-conduction mode. The presentation will start by introducing the concept of PFC and why it is required, show the different active PFC solutions available, expand on the different types of boost topologies, and discuss their tradeoffs. A large portion of the presentation focuses on deriving a model for the power stage that is conducive to controller design, designing the controller, and implementing the controller in a fixed-point processor. This presentation will end with additional algorithms that may improve overall performance, such as current total harmonic distortion (THD), power factor (PF), and efficiency. Attendees who do not have experience with digital power or designing PFCs should be able to leverage this material to develop their own digital PFC platform with a reduced time to market.

S05: Basic Switching Power Supply Design

Track: Fundamentals

Marty Brown
ROOM 101A

A short presentation overviewing what worked and what hadn't during the author's long and varied career as a power electronics engineer. It includes what we have to know, our sources for continued learning, the care and feeding of the engineering team, and the present day realities of engineering life. Also some tips on being a consultant.

S06: Solid-State Transformers – Key Design Challenges, Applicability, and Future Concepts

Track: Grid Power Electronics

Kolar Johann W., Jonas E Huber
ROOM 103AB

This seminar introduces participants to the Solid State Transformer (SST) concept in a comprehensive and easy to follow fashion. After a brief review of transformer basics and of the SST concept history, the motivation, requirements, and challenges associated with SST applications in future locomotives, smart grids, and for general isolated DC/DC conversion are identified. E.g., conceptual aspects like single vs. multi cell converter approaches, multi cell converter reliability, protection, etc. are discussed. Furthermore, the operation of high power isolated DC/DC converters is detailed, and modern WBG power semiconductors, medium frequency transformer design, multi cell converter control system partitioning, etc. are discussed. Finally, aspects of testing high power medium voltage systems and construction issues of modular medium voltage converters are summarized. To render the discussions more tangible, the challenges and potential solutions are illustrated using an exemplary 1MVA multi cell distribution level SST system. Finally, future concepts such as unidirectional SSTs are addressed, and the most promising application scenarios for SSTs as well as future research areas are identified, before the seminar concludes with a critical evaluation of the SST concept. The seminar is tailored to serve the interests of a broad audience with academic or industrial backgrounds.

S07: Photovoltaic Modeling and Why it Matters for Power Electronics

Track: Inverters/Converters

Katherine A. Kim, Jeehoon Jung
ROOM 101B

Photovoltaic (PV) solar power is an important renewable energy resource for present-day and future power generation. As PV materials and efficiencies advance, the power electronics used in PV systems is also advancing. PV modeling is important for understanding PV cell operation and validating new converter and control concepts. Physical PV panels can be replaced with simulation that emulates a PV cell, panel, or full PV system and can be used for direct hardware testing using a power hardware-in-the-loop setup. The seminar will cover 1) current trends in PV applications and materials, and basic PV modeling, 2) PV emulation using power hardware-in-the-loop and related computational considerations, and 3) PV control and various PV power electronics applications using simulation and power hardware-in-the-loop. This seminar is geared towards people with entry- to intermediate-level background in PV systems.

Sunday, March 20

2:30 p.m. – 6:00 p.m.

S08: Stability and Damping of Grid-Connected Voltage-Source Converters

Track: Control

Frede Blaabjerg, Xiongfei Wang
ROOM 102AB

The ever-increasing penetration of grid-connected voltage-source converters challenges the power quality and stability of electric power grids. Besides the steady-state harmonic coupling caused by the switching operations, dynamic interactions among the controllers of converters, passive filters, and other passive components of systems may lead to instability and resonance phenomena over a wide frequency range.

This seminar will provide an in-depth discussion on the stability analysis and damping methods for grid-connected voltage-source converters. It will begin with the control fundamentals of converters and their small-signal models with complex transfer functions and transfer matrices. The influences of current control and grid synchronization on system stability will then be discussed. Stability analysis for multi-converter systems will next be explored with the examples. Subsequently, active stabilization techniques, including virtual impedance control and passivity-based control, will be elaborated. The design of passive and active dampers will also be covered. Perspectives on the challenges and future trends of modeling, stability analysis, and control of voltage-source converters will be given.

The intended audiences are graduate students, practicing engineers, and researchers in the area of power electronics applications in power systems.

S09: PMBus™: Review and New Capabilities

Track: System Design

Robert V. White
ROOM 104A

Since being introduced in 2005 the PMBus™ power management protocol has been widely adopted and is the accepted standard for digital power management. This seminar provides a review on the basics of the PMBus protocol and a deeper look at two major features introduced in Revision 1.3.

The first half of the seminar reviews the basics of the 2-wire SMBus including the electrical interface and how bits, bytes, and complete messages are transferred from one device to another. PMBus specific features such as the CONTROL signal and the use of SMBALERT# interrupt signal are also reviewed. Next a summary the PMBus

command language is presented including numerical formats (including the use of floating point introduced in Revision 1.3), setting and adjusting the output voltage, fault management, and status reporting.

The second half of the seminar takes a deeper look at two major PMBus additions introduced in Revision 1.3. The Zone Protocols offer important new tools for managing the larger and more complex power systems in today's systems. The ZONE_WRITE command offers an easy way for the system to send a command, such as turn on or turn off, simultaneously to selected converters in a system. The ZONE_READ command offers ways to efficiently discover devices on the bus or to quickly get status information based on the priority and urgency of the information.

The other major addition in Revision 1.3, the AVSBus, is then presented. The AVSBus is an all new protocol with an SPI-like interface that can operate at speeds up to 50 MHz. With a compact set of commands and fixed 32 bit frame, it allows a device like a processor, ASIC or FPGA to quickly command changes to its operating voltage. This provides for both improved performance of the powered device and energy savings.

S10: Wide Bandgap Device Characterization

Track: Power Semiconductors

Fred Wang, Zheyu Zhang, Edward A. Jones
ROOM 104B

Wide bandgap power devices, particularly SiC and GaN, are an important enabling technology for cutting-edge converter design. WBG devices have superior performance at higher temperatures and switching frequencies than conventional Si MOSFETs, IGBTs, and diodes. However, they present new challenges for converter design. Static and dynamic characterization are usually the first steps in designing a converter based on a new WBG device. Establishing static parameters such as on-resistance and saturation current are especially important at elevated junction temperatures. A Double Pulse Test (DPT) is then performed for dynamic characterization. Switching transient times and losses are often not listed on new device datasheets, and are heavily dependent on the voltage, current, topology, gate driver, and PCB layout. DPT design becomes more difficult as switching speed increases, because of limited measurement bandwidth and the impact of parasitics contributed by the PCB and test setup. The physical design of the gate driver and PCB layout are critical to effective DPT, as well as suitable probe selection and comprehensive data processing. Analyzing the results of the completed characterization allows for more precise estimation of the total device losses and other parameters. Accurate device parameters can improve the efficiency, size, and thermal design of a WBG converter, and this seminar will provide the tools to perform both static and dynamic characterization effectively.

S11: High Performance Digital Control

Track: Digital Control

Hamish Laird
ROOM 104C

This presentation, aimed at intermediate level power engineers, surveys and details techniques to successfully implement digital control for power electronic converters. In turn each component of the controller from digital (PWM and VPO) modulators, compensator pole zero placement, compensator numeric precision issues, single sample noise through to anti-aliasing filter design is covered. Digital pulse width modulators (PWM) and digital variable period oscillators (VPO) have different non-linear frequency response characteristics from equivalent analogue systems.

The effect of these differences on the control is discussed and spectral-shaping design methods to improve performance of the digital modulators are presented. The design of the compensator by directly placing the digital poles and zeros is then covered. By translating the pole and zero positions directly into digital filter coefficients for the digital compensator the translation of analogue coefficients to digital is avoided. A method that requires no coding or simulation for determining numeric precision issues in the digital compensator coefficients is then presented. As most systems require integrators the most suitable forms of digital integrators are discussed. The precision issues specific to digital integrators and methods to reduce these are presented in detail. Finally managing single sample errors, which have no analogue equivalent, and the choice of anti-aliasing filters is described.

S12: Non-linear Thermal Topics in Semiconductors and Electronics

Track: Fundamentals

Roger P. Stout
ROOM 101A

This half-day seminar is designed for advanced level thermal systems engineers, who are reasonably comfortable with Microsoft® Excel and finite element analysis techniques.

Topics covered will include thermal runaway, nonlinear material effects in micro-scale geometry, wire (and other structure) fusing and intrinsic current limits in micro-scale structures, the use of Excel in non-linear thermal analysis, and challenges in using finite-element analysis for non-linear thermal problems. Several case-studies will be covered.

Thermal runaway in semiconductor components applications will be approached by introducing a formalized method of analyzing exponential-power-growth devices,

along with several detailed examples of applications to datasheet and real-world thermal systems.

Nonlinear material effects (in particular, electrical resistivity that increases with temperature) will be addressed both from an analytical perspective as well as through finite-element modeling, including the circumstances under which temperature-dependent resistivity manifests itself as an intrinsic current limit generally observed only in small structures. Specific examples of a micro-scale embedded coil and the fusing of wires will be covered. How common wire-bonding materials such as gold, aluminum, and copper (used in semiconductor packaging) are affected by this effect will be discussed. Behavior of metal fuses on silicon will be discussed.

S13: Power Architectures, Protection and Control of DC Microgrids

Track: Grid Power Electronics

Tomislav Dragic'ević, Josep M. Guerrero
ROOM 103AB

The idea of merging small variable nature sources with energy storage systems (ESSs) and controllable loads into flexible entities that are called microgrids (MGs) has been presented more than a decade ago, as a possible solution to achieve a traceable control from the system-point of view. MGs can operate autonomously or be grid-connected and, depending on the type of voltage in the point of common coupling (PCC), AC and DC MGs can be distinguished. While remarkable progress has been made in improving the performance of AC MGs during the past decade, DC MG is a relatively novel concept that has been recognized to have higher efficiency, more natural interface with many types of RES and ESSs, better compliance with consumer electronics and other benefits. Besides, when components are coupled around a DC bus, there are no issues with reactive power flow, power quality and frequency regulation, resulting in a notably less complex control system when compared to AC MGs. However, there are a number of practical impediments that need to be resolved before adoption of DC MGs on a large scale. Most importantly, maturity of standards and practices in design of protection and grounding systems are far behind their counterparts in AC systems.

The emphasis of this tutorial is to provide a complete framework in hardware and control design of DC MGs, as well as overview of recent research activities in this area. Practical requirements and implementation details of sev-

eral types of DC distribution systems used in real world industrial applications will be presented. Also, a number of study cases regarding design of power architectures and protection systems will be discussed in the first part of the tutorial. On the other hand, second part will address the features of several types of coordinated control design concepts that can assure intelligent real-time control of MGs. Moreover, the concepts of constant power load (CPL) and negative impedance instability will be explained in detail. In line with this, principles of linear stability analysis techniques will be reviewed and a broad class of stabilization techniques for MGs loaded with CPLs will be presented and examined. This tutorial will also present the view of the instructors on the promising research directions and future industrial applications in the area of DC MGs.

S14: Soft Switching Three-phase Converter or Inverter

Track: Inverters/Converters

Dehong Xu, Rui Li
ROOM 101B

Increasing the switching frequency is critical to increase efficiency, power density and dynamic performance. Beside improving power device characteristics, Soft Switching Technology is another effective way to increase the switching frequency, which have been successfully applied in switching power supplies and induction heating etc. However, three-phase inverters using soft switching technique are not common up to now. Parts of the reasons come from complexity of three-phase soft switching inverter topologies in addition to the requirement of accurate PWM timing control and its sensitivity to the operation condition. This tutorial is intend to introduce the fundamental of three-phase ZVS inverters with pedagogy way. At the beginning, the overview of soft switching converter/inverter is introduced. Then, fundamental of three-phase ZVS inverters is investigated with respect to modulation scheme, Zero-Voltage-Switching Condition etc. Afterwards this tutorial will extend to other ZVS inverter /converter topologies.

The experiment results of 30kW ZVS inverter/converters will be introduced. Finally, The impact of SiC device on soft switching inverters are investigated with respect to the power density and conversion efficiency. The intended audiences are researchers and manufacturers interested in either an entry-level of introduction or an in-depth level of evaluation of soft switching three-phase inverters.

Monday, March 21

8:30 a.m. – 12:00 p.m.

S15: Introduction to Fast Analytical Techniques: Application to Small-Signal Modeling

Track: Control

Christophe Basso
ROOM 104A

Loop control is an essential part of power converter design and requires the transfer function of the system you want to stabilize. The control-to-output transfer function can be obtained in the laboratory with a hardware prototype or analytically derived with a small-signal model. A hardware prototype gives you the exact dynamic response at a given operating point but does not explicitly tell you what affects magnitude or phase. You need to know what elements contribute poles or zeros in the plant dynamic response so that natural production spreads and temperature drifts of components do not jeopardize stability once the loop is closed. On the other hand, determining a small-signal model can be done in different ways, all leading to similar dynamic responses. However, what matters is the ability to format the final transfer function in a compact form in which gains, poles and zeros are apparent. This is the concept of low-entropy expressions as defined by Dr. Middlebrook in his papers and seminars. This seminar will introduce you to Fast Analytical Circuits Techniques, or FACTs, exercised in determining the transfer functions of some typical circuit examples, up to the order two. The second part shows how you can apply these techniques to unveil switching converters transfer functions of buck and buck-boost converters.

S16: Reliability of Power Electronic Systems

Track: System Design

Frede Blaabjerg, Francesco Iannuzzo, Huai Wang, Ke Ma
ROOM 102AB

Advances in power electronics enable efficient and flexible processing of electric power in the application of renewable energy sources, electric vehicles, adjustable-speed drives, etc. More and more efforts are devoted to having better power electronic systems in terms of reliability to ensure high availability, long lifetime, sufficient robustness and low maintenance cost. Today customers of many power electronic products expect up to 20 years of lifetime and they also want to have a “failure free period” and all with focus at the financials. However, the reliability predictions are still dominantly according to outdated models and terms, such as MIL-HDBK-217F handbook models, mean-time-to failure (MTTF), and mean-time-between-failures (MTBF).

The emphasis of this tutorial is to give a framework on the design for reliability of power electronic systems and the recent research activities and paradigm shifts in this research area. It will cover the reliability requirements in different industry sectors, reliability and lifetime of IGBT modules and capacitors used in power electronic converters, testing of power components, and the specific design for reliability procedure for power electronic systems. Study cases on mission profile based design of photovoltaic inverters and wind power converters, and active thermal control and condition monitoring of power converters are also discussed. The approaches presented in the tutorial are also the common interest for the companies involved in the Center of Reliable Power Electronics (CORPE) at Aalborg University (<http://www.corpe.et.aau.dk/>). The tutorial will also present the views of the instructors on the future research opportunities in the area of reliability of power electronics.

S17: Addressing Challenges in High Power and High Voltage Designs with IGBTs

Track: Power Semiconductors

Crisafulli Vittorio, Dhaval Dalal, Tomas Krecek, Dominic L
ROOM 101A

Proliferation of high performance power conversion equipment in applications such as solar inverters, UPS, motor drives, IH, welding, automotive and traction has rekindled the interest in understanding and optimizing IGBT characteristics in order to optimize the system performance. Efficiency and thermal performance are the key metrics along with reliability and ruggedness.

The emphasis of this seminar is to provide a framework on how to address challenges in high power and high voltage designs with IGBTs. A contextual overview of power silicon technologies and general topologies/applications is provided. Common system requirements for high power applications are discussed. It is shown that each end-application has a different set of requirements in terms of IGBT characteristics.

Next, many common high power applications are discussed in details with emphasis on topologies, control and common issues. Emergent topologies such as multilevel converters are also discussed.

In the last part, some practical issues related to IGBT Design are covered with special focus on measurements challenges and approaches for high power systems. Further, gate driver techniques and impact, freewheeling diode and simulations method are explored.

S18: A State-Space Design Approach to Digital Feedback Control of DC/DC Converters

Track: Digital Control

Dorin O. Neacsu
ROOM 101B

This tutorial is attempting to help speeding up the deployment of modern digital control systems based on state-space feedback control (also referred to as "modern control") onto the exciting new digital hardware for DC/DC converters. All the possible steps in design are explained from a general textbook definition applied to the particular case of a DC/DC converter, constituting an unique and possibly first-ever complete design tutorial for the state-space digital feedback control of a DC/DC converter. Such steps include the well-known state-space modeling, averaging, and digital implementation of auxiliary functions like start-up and pre-charging, along with feedback control setup, selection of pole location, state-space controller design, equivalence to an optimal PI controller, reference introduction into the state-space form, usage of a feed-forward component for improvement of the dynamic performance, full- and reduced-order state estimation, estimator's pole selection. The process of closing the feedback control loop after the estimated variable, and evaluation of system performance are completing the overview. The step-by-step design procedure is followed up with results derived with a comprehensive MATLAB-SIMULINK analysis and a Microchip platform implementation. The presentation is at "introductory" level, mostly for practicing engineers and students.

S19: How to go from Si to SiC Components in the Design of Converters Including Safety & EMC

Track: Fundamentals

Supratim Basu, Tore Undeland
ROOM 103AB

The ability of SiC components to switch very fast, have negligible switching losses and also low on-state losses at high voltages greater than 600 V, etc, makes them near an ideal switch. While Practical Power Electronics design has never been something straightforward, realizing converters having high power densities at lowest cost, stringent EMI and safety requirements and high efficiency at both full/light load, makes their design even more challenging. Thus good design practice and in depth technical knowledge of power-electronics design, thermal design, failure modes, designing for immunity to noise susceptibility, control system design, conservative PCB layout, wiring and grounding issues, etc., is the key to success in designing with SiC components.

This intermediate to advanced level course will begin with a refresh on SiC components followed by an in-depth treatment of various topics like switching speed considerations, EMI generation and management, PCB layout, control loop noise susceptibility, ground loops etc. Lastly the focus of this presentation is to present everything with as many practical engineering examples as possible and thus have a mix of both practice and theoretical explanations and not focus on only theory or physics.

S20: Principles and Practices of Digital Current Regulation for AC Systems

Track: Grid Power Electronics

Grahame Holmes
ROOM 104B

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. 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.

S21: Latest Technologies of LLC Converters for High Current, Fast Response, and Wide Input Voltage Range Applications

Track: Inverters/Converters

Yan-Fei Liu
ROOM 104C

The LLC resonant converter has attracted a lot of attention and application recently due to its advantages, such as soft switching and narrow switching frequency range, as well as possibility to integrate parallel inductor and resonant inductor into the transformer structure.

The purpose of this seminar is to provide an overview of the LLC converter, its advantages and problems.

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Plenary Session

Monday, March 21

1:30 p.m. – 5:00 p.m.
GRAND BALLROOM

One of the goals in assembling this year's slate of Plenary presentations is to explore familiar topics from a unique perspective – to think about problems and solutions in ways we previously had not considered. Tony Sagneri's presentation will look at operating power converters at frequencies far beyond what most of us are familiar with. His approach may change your opinion on what high frequency power conversion is, and where it is going. Following that, Michael Harrison's presentation will posit a "Power Conversion Paradigm" that ties together the relationship between parasitics, losses, and physical size of a power converter. Moreover, he will challenge your ideas of what level of control complexity is really possible to achieve high performance power conversion. Next, we have heard a lot about GaN devices in the past several years at APEC, but Dan Kinzer will show us that the device alone is only a partial solution: the entire "eco-system" has to be addressed. This includes integration of devices, drivers, controllers, magnetics – and addressing packaging topics as well.

After Intermission, Antonio Ginart will kick-off with a detailed look at residential nanogrids – essentially multi-kilowatt power electronic systems in our homes with battery storage to improve the overall reliability of our utility power, and reduce energy expenses by shifting power use away from peak demand periods where cost will be highest, then replenish the battery during low demand periods. Next is the well-known Ray Ridley, who could cover many topics, but this year it is magnetics. He will discuss the trends he sees in how we go about optimizing and integrating magnetic designs within our power electronic circuits. To wrap-up the plenary session is David Hill from Power Clinic. He has a very interesting set of observations from performing thousands of "post-mortems" on power supplies that have failed. His perspective and "lessons-learned" can help all of us to better understand how to design more reliable power electronics with potentially longer lifetimes.

The Challenges of VHF Power Conversion

1:30 p.m. – 2:00 p.m.



SPEAKER:

Tony Sagneri
Finsix corp.

How much could power supply density increase if operating frequency was substantially increased? Not just by a factor of 5 or 10, but into the 10's of MHz, the frequency band known as Very High Frequency (VHF) in the radio world. Making very high density, high frequency power supplies with sufficient energy efficiency to meet thermal requirements is a significant challenge. In this presentation, resonant power converter topologies based on class-E inverters will be reviewed. The design challenges of tuning the resonant elements, control, magnetic design, meeting EMI and safety requirements, and packaging for high density will be discussed, along with a vision of the future of high frequency power conversion.

The Future of Power Electronic Design

2:00 p.m. – 2:30 p.m.



SPEAKER:

Michael Harrison
Enphase Energy

Four decades ago, power electronics consisted of thyristor controlled line-frequency transformers with linear regulators, or maybe self-oscillating circuits driving saturable magnetics. Then the first analog PWM integrated circuits were introduced, enabling closed-loop control of power converters. Of course the speed and complexity of the analog controllers grew, while the cost went down. Efficiency figures seemed to parallel the decade (70's, 80's, etc.). More recently digital control of power converters has become the norm. This has enabled more complex operational modes which improve performance and efficiency, while still driving the cost and size downwards. We are now at a point where the incremental cost of control complexity is nearing zero – to the point where we can not ignore the economies of adopting complex control schemes at the expense of the more primitive methods of the past, only because they were easy to understand. This presentation will look at the trends in power converter performance and design philosophy from a control perspective, and project where we go in the future, and what kinds of role the power electronic designers of the future will play in our industry.

Breaking Speed Limits with GaN Power ICs,

2:30 p.m. – 3:00 p.m.



SPEAKER:

Dan Kinzer

Navitas Semiconductor

GaN technology is progressing rapidly. Reliable power transistors are available in the market today ranging from 40V to 650V, with manufacturing processes qualified at several high volume production

wafer fabs. GaN's performance advantages: low resistance, low capacitance, high frequency, elimination of reverse recovery issues & small size are undeniable and have created much excitement and anticipation in the market. Unfortunately system complexity, cost and the limits of other components have restricted realized performance and corresponding market adoption. A complete, high-frequency eco-system is essential to enable GaN to achieve its full potential in the power electronics industry.

This presentation will review the GaN eco-system with the key elements defined below including significant recent developments that are addressing these remaining adoption issues of system complexity, cost and component availability.

- a) Control ICs & topologies – from 25W to 1kW+ high frequency, soft-switching topologies
- b) Drive - discrete, co-packaged and monolithic implementation
- c) Packaging – cascoding, co-packaging, integration
- d) Magnetics – HF & VHF developments for density and cost improvements

Specific examples of complete eco-system solutions will be given that show the GaN market is poised for mainstream adoption and is ready to achieve its growth potential.

Break

3:00 p.m. – 3:30 p.m.

Residential Nanogrids with Battery Storage – Is This Our Future?

3:30 p.m. – 4:00 p.m.



SPEAKER:

Antonio Ginart

SonnenBatterie, Inc. and the University of Georgia

Renewables and their intrinsic distributed nature are reshaping our power distribution networks. “The Grid” transformation towards the “Smart Grid” implies fundamental

structural changes that face simultaneously many challenges from environmental and regulatory groups and government agencies to name a few. Grid utilization can be significantly improved and optimized through the deployment of distributed networks of microgrids and nanogrids that include energy storage. This helps drive down the overall cost and improve the reliability of electrical power distribution systems for all of us.

This presentation will cover the definition of a residential nanogrid, its operational modes such as grid-tied and stand alone, types of nanogrids (AC or DC), and the fundamental role that energy storage plays in this area. It will explain the benefits, risks, technical challenges, economic drivers, and regulatory hurdles for the broad adoption of residential nanogrids, along with a roadmap of how battery storage and power electronics will play a major role in the future.

The Future of Magnetic Design for Power Electronics

4:00 p.m. – 4:30 p.m.



SPEAKER:

Ray Ridley

Ridley Engineering

Size reduction has become crucial to the power supply industry, with simultaneous demand for an increase in efficiency. Great strides have been made with semiconductors, capacitors, and packaging

technologies. This has focused attention on the magnetics components which are frequently the bulkiest element in many designs.

However, magnetics materials and conductors are mature technologies, having been used for over a century. We cannot count on radically better magnetic materials or

new conductor technology to move the industry forwards. There is no magic bullet to be had - we have to find new and creative ways to leverage what is already available.

Misunderstanding of magnetics prevents many designers from being able to realize the full potential of their designs. In this presentation, Dr. Ridley will highlight how better magnetics understanding can provide better practical insight into this very complex topic.

Why Do Power Supplies Fail? – A Real-World Analysis

4:30 p.m. – 5:00 p.m.



SPEAKER:

David Hill

Power Clinic Inc.

Many of you attending APEC are involved in the specification, design, manufacture and/or distribution of power electronics, especially power supplies. But how many of you know what happens after the

installation, after the warranty runs out, when something goes wrong? This presentation will show you a behind-the-scenes look at the power supply repair industry, where thousands upon thousands of different power supplies are opened-up, evaluated, refurbished, repaired, tested and put back into service. It will provide a unique insight into some common themes and trends in power supply reliability and failure modes – not from an academic study, but a real-world, hands-on assessment from the experts who do this every day with a huge variety of different designs and end-applications.



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Rap Sessions

Tuesday, March 22

5:00 p.m. – 6:00 p.m.

R1: Future of Semiconductor Technology Development

ROOM 104A

MODERATOR:

Veena Misra, *Director, Professor, North Carolina State University*

PANELISTS:

- > Eric R. Motto, *Chief Engineer, Power Semiconductor Applications, Powerex Inc.*
- > Peter Friedrichs, *Senior Sirecor SiC, Infineon*
- > David N. Henshall, *Deputy Director of Commercialization, ARPA-E*
- > Madhu Chinthavali, *Research Scientist, Oak Ridge National Laboratory*

For automotive applications, there are many advantages of emerging semiconductor devices such as SiC or GaN such as higher switching frequency, reduced losses, high temperature operation capability, and higher power density. With properties operating in extreme conditions, they are ideal devices for applications that are subject to high voltages and temperatures found in emerging applications.

On the other hand, cost, reliability, and maturity are still driving factors for conventional silicon-based devices. While past problems with substrate defects are rapidly being addressed and companies are working to develop more robust switches, IGBT and MOSFET technologies are also progressing towards higher performance at lower costs. This panel will discuss the needs of future semiconductor technology development for power electronics industry in order to offer high-performance and low-cost power electronic interfaces. This panel will also discuss WBG development issues range from fundamental science to technology development and maturation strategies with a focus on materials research, device design, pack aging, manufacturing processes, system design and development, and reliability.

R2: Power Electronics for Internet of Things: Will it happen?

ROOM 104B

MODERATOR:

Burak Ozpineci, *Leader, Power Electronics and Electric Machinery Group, Manager, Electric Drive Technologies Program, Oak Ridge National Laboratory*

PANELISTS:

- > Martin Fornage, *CTO Enphase Energy*
- > Chris Glaser, *Applications Engineer, Texas Instruments*
- > Doug Houseman, *Vice President for Technology and Innovations, EnerNex LLC*
- > Steve Collier, *Director, Smart Grid Strategies, Milsoft Utility*

This panel will discuss the ability/feasibility of our “smart” systems to measure, share, compute, analyze, and control power electronic converters with the new vision of Internet of Things (IoT) to achieve increased efficiency, performance, resiliency, intelligence, and security in integrated power electronics systems. This Rap Session will go beyond the consumer IoT technology market, to consider the very important evolution and application of sensors, communications, embedded computing, and cloud computing to the control and transaction of energy, the monitoring and diagnostics of equipment, the delivery of services, and the protection of critical infrastructure through the power electronics interfaces.

The rap session will cover:

- > Modern power electronics with internet connectivity to support and enhance vehicular systems, microgrids, renewables integration, smart appliances, resiliency and protection, and cybersecurity.
- > Sensors and control technologies and integration with the power electronics both at system and device levels.
- > Smart processing and computing with internet connected power electronics.
- > Transportation systems and connected vehicle communications and security.
- > Ubiquitous low-cost, low-power, and energy harvesting electronics and sensors,
- > Embedded computing and controls at the edge of sensing and communications,
- > Big data, cloud management, and data analytics of IoT for power electronics.

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ROOM 104C

MODERATOR:

Babak Fahimi, *Founding Director, Renewable Energy and Vehicular Technology (REVT), University of Texas at Dallas*

PANELISTS:

- > Andrew Daga, *CEO and Founder, Momentum Dynamics*
- > Grant Covic, *University of Auckland-New Zealand, Qualcomm*
- > Ken Karklin, *Vice President & General Manager, ESS AeroVironment*
- > Abas Goodarzi, *President and CEO, U.S. Hybrid Corporation*

This Rap Session will discuss the advanced refueling technologies and conventional/unconventional methods for electric vehicle charging applications. The vision of the panelists on how the refueling structure of EVs will be shaped will be expressed. From a power electronics point of view, there are several topological architectures such as isolated/non-isolated, on-board/off-board, single/multi-level, single/multi-stage charging technologies. Practically, there are an emerging number of different options such as DC fast charging, wireless charging, SuperChargers, CHAdeMO or J1772 charging protocols, and so on. While these charging technologies are expected to increase the consumer acceptance of plug-in electric vehicles, there are advantages and drawbacks of each methods. Charging times, convenience, performance, efficiency, and the current and future availability of these technologies will be discussed.



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Dialogue Sessions

Dialogue Session papers have been selected through the same rigorous peer review process as papers in the oral 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.

Thursday, March 24, 2016

11:30 a.m. – 1:30 p.m.

HALL A

DD1: AC-DC Converters

Track: AC-DC Converters

CHAIRS:

Nathan Weise, *Marquette*

Daniel Costinett, *University of Tennessee-Knoxville*

D01.1: An Input Current Calculation Switching Driver for High Power-Factor and Phase-Cut Dimmer Compatibility

Hyunchul Eum, Youngjong Kim, Kuohsien Huang, *Fairchild Semiconductor International, Inc., Taiwan*

D01.2: High Frequency Range Conducted Common-Mode Noise Suppression in SMPS

Jinping Zhou, Yicong Xie, Min Zhou, *Delta Power Electronics Center, China*

D01.3: Improved Medium Voltage AC-DC Rectifier Based on 10kV SiC MOSFET for Solid State Transformer (SST) Application

Qianlai Zhu, Li Wang, Liqi Zhang, Wensong Yu, Alex. Q Huang, *North Carolina State University, United States*

D01.4: Suppression of Circulating Current in Parallel Operation of Three-Level Converters

Youngkwang Son¹, Seung-Jun Chee¹, Younggi Lee¹, Seung-Ki Sul¹, Changjin Lim², Sungjae Huh², Jaeyoon Oh², ¹*Seoul National University, Korea, South*, ²*LG Electronics, Korea, South*

D01.5: Hybrid Bridgeless DCM SEPIC Rectifier Integrated with a Modified Switched Capacitor Cell

Paulo Junior Silva Costa¹, Telles Brunelli Lazzarin¹, Carlos Henrique Illa Font², ¹*Universidade Federal de Santa Catarina, Brazil*, ²*Universidade Tecnológica Federal do Paraná, Brazil*

D01.6: LCL Filter Design for Three-Phase Two-Level Power Factor Correction Using Line Impedance Stabilization Network

Alireza Kouchaki, Morten Nymand, *University of Southern Denmark, Denmark*

D01.7: Sensorless Current Rebuilding Strategy in a Single Phase Bridgeless PFC

Felipe López, Paula Lamo, Alberto Pigazo, Francisco J. Azcondo, *Universidad de Cantabria, Spain*

D01.8: A Compact Electrolytic-Free Two-Stage Universal Input Offline LED Driver

Saad Pervaiz, Ashish Kumar, Khurram K. Afridi, *University of Colorado Boulder, United States*

DD2: DC-DC Converters I

Track: DC-DC Converters

CHAIRS:

Charles Sullivan, *Dartmouth*

Mahshid Amirabadi, *Northeastern University*

D02.1: Design Methodology for a High Insulation Voltage Power Transmission Function for IGBT Gate Driver

Sokchea Am, Pierre Lefranc, David Frey, Mahmoud Ibrahim, *Grenoble Institute of Technology, France*

D02.2: Optimized Design of GaN Switching Capacitor Based Envelope Tracking Power Supply for Satellite Applications

Qian Jin¹, Miroslav Vasic², Oscar Garcia², Pedro Alou², Jesus Angel Oliver², Jose Antonio Cobos², ¹*Nanjing University of Aeronautics and Astronautics, China*, ²*Universidad Politécnica de Madrid, Spain*

D02.3: An Isolated High Step-Up Converter with Continuous Input Current and LC Snubber

K. I. Hwu¹, W. Z. Jiang, Y. T. Yau², ¹*National Taipei University of Technology, Taiwan*, ²*Asian Power Devices Inc., Taiwan*

D02.4: Output-Inductor-Less Full-Bridge Converter with SiC-MOSFETs for Low Noise and ZVS Operation

Kazuhide Domoto¹, Yoichi Ishizuka¹, Seiya Abe², Tamotsu Ninomiya³, ¹Nagasaki University, Japan, ²Kyushu Institute of Technology, Japan, ³Green Electronics Research Institute, Kitakyushu, Japan

D02.5: Reduction Technique of Leakage Flux Effects on GaN-HEMTs in 5 MHz / 100 W Isolated DC-DC Converters

Akinori Hariya¹, Tomoya Koga¹, Ken Matsuura², Hiroshige Yanagi², Satoshi Tomioka², Yoichi Ishizuka¹, Tamotsu Ninomiya³, ¹Nagasaki University, Japan, ²TDK Corporation, Japan, ³Kyushu University, Japan

D02.6: A High-Voltage Level Shifter with Sub-Nano-Second Propagation Delay for Switching Power Converters

Ahmed Abdelmoaty¹, Mohammad Al-Shyoukh², Ayman Fayed¹, ¹Ohio State University, United States, ²TSMC Inc., United States

D02.7: Dual-Output, Three-Level GaN-Based DC-DC Converter for Battery Charger Applications

Ren Ren¹, Bo Liu², Edward A. Jones², Fred Wang², Zheyu Zhang², Daniel Jes Costinett², ¹Nanjing University of Aeronautics and Astronautics, China, ²University of Tennessee, United States

D02.8: Quadruple Active Bridge DC-DC Converter as the Basic Cell of a Modular Smart Transformer

Levy Costa, Giampaolo Buticchi, Marco Liserre, Christian-Albrechts-Universität zu Kiel, Germany

D02.9: Analytical Model of a Phase-Shift Controlled Three-Level Zero-Voltage Switching Converter

Cas Bakker¹, Bas Vermulst², Anton Driessen¹, ¹Prodrive Technologies, Netherlands, ²Technische Universiteit Eindhoven, Netherlands

D02.10: High Efficiency Design for ISOP Converter System with Dual Active Bridge DC-DC Converter

Masaki Sato¹, Kazuhide Domoto¹, Yoichi Ishizuka¹, Masahiro Yamaguchi², Shinya Manabe³, Hiizu Okubo³, Atsushi Itagaki⁴, ¹Nagasaki University, Japan, ²Tohoku University, Japan, ³RICOH Electronic Devices Co., Ltd., Japan, ⁴RICOH Electronic Devices Co., Ltd., Japan, ⁴Ryowa Electronics Co., Ltd., Japan

D02.11: Wide Input Range Power Converters Using a Variable Turns Ratio Transformer

Ziwei Ouyang, Michael A.E. Andersen, Danmarks Tekniske Universitet, Denmark

D02.12: Design Approaches for Fast Supercapacitor Chargers for Applications like SCATMA, SRUPS

Nicoloy Gurusinghe, Nihal Kularatna, W. Howell Round, D. Alistair Steyn-Ross, University of Waikato, New Zealand

D02.13: Stack Multiphase Asymmetrical Half-Bridge Topology Offering Advance Performance and Efficiency

Trong Tue Vu, George Young, Eisergy Ltd., Ireland

D03: DC-DC Converters II

Track: DC-DC Converters

CHAIRS:

Jason Stauth, Dartmouth

Yan-Fei Liu, Queens University

D03.1: Design of a Novel APWM Half-Bridge DC-DC Resonant Converter with Load-Independent Soft-Switching and Reduced Circulating Current

Kawsar Ali, Sandeep Kolluri, Naga Brahmendra Gorla, Pritam Das, Sanjib Kumar Panda, National University of Singapore, Singapore

D03.2: A Low-Volume Hybrid Step-Down DC-DC Converter Based on the Dual Use of Flying Capacitor

S M Ahsanuzzaman, Yingxian Ma, Abrar Ahmed Pathan, Aleksandar Prodic, University of Toronto, Canada

D03.3: Fractional Pulse Skipping in Digitally Controlled DC-DC Converters for Improved Light-Load Efficiency and Power Spectrum

Bipin Mandi, Santanu Kapat, Amit Patra, Indian Institute of Technology Kharagpur, India

D03.4: A New Compact and High Efficiency Resonant Converter

Sheng-Yang Yu, Texas Instruments Inc., United States

D03.5: A 10-MHz eGaN FETs Based Isolated Class-Phi2 DCX

Xuwen Zou, Zhiliang Zhang, Zhou Dong, Yuan Zhou, Xiaoyong Ren, Qianhong Chen, Nanjing University of Aeronautics and Astronautics, China

D03.6: Multi-Level Capacitor Clamped DC-DC Multiplier/Divider with Variable and Fractional Voltage Gain – an (N/m)X DC-DC Converter

Deepak Gunasekaran¹, Liang Qin², Ujjwal Karki¹, Yuan Li³, Fang Zheng Peng¹, ¹Michigan State University, United States, ²Wuhan University, China, ³Sichuan University/Northeastern University, China

D03.7: Multi-Mode Quasi-Z-Source Series Resonant DC/DC Converter for Wide Input Voltage Range Applications

Dmitri Vinnikov¹, Andrii Chub², Indrek Roasto¹, Liisa Liivik², ¹Ubik Solutions LLC., Estonia, ²Tallinn University of Technology, Estonia

D03.8: Hybrid Serial-Output Converter for Integrated LED Lighting Applications

Tim McRae¹, Aleksandar Prodic¹, Gianpaolo Lisi², William McIntyre², Alvaro Aguilar², ¹University of Toronto, Canada, ²Texas Instruments Inc., United States

D03.9: Analysis and Modeling of a Modular ISOP Full Bridge Based Converter with Input Filter

Pablo Zumel¹, Edwin Oña¹, Cristina Fernandez¹, Marina Sanz¹, Antonio Lazaro¹, Andres Barrado¹, Aitor Vazquez², Diego G. Lamar², ¹Universidad Carlos III de Madrid, Spain ²Universidad de Oviedo, Spain

D03.10: Wide-Input High Power Density Flexible Converter Topology for DC-DC Applications

Parth Jain¹, Aleksandar Prodic¹, Alexander Gerfer², ¹University of Toronto, Canada ²Wuerth Elektronik eiSos GmbH & Co. KG, Germany

D03.11: High Efficiency LLC Converter Design for Universal Battery Chargers

Navid Shafiei, Ali Arefifar, Mohammad Ali Saket, Martin Ordonez, *University of British Columbia, Canada*

D03.12: A New High Power Density Modular Multilevel DC-DC Converter with Localized Voltage Balancing Control for Arbitrary Number of Levels

Ahmed Morsy, Yong Zhou, Prasad Enjeti, *Texas A&M University, United States*

D03.13: Design and Control of a Fault Tolerant Soft Switching DC-DC Converter for High Power High Voltage Applications

Tao Li, Leila Parsa, *Rensselaer Polytechnic Institute, United States*

D03.14: Accurate Parametric Steady State Analysis and Design Tool for DC-DC Power Converters

Mohammad Daryaei, Mohammad Ebrahimi, Sayed Ali Khajehoddin, *University of Alberta, Canada*

D03.15: Analysis of Multi-Output Half-Wave Semi-Synchronous Rectifier with a Uniform Magnetic Field Transmitter

Erdem Asa¹, Kerim Colak², Dariusz Czarkowski³, ¹New York University / Hevo Power Inc., United States, ²Istanbul Ulasim A.S., Turkey, ³New York University, United States

D03.16: High Gain QZS DC/DC Converter with Coupled Inductor

Rafael Vitor E Silva, Antonio Alisson A. Freitas, Marcus Rogério de Castro, Fernando Luiz M. Antunes, Edison Mineiro Sá Jr., *Universidade Federal do Ceará, Brazil*

D04: Utility Interface

Track: Power Electronics for Utility Interface

CHAIRS:

Ali Khajehoddin, *University of Alberta*

Babak Nahid-Mobarakeh, *University of Lorraine*

D04.1: A Power Decoupling Method with Small Capacitance Requirement Based on Single-Phase Quasi-Z-Source Inverter for DC Microgrid Applications

Dingyi He, Wen Cai, Fan Yi, *University of Texas at Dallas, United States*

D04.2: Operation Analysis of High Efficiency Grid Connected Bi-Directional Power Conversion System for Various Storage Battery Systems with Bi-Directional Switch Circuit Topology

Go Yamada¹, Takaaki Norisada¹, Fumito Kusama¹, Keiji Akamatsu¹, Masakazu Michihira², ¹Panasonic Corporation, Japan, ²Kobe City College of Technology, Japan

D04.3: Fault Tolerant Control of MMC with Redundant Sub-Modules Based on Carrier Phase Shift Modulation

Kai Li¹, Zhengming Zhao¹, Liqiang Yuan¹, Sizhao Lu¹, Bing Pan², Zhengang Lu², ¹Tsinghua University, China, ²State Grid Smart Grid Research Institute, China

D04.4: A New Topology of Multilevel VSC Converter for Hybrid HVDC Transmission System

Jae-Jung Jung¹, Shenghui Cui², Seung-Ki Sul¹, ¹Seoul National University, Korea, South, ²Rheinisch-Westfälische Technische Hochschule Aachen, Germany

D04.5: Performance of Solid State Transformers Under Imbalanced Loads in Distribution Systems

Tao Yang, Ronan Meere, Cathal O'Loughlin, Terence O'Donnell, University College Dublin, Ireland

D04.6: Steady-State Analysis of Modular Multilevel Converter (MMC) Under Unbalanced Grid Conditions

Xiaojie Shi¹, Yalong Li¹, Zhiqiang Wang¹, Bo Liu¹, Leon M. Tolbert², Fred Wang¹, ¹University of Tennessee, United States, ²University of Tennessee / Oak Ridge National Laboratory, United States

D04.7: Design and Control of a Compensated Submodule Testing Scheme for Modular Multilevel Converter

Yuan Tang, Li Ran, Olaiwola Alatise, Philip Mawby, University of Warwick, United Kingdom

D04.8: A Voltage Independent Islanding Detection Method and Low Voltage Ride Through of a Two-Stage PV Inverter

Partha Das, Souvik Chattopadhyay, Shiladri Chakraborty, Indian Institute of Technology Kharagpur, India

D04.9: Low Cost and High Efficiency Topology for Flexible Integration of Multi-PV and Batteries in Resonant-Based Converters

Ali Elrayyah, Qatar Environment and Energy Institute, Qatar

D04.10: Real-Time Integrated Model of a Micro-Grid with Distributed Clean Energy Generators and Their Power Electronics

Weiqiang Chen, Ali Bazzi, James Hare, Shalabh Gupta, University of Connecticut, United States

D04.11: Minimization of Inter-Module Leakage Current in Cascaded H-Bridge Multilevel Inverters for Grid Connected Solar PV Applications

Pradeep Kumar V V S, Fernandes B G, Indian Institute of Technology Bombay, India

D04.12: Effect of Grid Inductance on Grid Current Quality of Parallel Grid-Connected Inverter System with Output LCL Filter and Closed-Loop Control

Wooyoung Choi, Woongkul Lee, Bulent Sarlioglu, University of Wisconsin-Madison, United States

D04.13: Small Signal Modeling and Control of a Grid Tied Converter Without a Synchronization Unit

Subhajyoti Mukherjee, Pourya Shamsi, Mehdi Ferdowsi, Missouri University of Science and Technology, United States

D04.14: Bridgeless SEPIC PFC Converter for Low Total Harmonic Distortion and High Power Factor

Yasemin Onal, Yilmaz Sozer, University of Akron, United States

D04.15: Effectiveness of Pareto-Front Analysis Applied to the Design of a Single-Phase PFC Rectifier

Mahmoud Ibrahim¹, Luc Gonnet¹, Pierre Lefranc², David Frey², Jean-Paul Ferrieux², Sokchea Am², ¹Eaton Corporation Plc, France, ²Grenoble Institute of Technology, France

D04.16: State Space Analysis and Duty Cycle Control of a Switched Reactance Based Center-Point-Clamped Reactive Power Compensator

Pankaj Kumar Bhowmik, Somasundaram Essakiappan, Madhav Manjrekar, University of North Carolina at Charlotte, United States

D04.17: A SiC-Based Power Converter Module for Medium-Voltage Fast Charger for Plug-in Electric Vehicles

Srdjan Srdic, Chi Zhang, Xinyu Liang, Wensong Yu, Srdjan Lukic, North Carolina State University, United States

D04.18: Shunt Active Power Filter Based on Cascaded Transformers Coupled with Three-Phase Bridge Converters

Gregory A. de Almeida Carlos¹, Cursino B. Jacobina¹, Joao Paulo R. Mello¹, Euzeli C. dos Santos Jr.², ¹Universidade Federal de Campina Grande, Brazil, ²Indiana University – Purdue University, United States

D04.19: Independent DC Link Voltage Control of Cascaded Multilevel PV Inverter

Qingyun Huang, Wensong Yu, Alex. Q Huang, North Carolina State University, United States

D04.20: New Active Damping Method for LCL Filter Resonance Based on Two Feedback System

Mahmoud Gaafar¹, Gamal Dousoky²,
Masahito Shoyama¹, ¹Kyushu University, Japan,
²Minia University, Egypt

D04.21: Static Synchronous Generator Model for Investigating Dynamic Behaviors and Stability Issues of Grid-Tied Inverters

Liansong Xiong, Xiaokang Liu, Feng Wang,
Fang Zhuo, *Xi'an Jiaotong University, China*

D05: Motor Drives and Inverters: Modeling and Control I

Track: Motor Drives and Inverters

CHAIRS:

Liming Liu, *ABB Inc.*

Thomas Gietzold, *United Technologies Aerospace Systems*

D05.1: Initial Orientation and Sensorless Starting Strategy of Wound-Rotor Synchronous Starter/Generator

Jichang Peng, Weiguo Liu, Jinhao Meng,
Tao Meng, Guangzhao Luo, *Northwestern Polytechnical University, China*

D05.2: A Novel Method for Polarity Detection of Non-Salient PMSMs in Initial Position Estimation

Bing Liu, Bo Zhou, Jiadan Wei, Long Wang,
Tianheng Ni, *Nanjing University of Aeronautics and Astronautics, China*

D05.3: A Speed Adaptive Sensorless Flux Observer for the Induction Motor Drive Using Sylvester Criterion Design

Mihai Comanescu, *Penn State Altoona, United States*

D05.4: Discontinuous PWM for Low Switching Losses in Indirect Matrix Converter Drives

Yeongsu Bak, Kyo-Beum Lee, *Ajou University, Korea, South*

D05.5: Model Predictive Control for Extended Kalman Filter Based Speed Sensorless Induction Motor Drives

Jie Li, Liheng Zhang, Ying Niu, Haipeng Ren,
Xi'an University of Technology, China

D05.6: Research on Excitation Control Methods for the Two-Phase Brushless Exciter of Wound-Rotor Synchronous Starter/Generators in the Starting Mode

Ningfei Jiao, Weiguo Liu, Tao Meng, Jichang Peng,
Shuai Mao, *Northwestern Polytechnical University, China*

D05.7: A High Performance Speed Regulator Design for AC Machines

Adil Khurram, Habibur Rehman, Shayok Mukhopadhyay, *American University of Sharjah, U.A.E.*

D05.8: Zero-Sequence Current Suppression for Open-End Winding Induction Motor Drive with Resonant Controller

Hajime Kubo¹, Yasuhiro Yamamoto¹, Takeshi Kondo¹, Kaushik Rajashekara², Bohang Zhu²,
¹Meidensha Corporation, Japan, ²University of Texas at Dallas, United States

D05.9: Optimized Control of High-Performance Servo-Motor Drives in the Field-Weakening Region

Jack Bermingham¹, Gerard O'Donovan¹, Ray Walsh¹, Michael Egan², Gordon Lightbody², John Hayes², ¹Moog Ireland Ltd, Ireland,
²University College Cork, Ireland

D05.10: Motor Current Reference Generation for Reducing Motor Currents in Drive Systems with Single-Phase Diode Rectifier and Small DC-Link Capacitor

Young-Ho Chae, Jung-Ik Ha, *Seoul National University, Korea, South*

D05.11: A Simple Double Mapping Based SVPWM Method for Balancing DC-Link Capacitor Voltages of Five-Level Diode-Clamped Converters

Aparna Saha¹, Ali Elrayah², Yilmaz Sozer¹,
¹University of Akron, United States,
²Qatar Research Foundation, Qatar



D06: Motor Drives and Inverters: Modeling and Control II

Track: Motor Drives and Inverters

CHAIRS:

Bulent Sarioglu, *University of Wisconsin – Madison*

Yichao Tang, *Texas Instruments*

D06.1: Capacitor-Clamped Inverter Based Transient Suppression Method for Azimuth Thruster Drives

Shantha Gamini Jayasinghe¹, Viknash Shagar¹, Hossein Enshaee¹, Danyal Mohammadi², Mahinda Vilathgamuwa³, ¹*Australian Maritime College – University of Tasmania, Australia*, ²*Boise State University, United States*, ³*Queensland University of Technology, Australia*

D06.2: Active Common-Mode Voltage Reduction in a Fault-Tolerant Three-Phase Inverter

Danyal Mohammadi, Said Ahmed-Zaid, *Boise State University, United States*

D06.3: Power Cycling Lifetime Improvement of Three-Level NPC Inverters with an Improved DPWM Method

Jiangbiao He¹, Lixiang Wei², Nabeel Demerdash¹, ¹*Marquette University, United States*, ²*Rockwell Automation, United States*

D06.4: Synchronous Optimal Pulsewidth Modulation Digital Implementation Concept for Multilevel Converters

Jackson Lago, Marcelo Lobo Heldwein, *Universidade Federal de Santa Catarina, Brazil*

D06.5: Analytical Determination of Conduction Losses for Modified Flying Capacitor Multicell Converters

Vahid Dargahi¹, Arash Khoshkbar Sadigh², Keith Corzine¹, ¹*Clemson University, United States*, ²*Extron Electronics, United States*

D06.6: Comparison of Electrical Losses in an Inverter-Fed Five-Phase and Three-Phase Permanent Magnet Assisted Synchronous Reluctance Motor

Akm Arafat, Seungdeog Choi, *University of Akron, United States*

D06.7: A Hybrid Adaptive Observer for the Speed and Flux Estimation of Induction Motors

Mihai Comanescu, *Penn State Altoona, United States*

D06.8: Determination of CM Choke Parameters for SiC MOSFET Motor Drive Based on Simple Measurements and Frequency Domain Modeling

Di Han, Casey Morris, Woongkul Lee, Bulent Sarioglu, *University of Wisconsin-Madison, United States*

D06.9: An Improved Model Predictive Current Control of Permanent Magnet Synchronous Motor Drives

Yongchang Zhang¹, Sugu Gao¹, Wei Xu², ¹*North China University of Technology, China*, ²*Huazhong University of Science and Technology, China*

D06.10: Analysis of Magnet Defect Faults in Permanent Magnet Synchronous Motors Through Fluxgate Sensors

Taner Goktas, Kun Wang Lee, Mohsen Zafarani, Bilal Akin, *University of Texas at Dallas, United States*

D07: Motor Drives and Inverters: Topologies

Track: Motor Drives and Inverters

CHAIRS:

Amirnaser Yazdani, *Ryerson University*

Babak Nahid-Mobarakheh, *University of Lorraine*

D07.1: Performance Comparison of Transfer Switch Topologies in Switched-Doubly-Fed Machine Drives

Arijit Banerjee, Steven B. Leeb, James L. Kirtley, *Massachusetts Institute of Technology, United States*

D07.2: Multilevel Converter Topologies for High-Power High-Speed Switched Reluctance Motor: Performance Comparison

Devendra Patil, Shiliang Wang, Lei Gu, *University of Texas at Dallas, United States*

D07.3: Bidirectional Magnetically Coupled T-Source Inverter for Extra Low Voltage Application

Thomas Baier, Bernhard Piepenbreier, *Friedrich-Alexander-Universität Erlangen-Nürnberg, Germany*

D07.4: Active Virtual Ground: Single Phase Grid-Connected Voltage Source Inverter Topology

River Tin-Ho Li¹, Carl Ngai-Man Ho², ¹*ABB China Ltd., China*, ²*University of Manitoba, Canada*

D07.5: Design and Evaluation of 30kVA Inverter Using SiC MOSFET for 180°C Ambient Temperature Operation

Feng Qi¹, Miao Wang¹, Longya Xu¹, Bo Zhao², Zhe Zhou², Xizhou Ren², ¹Ohio State University, United States, ²State Grid Corporation of China, China

D07.6: A DC to Three-Phase Boost-Buck Inverter with Stored Energy Modulation and a Tiny DC Link Capacitor

Mahima Gupta, Giri Venkataramanan, University of Wisconsin-Madison, United States

D07.7: Drive Circuits for Ultra-Fast and Reliable Actuation of Thomson Coil Actuators Used in Hybrid AC and DC Circuit Breakers

Chang Peng¹, Alex. Q. Huang¹, Iqbal Husain¹, Bruno Lequesne², Roger Briggs³, ¹North Carolina State University, United States, ²E-Motors Consulting, United States, ³Energy Efficiency Research, United States

D07.8: Improved Transformerless Dual Buck Inverters with Buffer Inductors

Liwei Zhou, Feng Gao, Shandong University, China

D07.9: A 99% Efficiency SiC Three-Phase Inverter Using Synchronous Rectification

Shan Yin¹, King-Jet Tseng¹, Chin-Foong Tong¹, Rejeki Simanjorang², Chandana Gajanayake², Amit Gupta², ¹Nanyang Technological University, Singapore, ²Rolls-Royce Singapore Pte. Ltd., Singapore

D07.10: Comparison and Evaluation of Common Mode EMI Filter Topologies for GaN-Based Motor Drive Systems

Casey Morris, Di Han, Bulent Sariloglu, University of Wisconsin-Madison, United States

D07.11: Analysis of Thermal Cycling Stress on Semiconductor Devices of the Modular Multilevel Converter for Drive Applications

Xiangyu Han, Qichen Yang, Liyao Wu, Maryam Saeedifard, Georgia Institute of Technology, United States

D07.12: Fault Tolerant Topologies of Five-Level Active Neutral-Point-Clamped Converters

Jun Li, ABB Inc., United States

D08: Advanced Components and Devices

Track: Devices and Components

CHAIRS:

Abhijit Pathak, Infineon/IR

Doug Hopkins, North Carolina State University

D08.1: Dynamic Characterization of the Input and Reverse Transfer Capacitances in Power MOSFETs Under High Current Conduction

Cristino Salcines¹, Ingmar Kallfass¹, Hisao Kakitani², Atsushi Mikata², ¹Universität Stuttgart, Germany, ²Keysight Technologies International, Japan

D08.2: Medium Voltage Power Switch Based on SiC JFETs

Xueqing Li, Hao Zhang, Peter Alexandrov, Anup Bhalla, United Silicon Carbide, Inc., United States

D08.3: Numerical Model and Experimental Study on Comparison of Semiconductor Pulsed Power Devices

Lin Liang¹, Changdong Chen¹, Fang Luo², ¹Huazhong University of Science and Technology, China, ²Ohio State University, United States

D08.4: A Normalization Procedure of DC-Side Stray Inductance for High-Speed Switching Circuit

Masato Ando, Keiji Wada, Tokyo Metropolitan University, Japan

D08.5: Thermal Network Parameter Identification of IGBT Module Based on the Cooling Curve of Junction Temperature

Xiong Du¹, Tengfei Li¹, Jun Zhang¹, Heng-Ming Tai², Pengju Sun¹, Luowei Zhou¹, ¹Chongqing University, China, ²University of Tulsa, United States

D08.6: Design and Evaluation of High Current PCB Embedded Inductor for High Frequency Inverters

Mehrdad Biglarbegian, Neel Shah, Iman Mazhari, Johan Enslin, Babak Parkhideh, University of North Carolina at Charlotte, United States

D08.7: Prognosis of Wire Bond Lift-Off Fault of an IGBT Based on Multisensory Approach

Moinul Shahidul Haque¹, Jeihoon Baek², Joseph Herbert¹, Seungdeog Choi¹, ¹University of Akron, United States, ²Korean Rail Research Institute, Korea, South

D08.8: Electrical Parasitics and Thermal Modeling for Optimized Layout Design of High Power SiC Modules

Amir Sajjad Bahman¹, Frede Blaabjerg¹, Atanu Dutta², Alan Mantooth², ¹Aalborg University, Denmark, ²University of Arkansas, United States

D08.9: Calculation of Losses in PCB Windings for Multi-Coil Contactless Charging Systems

Javier Serrano¹, Jesús Acero¹, Ignacio Lope², Claudio Carretero¹, José Miguel Burdío¹, Rafael Alonso¹, ¹Universidad de Zaragoza, Spain, ²BSH Home Appliances Group, Spain

D08.10: Design of Efficient Loads for Domestic Induction Heating Applications by Means of Non-Magnetic Thin Metallic Layers

Jesús Acero, Claudio Carretero, Rafael Alonso, José Miguel Burdío, Universidad de Zaragoza, Spain

D08.11: A New Evaluation Circuit with a Low-Voltage Inverter Intended for Capacitors Used in a High-Power Three-Phase Inverter

Kazunori Hasegawa¹, Ichiro Omura¹, Shin-Ichi Nishizawa², ¹Kyushu Institute of Technology, Japan, ²Kyushu Institute of Technology / National Institute of Advanced Industrial Science and Technology, Japan

D08.12: Energy Absorption Capability of Low Voltage Metal Oxide Varistors in AC and Impulse Currents

Dawood Talebi Khanmiri¹, Roy Ball², Craig McKenzie², Brad Lehman¹, ¹Northeastern University, United States, ²Mersen-USA, United States

D08.13: Optimization and Experimental Validation of Medium-Frequency High Power Transformers in Solid-State Transformer Applications

Mohammadamin Bahmani¹, Torbjörn Thiringer¹, Mohammad Kharezy², ¹Chalmers University of Technology, Sweden, ²SP Technical Research Institute of Sweden, Sweden

D08.14: Evaluation of Core Loss in Magnetic Materials Employed in Utility Grid AC Filters

Remus Beres¹, Xiongfei Wang¹, Frede Blaabjerg¹, Claus Leth Bak¹, Hiroaki Matsumori², Toshihisa Shimizu², ¹Aalborg University, Denmark, ²Tokyo Metropolitan University, Japan

D08.15: A Novel Gate Assisted Circuit to Reduce Switching Loss and Eliminate Shoot-Through in SiC Half Bridge Configuration

Shan Yin¹, King-Jet Tseng¹, Chin-Foong Tong¹, Rejeki Simanjorang², Chandana Gajanayake², Amit Gupta², ¹Nanyang Technological University, Singapore, ²Rolls-Royce Singapore Pte. Ltd., Singapore

D09: System Design Considerations for Power Electronics

Track: System Integration

CHAIRS:

John Vigars, *Allegro Microsystems*

Ernie Parker, *Crane Aerospace & Electronics*

D09.1: Methods to Enhance the Thermal Performance of a 3D Power Package

Jonathan Noquil¹, Ozzie Lopez¹, Tianyi Luo², ¹Texas Instruments Inc., United States, ²Lehigh University, United States

D09.2: Highly Reliable and Cost Effective Thick Film Substrates for Power LEDs

Paul Gundel¹, Ryan Persons¹, Melanie Bawohl¹, Mark Challingsworth¹, Christoph Czwickla¹, Virginia Garcia¹, Christina Modes¹, Ilias Nikolaidis¹, Jessica Reitz¹, Caitlin Shahbazi¹, Torsten Nowak^{1,2}, ¹Heraeus Deutschland GmbH & Co. KG, Germany, ²Fraunhofer-Institut für Zuverlässigkeit und Mikrointegration, Germany

D09.3: Design and Evaluation of SiC-Based High Power Density Inverter, 70kW/Liter, 50kW/kg

Koji Ymaguchi, *IHI Corporation, Japan*

D09.4: An Improved Automatic Layout Method for Planar Power Module

Puqi Ning, Xuhui Wen, Yaohua Li, Qiongxuan Ge, *Institute of Electrical Engineering, Chinese Academy of Sciences, China*

D09.5: Practical Implementation Schemes of Motor Speed Measurement by Magnetic Encoder on Electric Power Steering Applications

Jaehyun Lee, *Hyundai Mobis, Korea, South*

D09.6: Low-Cost Input Impedance Estimator of DC-to-Dc Converters for Designing the Control Loop in Cascaded Converters

Marina Sanz, Antonio Lázaro, Manuel Bermejo, David López del Moral, Pablo Zumel, Cristina Fernández, Andres Barrado, *Universidad Carlos III de Madrid, Spain*

D09.7: On-Chip High Performance Magnetics for Point-of-Load High-Frequency DC-DC Converters

Dragan Dinulovic¹, Mahmoud Shousha¹, Martin Haug¹, Alexander Gerfer¹, Mike Wens², Jef Thone², ¹Wuerth Elektronik eiSos GmbH & Co. KG, Germany, ²MinDCet NV, Belgium

D09.8: Effects of Auxiliary Source Connections in Multichip Power Module

Helong Li, Stig Munk-Nielsen, Szymon Beczkowski, Xiongfei Wang, Emanuel-Petre Eni, Aalborg University, Denmark

D10: Modeling and Simulation

Track: Modeling and Simulation

CHAIRS:

Marco Meola, ZMD AG

Mehdi Ferdowsi, Missouri University of Science & Technology

D10.1: Modelling Technique Utilizing Modified Sigmoid Functions for Describing Power Transistor Device Capacitances Applied on GaN HEMT and Silicon MOSFET

Howe Li Yeo, King-Jet Tseng, Nanyang Technological University, Singapore

D10.2: Design and Precise Modeling of a Novel Digital Active EMI Filter

Junpeng Ji, Wenjie Chen, Xu Yang, Xi'an Jiaotong University, China

D10.3: Development of a Hybrid Emulation Platform Based on RTDS and Reconfigurable Power Converter-Based Testbed

Shuoting Zhang¹, Yiwei Ma¹, Liu Yang¹, Fred Wang¹, Leon M. Tolbert², ¹University of Tennessee, United States, ²University of Tennessee / Oak Ridge National Laboratory, United States

D10.4: Online Temperature Estimation for Phase Change Composite – 18650 Lithium Ion Cells Based Battery Pack

Mohamad Salameh¹, Ben Schweitzer², Peter Sveum², Said Al-Hallaj², Mahesh Krishnamurthy¹, ¹Illinois Institute of Technology, United States, ²AllCell Technologies, United States

D10.5: Modeling and Fault Diagnosis of Inter-Turn Short Circuit for Five-Phase PMSM Based on Particle Swarm Optimization

Jianwei Yang, Manfeng Dou, Zhiyong Dai, Dongdong Zhao, Zhen Zhang, Northwestern Polytechnical University, China

D10.6: Comprehensive Modeling, Testing, and Experimental Validation of Ultracapacitor Open Circuit Voltage Characteristics

Amandeep Singh, Najath Abdul Azeez, Sheldon Williamson, University of Ontario Institute of Technology, Canada

D10.7: Novel SPICE Model for Common Mode Choke Including Complex Permeability

Katsuya Nomura, Naoto Kikuchi, Yoshitoshi Watanabe, Shuntaro Inoue, Yoshiyuki Hattori, Toyota Central R&D Labs., Inc., Japan

D11: Control I

Track: Control

CHAIR:

Bilal Akin, University of Texas, Dallas

Brian Zahnstecher, PowerRox LLC

D11.1: Analysis and Design of Capacitive Power Transmission System Employing Out-of-Band Wireless Feedback Link

Sung-Jin Choi, Hee-Su Choi, University of Ulsan, Korea, South

D11.2: Introducing Fourier-Based Modeling and Control of Active-Bridge Converters

Bas Vermulst¹, Jorge Duarte¹, Korneel Wijnands², Elena A. Lomonova¹, ¹Technische Universiteit Eindhoven, Netherlands, ²Prodrive Technologies BV / Technische Universiteit Eindhoven, Netherlands

D11.3: A Stability Analysis and Efficiency Improvement of Synchronverter

Prasanna Piya, Masoud Karimi-Ghartemani, Mississippi State University, United States

D11.4: Compensation of Switching Dead-Time Effects in Voltage-Fed PWM Inverters Using FPGA-Based Current Oversampling

Bastian Weber, Tobias Brandt, Axel Mertens, Gottfried Wilhelm Leibniz Universität Hannover, Germany

D11.5: Control Strategy of High Power Converters with Synchronous Generator Characteristics for PMSG-Based Wind Power Application

Yuzhi Zhang, Haoyan Liu, Alan Mantooth, University of Arkansas, United States

D11.6: Phase Compensation, ZVS Operation of Wireless Power Transfer System Based on SOGI-PLL

Pingan Tan, Haibing He, Xieping Gao, Xiangtan University, China

D11.7: A Novel Low-Cost Online State of Charge Estimation Method for Reconfigurable Battery Pack

Ni Lin¹, Song Ci¹, Dalei Wu², ¹University of Nebraska-Lincoln, United States, ²University of Tennessee at Chattanooga, United States

D11.8: Effect of Decoupling Terms on the Performance of PR Current Controllers Implemented in Stationary Reference Frame

Sizhan Zhou, Jinjun Liu, Xi'an Jiaotong University, China

D11.9: Fuzzy Predictive DTC of Induction Machines with Reduced Torque Ripple and High Performance Operation

Alberto Berzoy¹, Osama Mohammed¹, Johnny Rengifo², ¹Florida International University, United States, ²Universidad Simon Bolivar, Venezuela

D12: Control II

Track: Control

CHAIRS:

Martin Ordonez, University of British Columbia

Jiangbiao He, GE Global Research

D12.1: Fixed-Frequency Generalized Peak Current Control (GPCC) for Inverters

Mohammad Ebrahimi, Sayed Ali Khajehoddin, University of Alberta, Canada

D12.2: Improved Control Strategy of 1 MHz LLC Converter for High Frequency Resolution

Hwapyeong Park, Jeehoon Jung, Ulsan National Institute of Science and Technology, Korea, South

D12.3: Bumpless Control for Reduced THD in Power Factor Correction Circuits

Joel Steenis, Alex Dumais, Microchip Technology, United States

D12.4: Mixed-Signal Hysteretic Internal Model Control of Buck Converters for Ultra-Fast Envelope Tracking

Inder Kumar, Santanu Kapat, Indian Institute of Technology Kharagpur, India

D12.5: A Continuous Actor-Critic Maximum Power Point Tracker Applied to Low Power Wind Turbine Systems

Jorge Luiz Wattes Oliveira Junior, Antônio José Dias Júnior, Arthur Plínio Braga, Paulo Peixoto Praça, Allan Uchoa Barbosa, Demercil de Souza Oliveira Junior, Universidade Federal do Ceará, Brazil

D12.6: Multi-Band Mixed-Signal Hysteresis Current Control for EMI Reduction in Switch-Mode Power Supplies

Arindam Mandal, Inder Kumar, Santanu Kapat, Indian Institute of Technology Kharagpur, India

D12.7: A Parabolic Current Control Based Digital Current Control Strategy for High Switching Frequency Voltage Source Inverters

Lanhua Zhang¹, Rachael Born¹, Xiaonan Zhao¹, Jih-Sheng Jason Lai¹, Hongbo Ma², ¹Virginia Polytechnic Institute and State University, United States, ²Southwest Jiaotong University, China

D12.8: Finite Control Set Model Predictive Control of Dual-Output Four-Leg Indirect Matrix Converter Under Unbalanced Load and Supply Conditions

Ozan Gulbudak, Enrico Santi, University of South Carolina, United States

D12.9: A Silicon Carbide Integrated Circuit Implementing Nonlinear-Carrier Control for Boost Converter Applications

Richard Harris¹, Benjamin McCue¹, Benjamin Roehrs¹, Charles Roberts II¹, Benjamin J. Blalock¹, Daniel Jes Costinett¹, Kouros Sariri², George Megyei², Cheng-Po Chen³, Avinash Kashyap³, Reza Ghandi³, ¹University of Tennessee, United States, ²Frequency Management International, United States, ³GE Global Research, United States

D12.10: A New Current Mode Constant on Time Control with Ultrafast Load Transient Response

Syed Bari, Qiang Li, Fred C. Lee, Virginia Polytechnic Institute and State University, United States

D12.11: A Web-Based Tool for Compensation Design of Power Converters Using Hybrid Optimization

Srikanth Pam¹, Yudhister Satija¹, Pradeep Chawda², Makram Mansour², Robert Hanrahan², Jeff Perry², ¹Texas Instruments Inc., India, ²Texas Instruments Inc., United States

D12.12: Second Order Sliding Mode Controlled Point of Load Power Supply

Prasanta Achanta¹, David Jones¹, Dragan Maksimovic¹, Serhii Zhak², Brett Miwa³, Cory Arnold³, ¹University of Colorado Boulder, United States, ²Linear Technology Corporation, United States, ³Maxim Integrated, United States

D12.13: Vibration and Torque Ripple Reduction of Switched Reluctance Motors Through Current Profile Optimization

Cong Ma¹, Liyan Qu¹, Rakesh Mitra²,
Prerit Pramod², Rakib Islam², ¹University
of Nebraska-Lincoln, United States,
²Nexteer Automotive, United States

D12.14: Modified Predictive Current Control of Neutral-Point Clamped Converter with Reduced Switching Frequency

Dinto Mathew, Anshuman Shukla, Santanu
Bandyopadhyay, Indian Institute of Technology
Bombay, India

D12.15: Implicit Finite Control Set Model Predictive Current Control for Modular Multilevel Converter Based on IPA-SQP Algorithm

Hamed Nademi¹, Lars Norum², ¹ABB AS, Norway,
²Norwegian University of Science and Technology,
Norway

D12.16: Resolution Requirements to Avoid Limit Cycling in LLC Resonant Converter

Shadi Dashmiz¹, Behzad Mahdavihah¹,
Aleksandar Prodic¹, Brent McDonald²,
¹University of Toronto, Canada,
²Texas Instruments Inc., United States

D13: Renewable Energy Systems I

Track: Renewable Energy Systems

CHAIRS:

Akshay Kumar Rathore, *Concordia University*

Xiaoqiang Guo, *Yanshan University, China*

D13.1: Reduction of Storage Capacity in DC Microgrids Using PV-Embedded Series DC Electric Springs

Minghao Wang, Siew-Chong Tan, Shu Yuen Ron
Hui, *University of Hong Kong, Hong Kong*

D13.2: A Vector Control Strategy of Grid-Connected Brushless Doubly Fed Induction Generator Based on the Vector Control of Doubly Fed Induction Generator

Sheng Hu, Guorong Zhu, *Wuhan University of
Technology, China*

D13.3: An Energy Router Based on Multi-Winding High-Frequency Transformer

Xianzhuo Liu, Zedong Zheng, Kui Wang,
Yongdong Li, *Tsinghua University, China*

D13.4: Noise Suppression of the DWT-Based MRA on Mother Wavelet and Decomposition Level Optimization for a Robust Adaptive SOC Estimator in Multi-Cell Battery String

Jonghoon Kim¹, Chang Yoon Chun², Woonki
Na³, ¹Chosun University, Korea, South, ²Seoul
National University, Korea, South, ³California State
University, Fresno, United States

D13.5: A Feedforward Control Based Power Decoupling Scheme for Voltage-Controlled Grid-Tied Inverters

Baojin Liu, Zeng Liu, Jinjun Liu, Teng Wu,
Shike Wang, *Xi'an Jiaotong University, China*

D13.6: Light Load Efficiency Improvement of Solar Farms Three-Phase Two-Stage Module Integrated Converter

Ahmadreza Amirahmadi, Utsav Somani,
Mahmood Alharbi, Charlie Jourdan, Issa Batarseh,
University of Central Florida, United States

D13.7: Switching System Stability Analysis of DC Microgrids with DBS Control

Na Zhi¹, Hui Zhang¹, Xi Xiao², ¹Xi'an University of
Technology, China, ²Tsinghua University, China

D13.8: A Grid-Connected WECS with Power Limiting Control

Jéssica Guimarães, Demercil de Souza Oliveira
Junior, Juliano de Oliveira Pacheco, Paulo P.
Peixoto, *Universidade Federal do Ceará, Brazil*

D13.9: Overshoot Control of the Electromagnetic Torque During Fault Recovery for an SCIG with a STATCOM

Zahra Mahmoodzadeh, Mehrdad Yazdanian,
Hooman Ghaffarzadeh, Ali Mehrizi-Sani,
Washington State University, United States

D13.10: A Self-Adaptive Power Balance Control Strategy for PV Inverters in Islanded Microgrids

Zhenxiong Wang, Hao Yi, Fang Zhuo,
Zhigang Zhang, *Xi'an Jiaotong University, China*

D13.11: High Performance ZVT with Bus Clamping Modulation Technique for Single Phase Full Bridge Inverters

Yinglai Xia, Raja Ayyanar, *Arizona State University,
United States*

D13.12: Small AC Signal Droop Based Secondary Control for Microgrids

Teng Wu, Zeng Liu, Jinjun Liu, Baojin Liu,
Shike Wang, *Xi'an Jiaotong University, China*

D13.13: Mode Transition Control Strategy for Multiple Inverter Based Distributed Generators Operating in Grid-Connected and Stand-Alone Mode

Onkar Kulkarni, Suryanarayana Doolla, Baylon Fernandes, *Indian Institute of Technology Bombay, India*

D13.14: An Autonomous Power Management Strategy Based on DC Bus Signaling for Solid-State Transformer Interfaced PMSG Wind Energy Conversion System

Rui Gao, Iqbal Husain, Alex. Q Huang, *North Carolina State University, United States*

D13.15: An Isolated Buck-Boost Type High-Frequency Link Photovoltaic Microinverter

Shiladri Chakraborty, Souvik Chattopadhyay, *Indian Institute of Technology Kharagpur, India*

D13.16: Energy Management and Stabilization of a Hybrid DC Microgrid for Transportation Applications

Mehdi Karbalaye Zadeh¹, Louis-Marie Saublet², Roghayeh Gavagsaz-Ghoachani², Babak Nahid-Mobarakeh², Serge Pierfederici², Marta Molinas¹, ¹Norwegian University of Science and Technology, Norway, ²Université de Lorraine, France

D13.17: A Low-Cost Solar Micro-Inverter with Soft-Switching Capability Utilizing Circulating Current

Xiaohu Liu, Mohammed Agamy, Dong Dong, Maja Harfman-Todorovic, Luis Garces, *GE Global Research, United States*

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D14: Renewable Energy Systems II

Track: Renewable Energy Systems

CHAIRS:

Haoyu Wang, *Shanghai Tech University*

Robert Pilawa-Podgurski, *University of Illinois at Urbana-Champaign*

D14.1: Design and Stability Analysis for an Autonomous DC Microgrid with Constant Power Load

Qianwen Xu¹, Xiaolei Hu¹, Peng Wang¹, Jianfang Xiao¹, Leonardy Setyawan¹, Changyun Wen¹, Lee Meng Yeong², ¹Nanyang Technological University, Singapore, ²Rolls-Royce Singapore Pte. Ltd., Singapore

D14.2: MPC-SVM Method for Vienna Rectifier with PMSG Used in Wind Turbine Systems

June-Seok Lee¹, Yeongsu Bak¹, Kyo-Beum Lee¹, Frede Blaabjerg², ¹Ajou University, Korea, South ²Aalborg University, Denmark

D14.3: An Equivalent Circuit Model for State of Energy Estimation of Lithium-Ion Battery

Kaiyuan Li, King-Jet Tseng, *Nanyang Technological University, Singapore*

D14.4: Distributed Optimal Control of Reactive Power and Voltage in Islanded Microgrids

Yanbo Wang, Xiongfei Wang, Zhe Chen, Frede Blaabjerg, *Aalborg University, Denmark*

D14.5: New Start-Up Scheme for HF Transformer Link Photovoltaic Inverter

Abhijit Kulkarni, Vinod John, *Indian Institute of Science, India*

D14.6: Analysis and Improvement of Harmonic Quasi Resonant Control for LCL-Filtered Grid-Connected Inverters in Weak Grid

Qiang Qian, Jinming Xu, Shaojun Xie, Lin Ji, *Nanjing University of Aeronautics and Astronautics, China*

D14.7: Model Predictive Control Method to Reduce Common-Mode Voltage and Balance the Neutral-Point Voltage in Three-Level T-Type Inverter

Xiangyang Xing, Alian Chen, Zicheng Zhang, Jie Chen, Chenghui Zhang, *Shandong University, China*

D14.8: Convergence Analysis of Distributed Control for Operation Cost Minimization of Droop Controlled DC Microgrid Based on Multiagent

Chendan Li, Juan C. Vásquez, Josep Maria Guerrero, *Aalborg University, Denmark*

D14.9: A Novel Model Predictive Control Algorithm to Suppress the Zero-Sequence Circulating Currents for Parallel Three-Phase Voltage Source Inverters

Zicheng Zhang, Alian Chen, Xiangyang Xing, Chenghui Zhang, *Shandong University, China*

D14.10: Design of Dynamic Voltage Restorer and Active Power Filter for Wind Power Systems Subject to Unbalanced and Harmonic Distorted Grid

Woei-Luen Chen, Meng-Jie Wang, *Chang Gung University, Taiwan*

D14.11: Dynamic Variable Coupling Analysis and Modeling of Proton Exchange Membrane Fuel Cells for Water and Thermal Management

Daming Zhou¹, Elena Breaz¹, Alexandre Ravey¹,
Fei Gao¹, Abdellatif Miraoui¹, Ke Zhang²,
¹Universite de technologie de Belfort-Montbéliard,
France, ²Northwestern Polytechnical University,
China

D14.12: Voltage and Frequency Control of Electric Spring Based Smart Loads

Yun Yang, Siew-Chong Tan, Shu Yuen Ron Hui,
University of Hong Kong, Hong Kong

D14.13: Second Harmonic Current Compensator with Improved One-Cycle-Control

Li Zhang, Xinbo Ruan, Xiaoyong Ren, Nanjing
University of Aeronautics and Astronautics, China

D14.14: Frequency Adaptive Control of a Smart Transformer-Fed Distribution Grid

Zhi-Xiang Zou, Giovanni De Carne, Giampaolo
Buticchi, Marco Liserre, Christian-Albrechts-
Universität zu Kiel, Germany

D14.15: A Synchronization Scheme for Single-Phase Grid-Tied Inverters Under Harmonic Distortion and Grid Disturbances

Lenos Hadjidemetriou¹, Elias Kyriakides¹,
Yongheng Yang², Frede Blaabjerg², ¹University of
Cyprus, Cyprus, ²Aalborg University, Denmark

D14.16: Series-Parallel Connection of Low-Voltage Sources for Integration of Galvanically Isolated Energy Storage Systems

Ramy Georgious, Jorge Garcia, Angel Navarro,
Sarah Saeed, Pablo Garcia, Universidad de
Oviedo, Spain

D14.17: Saturation Controller-Based Direct Power Control for Doubly-Fed Induction Generator

Chun Wei¹, Zhe Zhang², Wei Qiao¹, Liyan Qu¹,
¹University of Nebraska-Lincoln, United States,
²Nexteer automotive, United States

D14.18: Inductance-Simulating Control for DFIG-Based Wind Turbine to Ride-Through Grid Faults

Donghai Zhu¹, Xudong Zou¹, Yong Kang¹,
Lu Deng², Qingjun Huang³, ¹Huazhong University
of Science and Technology, China, ²Wuhan NARI
Limited Company of State Grid Electric Power
Research Institute, China, ³State Key Laboratory
of Disaster Prevention & Reduction for Power Grid
Transmission and Distribution, China

D15: Transportation Power Electronics

Track: Transportation Power Electronics

CHAIRS:

Ted Bohn, Argonne National Labs

Khurram Afridi, University of Colorado, Boulder

D15.1: Misalignment Effect on Efficiency of Wireless Power Transfer for Electric Vehicles

Yabiao Gao¹, Antonio Ginart², Kathleen Farley³,
Zion Tsz Ho Tse¹, ¹University of Georgia,
United States, ²Sonnenbatterie GmbH / University
of Georgia, United States, ³Southern Company
Services, Inc., United States

D15.2: Genetic Algorithm Design of a 3D Printed Heat Sink

Tong Wu, Burak Ozpineci, Curtis Ayers,
Oak Ridge National Laboratory, United States

D15.3: Evaluation of Power Flow Control for an All-Electric Warship Power System with Pulsed Load Applications

Jason Neely, Lee Rashkin, Marvin Cook,
David Wilson, Steve Glover, Sandia National
Laboratories, United States

D15.4: Reduced Active Switch AC to DC Rectifier with High Frequency Isolation for Electric Vehicle Chargers

Jose Sandoval, Taeyong Kang, Prasad Enjeti,
Texas A&M University, United States

D15.5: A Wide Bandgap Device Based Multilevel Switched-Capacitor Converter

Diogo Cesar Santos de Moura, Boris Curuvija,
Dong Cao, North Dakota State University,
United States

D16: Power Topologies, Distribution, and Control

Track: Power Electronics Applications

CHAIR:

Tiefu Zhao, Eaton

Xiaonan Lu, Argonne National Laboratory

D16.1: Novel Circulating Current Suppression Strategy for MMC Based on Quasi-PR Controller

Shengbao Geng, Yiliang Gan, Yungui Li,
Lijun Hang, Guojie Li, Shanghai Jiao Tong
University, China

D16.2: Asymmetric Duty-Cycle Phase-Shift Modulation for Power Management in Double Half-Bridge Inverter with Partly Coupled Inductive Loads

Claudio Carretero, Hector Sarnago, Oscar Lucia, Jesús Acero, José Miguel Burdío, *Universidad de Zaragoza, Spain*

D16.3: Control Implementation for a Wide Voltage Range High Efficiency Power Supply Utilizing Low Voltage MOSFETs

Werner Konrad¹, Gerald Deboy², Annette Muetze¹, ¹Technische Universität Graz, Austria, ²Infineon AG, Austria

D16.4: A Single-Phase Dual Frequency Inverter Based on Multi-Frequency Selective Harmonic Elimination

Chongwen Zhao¹, Daniel Jes Costinett¹, Brad Trento¹, Daniel Friedrichs², ¹University of Tennessee, United States, ²Medtronic, United States

D16.5: Grid Connected DC Distribution Network Deploying High Power Density Rectifier for DC Voltage Stabilization

Danillo Rodrigues¹, Paulo Silva², Gustavo Lima¹, Ernane A. A. Coelho², Luiz C. G. Freitas², ¹Universidade Federal do Triângulo Mineiro, Brazil, ²Universidade Federal de Uberlândia, Brazil

D16.6: Even-Harmonic Repetitive Control for Circulating Current Suppression in Modular Multilevel Converters

Shunfeng Yang¹, Peng Wang¹, Yi Tang¹, Michael Zagrodnik², Xiaolei Hu¹, King-Jet Tseng¹, ¹Nanyang Technological University, Singapore, ²Rolls-Royce Singapore Pte. Ltd., Singapore

D16.7: A New DSC-PLL Using Recursive Discrete Fourier Transform for Robustness to Frequency Variation

Jae Do Lee¹, Hanju Cha², ¹Korea Institute of Nuclear Safety, Korea, South, ²Chungnam National University, Korea, South

D16.8: A Four-Quadrant Modulation Technique for Cascaded Multilevel Inverters to Extend Solution Range for Selective Harmonic Elimination / Compensation

Hui Zhao, Shuo Wang, *University of Florida, United States*

D16.9: Online Battery Impedance Spectrum Measurement Method

Jaber Abu Qahouq, *University of Alabama, United States*

D16.10: Analysis and Control of a Reduced Switch Converter for Active Magnetic Bearings

Dong Jiang¹, Parag Kshirsagar², ¹Huazhong University of Science and Technology, United States, ²United Technologies Research Center, United States

D16.11: A Novel Balanced Winding Topology to Mitigate EMI Without the Need for a Y-Capacitor

Yongjiang Bai¹, Xu Yang¹, Xinlei Li², Dan Zhang², Wenjie Chen¹, ¹Xi'an Jiaotong University, China, ²Silergy Corp., China

D16.12: Topology and Control Strategy for Accelerated Lifetime Test Setup of DC-Link Capacitor of Wind Turbine Converter

Youngjong Ko, Holger Jedtberg, Giampaolo Buticchi, Marco Liserre, *Christian-Albrechts-Universität zu Kiel, Germany*

D16.13: Voltage Droop Compensation Based on Resonant Circuit for Generalized High Voltage Solid-State Marx Modulator

Hiren Canacsinh¹, Luís Redondo¹, José Silva², Beatriz Borges², ¹Instituto Superior de Engenharia de Lisboa, Portugal, ²Instituto Superior Técnico, Portugal

D16.14: Four H-Bridge Based Shunt Active Power Filter for Three-Phase Four Wire System

Edgard L. L. Fabricio¹, Cursino B. Jacobina², Gregory A. de Almeida Carlos², Maurício B. R. Correa², ¹Universidade Federal da Paraíba, Brazil, ²Universidade Federal de Campina Grande, Brazil

D16.15: High-Frequency AC Distributed Power Delivery System

Mengqi Wang¹, Qingyun Huang², Wensong Yu², Alex. Q. Huang², ¹University of Michigan-Dearborn, United States, ²North Carolina State University, United States

D16.16: Effect of the Capacitance Distribution on the Output Impedance of the Half-Wave Cockcroft-Walton Voltage Multiplier

Liran Katzir, Doron Shmilovitz, *Tel Aviv University, Israel*

D17: Emerging and Renewable Power

Track: Power Electronics Applications

CHAIRS:

Katherine Kim, *Ulsan NIST*

Dimitri Torregrossa, *EPFL*

D17.1: A Cost Effective High Performance LED Driver Powered by Electronic Ballasts

Jianwen Shao, Thomas Stamm,
STMicroelectronics, United States

D17.2: Model Predictive Control of Z-Source Four-Leg Inverter for Standalone Photovoltaic System with Unbalanced Load

Sertac Bayhan, Mohamed Trabelsi, Haitham Abu-Rub, *Texas A&M University at Qatar, Qatar*

D17.3: Efficiency Optimization of an Integrated Wireless Power Transfer System by a Genetic Algorithm

Rosario Pagano¹, Siamak Abedinpour¹, Angelo Raciti², Salvatore Musumeci², *¹Integrated Device Technology Inc., United States, ²Università degli Studi di Catania, Italy*

D17.4: Loss Analysis of a High Efficiency GaN and Si Device Mixed Isolated Bidirectional DC-DC Converter

Fei Xue, Ruiyang Yu, Alex. Q. Huang,
North Carolina State University, United States

D17.5: Dynamic Efficiency Tracking Controller for Reconfigurable Four-Coil Wireless Power Transfer System

Yuan Cao, Zhigang Dang, Jaber Abu Qahouq, Evan Phillips, *University of Alabama, United States*

D17.6: Wireless Power and Data Transfer System for Smart Bridge Sensors

Yujin Jang, Jung Kyu Han, Shin Young Cho, Gun-Woo Moon, Ji-Min Kim, Hoon Sohn, *Korea Advanced Institute of Science and Technology, Korea, South*

D17.7: Inrush Transient Current Analysis and Suppression of Photovoltaic Grid-Connected Inverters During Voltage Sag

Zhongyu Li¹, Rende Zhao¹, Zhen Xin², Josep Maria Guerrero², Mehdi Savaghebi², Peide Li³,
¹China University of Petroleum, China, ²Aalborg University, Denmark, ³Shandong Jinan Power Equipment Factory Co., LTD, China

D17.8: A Highly Reliable Single-Stage Converter for Electric Vehicle Applications

S.A.Kh. Seyedabdolkh Mozaffari Niapour, Mahshid Amirabadi, *Northeastern University, United States*

D17.9: A Modular High Frequency High Voltage Generator with Silicon Carbide Power Semiconductor Devices

Saijun Mao¹, Tao Wu¹, Xi Lu¹, Jelena Popovic², Jan Abraham Ferreira², *¹GE Global Research, China ²Delft University of Technology, Netherlands*

D17.10: Simple and Efficient Low Power Photovoltaic Emulator for Evaluation of Power Conditioning Systems

Jesus Gonzalez-Llorente¹, Andres Rambal-Vecino¹, Luciano Garcia-Rodriguez², Juan Carlos Balda², Eduardo I. Ortiz-Rivera³, *¹Universidad Sergio Arboleda, Colombia, ²University of Arkansas, United States, ³University of Puerto Rico at Mayaguez, Puerto Rico*

D17.11: Data Transmission Method Without Additional Circuits in Bidirectional Wireless Power Transfer System

Yeongrack Son, Jung-Ik Ha, *Seoul National University, Korea, South*

D17.12: Improved Impedance Source Inverter for Hybrid/Electric Vehicle Application with Continuous Conduction Operation

Thilak Senanayake, Ryuji Iijima, Takanori Isobe, Hiroshi Tadano, *Tsukuba University, Japan*

Dialogue Sessions Floor Plan

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D17.8 D17.9 D17.10 D17.11 D17.12
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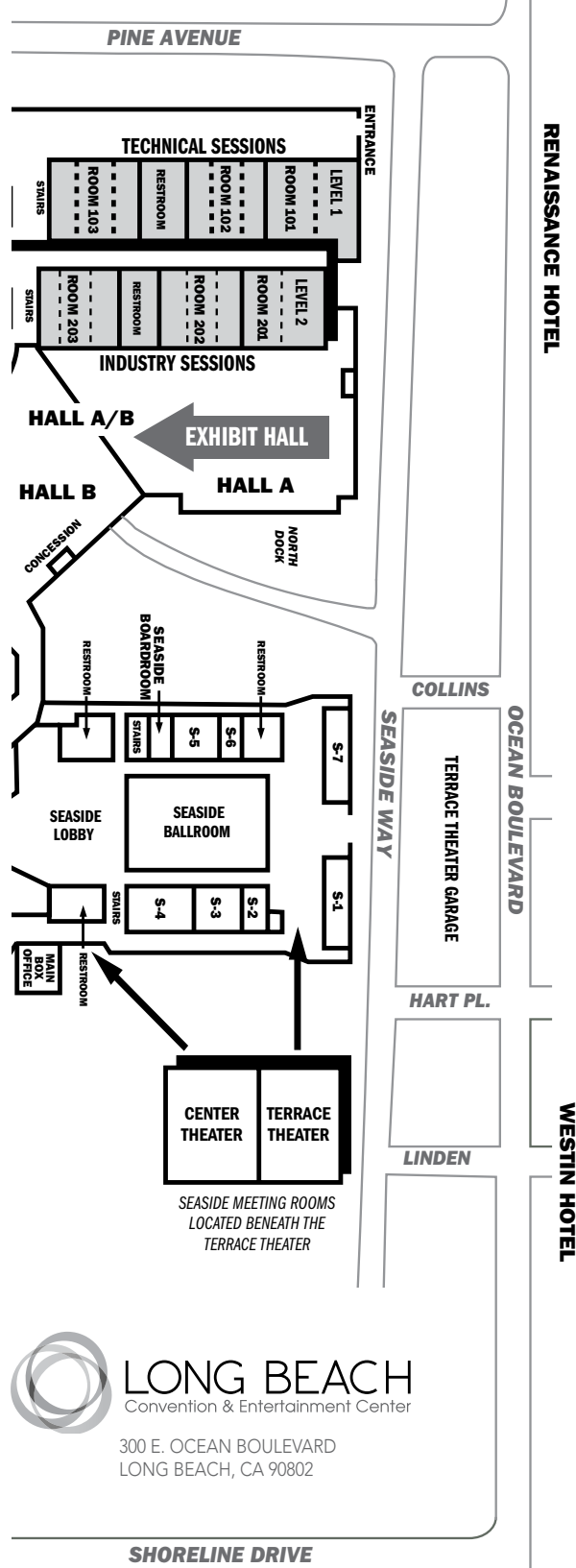
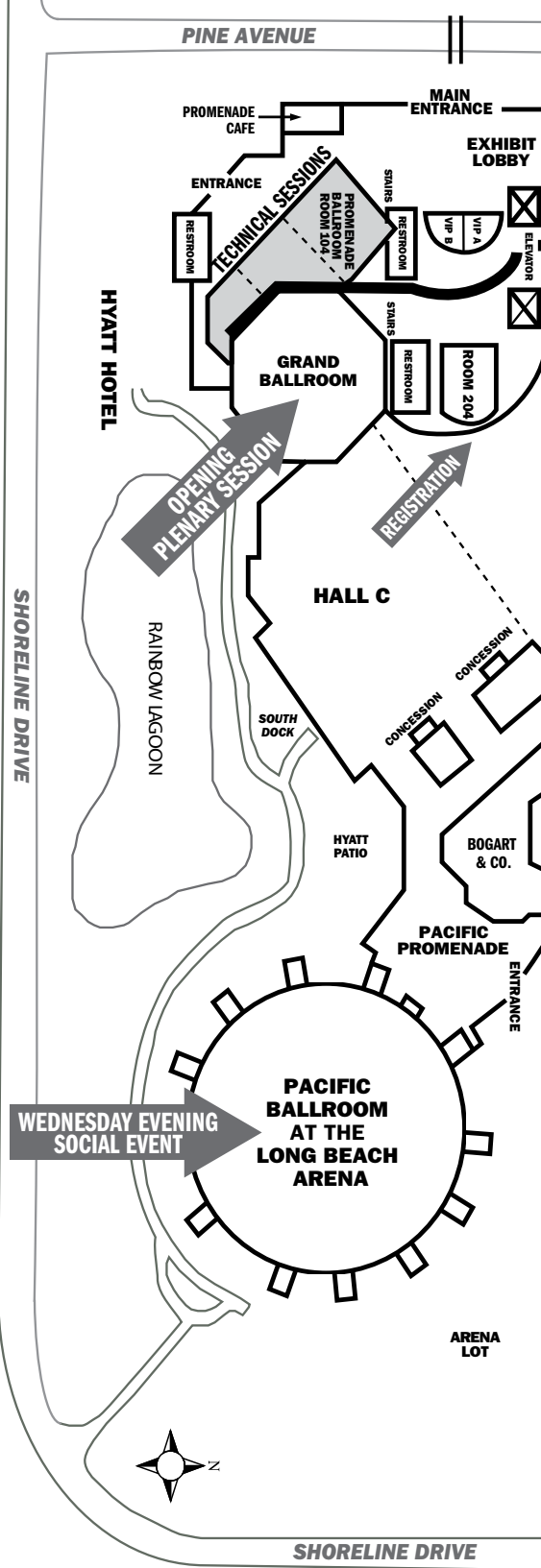
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APEC 2016 Exposition

The 2016 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 25th 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!

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DIAMOND



PLATINUM



SILVER



PRESS ROOM



Exposition Information

The Exposition will open on Monday, March 21 when the Plenary Session concludes.

**Hall will open upon conclusion of the Plenary*

Exhibit Hall Hours

Monday, March 21 5:00 p.m.* – 8:00 p.m.
 Tuesday, March 22 12:00 p.m. – 5:00 p.m.
 Wednesday, March 23 10:00 a.m. – 2:00 p.m.

Admission

Entry is granted to persons 18 or older with any APEC badge, including the free “Exhibits Only” badge which also grants admission to the exhibitor seminars, plenary session, micromouse contest and rap sessions.

Exhibit Hall Functions

Exhibitors' Reception

A Welcoming Reception will be held in the Exhibit Halls on Monday, March 21, 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 – Booth 939

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.

Exhibitor Seminars

Exhibitor Seminars – Session #1

Tuesday, March 22, 1:30 p.m. – 2:00 p.m.

Coilcraft

ROOM 101A

New Power Inductors for High Frequency DC-DC Converters

SPEAKER: Len Crane

This presentation introduces new power inductors optimized for 2 to 10 MHz switching. As switching frequencies increase in order to reduce the size of passive components, new magnetic designs are required to fulfill that promise. This presentation will describe new inductors and the data users need from inductor suppliers to incorporate them in optimized designs for best efficiency and small size.

Dino-Lite Scopes (BigC)

ROOM 101B

Dino-Lite Digital Microscope: Edge Series

SPEAKER: Lance Dominguez

Dino-Lite handheld USB microscopes used for inspection and quality control. Most models provide 10x-200x magnification, with higher magnification ranges going up to 500x and 900x. The included DinoCapture software includes capability to capture images, record videos annotate and perform measurements, and save and email discoveries. The Edge series contain an enhanced sensor for improved image quality. New features include Extended Depth of Field (EDOF), Extended Dynamic Range (EDR), and Automatic Magnification Reading (AMR). 5MP resolution Edge series units also have Flexible LED Control (FLC) to enable partial illumination. Mobile solutions include use with our wifi adapter or a direct connection to Windows RT tablets or select Android devices.

Hydro-Québec Research Institute (IREQ)

ROOM 102AB

Simulating Power Electronics Converters Using MATLAB/SimPowerSystems.

The Right Balance between Performance and Fidelity

SPEAKER: Pierre Giroux et Patrice Brunelle,
Research Scientists

When power system engineers are simulating power electronics converter-based systems using advanced simulation tools, they are often required to use special modeling techniques in order to speed-up simulation. However, these techniques may have drawbacks that will impair simulation results, hence the need to find the right balance between performance and fidelity.

The tutorial presents four different levels of abstraction for modeling power electronics converters. These levels are described, along with simulation results. A comparison of the methods and a description of their respective domains of validity are also presented. Last, the most appropriate method for a given phenomenon under study is proposed.

Infineon Technologies

ROOM 103AB

MOSFET Driver IC Solutions from Infineon Technologies

SPEAKER: Hubert Baierl

Driver ICs are used for high power SMPS to create a crucial link between control ICs and switching MOSFETS which require higher gate drive voltage and current. Use of Driver IC offers ease of design, leads to higher power density and increases reliability and robustness of the solution. This session focuses on important features and requirements for driver IC and also highlights driver IC solutions from Infineon. The audience will benefit from this session by understanding the criteria for selecting the right driver IC solution for their application.

LEM USA

ROOM 201A

New ASIC based Open Loop Transducers

SPEAKER: Mark Spiering

How LEM's new ASIC design greatly improves Open Loop Transducer performance and flexibility.

NXP Semiconductors USA, Inc.

ROOM 201B

Introducing new Motor Drivers featuring Functional Safety and Higher Torque

SPEAKER: Tom Zemites

Introducing a new motor driver product family designed for automotive engine control applications. The MC33HB2000 and MC33HB2001 product family providing many firsts in the industry.

It will be the first motor driver fully certified to ISO26262 to support ASIL level D system qualification. It features a patented thermal management scheme ensuring high efficient operation by reducing switching losses when motor is experiencing heavy loads or binding. It provides the lowest integrated RDS (ON) as well as the most accurate current feed-back circuit providing continuous motor operation in critical applications and harsh environments.

The product will be featured in the NXP booth with a hands-on demonstration using the MC33HB2001 brushed dc motor driver. We will apply loads to these devices driving them into their over current condition and using a scope to monitor the devices thermal management functions.

STMicroelectronics

ROOM 202AB

Silicon Carbide MOSFET Benefits in Automotive Applications

SPEAKER: Jeffrey Fedison

In Automotive applications large advantages are offered by Silicon Carbide (SiC) solutions at any load condition in terms of power losses, efficiency and consequently longer battery autonomy as well as smaller cooling system. However SiC MOSFET solution must be dimensioned in order to maintain a reasonable junction temperature at the peak power

condition where any MOSFET solution is affected by huge conduction losses that can be only partially counter-compensated by the much better switching performance.

Texas Instruments

ROOM 203AB

Big Batteries: take a walk on the high side with TI's 100-V FET driverSPEAKER: Allen Y Chen, *Product Marketing & Applications Manager***Battery Management Solutions – Monitoring & Protection**

Drones, cordless robotics, energy storage systems and light electric vehicles all share one key thing in common: they rely on big batteries, and consumers expect a premium product to match the premium price tag. TI's new bq76200 is the first-ever high-side battery FET driver for such high-voltage battery applications, offering incredible flexibility to battery pack designers looking for robust, low power protection FET control. The bq76200 eliminates the struggles associated with building complicated, reliability-constrained discrete charge-pump circuits to achieve a high-side FET drive, and is a perfect complement to many of TI's existing battery monitors and companion fuel gauges. It helps designers promise the best of all worlds: a truly intelligent battery, capable of collaborating with a system 24/7 while maintaining protection and ensuring longevity.

Exhibitor Seminars – Session #2

Tuesday, March 22, 2:15 p.m. – 2:45 p.m.

Aavid Thermalloy LLC

ROOM 101A

Aavid Thermalloy Expands Capabilities & Products with Niagara Acquisition

SPEAKER: Robert Soucy, Mark Parisi

With the acquisition of Niagara Thermal Products, Aavid continues to expand and round out its capabilities and products to serve multiple industries, and markets with the latest in technology, manufacturing and complete Global Supply Chain management. This discussion will outline the advantage of working with Aavid – Niagara on any Electronic Cooling

Application, with complete Global manufacturing and technology centers located around the world. With the added specialization in process, engineering, and manufacturing, the Aavid-Niagara offers the market a complete supplier that really is the leader in all aspects of Electronic Cooling, from complete systems to simple components.

CogniPower

ROOM 101B

The Practical Side of Faster, Smaller, More Efficient Power Converters

SPEAKER: Tom Lawson

Faster, better power switches are essential for building faster, better power converters, but they are not a solution by themselves. Parasitics and latency must be minimized, and controls, magnetics and filters must be reexamined.

CogniPower is demonstrating a fast Predictive Energy Balancing power converter that takes good advantage of an advanced GaN output stage. What are the challenges involved?

Magnetics

ROOM 102AB

Large XFLUX® and Block Structures for High Current Applications

SPEAKER: Brad Van Fleet

In this presentation, we will go over new offerings from Magnetics geared for use in high current inductors and chokes. This includes discussion about the expansion of our XFLUX product line as well as new capabilities related to the creation of custom block structures. An overview of a few inductor designs with these new products will be presented to showcase the advantages of each and to provide guidance on applications where they will be useful. In addition, topics related to inductance calculations and testing for block structures will be reviewed.

NH Research, Inc.

ROOM 103AB

Testing Vehicle Power & V2G Applications

SPEAKER: Martin Weiss

This session describes the key factors in selecting the right equipment used for testing vehicle power systems as well as vehicle-to-grid (V2G) applications. Selecting the right equipment simplifies testing allowing for earlier validation, faster time to results, increased test coverage, improved design characterization, and enables research for emerging applications such as vehicle-to-grid (V2G). Use these key factors in selecting test equipment as using the right tool for the job always simplifies the effort required.

Powerex, Inc.

ROOM 201A

New DIIPM™s Featuring More Integration and Lower Cost

SPEAKER: Michael Rogers, *Powerex Applications Engineer*

Powerex is pleased to introduce the latest Dual In-line Package Intelligent Power Modules (DIIPMs™) designed to meet demands for low cost, high reliability, more integration and space savings in small industrial and commercial motor drive applications. This presentation will feature two new products:

- (1) The new slim package SLIMDIP series power module, developed primarily for white goods applications such as air conditioning, refrigeration and washing machines, utilizing RC-IGBT (Reverse Conducting IGBT) technology which integrates the IGBT and free-wheel diode into a single super thin chip to provide considerable space savings and lower cost.
- (2) The new all-in-one transfer molded DIIPM+, developed primarily for small industrial motor drives, includes CIB (Converter-Inverter-Brake) circuits and built-in gate drivers with protection functions. The result is a significant total system size and cost reduction.

DIIPM is a registered trademark of Mitsubishi Electric

SIMPLIS Technologies

ROOM 201B

Designing Digitally Controlled Systems with SIMPLIS

SPEAKER: Christopher Bridge

A design methodology is presented for designing digitally controlled systems using the SystemDesigner features of the SIMPLIS simulator. Taking full advantage of these SystemDesigner capabilities, we demonstrate how users can simulate their digitally controlled systems such that they have the option, with a single schematic, to model the signal path as either signed integers or double precision floating-point numbers. Modeling the signal path with double precision allows users to take advantage of the SIMPLIS Periodic Operating Point and AC analyses. Modeling the signal path as signed integers captures the expected quantization effects of the digitally controlled loop.

This technique is applicable for both hardware and firmware/software digital control implementations. Using an LLC DC-DC converter as an example, we show how to transition from an analog controller to a digital control implementation.

Mouser Electronics

ROOM 203AB

An Integrated Filter and Power Converter Electric Vehicle Powertrain Solution

SPEAKER: Matthew Reynolds, *EPCOS, Inc. A TDK Group Company*

Dr. David Levett, *Infineon Technologies Industrial Power and Control Division*

As electric and hybrid electric vehicles increase their share of the overall passenger vehicle market, the design requirements for the traction drives and filters becomes more demanding. The drives must become more compact, resistant to mechanical shock and vibration, and operate over longer lifetimes, both more reliably and more efficiently. Additionally, specialized filters are required for the reduction of electromagnetic noise, voltage spikes and ground currents in order to further extend the life of the electric motor and to reduce interference with communication systems within the vehicle. Join

us as we further discuss the solutions EPCOS and Infineon have developed to address the challenges faced in the ever growing market of electric and hybrid vehicles.

Vishay Intertechnology

ROOM 202AB

Performance Components for Power Applications

SPEAKER: Breno Albuquerque

Vishay will highlight its latest industry-leading power MOSFET, passive component, and diode technologies for a wide range of power applications.

Exhibitor Seminars – Session #3

Tuesday, March 22, 3:00 p.m. – 3:30 p.m.

AgileSwitch, LLC

ROOM 101A

An Industry First – Silicon Carbide based Intelligent Power Module

SPEAKER: Nitesh Satheesh

Since inception, AgileSwitch has introduced products true to its mission “Digitize a traditionally Analog Power Electronics World” and with the introduction of the Industry’s First SiC IPM, we take this a step further.

Come Take a peek at how AgileSwitch’s technology can enable a quick turn implementation of next generation SiC technology at a fraction of the cost of a standard development cycle.

Fair-Rite Products Corp.

ROOM 101B

Low loss 67 Material for High Frequency Power Applications

SPEAKER: Rachael Parker

The development of high frequency switching power converters has driven the need for low loss magnetic materials.

Due to the lack of material performance data, the design of power magnetic components for high frequency operation (2-20 MHz) has been difficult to achieve.

This presentation will review the intrinsic material characteristics (such as power loss density & useable flux density) in low permeability Ni Zn ferrites and will focus on Fair-Rite type 67 Material.

Magsoft Corporation

ROOM 102AB

Fast Computation of Inductance, Capacitance, Current Density in Conductor Arrangements

SPEAKER: Philippe Wendling

In power converters, the electromagnetic behavior of “metallic cabling” which interconnects semiconductor components is non-ideal: parasitic resistive, inductive and capacitive effects occur in such power devices causing respectively energy losses, switching overvoltages and EMC issues. In particular, interconnection parts (i.e. electrical conductors) generate electromagnetic stress and possibly system failures, since they add to the expected functional behavior of the converters.

This presentation will highlight the importance of 3D electromagnetic simulations which help designers in assessing these undesirable effects and improving system performances: InCa3D is a simulation software for low & medium frequencies dedicated to electrical interconnection modeling. Based on the innovative and very efficient PEEC (Partial Element Equivalent Circuit) method, it is well suited for analyzing the behavior (current distributions, radiated magnetic fields) of almost any kind of connections, additionally providing RLC extraction and generation of equivalent circuits.

Benefits of its use during the design of power devices will be illustrated by examples.

Monolithic Power Systems (MPS)

ROOM 103AB

High Performance PMSM Servo System Using MPS e.Motion Technology

SPEAKER: Ted Smith, *Sr. Field Applications Engineer*

The booming robotic industry is calling for high-performance servo systems. This presentation introduces a high-performance PMSM servo system using MPS proprietary eMotion technology, which combines an accurate magnetic position sensor, a

3-phase PMSM motor driver, and an FOC control algorithm. This presentation will discuss MPS' magnetic sensor technology, the benefits of FOC control, and the GUI software.

ON Semiconductor

ROOM 201A

Energy Efficient Innovations

SPEAKER: Dhaval Dalal

ON Semiconductor will present the latest developments in power semiconductors and high density power applications. This will include new high efficiency products and design considerations.

Typhoon HIL, Inc.

ROOM 201B

Ultra-high Fidelity Hardware-in-the-loop Simulation for Power Electronics and Microgrid

SPEAKER: Alex Sedaghat, *Applications Engineer, Typhoon HIL, Inc.*

Significant and growing penetration of smart inverters represents both challenges and incipient opportunities to increase utility grid agility and stability. In addition to inherently fast dynamic control capabilities, these power electronics systems interact with increasingly diverse physical systems (such as renewable generation technologies) in complex ways. Indeed, grid is becoming a true cyberphysical system with a layered architecture comprising both power processing and control and communications. Classical tools that are used for simulation, testing, and system validation are very limited in both model fidelity and flexibility. In this talk we will present a new approach to power electronics and power system controls testing and validation based on ultra-high fidelity Hardware-in-the-Loop (HIL) real-time simulation.

Our HIL platform enables ultra-high-fidelity real-time simulation of power electronics converters, microgrids, distribution and transmission networks, with 1 μ s simulation time step. In addition, our HIL simulation is directly interfaced with real digital controllers, thereby eliminating modeling assumptions and thus providing the most realistic “flight simula-

tor” experiences for power electronics and power system simulations. We will discuss how Typhoon HIL is changing the testing and quality assurance processes in power electronics industry today and how we are helping, in our small way, utilities and system integrators revolutionize the grid.

Würth Elektronik eiSos

ROOM 203AB

8 Simple Design Tips – How to Design in a Power Inductor

SPEAKER: Raghu Narayanan

This practical session is developed to help you with your applications and designs to gain a better understanding, and make your daily work easier, when choosing the correct power inductor for your switch mode power supply. You'll be able to differentiate between a low loss and a low cost magnetic component at the end of the session.

ZES ZIMMER Inc.

ROOM 202AB

New AC Power Measuring Advancements: Power Supplies, Drives, PWM, Harmonics, Waveforms and More

SPEAKER: Robert Emerson

ZES ZIMMER, the German company dedicated to precise power measurement, recently has introduced its 4th generation power analysis platform with major improvements for measuring high speed switching circuits: analyze high frequencies accurately while also conforming to Nyquist constraints for waveform transformations without alias. Special DualPath technology offers revolutionary A-D improvements and advanced filtering to recast the power analysis landscape. Cut engineering time in half, reduce cost and time to approval, while maintaining the world-class accuracy for which ZES ZIMMER has been known for more than 30 years. Come see advancements also in waveform processing and streaming, UI, versatility process control, QA and more.

Exhibitor Seminars – Session #4

Tuesday, March 22, 3:45 p.m. – 4:15 p.m.

Fairchild Semiconductor

ROOM 101A

1200V Smart Power Module for Low-Power Industrial Motor Drive Applications

SPEAKER: TS Kwon

1200V Smart Power Module for Low-Power Industrial Motor Drive Applications

As environmental issues continue to be a worldwide concern, energy saving opportunities become more essential in system development. The adoption of low-cost inverter drive technology in motor drive applications can help. To address these demands in low-power industrial applications, the 1200V SPM® smart power module has been developed. This paper will present in detail the design issues, performance investigation, and other important considerations about the new 1200V SPM 3 module family.

The 1200V SPM® 3 series of intelligent, integrated IGBT inverter modules are optimized for low-power industrial motor drive applications. The technology utilizes non-punch-through trench IGBTs with advanced STEALTH™ free-wheeling diodes, high-voltage ICs, and multi-function low-voltage IC. It also provides technical advantages such as improved thermal performance and reliability characteristics through the DBC substrate, as well as temperature monitoring with the TSU (temperature sensing unit) function of the LVIC.

Intersil

ROOM 101B

Digital Power Design Featuring Intersil's ChargeMode and Hybrid Digital Controllers

SPEAKER: Brandon Howell and Chance Dunlap

In this session, we'll explore Intersil's latest full digital ChargeMode™ controllers, along with a new family of hybrid digital controllers featuring Intersil's proprietary R4™ control loop. Both controller families include a PMBus™ interface, which when coupled with Intersil's PowerNavigator™ software

design tool, provide a paradigm shift in ease of use for power supply design. Where traditional analog controllers have typically taken days to fully implement, Intersil's new family of controllers utilize built-in intelligence, advanced control loops and PMBus flexibility to dramatically shrink design times. In this session, we'll introduce Intersil's latest digital POL controllers and demonstrate design examples using PowerNavigator.

KEMET Electronics Corporation

ROOM 102AB

Capacitor Modeling and Simulation

SPEAKER: Wilmer Companioni, *Technical Marketing Engineer*

Methods and techniques for simulating capacitor behavior

Schunk Hoffmann Carbon Technology

ROOM 103AB

Aluminium Graphite: The Optimal Thermal Management Solution for High Reliability Applications

SPEAKER: Dr. Sandra Reisinger

Schunk Hoffmann is a world leader in the automotive and rail sectors. By modifying our existing product portfolio, we have developed a set of metal matrix composites called Aluminium Graphite (ALG). They combine a low coefficient of thermal expansion (CTE) with a high thermal conductivity, making them ideal candidates for systems that are subject to active or passive thermal cycles. The use of ALG leads to 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, base plates for power modules and housings. Schunk Hoffmann can deliver customized designs and platings as the fabrication and machining of all parts is conducted in-house.

Synopsys

ROOM 201A

Accurate Modeling and Simulation of Contemporary Power Converters using Saber

SPEAKER: Alan Courtney

Saber is a multi-domain system modeling and simulation platform that meets the challenges of contemporary power electronics verification. Saber combines robust mixed signal simulation with advanced modeling capabilities including power semiconductor and magnetic tools, state-flow and logic for control, and HDL and table look-up methods for efficient behavioral modeling. New Saber fault modeling and simulation enables functional safety and reliability verification of power electronics systems. Optimization-based algorithms identify the design parameters leading to optimal or worst-case performances, such as power efficiency. This presentation will showcase these features on a commercially available quasi-resonant flyback power converter.

Saber is particularly advantageous to model the control of power converters. The key features of the IC controller modeled in this flyback example are the frequency foldback and the input voltage feedforward function. A SPICE approach would not be able to easily model the blanking time of the frequency foldback function, which is a nonlinear curve conveniently created with the Saber Table Look Up modeling tool. Similarly, the MAST and VHDL-AMS hardware description languages offer a straightforward way to implement the expression for voltage feedforward without rigging up a subcircuit required by many other simulators.

Taiwan Semiconductor

ROOM 201B

Improved Efficiency in LED Lighting Control

SPEAKER: Mark Christopher

AC/DC LED lighting control and product design face many challenges as global markets and government regulations drive requirements for efficiency, reliability, EMI performance, and cost reduction. In this session, Taiwan Semiconductor will present efficient solutions for LED power supply regulation, power

factor control, LED dimming, and LED load protection. Various high efficiency, low noise constant current and constant voltage switch mode power supply topologies and supporting component technologies will be presented.

Würth Electronics Midcom

ROOM 203AB

Custom Flyback Transformers Made Easy

SPEAKER: Dean Huumala

Have you ever struggled to find a transformer for your flyback power supply design? Has the transformer threatened to delay or even kill your project? Attend this session to find out how easy it can be to find a custom solution for your design with samples available in stock. The STS (Smart Transformer Selector) makes finding a custom flyback transformer for your specific design as easy and efficient. In basic mode, you can find suitable parts in seconds. If you wish to be more specific you can use the expert mode to define more detailed parameters.

Exhibitor Seminars – Session #5

Wednesday, March 23, 10:30 a.m. – 11:00 a.m.

Adaptive Power Systems

ROOM 101A

Advanced Power Conversion Test Equipment

SPEAKER: Herman van Eijkelenburg

This session provides an overview of available solid state AC power sources for development and test applications. Highlights what to look for in product specifications and how to properly size the AC source for your requirements.

Efficient Power Conversion Corporation (EPC)

ROOM 101B

GaN...Changing the Way We Live

SPEAKER: Dr. Alex Lidow

GaN is taking power conversion to the next performance level. Gallium nitride transistors are rapidly being designed into many power conversion. 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 and end-use applications including high power density DC-DC converters, high frequency envelope tracking, and wireless power transfer.

Mersen

ROOM 102AB

Safety and Reliability for Power Electronics

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 for SiC and WBG devices.
- > 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 fast switching SiC components.
- > 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. Laminated bus bars provide clear advantages in SiC applications.

Microchip Technology Inc.

ROOM 103AB

Brutes and Brains: When Adding Intelligence to Power Supplies Makes Sense

SPEAKER: Janmichael Aberouette and Fionn Sheerin

Many power supplies can benefit from digital interfaces or digital controls – but the additional design challenges can be daunting. In many cases, a traditional analog control loop can be an elegant and

effective solution. Microchip will describe the system tradeoffs and go through application-specific use case examples including LED drive, point-of-load power conversion, PMBus implementation, and server power. For each application the difference between digital and analog control presents different benefits and challenges. In addition, this presentation will include a short demonstration of the MPLAB® Code Configurator development tool, which uses a graphical interface to setup closed loop power supplies and automatically generate digital power control firmware.

Pacific Sowa Corp C/O Epson Atmix Corp

ROOM 201A

Atmix's High Performing Magnetic Powder for Inductors

SPEAKER: Masahito Yoshizawa

Introduction of the soft magnetic powder produced by Epson Atmix Corporation.

Renesas Electronics America Inc.

ROOM 201B

Lithium Ion Battery Charging and Fuel Gauging for better functionality

SPEAKER: Peter H. Wilson

This seminar will discuss extending battery life utilizing Renesas' lithium ion battery management solution for mobile platforms. We will show improved performance for faster charging time and minimized battery degradation for longer battery life. A typical lithium ion battery management solution includes fuel gauging plus charge control. Previously, the fuel gauging and charging functions have been separate ICs. Combining the fuel gauging and charging into one IC has advantages to better managing the fundamental task of fully recharging the batteries in 1S to 3S cell applications. We will explore the enhancements to the functionality and performance for mobile applications where space is premium.

SBE, Inc.

ROOM 202AB

High Performance Integrated DC Link Capacitor/Bus Structures and AC Filter Capacitors

SPEAKER: Dr. Michael Brubaker, *VP Engineering and CTO*

The session will begin with an overview of SBE's unique ring capacitor technology and the advantages of this form factor in terms of losses and thermal resistance. The discussion will then shift to DC link capacitors and the use of SBE capacitor/bus technology to achieve very low inductance topologies. Some representative commercially available parts using "surface mount" capacitors will be discussed and compared to conventional technology. The remainder of the session will focus on AC filter capacitors and the unique advantages of the SBE ring form factor combined with patented pulse technology to eliminate catastrophic failure. The SBE AC filter offers novel mounting topologies and operates at lower hotspot temperatures than conventional cans. Examples of AC filter implementations using ring capacitors will be provided.

Exhibitor Seminars – Session #6

Wednesday, March 23, 11:15 a.m. – 11:45 a.m.

(PANEL) Eaton, Power Systems Design, Vicor, GaN Systems

ROOM 101A

Next Generation of Power Supplies

SPEAKERS:

- > Zhuo Min "Joe" Liu (*Eaton*)
- > Alex Paultre (*Power Systems Design*)
- > Larry Spaziani (*GaN Systems*)
- > Paul Yeaman (*Vicor*)

Between evolving topologies, advanced materials, and improved core technologies, the way we manage and distribute power is under multiple pressures to change and evolve as well. This is especially dramatic in the area of power supplies themselves, the heart of every electronic system. These core enablers also change the devices they power, in areas such as form factor, thermal management,

operational lifetime and the increased focus on higher power densities. From wide-bandgap semiconductors to advanced power supply topologies to the latest magnetics, the panelists from Vicor, Eaton, and GAN Systems have a deep understanding of these pressures. The panel will explore some of the ways to address these issues and help predict the future of the power supply.

ABC Trading Beijing Co. LTD.

ROOM 101B

BsT-x measuring system for soft magnetic materials under high excitation

SPEAKER: Mr. JC Sun

Characterisation of magnetic properties under high excitation becomes increasingly important, the differentiation under high excitation i.e. high frequency ripple current biased with quasi DC complicates structured and systematic approach to target the specific target. The available data of core vendors can not afford nowadays demand of design engineers for accurate simulation and tailor made inductive component designs.

BST offering open & transparent automatic measuring system, effectively provides desired information of different soft magnetic materials over wide range of permeability level, especially the bst-pro highlights the loss characteristics with more dimension dependency (frequency, delta B, biased field strength and temperature), this helps material innovator to navigate development roadmap and enables design engineer for accurate and customized inductive component design

Amantys Power Electronics Ltd

ROOM 102AB

Intelligent Gate Drives – Delivering the Silicon Squeeze

SPEAKER: Bryn Parry

Recent advances in power converter technology have demonstrated that intelligent gate drives can deliver a “smart converter”. There is the opportunity to apply advanced gate drive techniques to the devices to further increase their utilization – a “silicon squeeze” – and with this comes the need to monitor

more closely their operation, e.g. through condition monitoring. This presentation considers not only the challenges of such an approach, but also the potential economic and technical benefits and opportunities for the end user and operator.

Analog Devices Inc

ROOM 103AB

Ultra Low Noise LDOs Maximize Signal Chain Performance

SPEAKER: Justin Zhao

This session introduces LDO fundamentals and important Noise/PSRR characteristics. It dives into the noise sensitivity on various signal-chain loads, and provides an understanding of how to choose right LDOs to achieve best performance for RF transceivers, Clocking ICs, PLL/VCOs and latest high-speed ADCs and DACs. A particular focus on where ultra-low noise LDOs to maximize overall RF signal-chain performance will be discussed.

CUI Inc

ROOM 201A

Software Defined Power®

SPEAKER: Mark Adams

Software defined power is the next evolution of power supply optimization. In general, the efforts have resided in the power supply, whether Point of Load, Bus Converter or a front end power supply. CUI will discuss the next evolution of software defined power by adopting Virtual Power Systems' Integrated Control of Energy (ICE®) in a datacenter racking system.

CUI will review the ICE Block platform and the advantages that ICE has in realizing a 15-25% savings in power, significant capital expenditure reduction and better optimization of the power footprint in a datacenter environment.

Hitachi Power Semiconductor Device, Ltd.

ROOM 201B

New Packaging Generation.

The next standard for High Voltage (1.2kV-6.5kV) IGBTs

SPEAKER: Katsuaki Saito

Hitachi has introduced nHPD2 (next High Power Density Dual) as the next generation package standard for high voltage power modules. It has the benefits of low inductance, high power density and scalability, and also includes a current sensor and temperature sensor. This package not only targets the next generation of Si chip technology, but also brings significant advantages for use with SiC technology. In this seminar, we would like to introduce the state-of-the-art for Si and SiC in the nHPD2 form factor.

In addition to nHPD2, we have introduced the latest generation of 4.5kV IGBT for medium voltage drive applications, covering a wide frequency range. By using advanced trench HiGT (High conductivity IGBT), rated current was successfully increased by 25% realizing 1500A within the same footprint.



Software Cradle Co., Ltd.

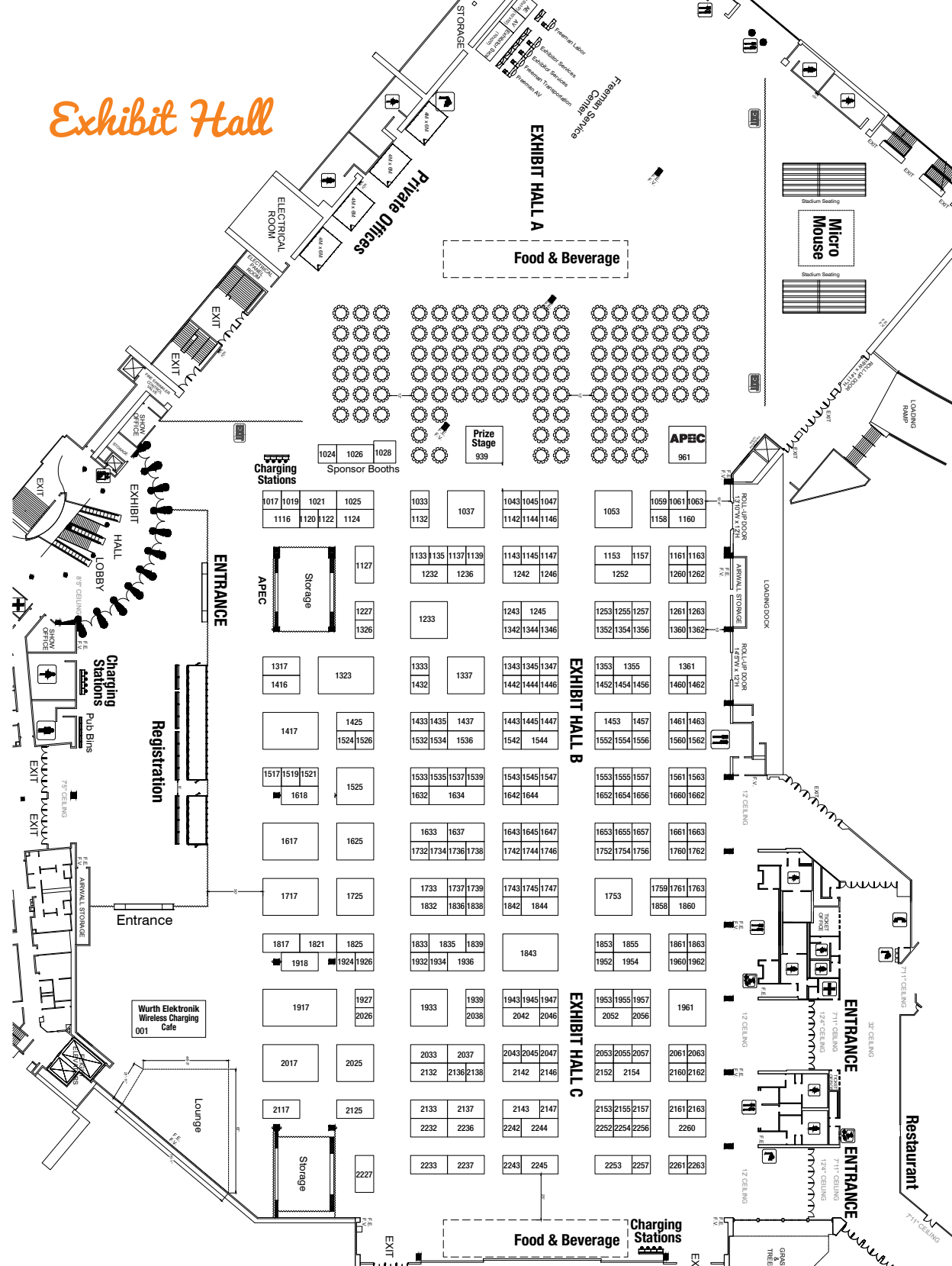
ROOM 202AB

Cooling Fan Design System with Automated Performance Prediction

SPEAKER: Yuya Ando

A cooling fan is widely used as a cooling device in electronics. In CFD, modeling methods of cooling fans can be categorized into two methods. One method is used to predict detailed flow by modeling the shape of the blade and the frame in detail. The other method is used to predict the flow rate as a simplified model defining the relation between the pressure and the flow rate (P-Q Curve). The former method is best suited for predicting performance of the fan itself while the latter method is suitable for an electronic system level simulation. While the latter method significantly simplifies the procedures of the electronic thermal simulation, it has still been challenging to utilize CFD for axial fans due to the complexity of modeling a fan in 3D, as well as the knowledge required to perform detailed fan simulations in CFD.

Therefore, we developed an innovative tool "Smart-Blades", which allows a fan designer to quickly and easily design a fan in 3D and to predict its performance. SmartBlades is equipped with a sophisticated GUI which enables a user to intuitively design a blade profile by specifying parameters or dragging graph lines to define rake angles, skew angles, thickness, and other parameters of a blade. In this way, 3D geometry of a fan can be quickly and easily created even without any CAD experience. Furthermore, SmartBlades is linked to Cradle SC/Tetra CFD software and automatically performs the CFD simulation to report a fan performance curve including P-Q curve, power curve, and efficiency curve. As a result, the fan designer can quickly design an optimized axial fan to meet various criteria using Smart-Blades and can significantly reduce the product lead time.



Exhibitor Listing

as of 3/4/16

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Exhibitor Company Descriptions

5S Components Booth 1860

630 Fifth Avenue
East McKeesport, PA 15035 USA
www.5SComponents.com

5S Components, Inc are authorized North American distributor for ABB Semiconductor, ABB Current/Voltage Sensors, Astrol Electronics, components and assemblies, Danotherm Resistors, Icar Power Film Capacitors & Power Integration, IGBT gate drivers.

Aavid Thermalloy Booth 1839

1 Aavid Circle
Laconia, NH 03246 USA
www.aavid.com

Global Leader in Thermal Management, Design, Engineering, & Manufacturing of Electronic Cooling Solutions. Global Supply Chain for Heat Sinks, Heat Exchangers, Air & Liquid Cooling Systems, Components, with Complete Design, Modeling, & Supply Chain.

ABC Trading Beijing Co. LTD. Booth 2163

B-1-101, Hong Xing Hong Buisness Building, Beiqiji
Beijing, 102209 China
www.abcstone.com.cn
www.powerlosstester.de

we are specialist for measuring technique of soft magnetic materials under high excitation (sinusoidal and pulse), for non linear behavior of hysteresis loop for material development, inductive component design and tailor made simulation.

ACME Electronics Corporation Booth 1552

No. 2, Fuqian Zast Road
Zengjiang Street, Zast Square
Guangzhou-Zengcheng, China

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 isa subsidiary of USI Corporation, a public listed company in Taiwan.

Acopian Power Supplies Booth 2142

P.O. Box 638
Easton, PA 18044 USA
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 1457

17711 Mitchel North
Irvine, CA 92614 USA
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 2042

2200 Gateway Centers Boulevard
Suite 213
Morrisville, NC 27560 USA
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 Test Equipment Rentals Booth 1142

10401 Roselle Street
San Diego, CA 92121 USA
www.atecorp.com

Agile Magnetics Booth 1556

24 Chenell Drive
Concord, NH 03301 USA
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.

AgileSwitch, LLC Booth 1756

2002 Ludlow Street, #4
Philadelphia, PA 19103 USA
www.AgileSwitch.com

On March 21...The Rules Change. New AgileSwitch SiC IPM Stack Electronics give renewable energy sources a boost, with increased speed, real-time temperature control and higher power capacity than ever before. It's a game-changer.

Alcon Electronics Private Limited Booth 2060

34-B, MIDC Industrial Estate
Satpur, Nashik 422 007 India
www.alconelectronics.com

Custom and standard high performance capacitors. Represented by ICT Power in North America featuring direct mount and axial leaded IGBT snubber capacitors and high frequency power film capacitors for induction heating, plasma generators, etc.

Allstar Magnetics Booth 1553

6205 NE 63rd Street
Vancouver, WA 98661 USA
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 & Omega Semiconductor Booth 1835

475 Oakmead Parkway
Sunnyvale, CA 94085 USA
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 Assembly Solutions Booth 1561

300 Atrium Drive
Somerset, NJ 08873 USA
www.AlphaAssembly.com

Alpha Assembly Solutions, a MacDermid Performance Solutions Company, is the global leader in the development of innovative materials used for electronics assembly, power electronics, die attach, semiconductor packaging, automotive and others.

Alps Electric Co. Ltd. Booth 1947
3151 Jay Street
S-100
Santa Clara, CA 95054 USA
www.alps.com

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.

Altera® now part of Intel Booth 2253
101 Innovation Drive
San Jose, CA 95134 USA
www.altera.com

Altera® now part of Intel, is the pioneer of programmable logic solutions, enabling designers of electronic systems to rapidly and cost effectively innovate, differentiate, and win in their markets.

Ametherm, Inc. Booth 1833
961 Fairview Drive
Carson City, NV 89701 USA
www.ametherm.com

Since 1994 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.

Amogreentech Booth 1255
600-4, Wonsan-Ri, Hasung-Myun
Gimpo-Si, Gyeonggi-Do 415-887 South Korea
www.amoscore.com

Amogreentech is the leading manufacturer of Fe-Amorphous & Nanocrystalline materials for magnetic inductive parts as Powder core, Cut-core & noise protection core. We've supplied to global power conversion & automotive tier 1 companies.

Amphenol Interconnect Products . . Booth 1232
20 Valley Street
Endicott, NY 13760 USA
www.Amphenol-AIPC.com

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.

Analog Devices Booth 1160
3 Technology Way
Norwood, MA 02062 USA
www.analog.com

ADI is a leading supplier of high performance signal processing products. ADI's power management IC's enable customers to push the boundaries of technology in communications, Instrumentation, industrial automation and more. www.analog.com/power

Anpec Electronics Booth 1752
9890 Irvine Center Drive
Irvine, CA 92618 USA
www.anpec.com.tw

ANPEC Electronics is the leader in high- performance analog and mixed signal IC solutions. ANPEC offers a full line of power management products such as Switching Regulators, Motor Drivers as well as cost effective PMICs.

ANSYS, Inc. Booth 1146
2600 Ansys Drive
Canonsburg, PA 15137
www.ansys.com

ANSYS simulation software enables engineers to accurately and quickly design power electronic and electrically controlled systems.

APEC 2017 Exhibit Sales Booth 961
2025 M Street NW
Suite 800
Washington, DC 20036 USA
www.apec-conf.org

Please stop by the APEC 2016 Show Management Booth during your designated time slot to sign up for the 2017 show in Tampa, FL!

Apex Microtechnology Booth 1261
5980 N Shannon Road
Tuscon, AZ 85741 USA
www.apexanalog.com

Apex Microtechnology offers power operational amplifiers, PWM amplifiers and voltage references for applications requiring precision control of current, voltage and speed in the industrial, defense/aerospace, medical, and semiconductor markets.

Athena Energy Corp. Booth 2162
3100 Airport Way S.
Seattle, WA 98134 USA
www.athenaenergycorp.com

Rogowski Coils for High Frequency Current Measurements. A wide range of high performance current sensors for high temperature, easy service, and replacement probes.

Auxel FTG Booth 1253

33 Hartford Avenue
Suite 201, PO Box 143
Granby, CT 06035 USA
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 1536

1 AVX Boulevard
Fountain Inn, SC 29644 USA
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.

Baknor Thermal & Packaging Booth 1260

5225 Orbitor Drive
Suite 2
Mississauga, ON L4W 4Y8 Canada
www.baknor.com

Heat Sinks, Cold Plates, Bus Bars. Includes cooling power electronics with various tradeoffs & factors such as costs, packaging, manufacturability, efficiency and reliability. Friction stir welding, brazing, tube cold plates and extrusion welding.

BH Electronics, Inc. Booth 1158

12219 Wood Lake Drive
Burnsville, MN 55337 USA

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.

Bicron Electronics Co. Booth 1660

50 Barlow Street
Canaan, CT 06018 USA
www.bicronusa.com

Bicron specializes in long life, corona free transformers, and high efficiency toroidal CT's and Current Sensors while collaborating with the world's largest manufacturers of Inverters, Power Supplies and Power Distribution Automation Equipment.

Bomatec International Corp. Booth 1955

400 Finchdene SQ
Unit 6
Toronto, ON M1X 1E2 Canada
www.bomatec.com

Soft magnetics of nanocrystalline and amorphous tape wound cores and chokes, current sensors, transformers, inductors. Permanent magnets for motors and sensors.

CalRamic Technologies, LLC Booth 1246

Mfg. Facility
5462 Louie Lane
Reno, NV 89511 USA
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.

Caton Connector Corp Booth 1545

26 Wapping Road
Kingston, MA 02364 USA
www.caton.com

Caton Connector is a specialty manufacturer of Custom and Standard High Voltage, Corona-Free Connectors and Cable Assemblies offering configurations from 1 to 19 conductors and voltages to 100kvDC. Caton is registered ISO9001:2008 and AS9100

Central Semiconductor Corp. Booth 1661

145 Adams Avenue
Hauppauge, NY 11788 USA
www.centralsemi.com

Central™ manufactures discrete semiconductors including; diodes, rectifiers, transistors, MOSFETs and protection devices. Central will be featuring its latest UltraMOS™ and HV MOSFETs, Silicon Carbide devices and HyperFast Rectifiers.

Chroma Systems Solutions, Inc. . . Booth 1821
19772 Pauling
Foothill Ranch, CA 92610 USA
www.ChromaUSA.com

Chroma is a world leading provider of power test instrumentation and automated test systems including AC/DC Power Sources, Electronic Loads, Power Meters, and ATE for diverse bench-top, R&D and design verification of EV/PHEV, Solar, LED, Battery, Medical, and Power Supply applications.

CogniPower Booth 1924
3217 Phoenixville Pike
Malvern, PA 19355 USA
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 mWs to KWs.

Coil Winding Specialist, Inc. Booth 1653
353 West Grove Avenue
Orange, CA 92865 USA
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 1618
1102 Silver Lake Road
Cary, IL 60013 USA
www.coilcraft.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

Component Distributors, Inc. (CDI) Booth 1157
2601 Blake Street
Suite 450
Denver, CO 80205 USA
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.

Cornell Dubilier Electronics Booth 1747
140 Technology Place
Liberty, SC 29657 USA
www.cde.com

Cornell Dubilier is a N. American capacitor MFR with three ISO 9001 certified facilities & a sales office in Hong Kong. Its principal market is power electronics it is the largest aluminum electrolytic screw terminal capacitor supplier in the US.

Cosmo Ferrites Limited Booth 1560
Jabli, Distt. Solan
Parwanoo, Himachal Pradesh 173209 India
www.cosmoferrites.com

Cosmo Ferrites Limited is leading soft ferrite manufacturer in India, is ISO9000:2008, ISO 14001:2004 & TS-16949 certified. Alisha coils & Transformers – Manufacturer of Transformers & wound components. www.alishacoils.com

CPS Technologies Booth 1456
111 South Worcester Street
Norton, MA 02766 USA
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 1132

401 N. Progress Drive
Saukville, WI 53080 USA
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.

CUI Inc. Booth 1337

20050 SW 112th Avenue
Tualatin, OR 97062 USA
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.

Current Ways, Inc. Booth 1137

10221 Buena Vista Avenue
Santee, CA 92071 USA
www.currentways.com

Current Ways Inc., a leading innovator of smart battery chargers for electric vehicles and alternative energy applications, announces the release of the BC-Series 6.6kW EV Battery Charger featuring 3 models, 450 VDC, 750 VDC and 1020 VDC.

Daco Semiconductor Co., Ltd. Booth 1744

No. 28-4, Cheng-Tien Road
Taipei City, Taiwan
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 1236

Husumer Strasse 251
Flensburg, Schleswig-Holstein 24941 Germany
www.siliconpower.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' quality system is certified to ISO/TS-16949.

Datatronics Booth 1333

28151 Highway 74
Romoland, CA 92585 USA
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 1734

1657 East Park Drive
Macedon, NY 14502 USA
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 1738

3227 Skylane Drive
Carrollton, TX 75006 USA
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.

DEWETRON Inc. Booth 1345

10 High Street
Suite K
Wakefield, RI 02879 USA
www.dewamerica.com

DEWETRON is a market-leading specialist for universal test & measurement systems. Our solutions allow broadband power measurements (mobile or stationary) and they master the challenge of distributed measurement technology –all 100% synchronized.

Dexter Magnetic Technologies Booth 2242

1050 Morse Avenue
Elk Grove Village, IL 60007 USA
www.dextermag.com

Dexter is the premier distributor for Ferrite, Powder, Amorphous and Nanocrystalline cores, plus bobbins and specialty wire. Our diverse offering of magnetic materials, allows you to choose the correct standard or custom machined component.

Dialog Semiconductor Booth 1346

675 Campbell Technology Parkway
Suite 150
Campbell, CA 95008 USA
www.dialog-semiconductor.com

Dialog Semiconductor provides highly integrated mixed-signal ICs. Our AC/DC converter products address applications up to 45W and include various fast charging ICs, supporting many protocols, including Qualcomm™ Quick Charge™ 3.0 technology.

Digi-Key Electronics Booth 1663

701 Brooks Avenue South
Thief River Falls, MN 56701 USA
www.digikey.com

Global distributor Digi-Key Electronics is the industry leader in electronic component selection, availability and delivery. Digi-Key is committed to providing the broadest range of components and exceptional service.

Dino-Lite Scopes (BigC) Booth 1356

19803 Hamilton Avenue
Suite 200
Torrance, CA 90502 USA
www.dinolite.com

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 DinoCapturesoftware makes it easy to take snapshots, record videos, manipulate images, save and email discoveries.

Ducati Energia Booth 1963

Via M. E. Lepido, 182
Bologna, 40132 Italy
<http://www.ducatienergia.it>

A world leader in AC & DC capacitors for power electronics applications with high current and harmonic distortion. DC capacitors for power inverters for railways, welding, energy storage and filtering applications. New HIGH TEMPERATURE capacitor range.

Eaton Booth 2147

5735 W. Las Positas
Suite 100
Pleasanton, CA 94588 USA
www.eaton.com/electronics

Eaton's Electronics Division is a global leader in circuit protection, power magnetics, and high power energy storage solutions. Product technologies include Bussmann Series fuses and overvoltage devices, inductors, transformers and supercapacitors.

EBG Resistors Booth 1736

460 Spruce Street
P.O. Box 519
Middletown, PA 17057 USA
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 1532

53 Main Line Drive
POB 1536
Westfield, MA 01086 USA
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.

EFC/WESCO Booth 1737

41 Interstate Lane
Waterbury, CT 06705 USA
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.

Efficient Power Conversion Corporation (EPC) Booth 2244

909 N. Sepulveda
Suite 230
El Segundo, CA 90245 USA
www.epc-co.com

Efficient Power Conversion (EPC) is the leading provider of GaN-based power management technology. In booth 2244, EPC is showing GaN-based applications including wireless power, high-speed communications, and high power density DC-DC converters.

Egston System Electronics

Eggenburg Booth 1347

Grafenberger Str. 37
Eggenburg, 3730 Austria
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.

Electro Technik Booth 2154

P.O. Box 18802
Clearwater, FL 33762
www.electrotechnik.com

For more than thirty-four years Electro Technik Industries (ETI) has designed and manufactured leading edge passive electronic components. ETI owns and operates several subsidiary companies in various passive electronic component fields

Electrocube, Inc. Booth 1245

3366 Pomona Blvd.
Pomona, CA 91768 USA
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 1317

526 Industrial Way West
Eatontown, NJ 07724 USA
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 2056

1175 W. Mahalo Place
Rancho Dominguez, CA 90220 USA
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 1742

203 Malden Turnpike
Saugerties, NY 12477 USA
www.elnamagnetics.com

Elna Magnetics is an ISO 9001:2008 & AS9100 certified authorized distributor and full service manufacturer of quality magnetic components in standard and non-standard core shapes for the electronics industry.

Exar Corporation Booth 1637

48720 Kato Road
Fremont, CA 94538 USA
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.

Exxelia USA Booth 1644

1221 N. Highway 17-92
Longwood, FL 32750 USA
www.exxeliausa.com

Exxelia Group is a global leader of passive components. A wide range of capacitors, magnetic components, EMI / RFI filters and more. Serving the military, aerospace, space and extreme environment markets.

Fairchild Semiconductor Booth 1717

3001 Orchard Parkway
San Jose, CA 95134 USA
fairchildsemi.com

Fairchild has a rich history of innovation as a semiconductor pioneer. We specialize in the development and manufacture of a complete portfolio of low to high power solutions for mobile, industrial, cloud, automotive, lighting, and computing systems.

Fair-Rite Products Corp. Booth 1842

1 Commercial Row
P.O. Box 288
Wallkill, NY 12589 USA
www.fair-rite.com

For over 50 years, Fair-Rite Products Corp. has been a leader in the ferrite industry placing the highest value on quality. With a full product line that includes a wide range of materials and geometries for EMI Suppression, Power Applications, and RFID A.

Faratronic Co., Ltd. Booth 1021

99, Xinyuan Road, Haicang District
Xiamen, 361022 China
www.faratronic.com

Ferroxcube USA, Inc. Booth 1524

1200 Golden Key Circle
Suite 233
El Paso, TX 79925 USA
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.

FTCAP Booth 1861

Carl-Benz-Strasse 1
Husum, 25813 Germany
www.ftcap.de

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.

Fuji Electric Corp. of America Booth 2132

50 Northfield Avenue
Edison, NJ 08837 USA
www.americas.fujielectric.com

Fuji Electric Corp. of America is dedicated to provide quality products. Our extensive product line includes IGBT Modules and IPM for industrial application, IGBT modules for automotive application, Power MOSFET and Fast-recovery diodes.

GAN Systems Booth 2125

1145 Innovation Drive
Suite 101
#501
Ottawa, ON K2K 3G8 Canada
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.

Global Choice International LLC . . . Booth 1555

1699 Wall Street
Suite 119A
Mount Prospect, IL 60056 USA
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 Power Technologies Group . Booth 1547

20692 Prism Place
Lake Forest, CA 92630 USA
www.gptechgroup.com

GPTG Silicon Carbide (SiC) technologies and research into products for the commercial Power and Energy market. GPTG is vertically integrated value chain of SiC technologies. Under this structure, SiC technology is expected to be fully and economically deployed to meet the market pull by the industry segments which desperately seeks power system efficiency improvements. Because of vertical integration GPTG cost for SiC products will reach Silicon price point in volume to Critical, Important, and Emergin.

GLOBALFOUNDRIES Booth 1934

2600 Great America Way
Santa Clara, CA 95054 USA
www.globalfoundries.com

GMW Associates Booth 1342

955 Industrial Road
San Carlos, CA 94070 USA
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 Instrumentation with application to field mapping, quality control and non-contact machine condition monitoring.

Good-Ark Semiconductor Booth 1527

608 Johnson Avenue Ste. 7
Bohemia, NY 11716 USA
www.goodarksemi.com

Gowanda Electronics Booth 1257

One Magnetics Parkway
Gowanda, NY 14070 USA
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 – NSF I/UCRC Booth 2043

1 University of Arkansas
Fayetteville, AR 72701 USA
<http://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.

H & H Magnetics Booth 2155

5130 E. La Palma Avenue
#206
Anaheim, CA 92807 USA
www.hhmagnetics.com

Outsource Manufacturing, Marketing, Branding, Sales Representation, Supply Chain Management, Custom Engineering, Procurement, Product Sourcing, Product Placement.

HEFEI ECRIEE-TAMURA

Electric Co. Ltd. Booth 1360
NO 41 Tianzhi Road
Hefei, 230088 China
www.ecthf.com

Hengdian Group DMEGC

Magnetics Co., LTD. Booth 1534
c/o ASL Technologies Inc.
14568 Rutledge Sq.
San Diego, CA 92128 USA
www.chinaDMEGC.com

DMEGC is China's #1 leading soft magnetics 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 1453
24 Union Hill Road
West Conshohocken, PA 19428 USA
www.heraeus-electronics.com

Heraeus Electronics provides an innovative portfolio and expertise in matching materials for high performance electronics. Our Materials Solutions will shorten development cycles, lower costs, and bring next generation products to market faster.

Hesse Mechatronics, Inc. Booth 2033

225 Hammond Avenue
Fremont, CA 94539 USA
www.Hesse-Mechatroncis.com

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.

Himag Planar Magnetics, Ltd. Booth 2026

Unit A The Aquarius Centre
Edison Close, Waterwells Business Park
Quedgeley, Glos, GL2 2FN U.K.
www.himag.co.uk

Himag Planar possess over two decades of experience in the field of planar transformers & inductors with a long term history in inverter technology and PCB design.

Hitachi Metals Booth 1957
85 W. Arlington Heights Road
#400
Arlington Heights, IL 60005 USA
www.hitachimetals.com

Hitachi Metals manufactures and markets a diverse portfolio of high-grade metal products and materials, magnetic materials and applications, high-grade functional components and equipment, wires, cables and related products.

**Hitachi Semiconductors –
AmePower** Booth 1855
3550 NW 115TH Avenue
Miami, FL 33178 USA
www.AmePower.com

AmePower, Official Authorized Distributor of Hitachi Semiconductors, is a DBE, SBE, WBE and MBE Certified Engineering Company with more than 20yrs of experience in Power Electronics Solutions; offering from High Power Thyristors, Diodes, GTOs, IGBTs, IGCTs, Busbars, IGBT Gate Drivers to New Designs, Customizations, Assemblies, Repairs, Retrofit and Reverse-Engineering

Holy Stone International Booth 1654
41700 Ivy Street
Suite D
Murrieta, CA 92562 USA
www.holystonecaps.com

Holy Stone Enterprise Co., Ltd is a leading manufacturer of MLCC's for all power applications. Core product lines include: X and Y safety certified, high voltage and capacitance devices. Parametric part/inventory search engines available on website.

**HVR Advanced
Power Components, Inc.** Booth 1147
2090 Old Union Road
Cheektowaga, NY 14227 USA
www.hvrpc.com

HVR provides cost-effective engineered solutions for high-stress resistor applications. Application areas include: Industrial, T&D, Research, Transportation, and Medical.

**IAS (Industrial
Applications Society)** Booth 1024
445 Hoes Lane
Piscataway, NJ 08854 USA
www.ias.ieee.org

The scope of the Industry Applications Society, as a transnational organization, is the advancement of the theory and practice of electrical and electronic engineering in the development, design, manufacture and application of electrical systems, apparatus, devices and controls to the processes and equipment of industry and commerce; the promotion of safe, reliable and economic installations; industry leadership in energy conservation and environmental, health, and safety issues; the creation of voluntary engineering standards and recommended practices; and the professional development of its membership.

ICE Components, Inc. Booth 2038
1165 Allgood Road
Suite 20
Marietta, GA 30062 USA
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.

Illinois Capacitor Inc. Booth 1745
3757 W. Touhy Avenue
Lincolnwood, IL 60712 USA
www.illinoiscapacitor.com

Illinois Capacitor is a leading manufacturer of capacitors. IC offers aluminum electrolytic, polymer, supercapacitors, film and low/medium power film capacitors in multiple packages/terminations. New for APEC 2016: High Power Resonant Capacitors.

Imperix Booth 1525
Rue de l'Industrie
Sion, VS 1950 Switzerland
www.imperix.ch

Imperix Ltd. is a manufacturer of high-end control equipment and prototyping hardware for power electronics. Its modular products and solutions enable cutting-edge innovation and accelerate R&D activities, from the laboratory to the field. The company is a former spin-off the Swiss Federal Institute of Technology, Lausanne, Switzerland.

Indium Corporation Booth 2045

34 Robinson Road
Clinton, NY 13323 USA
www.indium.com

Indium Corporation is a premier materials supplier to global electronics assembly, semiconductor fabrication & packaging, & thermal management markets, offering a range of products, services, & technical support for advanced materials science.

Infineon Technologies Americas Corp Booth 1917

101 N. Sepulveda Boulevard
El Segundo, CA 90245 USA
www.infineon.com

Infineon Technologies is a world leader in semiconductor solutions that make life easier, safer and greener. Visit our booth for the latest energy-savings and high power density enabling technologies and solutions.

Infolytica Corporation Booth 1943

300 Leo-Pariseau
Suite 2222
Montreal, QC Canada
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 muchmore.

Innovation Plus Power Systems Inc. Booth 2062

3960 Commerce Drive
St. Charles, Illinois 60174 USA

Innovation Plus Power Systems Inc. is a power conversion and control systems specialist. We design & manufacture application specific, power semiconductor based components, assemblies & turn key systems .

INSTEK America Booth 2063

5198 Brooks Street
Montclair, CA 91763 USA
www.instekamerica.com

Founded in 1975, GW INSTEK is the first professional manufacturer in Taiwan specializing in electrical test and measurement instruments. INSTEK America is a wholly owned US subsidiary of GW INSTEK.

Intepro Systems Booth 2152

14712-A Franklin Avenue
Tustin, CA 92780 USA
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.

Inter Outstanding Electronics, Inc. Booth 1662

TWN/53-5 Zhen Shan ,Po Cheng Rd
Yuan Shan Hsiang, I-La 246 Taiwan
www.ioeinc.com.tw

We are specialized in standard and custom made transformers such as standard power & audio transformers. Our R&D teams provide total solution for all kind of inquiries. We offer rapid delivery and excellent service to satisfy customers requirement.

Intersil Corporation Booth 2117

1001 Murphy Ranch Road
Milpitas, CA 95035 USA
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 1017

100 Paramount Drive
Suite 300
Sarasota, FL 34232 USA
www.itape.com

Intertape Polymer offers a wide selection of electrical insulating tapes, industrial grade pressure sensitive tapes, and packaging tapes for virtually any application. Technical support, and cost effective solutions are the hallmarks of IPG.

Isotek Corporation, Subsidiary of Isabellenhutte Booth 2047

1199 G.A.R. Highway
Swansea, MA 02777 USA
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.

ITELCOND SRL Booth 2160

Viale de Gasperi, 36
Bareggio (MI), Mila 20010 Italy
www.itelcond.it – www.itelcond.com

Our society, from over 40 years it produces electrolytic aluminium capacitors. With an elevated qualitative level. We turn us to different societies that build electronic equipments as UPS, Inverter, Welders, Control Motor, Medical Equipment.

ITG Electronics Booth 1960

175 Clearbrook Road
Elmsford, NY 10523 USA
www.ITG-Electronics.com

Design and manufacture standard & custom magnetics components for automotive, consumer electronics, computer server, telecommunication and industrial applications.

Iwatsu Test Instruments Booth 2260

7-41,1-chome Kugayama
Suginami-ku, Tokyo, 168-8511 Japan
www.iti.iwatsu.co.jp

We manufacture a wide range of electronic testing equipment such as semiconductor curve tracers, B-H analyzers, highvoltage isolated probes to cover various types of demands from industries and research for energy-efficient power managements.

IXYS (Westcode) Booth 1961

2500 Mira Mar Avenue
Long Beach, CA 90815 USA
www.ixyslongbeach.com

IXYS Long Beach Inc. has been at the front line of innovation and service in the power semiconductors industry. It has evolved beyond distribution and providing silicon assemblies to include logical solutions for applications to specific needs.

JARO Thermal Booth 1242

6600 Park of Commerce Boulevard
Boca Raton, FL 33487 USA
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 1025

Hibiya Kokusai Bldg. 2-3
Uchisaiwai-cho, 2chome, Chiyoda-ku
Tokyo, Japan
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 America Inc Booth 1139

15920 A Halliburton Road
Suite 298
Hacienda heights, CA 91745 USA
www.jianghai.com

Jianghai is the largest electrolytic aluminum capacitor manufacture in China. It also provides DC link film capacitor, Super capacitor, LIC super capacitor, and polymer capacitor.

Johanson Dielectrics, Inc. Booth 1353

15191 Bledsoe Street
Sylmar, CA 91342 USA
www.johansondielectrics.com

Johanson Dielectrics specializes in power electronics solutions. Applications are for high voltage & high power electronics. Offering capacitors (high voltage, high temp, custom form factors), X2Y EMI Filters, planar array filters, resistors.

John Deere Electronic Solutions . . . Booth 2236

1441 44th Street N
Fargo, ND 58102 USA
www.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.

Kanthal Global, Sandvik Heating Technology USA Booth 2161

495 Commerce Drive
Amherst, NY 14228 USA
www.global.com

Kaschke Components GMBH Booth 1642

Rudolf-Winkel-Strasse 6
Goettingen, 37079 Germany
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 NBTM Keda Magnetoelectricity Co. Ltd. Booth 1939

525 Qu Yuan Road North
Wukang Town, Deqing County
Zhejiang Prov., China
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 1753

2835 Kemet Way
Simpsonville, SC 18045 USA
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 2053

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.

KEPCO, Inc. Booth 1858

131-38 Sanford Avenue
Flushing, NY 11355 USA

Kepeco offers a wide range of power supply products and Electronic Loads: AC/DC instrumentation power supplies, four quadrant power supplies, N+1 Redundant products, Din Rail, Medical Approved, and OEM. Please visit us at Booth 1858.

Keysight Technologies Booth 1252

5301 Stevens Creek Boulevard
Santa Clara, CA 95051 USA
www.keysight.com

Keysight Technologies is a global electronic measurement technology and market leader helping to transform its customers' measurement experience through innovations in wireless, modular, and software solutions.

KITAGAWA INDUSTRIES America, Inc. Booth 1945

2325 Paragon Drive
Suite 10
San Jose, CA 95131 USA
www.kgs-ind.com

KITAGAWA INDUSTRIES America, Inc. (formerly 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 1461

2777 Rte 20 East
Cazenovi, NY 13035 USA
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.

Lee Yuen Electrical Mfy Limited Booth 2252

Unit 4 G/F, Transport City Building
No.1-7 Shing Wan Road, Shat Hong Kong
www.Hoiluen.com

Lee Yuen / Hoi Luen group is the premier supplier of fully insulated wire and power cord. Established in 1987, we are the nominated supplier for various global brands, dedicated to be your one stop solution company in power electronics.

LEM USA, Inc. Booth 1352

11665 W. Bradley Road
Milwaukee, WI 53224 USA
www.lem.com

Lenco Electronics, Inc. Booth 1761

1330 S. Belden Street
McHenry, IL 60050 USA
www.lenco-elect.com

Lenco specializes in a wide variety of custom transformers and inductors. Our success has not come about by accident, but by providing our customers with the high quality products they have come to expect.

Linear Technology Corporation Booth 1233

1630 McCarthy Boulevard
Milpitas, CA 95035 USA
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 1432

4769 E.Wesley Drive
Anaheim, CA 92807 USA
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 1519

2880 Zanker Road
No. 203
San Jose, CA 95134 USA
www.ltecusa.com

LTEC Corporation, Japan's dominant intellectual property analysis company, provides in-depth competitive reverse engineering analysis services for the research and development engineering and industrial legal communities worldwide.

Mag. Layers USA Booth 1762

5406 Bolsa Avenue
Huntington Beach, CA 92649 USA
www.maglayersusa.com

Mag. Layers' products offer cutting-edge technology in Antenna, EMI, LAN transformer, NFC, Power, & RF solutions. Founded in 1990, we've become the top producer of molded power inductors globally. TS16949 certified, EICC, RoHS & Reach compliant.

MAGDEV Ltd. Booth 2061

Unit 23 Ash Industrial Estate
Kembrey Park
Swindon, England SN58JN
www.magdev.co.uk

When magnetics matter talk to MagDev. Formerly part of MMG, now the distribution arm of Delta Magnets Group, with over 70 years experience MagDev is a specialist supplier of magnetic products to various market sectors and is ISO 9001:2008 certified.

MagnaChip Semiconductor Booth 1144

424, Teheran-ro
Gangnam-gu
Seoul, 135-738 Korea
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 1542

39 Royal Road
Flemington, NJ 08822 USA
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.

Magnetec (Guangzhou)**Magnetic Device Co. Ltd. Booth 1563**

6/F East, Building 2. Huangzhou Industrial Zone
Chebei Road, Tianhe District
Guangzhou, China
www.magnetec-china.com

Magnetic Metals Corp Booth 1853

1900 Hayes Avenue
Camden, NJ 08105 USA
www.magneticmetals.corp.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 GFCl, ALCl and AFCl components. Established in 1942, Magnetic Metals is AS9100 and ISO9001 certified to service industrial, commercial, and defense clients worldwide.

Magnetics Booth 1433

110 Delta Drive
Pittsburgh, PA 15238 USA
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 1443

1 Fairchild Square
Clifton Park, NY 12065 USA
www.magsoft-flux.com

Take control of your design with Magsoft's suite of CAE tools: Flux, GOT-It, PORTUNUS, InCa3D & SPEED. Design, analyze and optimize your devices and systems: motors, actuators, busbars, electrical connections, power conversion and distribution.

Magtech & Power Conversion Inc. Booth 1562

1146 E. Ash Avenue
Fullerton, CA 92831 USA
www.magtechpower.com

Magtech & Power Conversion specializes in designing and manufacturing state-of-the art custom magnetics & power supplies with innovative solutions and superior quality.

Malico Inc. Booth 1362

5, Ming-Lung Road
Yangmei, 32663 Taiwan
www.malico.com

Malico is the leading manufacture of thermal solutions. We specialize in making cold plates and heat sinks for Electronics and Automotive industries.

Marathon Power Booth 2057

2538 E. 54th Street
Huntington Park, CA 90802 USA
www.marathon-power.com

Marathon Power offers customizable Uninterruptible Power Supplies designed for single-phase applications with powers ranging from 400VA to 12000VA and voltages from 110V to 240V.

MaxQ Technology, LLC Booth 1454

8270 S. Kyrene Road
Suite 108
Tempe, AZ 85284 USA
www.maxqtechnology.com

MaxQ Technology supplies advanced liquid cooling products for the power converter industry. Our patented Q-Chill™ Friction Stir Welded process has produced products for renewable energy, space, electric vehicle and industrial applications.

Mentor Graphics Corporation Booth 2052

8005 SW Boeckman Road
Wilsonville, OR 97070 USA
www.mentor.com/powertester-1500a

MicReD® thermal measurement & power cycling test solutions for failure diagnosis & lifetime prediction of IGBTs & MOSFETs. Simulation software: SystemVision® - system performance modeling & reliability evaluation; FloTHERM® for thermal CFD analysis.

Mersen Booth 1725

374 Merrimac Street
Newburyport, MA 01950 USA
www.ep-us.mersen.com

Mersen is an expert in electrical power and advanced materials and integrates its expertise in cooling and heatsink technology, laminated bus bar & semiconductor fuses in power electronics applications to make them safe, reliable and profitable

Mesago PCIM GmbH Booth 1445

Rotebuehlstrabe 83-85
Stuttgart, 70178 Germany
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.

Methode Power Solutions Group Booth 1116

1700 Hicks Road
Rolling Meadows, IL 60008 USA
www.methode.com/power

Methode manufactures power products across many industries, including: Data/Telecom, Military, Renewable Energy and Industrial. Methode's products include: laminated bus bars, thermal management, power connectors/cables and sub-assemblies.

MH&W Booth 1932

575 Corporate Drive
Mahwah, NJ 07430 USA
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 1127

2355 W. Chandler Boulevard
Chandler, AZ 85224 USA
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.

Micrometals, Inc. Booth 1526

5615 E. La Palma Avenue
Anaheim, CA 92807 USA
www.micrometals.com &
www.MicrometalsArnoldPowderCores.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.

Milplex Circuit (Canada) Inc. Booth 2254

70 Maybrook Drive
Toronto, ON M1V 4B6 Canada
www.milplexcircuit.com

Milplex manufactures PCB's for Industrial controls, Power supplies, automotive, and LED Industries. We specialize in high current and high temperature applications using heavy copper and thermal metal back/core technologies.

MK Magnetics Inc Booth 1539

17030 Muskrat Avenue
Adelanto, CA 92301 USA
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 1655

408 Fannin Avenue
Round Rock, TX 78664 USA
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 2025

79 Great Oaks Boulevard
San Jose, CA 95119 USA
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 1952

13 Country Club Lane
Suite C
Milford, MA 01757 USA
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 2245

1000 N. Main Street
Mansfield, TX 76063 USA
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 1122
19210 S. Vermont Avenue
Bldg. D Suite 405
Gardena, CA 90248 USA
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.

MS Power Semiconductor Co., Ltd Booth 2138
F-21, Block 9, Jiashan Sci-Tech Incubation Center
No., 568, East Jinyang Rd., Jiashan County 314100
Zhejiang Province, China
www.mspowergroup.com

MS Power GmbH, headquartered Germany, is recognized for manufacturing high quality power Semiconductor products. It is supplied into various applications such as Motor Drives, Power Suppliers, Solar and Wind Energy systems, smart grids etc..

MTL Distribution Booth 1838
23167 Temescal Canyon Road
Corona, CA 92883 USA
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.

**National Magnetics Group/
Ceramic Magnetics, Inc.** Booth 1632
1210 Win Drive
Bethlehem, PA 18017 USA
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.

NEC TOKIN America Inc. Booth 2243
2460 N 1st Street
Suite 220
San Jose, CA 95131 USA
www.nec-tokin.com/english

NEC TOKIN Corporation was established in 1938 through a partnership with Tohoku University in Japan.

Since its inception, NEC TOKIN offers innovative capacitor and magnetic products to meet the technological needs of today and the future.

New England Wire Technologies . . . Booth 1447
130 North Main Street
Lisbon, NH 03585 USA
www.newenglandwire.com

We manufacture Litz wire as well as an extensive range of custom multi-conductor, low-noise, high temperature and hybrid cables. We offer rapid prototyping, small quantity and production quantities as well as unparalleled customer service.

NH Research, Inc. Booth 1832
16601 Hale Avenue
Irvine, CA 92606 USA
www.nhresearch.com

NH Research is a global supplier of advance AC and DC electronic loads & automated power electronics test systems used for engineering characterization and high-volume manufacturing. Power levels are up to 125KW and 600V. Applications tested: AC/DC power supplies, DC/DC converters, adapters, chargers, LED drivers, batteries, battery chargers, and UPSs.

Nichicon (America) Corporation . . . Booth 1145
927 E. State Parkway
Schaumburg, IL 60173 USA
www.nichicon-us.com/english

Nichicon is a world leader in the manufacture of Aluminum Electrolytic Capacitors, Film Capacitors, Conductive Polymer Capacitors, Electric Double Layer Capacitors (EDLC). Our professional staff can help you with all of your power capacitor needs.

NORWE Inc. Booth 1543
2813 Carrington Street NW
North Canton, OH 44720 USA
www.norwe.com

NORWE is a leading manufacturer of thermoplastic Bobbins for Ferrites & Laminations, SMD components & accessories. All Products comply with the RoHS & REACH. NORWE is certified according to DIN EN ISO 9001:2008, DIN EN ISO 14001:2009 and UL 746D.

NXP Semiconductors Booth 1053

Gerstweg 2
6534AE Nijmegen, The Netherlands
www.nxp.com

NXP Semiconductors enables secure connections and infrastructure for a smarter world, advancing solutions that make lives easier, better and safer. NXP is driving innovation in the secure connected vehicle, end-to-end security & privacy markets.

Ohmite MFG Booth 2143

Bella Vista PK
Warrenville, IL 60555 USA
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.

ON Semiconductor Booth 1625

5005 East McDowell Road
Mail Drop A100
Phoenix, AZ 85008 USA
www.onsemi.com

ON Semiconductor is driving energy efficient innovations, empowering customers to reduce global energy use. The company offers a broad portfolio of energy efficient power management, analog, logic, timing, discrete, sensing, and custom solutions.

Opal-RT Booth 1446

1751 Richardson
Suite 2525
Montreal, QC H3K 1G6 Canada
www.opal-rt.com

OPAL-RT TECHNOLOGIES is a leading developer of open, real-time digital simulators and Hardware-In-the-Loop testing equipment for electrical, electro-mechanical and power electronics systems. Our validation and test benches are used by engineers and researchers at leading manufacturers, utilities and universities worldwide. Our technological approach integrates parallel, distributed computing with commercial-off-the-shelf technologies.

Oztek Corporation Booth 1652

11 Continental Boulevard
Merrimack, NH 03054 USA
www.oztekcorp.com

Oztek Corp, a global provider of OEM power electronics solutions, introduces the OZip family of Intelligent Power Modules. Both air and liquid cooled configurations are available with motor drive, inverter, or DC/DC control code.

**Pacific Sowa Corporation;
C/O Epson Atmix Corporat** Booth 1535

10 Anson Road
#13-11 International Plaza
Singapore
www.pacificsowa.co.jp

Sales and Customer support representative of EPSON ATMIX's Magnetic Powders.

Paktron Div. Pancon Corp Booth 1624

350 Revolutionary Dr.
E. Taunton, MA 02718 USA
www.panconcorp.com

Designs and manufactures in USA, a Multilayer Polymer (MLP) Film Capacitors that provide improved stability, both electrically and mechanically, compared to multilayer ceramics and áfeatures "non-shorting" operation and does not crack like large ceramic chip capacitors. Paktron is also the manufacturer of the Quencharc® RC Network.

Panasonic Booth 1918

1 Kotari-yakemachi
Nagaokakyo, Kyoto, Japan

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.

Parker Overseas Booth 1962

59/1/1, Industrial Area, Site – IV, Sahibabad
Distt. Ghaziabad, Utta Paredsh
Ghaziabad, 110092 India
www.parkeroverseas.com

Design, Manufacture & Supply of TH & SMT type. Wound Magnetic Components like Transformers, Inductors, Chokes, Coils, Line Filters, Power Transformers, Current Transformers, Power Toroidal Transformers, Switching and SMPS Transformers, Modules etc.

Payton America Booth 1927

1805 S. Powerline Road, Suite 109
Deerfield Beach, FL 33442 USA
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 1326

4009 Transport Street
Palo Alto, CA 94303 USA
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 (Power Electronics Society) Booth 1028

445 Hoes Lane
Piscataway, NJ 08854 USA
www.ieee-pels.org

The Power Electronics Society is one of the fastest growing technical societies of the Institute of Electrical and Electronics Engineers (IEEE). For over 20 years, PELS has facilitated and guided the development and innovation in power electronics technology. This technology encompasses the effective use of electronic components, the application of circuit theory and design techniques, and the development of analytical tools toward efficient conversion, control and condition of electric power. Our 7,000 members include preeminent researchers, practitioners, and distinguished award winners. IEEE PELS Publishes the IEEE Transactions on Power Electronics, a top referenced journal among all IEEE publications.

PINK GmbH Thermosysteme Booth 1463

704 Ginesi Drive
Suite 11A
Morganville, NJ 07751 USA
www.pink.de/en

PINK offers vacuum soldering systems for laboratory, batch production, or an automated inline system. Each system can accommodate both preforms and/or paste soldering.

Plexim Booth 1544

5 Upland Road
Suite 4
Cambridge, MA 02140 USA
www.plexim.com

Plexim provides solutions for the design and test of power electronic systems. Our portfolio consists of the simulation software PLECS, a new hardware-in-the-loop (HIL) platform, PLECS Processor-in-the-Loop (PIL), and Web-Based Simulation (WBS).

PMK Mess –und Kommunikationstechnik GmbH Booth 2263

Königsteiner Str. 98
Bad Soden, Hess 65812 Germany
www.pmk.de

PMK Mess- und Kommunikationstechnik GmbH is one of the leading independent manufacturers for electronic test and measurement equipment. Customers are industrial companies as well as developers.

POCO Holding Co., Ltd Booth 1043

No. 28 Langshan Rd, Northern Dist. High Tech Industry Park, Nanshan
Shenzhen, Guangdong 518057 China
www.pocomagnetic.com

One-Stop magnetic material (powder & powder core) manufacturer and inductor application solution provider.

Power Electronic Measurements Ltd. Booth 1344

Gloucester House, Wellington Street
Long Eaton, Nottingham, United Kingdom
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 Integrations Booth 1239

5245 Hellyer Avenue
San Jose, CA 951438 USA
www.power.com

Power Integrations is a leading innovator in high-voltage power conversion. Our ICs are key to the clean-power ecosystem; enabling renewable energy and providing efficient power consumption in applications ranging from milliwatts to megawatts.

Power Solutions Inc. Booth 1759

6555 Sugarloaf Parkway
Suite 307-159
Duluth, GA 30097 USA

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.

PowerAmerica Booth 1626

930 Main Campus Dr., Suite 200
Raleigh, NC 27606 USA
www.poweramericainstitute.org

PowerELab Ltd. Booth 2136

RM521-522, BLK 9, Enterprise Place
5 Science Park West Ave., HK Science Park, Shatin
Hong Kong, 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 1416

173 Pavilion Lane
Youngwood, PA 15697 USA
www.pwr.com

Powerex, a leading supplier of discrete devices, modules and integrated high power semiconductor solutions, will feature its new T-Series 7th Gen NX IGBTs; J-1 Series for automotive applications; and an expanded DIPIPM™ line-up at APEC 2016.

Powersim, Inc. Booth 1047

2275 Research Boulevard
Suite 500
Rockville, MD 20850 USA
www.powersimtech.com

PSIM is a power electronics simulation tool that empowers engineers to accelerate the pace of innovation with the fastest, most reliable and easy-to-use solution. PSIM: Expanding the possibilities of power electronics.

POWRMOD DC to DC Converters Booth 1557

1 Roned Road
Shirley, NY 11967 USA
www.POWRMOD.com

Powrmod offers innovative dc to dc converters for demanding environments. Addressing the industrial, robotic, railway and shipboard markets, these converters have internal mil-std 461 d,e, and f filtering contained in a single metal package.

Precision Inc. Booth 1743

1700 Freeway Boulevard
Minneapolis, MN 55430 USA
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 1452

Science Park Eindhoven 5501
Son, 5692EM The Netherlands
prodrive-technologies.com

Prodrive Technologies develops and manufactures 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.

PSMA (Power Sources Manufacturers Association) Booth 1026

PO Box 418
Mendham, NJ 07945 USA
www.pσμα.com

The Power Sources Manufacturers Association is an industry organization of power supply manufacturers, users, power component suppliers, academics and consultants. Incorporated in 1985, as a non-profit, democratic, participative organization, PSMA's main goal is to enhance the stature of the power supply industry and provide education and information through published reports, educational seminars, technical workshops and conference exhibits.

Qualtek Booth 1954

7610 Jenther Drive
Mentor, OH 44060 USA
www.qualtekusa.com

Qualtek Electronics since 1980 has established itself as the global leader of high quality low cost products while providing the latest technology in the industry. Showcased at APEC is our full line of power supplies ranging from 5W to 600W, AC and DC fa

Renco Electronics Inc. Booth 1634

595 International Place
Rockledge, FL 32955 USA
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 1746

2801 Scott Boulevard
Santa Clara, CA 95050 USA
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 Electronics, Ltd. Booth 1647

40W267 Keslinger Road
LaFox, IL 60147 USA
www.rell.com

Richardson Electronics, Ltd. is a leading global provider of engineered solutions, RF & microwave and power products. We add value through design-in support, systems integration, prototype design, testing, logistics, and aftermarket services.

Richardson RFPD Booth 2227

1950 S. Batavia Avenue
Suite 100
Geneva, IL 60134 USA
www.richardsonrfpd.com

Richardson RFPD, 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 RF and power component suppliers.

Ridley Engineering, Inc. Booth 1817

601 E. Daily Drive
Suite 112
Camarillo, CA 93010 USA
www.RIDLEYENGINEERING.com

Ridley Engineering is a global leader best known for its design workshops, POWER 4-5-6 software and AP300 frequency response analyzer. A new Design Center facility opens in California in March 2016 for training courses, research and consulting.

Rogers Corporation Booth 1437

One Technology Drive
Rogers, CT 06263 USA
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 Semiconductor Booth 1843

2323 Owen Street
Santa Clara, CA 95054 USA
www.rohm.com

The ROHM Group leverages the latest technologies to deliver a broad range of products for the power market, from ROHM's SiC modules to LAPIS Semiconductor's battery monitoring ICs and Powervation's intelligent digital power management solutions.

Rubadue Wire Company, Inc. Booth 1643

1301 N. 17th Avenue
Greeley, CO 80631 USA
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.

Rubycon Corporation Booth 2256

4293 Lee Avenue
Gurnee, IL 60031 USA
www.rubycon.com

Manufacturer of electrolytic capacitors, including snap in, screw type, film, electric double layer, polymer multi-layer and hybrid polymers.

RWP Electronic Sales Booth 2055

17451 Bastanchury Road
Yorba Linda, CA 92886 USA
www.rwpes.com

RWP Electronic Sales representing:

Premo / World-class manufacturer of standard and custom wire-wound and planar magnetic components and assemblies and single and three-phase EMC filters Premium / Manufacturer of highly-engineered standard and custom AC power supplies, DC/AC inverters and DC/DC converters IST Power / Manufacturer of standard and custom high-power, high-voltage single and three-phase transformers, inductors and reactors.

Samwha USA Inc. Booth 1355

2555 Melksee Street
San Diego, CA 92154 USA
www.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 2233

50 Seaview Boulevard
Port Washington, NY 11050 USA
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.

SBE, Inc. Booth 1754

81 Parker Road
Barre, VT 05641 USA
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 2146

2550 Brookpark Road
Cleveland, OH 44134 USA
www.trencos.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.

**Schunk Hoffmann
Carbon Technology Booth 1059**

Au 62
Bad Goisern, 4822 Austria
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.

Schurter, Inc. Booth 2157

447 Aviation Boulevard
Santa Rosa, CA 95403 USA
www.schurterinc.com

SCHURTER is a leading partner of the electronics and electrical industries for passive and electromechanical components. Our products include: fuses, circuit breakers, connectors, EMC products and Input Systems.

Scientific Test, Inc. Booth 2261

1110 E. Collins Boulevard
Suite 130
Richardson, TX 75081 USA
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 1124

11 Executive Drive
Hudson, NH 03051 USA
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 2137

200 Flynn Road
Camarillo, CA 93012 USA
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.

ShengYe Electrical Co. Ltd Booth 1143

Xinxi 4th Road Lunjiao
Shunde district Foshan, Guan 528309 China
www.shengye.com

ShengYe Electrical Co.,Ltd, an ISO9001 approved enterprise, specialized in R&D, manufacture, sales and after-sale service of film capacitors and other electrical elements. Strategic partners are with GE, Whirlpool, Lennox, Vortice, ABB and Emerson.

**Shenzhen Zeasset Electronic
Technology Co., Ltd Booth 1033**

B1 Building Anle Industrial Park
Hangcheng Road, Banan District
Shenzhen, China
www.zste.com

Sidelinesoft, LLC Booth 1163

4213 Rockview Court
Fort Collins, CO 80526 USA
www.sidelinesoft.com

Sidelinesoft develops software for scientific, research, and technological applications, with special interest in electronics. Our product, NL5 Circuit Simulator, has proven itself to be an excellent simulation tool for any field of electronics.

Silicon Frontline Technology, Inc. Booth 1063

4030 Moorpark Avenue
Suite 249
San Jose, CA 95117 USA
www.siliconfrontline.com

Simplis Technologies Booth 1733

P.O. Box 40084
Portland, OR USA
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.

SMC Diode Solutions Booth 1019

101 Sunnyside Boulevard
Plainview, NY 11803 USA
www.smc-diodes.com

We manufacture and design our own products which are widely accepted in both domestic and international markets. We follow rigorous qualification standards from large aerospace, communication, and consumer electronics suppliers.

Software Cradle Co., Ltd. Booth 2257

50 Chestnut Street, Suite A-214
Beavercreek, OH 45440 USA
www.cradle-cfd.com

Software Cradle is a leading provider of Computational Fluid Dynamics (CFD) software including SC/Tetra (general purpose unstructured mesh), scSTREAM (general purpose Cartesian mesh), and HeatDesigner (Cartesian mesh for electronics).

Solantro Semiconductor Corporation Booth 1262

146 Colonnade Road
Suite 200
Ottawa, ON K2E 7Y1 Canada
www.solantro.com

Solantro designs and manufactures chips to measure, process and drive power conversion architectures. Its dedicated chipset based on unique Digital Power Processing dP2 technology provides customers with the highest performance and reliability.

Sonoscan, Inc Booth 1435

2149 E. Pratt Boulevard
Elk Grove Village, IL 60007 USA
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.

SP Control Technologies Booth 1462

Calle Rios Rosas 47
Madrid, 28003 Spain
www.spcontroltechnologies.com

SP Control Technologies is a startup specialized in power electronics control. We develop state of the art technologies, focusing on simplicity. Our products will facilitate and improve the operation of all your electronic devices.

Standex-Meder Electronics Booth 1763

4538 Camberwell Road
Cincinnati, OH 45209 USA
www.standexelectronics.com

Design engineers trust Standex-Meder for high reliability magnetics solutions such as planar transformers & inductors, current, low frequency power and isolation, high-frequency transformers & inductors, and custom electronic components.

Stapla Ultrasonics Corp. Booth 1263

250 Andover Street
Wilmington, MA 01887 USA
www.staplaltrasonics.com

Stellar Industries Corp. Booth 1656

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 1417

30 Corporate Drive
 Suite 300
 Burlington, MA 01803 USA
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.

Storm Power Components Booth 1442

240 Industrial Park Lane
 Decatur, TN 37322 USA
www.stormpowercomponents.com

Sumida America Components Inc. Booth 2232

1251 N. Plum Grove Road
 Suite 150
 Schaumburg, IL 60173 USA
www.sumida.com

Sumida is a global manufacturer of high quality inductive components & modules. Our products are used in various applications within the Consumer, Automotive & Industrial markets. We offer customized & standard components for a broad market.

Synopsys, Inc. Booth 1161

690 E. Middlefield Road
 Mountain View, CA 94043 USA
www.synopsys.com

Synopsys is the Silicon to Software™ partner for companies developing electronic products, efficient power electronics and software applications. Synopsys has the solutions needed to deliver innovative, high-quality, secure products.

Syrma Technology Booth 1354

4340 Stevens Creek Boulevard
 Suite 275
 San Jose, CA 95129 USA
www.syrmatech.com

From RFID technology to power electronics and custom magnetics, we specialize in producing high-mix, flexible volume products in the telecom, networking & communications, power, industrial, medical, automotive, and computing industries.

Taiwan Semiconductor Inc. Booth 1657

3040 Saturn Street
 Suite 200
 Brea, CA 92821 USA
www.taiwansemi.com

Taiwan Semiconductor is a global supplier of power discrete semiconductor products. TSC provides high quality power control solutions for electronic applications such as power conversion, lighting, motor control, auto, industrial, and commercial.

Taiyo Kogyo Co., LTD Booth 1135

TOC Bldg. 11F-58, 7-22-17
 Shinagawa-ku, Tokyo, Japan
www.taiyo-technology.jp/english.html

Taiyo Kogyo manufactures Heavy Copper/High Current PCB (HPCB) used in low impedance power conversion, eliminating wires, dissipating heat efficiently. HPCB 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.

Tamura Corporation of America Booth 1444

1040 So. Andreasen Drive
 Suite 100
 Escondido, CA 92029 USA
www.tamuracorp.com

Tamura Corporation is a Global magnetics manufacturer. Products are Standard catalog Power, Telecom, Pulse and Custom Transformers, Inductors and Reactors. Hall Effect Current Sensors, Power Modules and other products.

TDK Corporation Booth 1323

475 Half Day Road
 Suite 300
 Lincolnshire, IL 60069 USA
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.

Tektronix Inc. Booth 1061

14150 SW Karl Braun Drive
Beaverton, OR 97077 USA
www.tektronix.com

Today's power electronic devices may include switch-mode power supplies (SMPS), linear regulators (LDO), voltage references and other power electronics. A single power supply's performance or failure can affect the fate of a large, costly system. Learn how to make accurate power measurements that are essential to ensure the efficiency, reliability, compliance, and safety of an emerging power electronic and power conversion design.

Teledyne LeCroy Booth 2037

700 Chestnut Ridge Road
Chestnut Ridge, NY 10977 USA
www.teledynelecroy.com

Teledyne LeCroy is a leading provider of oscilloscopes, probes, and software analysis solutions for power electronics and three-phase testing.

Texas Instruments Booth 1617

12500 TI Boulevard
MS 8680
Dallas, TX 75243 USA
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 1153**

100 School Street
Bergenfield, NJ 07621 USA
www.theallpowersource.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.

**The Bergquist Company
(a Henkel Company) Booth 1760**

18930 West 78th Street
Chanhassen, MN 55317 USA
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.

Thermik Corporation Booth 2046

3304 US Highway 70 E.
New Bern, NC 28560 USA
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.

TowerJazz Booth 1521

2570 N. 1st. Street
Suite 480
#500
San Jose, CA 95131 USA
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 1517

433 NW 4th Avenue
Suite 200
Portland, OR 97209 USA
www.transim.com

Transim Technology, the global leader in cloud based engineering solutions, creates revolutionary design tools backed by exceptional engineering/software expertise. Come check out our cool new tools that facilitate the engineering design process.

Transphorm Booth 2133

115 Castilian Drive
Goleta, CA 93117 USA
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.

Triad Magnetics Booth 1645

460 Harley Knox Boulevard
Perris, CA 92571 USA
www.triadmagnetics.com

Triad Magnetics is a global leader in the design and manufacture of Transformers, Power Supplies, and Inductors. Look for us in the Industrial/Commercial, Renewable Energy, Medical, Power Conversion/Measurement and Audio/Sound Processing markets

TSC Ferrite International Booth 1836

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 1936

4200 Bonita Place
Fullerton, CA 92835 USA
www.ttelectronics.com

TT electronics is a focused, global electronics group supplying leading manufacturers in the defence, aerospace, medical, transportation and industrial electronics markets.

Typhoon HIL, Inc. Booth 2153

35 Medford Street
Suite 305
Boston, MA 02143 USA
www.typhoon-hil.com

Typhoon HIL, Inc. is the market and technology leader in the rapidly-growing ultra-high-fidelity controller-Hardware-in-the-Loop (cHIL) for power electronics, microgrids, and distribution networks.

United Chemi-Con Booth 1825

1701 Golf Road 1-1200
Rolling Meadows, IL 60008 USA
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.

United Silicon Carbide, Inc. Booth 1844

7 Deer Park Drive
Suite E
Monmouth Junction, NJ 08852 USA
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 1243

800 W Campbell Road, EC33
Richardson, TX 75080 USA
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 1425

2935 Dolphin Drive
Suite 102
Elizabethtown, KY 42701 USA
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 1732

8656 Highway 71 West
Cuesta Centre, E Bldg
Austin, TX 78735 USA
www.venable.biz

Venable Instruments is an industry leader offering a broad range of tools for design/testing of feedback control loops and impedance measurements. Venable specializes in frequency response analyzers, injection transformers, 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.

Versatile Power Booth 1863

743 Camden Avenue
Campbell, CA 95136 USA
www.versatilepower.com

Versatile Power has a long history of designing robust power supplies for military, commercial, laboratory and medical applications. Founded in 2002, Versatile Power offers a line of standard power supplies as well as custom-design power solutions

Viking Tech America Corporation Booth 1953

70, Kuanfu N. Road
HsinChu Industrial Park, Hukou
HsinChu 303, Taiwan
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 1361

Biberger Strasse 93
Unterhaching, 82008 Germany
www.vincotech.com

Vincotech designs and manufactures a wide range of power modules from 4A to 1800A and 600V to 2400V. Topologies include IPMs, PIMs, sixpacks, rectifiers, PFC, H-bridges, half-bridges, and boosters as well as NPC/MNPC/AM-NPC and custom modules.

Vishay Intertechnology, Inc. Booth 2017

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

Voltage Multipliers, Inc. Booth 1533

8711 W. Roosevelt Avenue
Visalia, CA 93291 USA
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 1133

121 Jasmine Court
Driftwood, TX 78619 USA
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.

West Coast Magnetics Booth 1537

PO Box 31330
Stockton, CA 95213 USA
www.wcmagnetics.com

Wolfspeed, A Cree Company Booth 1633

3028 E Cornwallis Road
Research Triangle Park, NC 27709 USA
www.wolfspeed.com

The broadest, most field-tested & fully commercialized portfolio of SiC power MOSFETs, diodes & modules, increasing the applications supported by WBG technology & enabling more capable power systems for a responsible, energy-efficient future.

Wolverine Tube Inc. – MicroCool Division Booth 1460

2100 Market Street NE
Decatur, AL 35601 USA
www.microcooling.com

MicroCool has leveraged Wolverine's proprietary MDT technology to produce novel cold plates and integrated base plates for optimal liquid cooling solutions for the electronics industry.

Wurth Electronics Midcom Inc. Booth 1933

Wurth Electronics Midcom globally leads the design and manufacture of custom transformers and magnetics. Catalog products include inductors, ferrites, chokes, capacitors, LEDs, and connectors.

Two online tools help engineers design in magnetics including the Smart Transformer Selector, for isolated designs, and REDEXPERT, for non-isolated designs.

**Würth Elektronik
Wireless Charging** Booth 001
121 Airport Drive
Watertown, SD 57201 USA
www.we-online.com

**X-FAB Semiconductor
Foundries** Booth 1926
275 Saratoga Avenue
Santa Clara, CA 95050 USA
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 Booth 1227
7507 Convoy Street
San Diego, CA 92111 USA
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 1343
2 Dart Road
Newnan, GA 30265 USA
www.tmi.yokogawa.com

For 100 years, we have offered precision instruments to test power supplies, converters, motor drives, inverters and other power electronics circuits and systems. Visit us at booth 1343.

Yole Developpement Booth 1554
Le Quartz
75 cours Emile Zola
Villeurbanne, 69100 France
www.yole.fr

Beginning in 1998 with Yole Developpement, we have grown to become a group of companies providing market research, technology analysis, strategy consulting, media in addition to finance services.

ZES ZIMMER Inc. Booth 1739
2850 Thornhills Avenue SE
Grand Rapids, MI 49546 USA
www.zes.com

ZES ZIMMER is a German manufacturer uniquely dedicated to measuring electric power: precision Power Analyzers & accessories. Proprietary advantages regarding inverters, frequency converters & other PWM devices. Versatile, affordable, friendly.

**Zhuzhou CRRC Times
Electric Co., Ltd** Booth 1037
Shidai Road
Shifeng District
Zhuzhou, Hunan China
www.tec.csrzic.com

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 1045
850 Central Parkway E
Suite #160
Plano, TX 75074 USA
www.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.

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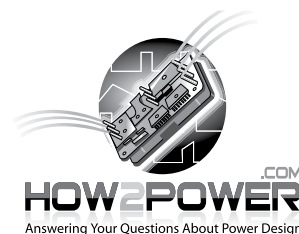
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