



APEC[®]

2017

THE PREMIER GLOBAL EVENT IN APPLIED POWER ELECTRONICS™

Applied Power Electronics Conference and Exposition

APEC 2017 Sponsors



MARCH 26-30, 2017 | TAMPA, FLORIDA

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APEC Mobile App & Internet Access

For the latest news and information, access to on-line conference and hotel information download the **APEC2017 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 App Store (IOS devices) when searching keyword **"APEC"**.



Internet is available throughout the Tampa Convention Center to APEC attendees and can be accessed by connecting to the APEC 2017 Attendee wireless network. After selecting the **APEC 2017 Attendee** wireless network, open your web browser and you will be prompted to input a password. The password is **TAMPA**.

Foreword

I am honored to personally welcome you to the 2017 IEEE Applied Power Electronics Conference and Exposition (APEC 2017), at the Tampa Convention Center, in Tampa, Florida.

APEC allows power electronics professionals from all sectors to gather annually and participate in a rewarding exchange of technical knowledge, gaining valuable industry connections. This is an opportunity which is truly only possible at APEC, the Premier Event in Applied Power Electronics. I look forward to APEC every year as a time to meet colleagues, see what new directions are emerging in our field, and find new solutions to the problems I face—or sometimes find new problems to solve.

This event is made possible through the tireless efforts of the APEC 2017 organizing committee and APEC's sponsors: IEEE Industry Applications Society (IAS), IEEE Power Electronics Society (PELS), and Power Sources Manufacturers Association (PSMA). It is their dedication, expertise, and support which drives this conference to be a showcase of exceptional advances in power electronics.

APEC 2017 will provide an unmatched technical program and exposition experience, highlighting the best our industry has to offer. The exposition will feature cutting edge technologies and products from 266 companies. Attendees will be able to easily navigate the exposition by using the APEC Mobile App, which will feature an interactive directory and map of the floor.

The technical program will touch on the latest concerns in power electronics. With presenters from industry, government, and academia, and from all around the globe, the Technical Sessions and Dialogue Sessions are sure to offer something for everyone. From Industry

Sessions to Professional Educational Seminars, you will be able to witness in-depth discussions of topics which combine theory with practical application. Initiatives such as the Micro Mouse Competition and Travel Grants will draw a global crowd of innovative thinkers that represent the future of power electronics. As always, the Plenary Session and Rap Sessions will feature hot topics affecting not only our industry, but society today.

Tampa is a stunning location which I'm sure you will enjoy as you experience all the city has to offer. I hope you take advantage of this by visiting Busch Gardens, the New York Yankees spring training facility, or one of the nearby world class beaches. Your families will have endless options to explore, including the Florida Aquarium, Lowry Park Zoo, SS American Victory, Henry B. Plant Museum, and Glazer Children's Museum. In addition there are extensive dining destinations and entertainment venues for you to visit with old friends and new colleagues at the conclusion of the day's programming.

I cannot thank the APEC attendees, exhibitors, sponsors, organizing & steering committee members, reviewers, and volunteers, enough. It is your passion and knowledge which makes APEC a memorable event year after year. I look forward to meeting you at APEC 2017 and sharing in this experience together.

Warmest Regards,



Jonathan W. Kimball

General Chair

2017 IEEE Applied Power Electronics Conference
and Exposition

APEC 2017

Conference Committee & Management

Conference Committee

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*Missouri University of Science
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Madrid*

Aung Thet Tu

PSMA
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Babak Fahimi

PELS
University of Texas at Dallas

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
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Sunday, March 26, 2017

Registration	8:00 a.m. – 5:00 p.m.	2ND FLOOR CONCOURSE
Presenter Breakfast	8:00 a.m. – 9:00 a.m.	BALLROOM A
S01: Bidirectional DC-DC Converters: Fundamentals and Advances	9:30 a.m. – 1:00 p.m.	ROOM 13/14
S02: Silicon Carbide MOSFETs – A Deep Dive to Accelerate Your Next Power Converter Design	9:30 a.m. – 1:00 p.m.	ROOM 15/16
S03: Direct Digital Design of Compensators for Power Electronics Control	9:30 a.m. – 1:00 p.m.	ROOM 18/19
S04: High Power Si and SiC Module Technology and Application Considerations	9:30 a.m. – 1:00 p.m.	ROOM 24/25
S05: EMI Causes, Measurement, and Reduction Techniques for Switch-Mode Power Converters	9:30 a.m. – 1:00 p.m.	ROOM 20/21
S06: Practical Design of Wireless Electric Vehicles: Dynamic & Stationary Charging Technologies	9:30 a.m. – 1:00 p.m.	ROOM 22/23
S07: A Comprehensive Introduction to Implementing a Fully Digital LLC Resonant Converter	2:30 p.m. – 6:00 p.m.	ROOM 13/14
S08: Practical Implementation of SiC Power Devices on Using Best Practices with a Focus on Electrification of Motor Vehicles	2:30 p.m. – 6:00 p.m.	ROOM 15/16
S09: Small-Signal Stability and Subsystem Interactions in Distributed Power Systems with Multiple Converters: DC Systems and 1-Phase AC Systems	2:30 p.m. – 6:00 p.m.	ROOM 18/19
S10: Advanced Packaging Technologies for Fully Exploiting Attributes of WBG Power Electronics	2:30 p.m. – 6:00 p.m.	ROOM 24/25
S11: Introduction to EMC	2:30 p.m. – 6:00 p.m.	ROOM 20/21
S12: High Frequency Magnetics Design and Modeling	2:30 p.m. – 6:00 p.m.	ROOM 22/23

Monday, March 27, 2017

Presenter Breakfast	7:00 a.m. – 8:00 a.m.	BALLROOM A
Registration	7:30 a.m. – 5:00 p.m.	2ND FLOOR CONCOURSE
Spouse and Guest Breakfast	8:00 a.m. – 9:00 a.m.	MARRIOTT – MEETING ROOM 4
Spouse and Guest Hospitality Room Open	8:00 a.m. – 11:00 a.m.	MARRIOTT – MEETING ROOM 4
S13: Input Filter Interactions with Switching Regulators	8:30 a.m. – 12:00 p.m.	ROOM 13/14
S14: SiC Power Devices and MV Power Converter Applications	8:30 a.m. – 12:00 p.m.	ROOM 15/16
S15: Current-Mode-Control Modeling – 3 Decades of Progress	8:30 a.m. – 12:00 p.m.	ROOM 18/19
S16: Google Little Box Reloaded: How to Achieve 200W/in ³ & Beyond? Concepts – Evaluation – Barriers – Future	8:30 a.m. – 12:00 p.m.	ROOM 24/25
S17: Design for Reliability: From Components to Systems	8:30 a.m. – 12:00 p.m.	ROOM 20/21
S18: High Frequency Planar Magnetics for Power Conversion	8:30 a.m. – 12:00 p.m.	ROOM 22/23
Spouse and Guest Tour “St. Pete Chihuly Collection and Glassblowing Demonstration” departs (<i>Registration Required</i>)	10:00 a.m.	MARRIOTT – MEETING ROOM 4
Opening Plenary Session	1:30 p.m. – 5:00 p.m.	BALLROOM B/C

KEY:	S = Professional Education Seminars	R = Rap Sessions	IS = Industry Sessions D = Dialogue Sessions	T = Technical Sessions
Exhibit Hall Welcome Reception			5:00 p.m. – 8:00 p.m.	EXPOSITION (WEST/EAST HALL)
MicroMouse Contest			8:00 p.m. – 10:00 p.m.	BACK OF EXPOSITION (WEST/EAST HALL)
Tuesday, March 28, 2017				
Presenter Breakfast			7:00 a.m. – 8:00 a.m.	BALLROOM A
Registration			7:30 a.m. – 5:00 p.m.	2ND FLOOR CONCOURSE
Spouse and Guest Breakfast			8:00 a.m. – 9:00 a.m.	MARRIOTT – MEETING ROOM 4
Spouse and Guest Hospitality Room Open			8:00 a.m. – 11:00 a.m.	MARRIOTT – MEETING ROOM 4
IS01: High Frequency Magnetics – Transforming the Black Magic to Engineering			8:30 a.m. – 11:55 a.m.	ROOM 15/16
IS02: Component, Reliability and Manufacturing Innovations for 3D Power Packaging			8:30 a.m. – 11:55 a.m.	ROOM 14
IS03: Electric Vehicles, Aerospace & Other Harsh Environments			8:30 a.m. – 11:55 a.m.	ROOM 13
IS04: PMBus Implementation and Applications			8:30 a.m. – 11:55 a.m.	ROOM 11
T01: Soft-switching DC-DC Converters			8:30 a.m. – 12:00 p.m.	ROOM 1/2
T02: AC-DC Converters I			8:30 a.m. – 12:00 p.m.	ROOM 18/19
T03: Multilevel Converters for Utility Applications			8:30 a.m. – 12:00 p.m.	ROOM 20
T04: Control of Motor Drives I			8:30 a.m. – 12:00 p.m.	ROOM 21
T05: Power Device Performance & Gate Drivers			8:30 a.m. – 12:00 p.m.	ROOM 22
T06: Control of DC-DC Converters			8:30 a.m. – 12:00 p.m.	ROOM 23
T07: Converters for Renewable Energy			8:30 a.m. – 12:00 p.m.	ROOM 24
T08: Lower Power Applications			8:30 a.m. – 12:00 p.m.	ROOM 25
Spouse and Guest Tour “Treasures of Tampa by Water and Land” departs (<i>Registration Required</i>)			9:30 a.m.	MARRIOTT – MEETING ROOM 4
Exhibit Hall Open			12:00 p.m. – 5:00 p.m.	EXPOSITION (WEST/EAST HALL)
Exhibitor Seminars – Session #1 (Concurrent Sessions)			1:30 p.m. – 2:00 p.m.	SEE PAGE 176
Exhibitor Seminars – Session #2 (Concurrent Sessions)			2:15 p.m. – 2:45 p.m.	SEE PAGE 179
Exhibitor Seminars – Session #3 (Concurrent Sessions)			3:00 p.m. – 3:30 p.m.	SEE PAGE 182
Exhibitor Seminars – Session #4 (Concurrent Sessions)			3:45 p.m. – 4:15 p.m.	SEE PAGE 185
R01: Power Electronic Topologies – Do We Need More or Any Benefit to Others?			5:00 p.m. – 6:30 p.m.	ROOM 15/16
R02: Do We Need to Progress Towards GHz Switching in High Power Systems and Applications?			5:00 p.m. – 6:30 p.m.	ROOM 18/19
R03: 3D Printing and Power Supply on Chip (PwrSoC)/Power Supply in Package (PSiP) vs. Discrete Designs			5:00 p.m. – 6:30 p.m.	ROOM 20/21
Wednesday, March 29, 2017				
Presenter Breakfast			7:00 a.m. – 8:00 a.m.	BALLROOM A
Registration			8:00 a.m. – 3:00 p.m.	2ND FLOOR CONCOURSE
Spouse and Guest Breakfast			8:00 a.m. – 9:00 a.m.	MARRIOTT – MEETING ROOM 4
Spouse and Guest Hospitality Room Open			8:00 a.m. – 11:00 a.m.	MARRIOTT – MEETING ROOM 4
IS05: Mobile Applications			8:30 a.m. – 10:10 a.m.	ROOM 15/16

KEY:	S = Professional Education Seminars	R = Rap Sessions	IS = Industry Sessions D = Dialogue Sessions	T = Technical Sessions
IS06:	Regulatory and Compliance Considerations for Power Electronics		8:30 a.m. – 10:10 a.m.	ROOM 14
IS07:	Offline Power Supplies		8:30 a.m. – 10:10 a.m.	ROOM 13
IS08:	Transactive Energy and the Electric Power Grid		8:30 a.m. – 10:10 a.m.	ROOM 11
T09:	High Power AC-DC Converters		8:30 a.m. – 10:10 a.m.	ROOM 1/2
T10:	Non-isolated DC-DC Converters		8:30 a.m. – 10:10 a.m.	ROOM 18/19
T11:	Power Converter Topologies		8:30 a.m. – 10:10 a.m.	ROOM 20
T12:	Power Device Reliability		8:30 a.m. – 10:10 a.m.	ROOM 21
T13:	Design Optimization for High Reliability		8:30 a.m. – 10:10 a.m.	ROOM 22
T14:	Reliability		8:30 a.m. – 10:10 a.m.	ROOM 23
T15:	Batteries for Renewable Energy		8:30 a.m. – 10:10 a.m.	ROOM 24
T16:	LED Applications		8:30 a.m. – 10:10 a.m.	ROOM 25
	Exhibit Hall Open		10:00 a.m. – 2:00 p.m.	EXPOSITION (WEST/EAST HALL)
	Exhibitor Seminars – Session #5 (Concurrent Sessions)		10:30 a.m. – 11:00 a.m.	SEE PAGE 188
	Exhibitor Seminars – Session #6 (Concurrent Sessions)		11:15 a.m. – 11:45 a.m.	SEE PAGE 191
	Exhibitor Seminars – Session #7 (Concurrent Sessions)		12:00 p.m. – 12:30 p.m.	SEE PAGE 194
IS09:	Silicon and WBG Power Devices for High Frequency Topologies		2:00 p.m. – 5:25 p.m.	ROOM 15/16
IS10:	Server Power Topics		2:00 p.m. – 5:25 p.m.	ROOM 14
IS11:	Vehicle Electrification – Not just the Powertrain		2:00 p.m. – 5:25 p.m.	ROOM 13
IS12:	IGBTs / Gate Drives		2:00 p.m. – 5:25 p.m.	ROOM 11
T17:	High Frequency DC-DC Converters		2:00 p.m. – 5:30 p.m.	ROOM 1/2
T18:	Magnetics		2:00 p.m. – 5:30 p.m.	ROOM 18/19
T19:	Multilevel Converters		2:00 p.m. – 5:30 p.m.	ROOM 20
T20:	Grid-Connected Inverter Control		2:00 p.m. – 5:30 p.m.	ROOM 21
T21:	Device Modeling & Simulation		2:00 p.m. – 5:30 p.m.	ROOM 22
T22:	Control Strategies for Inverters & Motor Drives		2:00 p.m. – 5:30 p.m.	ROOM 23
T23:	Renewable Energy System Considerations		2:00 p.m. – 5:30 p.m.	ROOM 24
T24:	Medium/High Power Applications		2:00 p.m. – 5:30 p.m.	ROOM 25
	“Little Havana” Evening Social Event (<i>Ticket Required</i>)		7:00 p.m. – 10:00 p.m.	CURTIS HIXON WATERFRONT PARK

Thursday, March 30, 2017

	Presenter Breakfast		7:00 a.m. – 8:00 a.m.	BALLROOM A
	Registration		8:00 a.m. – 12:00 p.m.	2ND FLOOR CONCOURSE
	Spouse and Guest Breakfast		8:00 a.m. – 9:00 a.m.	MARRIOTT – MEETING ROOM 4
	Spouse and Guest Hospitality Room Open		8:00 a.m. – 11:00 a.m.	MARRIOTT – MEETING ROOM 4
IS13:	GaN Topics and Applications		8:30 a.m. – 11:30 a.m.	ROOM 15/16
IS14:	Isolation Barrier Technologies for Power Electronics		8:30 a.m. – 11:30 a.m.	ROOM 14
IS15:	Industrial Power Applications of Silicon Carbide Semiconductors		8:30 a.m. – 11:30 a.m.	ROOM 13
IS16:	Energy Harvesting		8:30 a.m. – 11:30 a.m.	ROOM 11
T25:	DC-DC Converter Applications		8:30 a.m. – 11:20 a.m.	ROOM 1/2

KEY:	S = Professional Education Seminars	R = Rap Sessions	IS = Industry Sessions D = Dialogue Sessions	T = Technical Sessions
T26:	Renewable Energy Using Advanced Devices		8:30 a.m. – 11:20 a.m.	ROOM 18/19
T27:	Power Modules		8:30 a.m. – 11:20 a.m.	ROOM 20
T28:	Packaging Innovation for High Reliability		8:30 a.m. – 11:20 a.m.	ROOM 21
T29:	Systems & Components Modeling & Simulation		8:30 a.m. – 11:20 a.m.	ROOM 22
T30:	Control of Motor Drives II		8:30 a.m. – 11:20 a.m.	ROOM 23
T31:	DC-DC Conversion & Other Transportation Applications		8:30 a.m. – 11:20 a.m.	ROOM 24
T32:	Power Electronic Applications		8:30 a.m. – 11:20 a.m.	ROOM 25
D01:	AC-DC Converters II		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D02:	Miscellaneous Topics in DC-DC Converters I		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D03:	Miscellaneous Topics in DC-DC Converters II		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D04:	Power Electronics for Utility Interface		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D05:	Operation & Control of Motor Drives		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D06:	Converter Topologies & Control		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D07:	Devices & Reliability		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D08:	Devices & Components		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D09:	Magnetic Components		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D10:	Packaging & Design Optimization		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D11:	Component Modeling & Simulation		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D12:	Modeling and Analysis of Circuits & Systems		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D13:	Control for Power Electronics & Energy Systems		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D14:	DC Renewable Energy		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D15:	AC Renewable Energy		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D16:	Transportation Power Electronics		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D17:	AC-DC, DC-AC, Grid and LED Applications		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
D18:	Power Electronics Applications		11:30 a.m. – 2:00 p.m.	BALLROOM B/C
IS17:	Silicon Carbide Device Applications		2:00 p.m. – 5:25 p.m.	ROOM 15/16
IS18:	Capacitor Technologies for Evolving Power Electronic Applications		2:00 p.m. – 5:25 p.m.	ROOM 14
IS19:	Circuits and Applications		2:00 p.m. – 5:25 p.m.	ROOM 13
IS20:	Energy Management – Smart Microgrid		2:00 p.m. – 5:25 p.m.	ROOM 11
T33:	Active Var & Harmonic Compensation		2:00 p.m. – 5:30 p.m.	ROOM 1/2
T34:	DC-DC Converter Control Methods		2:00 p.m. – 5:30 p.m.	ROOM 18/19
T35:	Control Strategies for Power Converters		2:00 p.m. – 5:30 p.m.	ROOM 20
T36:	Converter Modeling & Analysis		2:00 p.m. – 5:30 p.m.	ROOM 21
T37:	Control Applications		2:00 p.m. – 5:30 p.m.	ROOM 22
T38:	Grid-Tied Renewable Energy		2:00 p.m. – 5:30 p.m.	ROOM 23
T39:	High Power Charging & Control Technology for Vehicular Power Systems		2:00 p.m. – 5:30 p.m.	ROOM 24
T40:	Wireless Power Applications		2:00 p.m. – 5:30 p.m.	ROOM 25

General Information

Conference Location

Tampa Convention Center

333 S Franklin St
Tampa, FL 33602
Phone: +1-813-274-8511

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

> Tampa Marriott Waterside Hotel & Marina

700 S Florida Ave
Tampa, FL 33602
Phone: +1-813-221-4900

> Embassy Suites by Hilton Tampa Downtown Convention Center

513 S Florida Ave
Tampa, FL 33602
Phone: +1-813-769-8300

> Sheraton Tampa Riverwalk

200 N Ashley Dr
Tampa, FL 33602
Phone: +1-813-223-2222

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Transportation

AREA AIRPORT

Tampa International Airport – TPA

Distance: 8 miles from Tampa Convention Center and APEC hotels.

Estimated taxi fare: \$30.00-\$35.00 USD (one way)

Alternate transportation: Super Shuttle, Uber and Lyft.

PARKING

There are numerous parking options throughout downtown Tampa and at/near the Tampa Convention Center. The following link shows you all of the parking options and rates for Tampa.

<http://www.tampagov.net/parking>

The closest lots for the convention center are: the Tampa Convention Center Garage and the South Regional Parking Garage.

Parking is also available at all (3) APEC hotels for \$24.00 USD per night at each hotel.

GETTING AROUND TOWN

Visit your hotel concierge desk or the visitors desk at the convention center for details regarding the numerous ways to get around town. To include the TECO Line Street Car, Water Taxi, Coast Bike, and The Downtowner.

Conference Registration

In order to participate in the APEC 2017 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 Registration Center at the Tampa Convention Center (2nd Floor Concourse).

Saturday, March 25	4:00 p.m. – 7:00 p.m.
Sunday, March 26	8:00 a.m. – 5:00 p.m.
Monday, March 27	7:30 a.m. – 5:00 p.m.
Tuesday, March 28	7:30 a.m. – 5:00 p.m.
Wednesday, March 29	8:00 a.m. – 3:00 p.m.
Thursday, March 30	8:00 a.m. – 12:00 p.m.

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. During breakfast, you will receive brief instructions from the Professional Education Seminar Chairs.

> Professional Education Seminar Presenter Breakfast

LOCATION: Ballroom A, Tampa Convention Center
DAY/TIME: Sunday at 8:00 a.m. and Monday at 7:00 a.m.

Industry Sessions and the Oral Technical Session Presenters:

You must attend a mandatory breakfast on the morning of your session. 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.

> Industry and Oral Technical Session Presenter Breakfast

LOCATION: Ballroom A, Tampa Convention Center
DAY/TIME: Tuesday-Thursday at 7:00 a.m.

Dialogue Technical Session Presenters:

You must attend a mandatory breakfast on the morning of your session. During breakfast you will receive brief instructions and will be able to mount your presentation on the poster boards in the room next door after the breakfast. Thumb tacks will be provided.

> Dialogue Technical Session Presenter Breakfast

LOCATION: Ballroom A, Tampa Convention Center
DAY/TIME: Thursday at 7:00 a.m.

Speaker Ready Room:

The Speaker Ready room is available to Professional Education Seminar, Industry Session and Oral Technical Session speakers should you need to review your presentation in advance of your session or make any edits.

LOCATION: Room 4, Tampa Convention Center

HOURS:

Sunday, March 26 8:00 a.m. – 5:00 p.m.
Monday, March 27 7:30 a.m. – 5:00 p.m.
Tuesday, March 28 7:30 a.m. – 5:00 p.m.
Wednesday, March 29 7:30 a.m. – 5:00 p.m.
Thursday, March 30 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 a U.S. bank). Checks and money orders returned unpaid will be assessed and an additional handling charge of \$50.00 USD.

A LIMITED NUMBER of copies of the Conference Proceedings and Seminar Workbooks may be available for sale at the Conference Registration Center, starting at 12:00 p.m. on Wednesday, March 29.

	<i>On-site</i>
Conference Proceedings (USB Only)	\$180.00 USD
Seminar Workbook (USB only)	\$180.00 USD

Publications purchased can be picked up at the registration desk.

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Important Rules, Notices, & Conference Policies

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All registrations sent by mail or fax must include payment. Payment methods include credit card, check or money order. Checks may be personal, business or certified. Checks and money orders must be payable in United States dollars and drawn on a United States bank. 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 \$50.00 USD.

Registrations must be submitted by March 24, after March 24 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 17, 2017. All refunds will be processed after the conclusion of the conference and will be subject to a \$50.00 USD 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 with 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 2017 hotel space, meeting facilities or Exhibit Hall.

Distributing Commercial Material at APEC

Rules For Non-Exhibitors

Distribution of commercial material in the APEC 2017 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 2017 Plenary Session is designed to cover the history of power, the current needs in energy efficiency and the future possibilities. The plenary is made up of 6 six presentations from respected industry leaders. Each presentation is 30 minutes in length and allows for interactive Q&A at the end of each presentation.

Professional Education Seminars

This year APEC will offer 18 Professional Education Seminars to take place on Sunday, March 26 and Monday, March 27. Seminars will be given within the following tracks: Design; SiC; Control; Components & Systems; EMI & Reliability; and Wireless Charging & Magnetics.

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 2017, the Industry Sessions track continues to expand. This track runs in parallel with the traditional Technical Sessions Track. Speakers are invited to make a presentation only, without submitting a formal manuscript for the APEC Proceedings. This allows APEC to present information on current topics in power electronics from sources that would not otherwise be present at an industry conference. While many of these sessions are technical in nature, some also target business-oriented people such as purchasing agents, electronic system designers, regulatory engineers, and other people who support the power electronics industry.

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 2017 Exposition. In addition APEC may use the information you provide to contact you with information about APEC 2017 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 names and contact information, including name, affiliation, and mailing address will be provided to the exhibitors and media partners. **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.



Rap Sessions

We have three exciting and contentious topics lined up for this year. Rap sessions allow for exciting dialogue amongst attendees and presenters. 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 morning.

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 Micro-Mouse Competition, the only event of its kind in North America, drawing contestants from all over the world. The contest will take place at the Tampa Convention Center, in the Exposition, on the evening of Monday, March 27 starting at 8:00 p.m.

All are welcome!



Conference Social Event

Escape to Little Havana! The APEC social event is sure to provide the perfect venue for you and your colleagues to relax, unwind and enjoy great food, entertainment, antique cars, games, and a cigar roller. Join us on Wednesday, **March 29 at 7:00 p.m. at Curtis Hixon Waterfront Park** located a short walk from the Tampa Convention Center and APEC hotels. Visit the APEC Registration desk for a walking map to the park. Limited bus transportation will also be available starting at 6:45 p.m. departing from the Tampa Convention Center. The event begins at 7:00 p.m. and food is available throughout the evening.

Young Professionals & Students Reception

(All Young Professionals and Students Welcome)

Sponsored by IEEE Power Electronics Society and Industrial Applications Society

LOCATION: Tampa Bay History Center

DAY/TIME: Tuesday, March 28, 6:30 p.m. – 8:30 p.m.

PELS and IAS Young Professionals invite students and young professionals to an evening of networking and fun. Interact with your fellow young professionals and leaders of industry and academia over food and drinks. For more details please visit <http://www.ieee-pels.org/membership/student-members-and-young-professionals>



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 27 – Thursday, March 30
8:00 a.m. – 11:00 a.m.

Breakfast available 8:00 a.m. – 9:00 a.m.

MEETING ROOM 4, TAMPA MARRIOTT WATERSIDE HOTEL & MARINA

Optional Tours

Registration is required for the following tours. If you did not register in advance, a few seats may still be available. Visit the APEC Registration desk at the Tampa Convention Center at least 2 hours before the tour to purchase tickets.

> ST. PETE CHIHULY COLLECTION AND GLASSBLOWING DEMONSTRATION

DATE: Monday, March 27

COST: \$95.00 USD/per person

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

You will begin with a quick trip across the bay to beautiful downtown St Petersburg; an area quickly becoming an art mecca in the southeast. Your tour will take you through town and along the beautiful waterfront to the Morean Art Chihuly Collection in its new home on Central Ave. Chihuly is credited with transforming the methods of creating glass art, however his contributions extend well beyond the boundaries of the studio glass movement and even the field of glass: his achievements have influenced contemporary art in general. After enjoying this fine collection of Chihuly you will walk across the street to the Hot Shop where you will enjoy a glass blowing demonstration. This narrated demonstration enables you to better understand the skills of this fabulous art form.

INCLUSIONS:

Round-trip motor coach transportation with a professional tour guide

Lunch at the Parkshore Grille on Beach Drive

All admissions

> TREASURES OF TAMPA BY WATER AND LAND

DATE: Tuesday, March 28

COST: \$85.00 USD/per person

TIME/LENGTH: 9:30 a.m. – 4:30 p.m. (7 hour tour)

Guests will begin their journey by land for a guided motor coach tour of the downtown area, across the Hillsborough River to see the Tampa landmark building, the former Tampa Bay Hotel where you'll feel as if you've been transported back into the 1980's. We'll continue on by boarding the water taxi to explore coastline of Hillsborough Bay and the Hillsborough River where there are sometimes whales (manatees) and gators. We will disembark and after a brief stroll past the springs (formerly Tampa's fresh water supply) step on board our motor coach and travel quickly into Ybor City, an important link in Tampa's history and former Cigar Capital of the World. While in Ybor City guests will hear about this former hub of the Latin community with its vibrant cigar stories.

INCLUSIONS:

Round trip motor coach transportation with a professional tour guide

Lunch at the famous Columbia Restaurant in Ybor City

All admissions



Sponsor Meetings

*All meetings held at the Tampa Convention Center unless otherwise indicated.

APEC Meetings

Wednesday, March 29, 2017

APEC 2017 Organizing/Steering Committee Luncheon	11:30 a.m. – 1:00 p.m.	ROOM 10
APEC 2017 Steering Committee Meeting	1:00 p.m. – 2:30 p.m.	ROOM 10

IAS Meetings

Tuesday, March 28, 2017

IEEE PELS/IAS Young Professional Reception	6:30 p.m. – 8:30 p.m.	OFFSITE – TAMPA BAY HISTORY CENTER
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PELS Meetings

Sunday, March 26, 2017

IEEE International Future Energy Challenge (IFEC) Workshop	8:00 a.m. – 6:00 p.m.	ROOM 12
New Administrative Committee Member Training	12:00 p.m. – 2:00 p.m.	ROOM 7
FEPPCON Organizing Committee Meeting	2:00 p.m. – 3:30 p.m.	ROOM 6
PELS Constitution and Bylaws Committee	5:00 p.m. – 6:00 p.m.	ROOM 6

Monday, March 27, 2017

ITRW Meetings	8:00 a.m. – 1:00 p.m.	ROOM 9
ETTC Electronics Transformers Technical Committee	8:30 a.m. – 12:00 p.m.	ROOM 6
IEEE PELS Chapter Officer's Forum & Membership Meeting (Students/Liaisons & Chapter Chairs)	9:00 a.m. – 1:30 p.m.	ROOM 7
PELS Technical Committee Chair Lunch	12:00 p.m. – 1:00 p.m.	ROOM 5

Tuesday, March 28, 2017

WIE Breakfast	8:00 a.m. – 9:00 a.m.	ROOM 12
PELS Digital Media and Education Committee Meeting	9:00 a.m. – 10:00 a.m.	ROOM 5
PELS Standards Committee Meeting	9:00 a.m. – 12:30 p.m.	ROOM 7
PELS Southern Conference Steering Committee (SPEC)	9:00 a.m. – 10:00 a.m.	ROOM 6
PELS Exec & CPSS Team Meeting	10:00 a.m. – 11:00 a.m.	ROOM 9
PELS TC6 – High Performance and Emerging Technologies	10:30 a.m. – 12:00 p.m.	ROOM 6
PELS Fellows Committee (Members Only)	12:00 p.m. – 1:00 p.m.	ROOM 7
PELS TC1 – Power and Control Core Technologies	12:00 p.m. – 2:00 p.m.	ROOM 9
PELS Humanitarian Adhoc Committee	1:30 p.m. – 3:00 p.m.	ROOM 6
PELS TC2 – Power Conversion Systems and Components	2:00 p.m. – 4:00 p.m.	ROOM 5
PEDG Steering Committee Meeting	3:00 p.m. – 4:00 p.m.	ROOM 6
PELS Vehicle and Transportation Systems Meeting	3:00 p.m. – 4:00 p.m.	ROOM 7
PELS TC3 – Motor Drives and Actuators	5:30 p.m. – 6:30 p.m.	ROOM 7
PELS Industry Board and Magazine Advisory Meeting (Members Only)	5:30 p.m. – 7:00 p.m.	ROOM 6

Tuesday, March 28, 2017 *(continued)*

IEEE PELS/IAS Young Professional Reception	6:30 p.m. – 8:30 p.m.	OFFSITE – TAMPA BAY HISTORY CENTER
PELS TC5 – Sustainable Energy Technical Committee	6:30 p.m. – 7:30 p.m.	ROOM 12
PELS Industry Board and Magazine Advisory Dinner	7:30 p.m. – 10:00 p.m.	OFFSITE – TBD

Wednesday, March 29, 2017

PELS Exec Team Meeting FinCom	9:00 a.m. – 10:00 a.m.	ROOM 6
PELS Editorial Board – IEEE Transactions on Power Electronics	11:30 a.m. – 1:30 p.m.	ROOM 12
PELS Technical Operations	1:30 p.m. – 3:30 p.m.	ROOM 12
PELS Products Committee	3:30 p.m. – 6:30 p.m.	ROOM 12

Thursday, March 30, 2017

PELS Conference Committee Breakfast	8:00 a.m. – 9:00 a.m.	ROOM 5
PELS Conference Committee Meeting	9:00 a.m. – 12:00 p.m.	ROOM 12
eT&D Steering Committee Meeting	12:00 p.m. – 1:30 p.m.	ROOM 5
PELS JESTPE Editorial Board Meeting	2:00 p.m. – 4:00 p.m.	ROOM 5
PELS Administrative Committee Dinner	6:00 p.m. – 9:30 p.m.	OFFSITE – JACKSON'S BISTRO

Friday, March 31, 2017

PELS Administrative Committee Breakfast <i>(Companions Welcome)</i>	8:00 a.m. – 9:00 a.m.	MARRIOTT – FLORIDA BALLROOM IV
PELS Administrative Committee Meeting	9:00 a.m. – 3:00 p.m.	MARRIOTT – FLORIDA BALLROOM VI
PELS Administrative Committee Lunch <i>(Companions Welcome)</i>	11:30 a.m. – 12:30 p.m.	MARRIOTT – FLORIDA BALLROOM IV

PSMA Meetings**Saturday, March 25, 2017**

PSMA/PELS Workshop on High Frequency Magnetics	7:00 a.m. – 5:00 p.m.	ROOM 15/16
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Monday, March 27, 2017

PSMA Annual Meeting - followed by March BoD Meeting	7:30 a.m. – 1:00 p.m.	ROOM 10/11
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Tuesday, March 28, 2017

PSMA Industry-Education / APEC Travel Support Committee Meeting	9:00 a.m. – 10:00 a.m.	ROOM 32
PSMA Semiconductor Committee Meeting	10:00 a.m. – 12:00 p.m.	ROOM 33
PSMA Marketing Committee Meeting	12:00 p.m. – 2:00 p.m.	ROOM 33
PSMA Power Technology Roadmap Committee Meeting	12:00 p.m. – 2:00 p.m.	ROOM 32
PSMA Transportation Power Electronics Committee Meeting	2:00 p.m. – 4:00 p.m.	ROOM 33
PSMA Energy Efficiency/ Alternative Committee Meeting	2:00 p.m. – 4:00 p.m.	ROOM 32

Wednesday, March 29, 2017

PSMA Magnetics Committee Meeting	8:00 a.m. – 10:00 a.m.	ROOM 33
PSMA Energy Harvesting Committee Meeting	8:00 a.m. – 10:00 a.m.	ROOM 32
PSMA Capacitor Committee Meeting	10:00 a.m. – 12:00 p.m.	ROOM 33
PSMA Power Electronics Packaging Committee Meeting	10:00 a.m. – 12:00 p.m.	ROOM 33
PSMA Safety & Compliance Committee Meeting	1:00 p.m. – 3:00 p.m.	ROOM 32



APEC[®]

2017

THE PREMIER GLOBAL EVENT IN APPLIED POWER ELECTRONICS™

CONFERENCE PROGRAM

Conference Program



2:30 p.m. – 6:00 p.m.

Professional Education Seminars

(for detailed information see page 113)

S07: A Comprehensive Introduction to Implementing a Fully Digital LLC Resonant Converter

Joel Steenis, Alex Dumais
Microchip Technology, United States
ROOM 13/14

S08: Practical Implementation of SiC Power Devices on Using Best Practices with a Focus on Electrification of Motor Vehicles

Adam Barkley, Edgar Ayerbe, Kraig Olejniczak
Wolfspeed, United States
ROOM 15/16

S09: Small-Signal Stability and Subsystem Interactions in Distributed Power Systems with Multiple Converters: DC Systems and 1-Phase AC Systems

Dushan Borojevich², Jinjun Liu³, Paolo Mattavelli¹
¹University of Padova, Italy; ²Virginia Polytechnic Institute and State University, United States;
³Xi'an Jiaotong University, China
ROOM 18/19

S10: Advanced Packaging Technologies for Fully Exploiting Attributes of WBG Power Electronics

Zhenxian Liang
Oak Ridge National Laboratory, United States
ROOM 24/25

S11: Introduction to EMC

Darryl Ray
Darryl Ray EMC Consulting, LLC, United States
ROOM 20/21

S12: High Frequency Magnetics Design and Modeling

Ray Ridley
RIDLEY ENGINEERING, United States
ROOM 22/23

Monday
March 27, 2017

7:00 a.m. – 8:00 a.m.

Presenter Breakfast

BALLROOM A

7:30 a.m. – 5:00 p.m.

Registration

2ND FLOOR CONCOURSE

8:00 a.m. – 9:00 a.m.

Spouse and Guest Breakfast

MARRIOTT – MEETING ROOM 4

8:00 a.m. – 11:00 a.m.

Spouse and Guest Hospitality Room Open

MARRIOTT – MEETING ROOM 4

8:30 a.m. – 12:00 p.m.

Professional Education Seminars

(for detailed information see page 121)

S13: Input Filter Interactions with Switching Regulators

Christophe Basso
ON Semiconductor, France
ROOM 13/14

S14: SiC Power Devices and MV Power Converter Applications

Subhashish Bhattacharyu, Victor Veliadis
North Carolina State University, United States
ROOM 15/16

S15: Current-Mode-Control Modeling – 3 Decades of Progress

Fred Lee
CPES-Virginia Tech, United States
ROOM 18/19

SUNDAY

MONDAY

S16: Google Little Box Reloaded: How to Achieve 200W/in³ & Beyond? Concepts – Evaluation – Barriers – Future
 Johann W. Kolar, Dominik Neumayr, Dominik Bortis
Eidgenössische Technische Hochschule Zürich, Switzerland
 ROOM 24/25

S17: Design for Reliability: From Components to Systems
 Frede Blaabjerg, Francesco Iannuzzo, Huai Wang
Aalborg University, Denmark
 ROOM 20/21

S18: High Frequency Planar Magnetics for Power Conversion
 William Gerard Hurley¹, Ziwei Ouyang²
¹*National University of Ireland, Ireland;*
²*Technical University of Denmark (DTU), Denmark*
 ROOM 22/23

10:00 a.m.

Spouse and Guest Tour “St. Pete Chihuly Collection and Glassblowing Demonstration” (Registration Required)
departs
 MARRIOTT – MEETING ROOM 4

1:30 p.m.-5:00 p.m.

Opening Plenary Session
(for detailed information see page 126)
 BALLROOM B/C

1:30 p.m. – 2:00 p.m.

USB Power Delivery – Opportunity for Today and Tomorrow
 Ahmad Bahai, *TI, Chief Technologist and Sr. VP*

2:00 p.m. – 2:30 p.m.

Empowering the Electronics Industry: A Power Technology Roadmap
 Conor Quinn, *Artesyn Embedded Technologies & PSMA, PSMA Power Technology Roadmap Co-Chair*

2:30 p.m. – 3:00 p.m.

A Historical Perspective on the Development of the PWM Switch Model

Vatché Vorperian, *Jet Propulsion Laboratory, Principal Engineer & Fellow of the IEEE*

3:00 p.m. – 3:30 p.m.

Break

3:30 p.m. – 4:00 p.m.

Google 48V Power Architecture

Shuai Jiang, *Google, Sr. DC-DC Power Architect for Data Centers*

Xin Li, *Google, Technical Lead Manager for Power Team*

4:00 p.m. – 4:30 p.m.

The Gap Between High Power and Low Power Converters and How It Is Closing

Hamish Laird, *ELMG Digital Power, Inc., CTO*

4:30 p.m. – 5:00 p.m.

From SiC MOSFET Devices to MW-scale Power Converters

Ljubisa Stevanovic, *GE Global Research, CTO Silicon Carbide Works*

5:00 p.m.-8:00 p.m.

Exhibit Hall Welcome Reception

EXPOSITION (WEST/EAST HALL)

8:00 p.m.-10:00 p.m.

MicroMouse Contest

BACK OF EXPOSITION (WEST/EAST HALL)



7:00 a.m. – 8:00 a.m.

Presenter Breakfast

BALLROOM A

7:30 a.m. – 5:00 p.m.

Registration

2ND FLOOR CONCOURSE

8:00 a.m. – 9:00 a.m.

Spouse and Guest Breakfast

MARRIOTT – MEETING ROOM 4

8:00 a.m. – 11:00 a.m.

Spouse and Guest Hospitality Room Open

MARRIOTT – MEETING ROOM 4

8:30 a.m. – 11:55 a.m.

IS01: High Frequency Magnetics – Transforming the Black Magic to Engineering

ROOM 15/16

SESSION CHAIRS:

Ed Herbert, *Independent*

Steve Carlsen, *Raytheon*

8:30 a.m. – 8:55 a.m.

IS01.1: Power Magnetics @ High Frequency Where We Are and Where We Need to Go

Johann Kolar, *Swiss Federal Institute of Technology, Switzerland*

8:55 a.m. – 9:20 a.m.

IS01.2: New Materials and Design Tools for Magnetic Materials Suitable for GaN and SiC Switching Frequencies

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

9:20 a.m. – 9:45 a.m.

IS01.3: Thin Amorphous Core Material for Power Applications

Paul McCloskey, Santosh Kulkarni, Ansar Masood, Cian O'Mathuna, *Tyndall National Institute, Ireland*

9:45 a.m. – 10:10 a.m.

IS01.4: Core Loss Initiative: Technical

Charles Sullivan, *Dartmouth College, United States*

10:40 a.m. – 11:05 a.m.

IS01.5: Introduction to the IMA Working Group

Chuck Wilde, *Dexter Magnetics, United States*

11:05 a.m. – 11:30 a.m.

IS01.6: Magnetics Modeling in Spice: Proximity Loss

Ray Ridley, *Ridley Engineering, United States*

11:30 a.m. – 11:55 a.m.

IS01.7: Core Loss Modeling

Ed Herbert, *Independent, United States*

8:30 a.m. – 11:55 a.m.

IS02: Component, Reliability and Manufacturing Innovations for 3D Power Packaging

ROOM 14

SESSION CHAIRS:

Ernie Parker, *Crane Aerospace*

Brian Narveson, *Independent*

8:30 a.m. – 8:55 a.m.

IS02.1: Reliability of 3D Integrated Power Packaging

Patrick McCluskey, *University of Maryland, College Park, United States*

8:55 a.m. – 9:20 a.m.

IS02.2: Innovations in Chip Embedding for Power Packaging

Ct Chiu, *ASE Global, Taiwan*

9:20 a.m. – 9:45 a.m.

IS02.3: 3D Sip with Embedded Chip Supply Chain Integration

Lee Smith², Steve Anderson¹, ¹*AT&S, United States*; ²*UTAC Group – United Test and Assembly Center, United States*

9:45 a.m. – 10:10 a.m.

IS02.4: Development Challenges for DC-Link Capacitors for Wide Band Gap Semiconductor Applications

John Bultitude, *Kemet Corporation, United States*

10:40 a.m. – 11:05 a.m.

IS02.5: Thin Film Inductors for Integrated Power Conversion

Noah Sturcken, *Ferric, Inc., United States*

11:05 a.m. – 11:30 a.m.

IS02.6: Challenges and Considerations for 3D Packaging of Self-Powered IoT Devices

Michael Hayes, *Tyndall National Institute, Ireland*

11:30 a.m. – 11:55 a.m.

IS02.7: Emerging High-Performance and Low-Cost Power Packaging Solutions with Nanoscale Capacitors and Inductors

P. Markondeya Raj, Himani Sharma, Vanessa Smet, Robert Grant Spurney, Teng Sun, Rao R. Tummala, Georgia Institute of Technology, United States

8:30 a.m. – 11:55 a.m.

IS03: Electric Vehicles, Aerospace & Other Harsh Environments

ROOM 13

SESSION CHAIR:

Pierric Gueguen, Yole Developpement

Indumini Ranmuthu, Texas Instruments, Inc.

8:30 a.m. – 8:55 a.m.

IS03.1: SiC and GaN Devices in High-Performance Harsh-Environment Applications: From Hybrid Electric-Turbo Chargers to Cryogenic Power Systems

Troy Beechner, Mainstream Engineering, United States

8:55 a.m. – 9:20 a.m.

IS03.2: Are Power Electronics Ready for High Temperature?

Pierric Gueguen, Yole Developpement, France

9:20 a.m. – 9:45 a.m.

IS03.3: HIL Prototyping of Intelligent Power Systems for More Electric Aircrafts

Shweta Sanjeev, Patrick Franks, Microsemi, United States

9:45 a.m. – 10:10 a.m.

IS03.4: Powering Electric Motors on Airplanes with Variable Frequency Systems

Kaz Furmanczyk, Crane Aerospace & Electronics, United States

10:40 a.m. – 11:05 a.m.

IS03.5: Extending Battery Life in Electric Buses with Supercapacitor Technology

Ramdev Kanapady, Kyle Kim, Jason Lee, Eaton, United States

11:05 a.m. – 11:30 a.m.

IS03.6: Si vs SiC Power Modules in HEV Integration: A Cost Point of View

Elena Barbarini, SystemPlus Consulting, France

11:30 a.m. – 11:55 a.m.

IS03.7: DC Protection for e-Mobility and Battery Related Systems

Philippe Roussel, MERSEN, France

8:30 a.m. – 11:55 a.m.

IS04: PMBus Implementation and Applications

ROOM 11

SESSION CHAIRS:

Ramesh Balasubramaniam, Infineon Technologies

Travis Summerlin, Texas Instruments, Inc.

8:30 a.m. – 8:55 a.m.

IS04.1: The Circle of Life: Using PMBus from Start to Finish

Ramesh Balasubramaniam, PMBus & Infineon, United States

8:55 a.m. – 9:20 a.m.

IS04.2: PMBus Application Profiles for PoLs

Chris Eckhoff, Maxim Integrated, United States

9:20 a.m. – 9:45 a.m.

IS04.3: Direct Format Usage for PMBus Data Transfer

Jeff Klaas, Intersil Corp, United States

9:45 a.m. – 10:10 a.m.

IS04.4: Ericsson's Config File Format and Loading Method for PMBus Devices

Björn Olsson, Ericsson AB, Sweden

10:40 a.m. – 11:05 a.m.

IS04.5: Enabling In-Circuit Programming of Power Solutions via PMBus

Peter Miller, Texas Instruments, United States

11:05 a.m. – 11:30 a.m.

IS04.6: Monitoring and Optimizing AC/DC Power Supply Performance for Different Applications using PMBus™

Chris Jones, PMBus & Artesyn, United States

11:30 a.m. – 11:55 a.m.

IS04.7: Challenges and Solutions for Multi-Master / Multi-Slave PMBus Systems

Peter Miller, Texas Instruments, United States

8:30 a.m. – 12:00 p.m.

T01: Soft-switching DC-DC Converters

ROOM 1/2

Track: DC-DC Converters

SESSION CHAIRS:

Khurram Afridi, *University of Colorado Boulder*

Pradeep Shenoy, *Texas Instruments, Inc.*

- 8:30 a.m. – 8:50 a.m.
- T01.1: Sheppard-Taylor Isolated High Boost DC-DC Converter**
Andrii Chub², Yam Siwakoti¹, Dmitri Vinnikov²,
Frede Blaabjerg¹, ¹Aalborg University, Denmark;
²Tallinn University of Technology, Estonia
- 8:50 a.m. – 9:10 a.m.
- T01.2: A Low-Cost Soft-Switching High Step-Up Flyback Converter with Stacked Output Cells**
Morteza Moosavi, Ajay Morya, Hamid A. Toliyat,
Texas A&M University, United States
- 9:10 a.m. – 9:30 a.m.
- T01.3: Single-Stage Switched-Resonator Converter Topology with Wide Conversion Ratio for Volume-Sensitive Applications**
Alon Cervera, Shmuel Ben-Yaakov, Mor Mordechai Peretz,
Ben-Gurion University of the Negev, Israel
- 9:30 a.m. – 9:50 a.m.
- T01.4: A Family of Resonant Two-Switch Boosting Switched-Capacitor Converter with ZVS Operation and a Wide Voltage-Gain Range**
Shouxiang Li¹, Yifei Zheng¹, Keyue Smedley¹, Bin Wu²,
¹University of California, Irvine, United States;
²University of Maryland, College Park, United States
- 9:50 a.m. – 10:10 a.m.
- T01.5: A LLC Type Resonant Converter based on PWM Voltage Quadrupler Rectifier with Wide Output Voltage**
Ming Shang, Haoyu Wang, *ShanghaiTech University, China*
- 10:40 a.m. – 11:00 a.m.
- T01.6: Three-Phase Isolated Soft-Switching DC-DC Converter with Secondary Phase Shift Modulation**
Tao Li, Rohit Suryadevara, Leila Parsa, *Rensselaer Polytechnic Institute, United States*

11:00 a.m. – 11:20 a.m.

T01.7: Isolated Resonant Full-Bridge Converter with Magnetic Integration

Stefano Saggini², Osvaldo Zambetti¹, Roberto Rizzolatti², Alessandro Zafarana¹, Paolo Saccon¹,
¹STMicroelectronics, Italy; ²Università degli Studi di Udine, Italy

11:20 a.m. – 11:40 a.m.

T01.8: Analysis and Design of a Series Resonant Converter with Constant Current Input and Regulated Output Current

Hongjie Wang, Tarak Saha, Regan Zane, *Utah State University, United States*

11:40 a.m. – 12:00 p.m.

T01.9: Detailed Analysis of a Current-Doubler Rectifier for an LLC Resonant Converter with High Output Current

Simon Nigsch², Manfred Schlenk¹, Kurt Schenk²,
¹Infineon Technologies AG, Germany; ²University of Applied Sciences NTB Buchs, Switzerland

8:30 a.m. – 12:00 p.m.

T02: AC-DC Converters I

ROOM 18/19

Track: AC-DC Converters

SESSION CHAIR:

Gerry Moschopoulos, *Western University*

- 8:30 a.m. – 8:50 a.m.
- T02.1: Adaptive Constant Power Control and Power Loss Analysis of a MHz GaN-based AC/DC Converter for Low Power Applications**
Chengcheng Yao, Yue Zhang, Xuan Zhang, He Li, Huan Yu Chen, Jin Wang, *Ohio State University, United States*
- 8:50 a.m. – 9:10 a.m.
- T02.2: Adaptive Zero-Voltage-Switching Control and Hybrid Current Control for High Efficiency GaN-based MHz Totem-Pole PFC Rectifier**
Qingyun Huang, Ruiyang Yu, Alex Huang, Wensong Yu,
North Carolina State University, United States
- 9:10 a.m. – 9:30 a.m.
- T02.3: A Conduction Band Control AC-DC Buck Converter for a High Efficiency and High Power Density Adapter**
Sangcheol Moon, Bonggeun Chung, Gwanbon Koo, Jason Guo, Laszlo Balogh, *Fairchild Semiconductor, United States; Fairchild Semiconductor, Korea, South*

9:30 a.m. – 9:50 a.m.

T02.4: A Novel Simplified Variable On-Time Method for CRM Boost PFC ConverterZhehui Guo, Xiaoyong Ren, Yu Wu, Zhi-Liang Zhang, Qianhong Chen, *Nanjing University of Aeronautics and Astronautics, China*

9:50 a.m. – 10:10 a.m.

T02.5: Digital Controller with Integrated Valley Switching Control for Light Load Efficiency and THD Improvements in PFC ConverterHrishikesh Nene², Chen Jiang¹, Shamim Choudhury², ¹*Georgia Institute of Technology, United States;* ²*Texas Instruments Inc., United States*

10:40 a.m. – 11:00 a.m.

T02.6: High-Frequency Isolated AC-DC Converter with Stacked ArchitectureSeungbum Lim¹, Saurav Bandyopadhyay², David Perreault¹, ¹*Massachusetts Institute of Technology, United States;* ²*Texas Instruments Inc., United States*

11:00 a.m. – 11:20 a.m.

T02.7: Analysis and Design Considerations for an Improved BCM Buck AC-DC LED Driver with High Output Voltage and Low Total Harmonic DistortionHaijun Lv, Jinxu Yang, Xinke Wu, *Zhejiang University, China*

11:20 a.m. – 11:40 a.m.

T02.8: Multi-Phase Coupled and Integrated Inductors for Critical Conduction Mode Totem-Pole PFC ConverterYuchen Yang, Zhengyang Liu, Fred C. Lee, Qiang Li, *Virginia Polytechnic Institute and State University, United States*

11:40 a.m. – 12:00 p.m.

T02.9: Universal Line Input Power Factor Preregulator using VFX TechniqueLei Gu¹, Wei Liang¹, Max Praglin¹, Sombuddha Chakraborty², Juan Rivas-Davila¹, ¹*Stanford University, United States;* ²*Texas Instruments Inc., United States*

8:30 a.m. – 12:00 p.m.

T03: Multilevel Converters for Utility Applications

ROOM 20

Track: Power Electronics for Utility Interface

SESSION CHAIRS:

YUNWEI LI, *UNIVERSITY OF ALBERTA*MOHAMMED AGAMY, *GE GLOBAL RESEARCH*

8:30 a.m. – 8:50 a.m.

T03.1: A Generalized Discontinuous PWM based Neutral Point Voltage Balancing Method for Three-Level NPC Voltage Source Inverter with Switching Losses ReductionKai Li², Min Wei², Chuan Xie², Fujin Deng¹, Josep M. Guerrero¹, Juan Carlos Vásquez¹, ¹*Aalborg University, Denmark;* ²*University of Electronic Science and Technology of China, China*

8:50 a.m. – 9:10 a.m.

T03.2: Capacitor Voltage Balancing Control of Modular Multilevel Converters with Energy Storage System by using Carrier Phase-Shifted ModulationYajun Ma, Hua Lin, Zhe Wang, Tao Wang, *Huazhong University of Science and Technology, China*

9:10 a.m. – 9:30 a.m.

T03.3: Capacitor Voltage Ripple Reduction with State Trajectory Analysis for Modular Multilevel ConverterYadong Lyu, Chen Li, Yi-Hsun Hsieh, Fred C. Lee, Qiang Li, Rong Xu, *Virginia Polytechnic Institute and State University, United States*

9:30 a.m. – 9:50 a.m.

T03.4: An Equivalent Power Test Scheme for Modular Multilevel Converters (MMCs)Junsong Tang², Yufei Dong², Heya Yang², Wuhua Li², Xiangning He², Jun Ma¹, Guodong Chen¹, Ye Tian¹, Enxing Yang¹, ¹*Shanghai Electric, China;* ²*Zhejiang University, China*

9:50 a.m. – 10:10 a.m.

T03.5: Unequal Damping of the Average Sub-Module Capacitor Voltages in Modular Multilevel ConvertersTeja Bandaru, Tanmoy Bhattacharya, Dheeman Chatterjee, *Indian Institute of Technology Kharagpur, India*

10:40 a.m. – 11:00 a.m.

T03.6: Methodology of Reliability and Power Density Analysis of SST TopologiesKuan Wang, Qin Lei, Chunhui Liu, *Arizona State University, United States*

11:00 a.m. – 11:20 a.m.
T03.7: Modulation and Control of a Single-Stage HVDC/AC Solid State Transformer using Modular Multilevel Converter
 Ashish Kumar Sahoo, Ned Mohan, *University of Minnesota, United States*

11:20 a.m. – 11:40 a.m.
T03.8: Analysis and Experimental Validation of a Modular Multilevel Converter with 3-Level T-Type Submodules
 Ashish Kumar Sahoo, Ned Mohan, *University of Minnesota, United States*

11:40 a.m. – 12:00 p.m.
T03.9: Fault-Tolerant Operation of Multilevel Diode-Clamped Converters for a Device Open-Circuit Fault
 Aparna Saha, Ali Elrabbay, Marina Sital-Dahone, Yilmaz Sozer, *University of Akron, United States*

8:30 a.m. – 12:00 p.m.

T04: Control of Motor Drives I

ROOM 21

Track: Motor Drives and Inverters

SESSION CHAIRS:

Siavash Pakdelian, *University of Massachusetts Lowell*

Julia Zhang, *Oregon State University*

8:30 a.m. – 8:50 a.m.
T04.1: Model Predictive Control for Permanent Magnet Synchronous Motor Drives Considering Cross-Saturation Effects
 Panagiotis Kakosimos², Minos Beniakar¹, Yushan Liu², Haitham Abu-Rub², ¹ABB, Sweden; ²Texas A&M University at Qatar, Qatar

8:50 a.m. – 9:10 a.m.
T04.2: A Mini-Ripple Control Method for Doubly Salient Electromagnetic Motor Control System
 Wan Ying Jia², Lan Xiao², Deming Zhu¹, ¹Electronic Technology Institute, China; ²Nanjing University of Aeronautics and Astronautics, China

9:10 a.m. – 9:30 a.m.
T04.3: New Sensorless Vector Control of PMSM by Discrete-Time Voltage Injection of PWM Carrier Frequency – Positive- and Negative-Phase Amplitudes Extraction Method
 Ryu Hosooka, Shinji Shinnaka, Naoto Nakamura, *Kanagawa University, Japan*

9:30 a.m. – 9:50 a.m.
T04.4: A Novel Commutation Correction Method for High-Speed PM Brushless DC Motor
 Xiaoqing Shi, Xiaolin Wang, Cong Gu, Zhiquan Deng, *Nanjing University of Aeronautics and Astronautics, China*

9:50 a.m. – 10:10 a.m.
T04.5: Angle Compensation based Rotor Position Estimation for Sensorless Vector Control of the Permanent Magnet Synchronous Motor
 Jeevan Adhikari, Sanjib K Panda, *National University of Singapore, Singapore*

10:40 a.m. – 11:00 a.m.
T04.6: Voltage Error Phase Locked Loop (PLL) based Model Adaptive Sensorless Vector Control Algorithm for Induction Motors
 Sadik Ozdemir¹, Yilmaz Sozer¹, Nurettin Umurkan², ¹University of Akron, United States; ²Yildiz Technical University, Turkey

11:00 a.m. – 11:20 a.m.
T04.7: An Active Front-End V/Hz Induction Machine Drive with a Tiny DC Link Capacitor
 Mahima Gupta, Giri Venkataramanan, *University of Wisconsin–Madison, United States*

11:20 a.m. – 11:40 a.m.
T04.8: Torque Ripple Minimization of a Five-Phase Permanent Magnet Assisted Synchronous Reluctance Motor under Open Phase Faults
 Akm Arafat, Seungdeog Choi, *University of Akron, United States*

11:40 a.m. – 12:00 p.m.
T04.9: Power Factor Control for High Efficiency Operation of an Open-Ended Winding Motor using a Dual Inverter Drive with a Floating Bridge
 Ian Smith, Reaz Ul Haque, Atrian Tavakoli, John Salmon, *University of Alberta, Canada*

8:30 a.m. – 12:00 p.m.

T05: Power Device Performance & Gate Drivers

ROOM 22

Track: Devices and Components

SESSION CHAIRS:

Arun Kadavelugu, *ABB Inc.*

Qiang Li, *Virginia Polytechnic Institute and State University*

8:30 a.m. – 8:50 a.m.
T05.1: Power Loss of GaN Transistor Reverse Diodes in a High Frequency High Voltage Resonant Rectifier
Sanghyeon Park, Juan Rivas-Davila, *Stanford University, United States*

8:50 a.m. – 9:10 a.m.
T05.2: dV/dt Immunization Limit of LV MOSFET in Cascode GaN FET and dV/dt Safe Chart for MOSFETs
Zhiyang Chen, Jaume Roig, *ON Semiconductor, United States; ON Semiconductor, Belgium*

9:10 a.m. – 9:30 a.m.
T05.3: A Novel 4H-SiC Pinched Barrier Rectifier
Na Ren², Kang L. Wang², Zheng Zuo¹, Ruigang Li¹, Kuang Sheng³, *¹AZ Power Inc., United States; ²University of California, Los Angeles, United States; ³Zhejiang University, China*

9:30 a.m. – 9:50 a.m.
T05.4: Analytical and Experimental Optimization of External Gate Resistance for Safe Rapid Turn On of Normally off GaN HFETs
Ansel Barchowsky¹, Joseph Kozak³, Michael Hontz², William Stanchina¹, Gregory Reed¹, Zhi-Hong Mao¹, Raghav Khanna², *¹University of Pittsburgh, United States; ²University of Toledo, United States; ³Virginia Polytechnic Institute and State University, United States*

9:50 a.m. – 10:10 a.m.
T05.5: Characterization of High-Voltage High-Speed Switching Power Semiconductors for High Frequency Cryogenically-Cooled Application
Zheyu Zhang, Craig Timms, Jingyi Tang, Ruirui Chen, Jordan Sangid, Fred Wang, Leon M. Tolbert, Benjamin Blalock, Daniel Costinett, *University of Tennessee, United States*

10:40 a.m. – 11:00 a.m.
T05.6: Reducing Q_{rr} in High-Voltage SuperJunction MOSFETs by using the Cascode Configuration
Juan Rodriguez², Alberto Rodriguez², Diego G. Lamar², Jaume Roig¹, Filip Bauwens¹, *¹ON Semiconductor, Belgium; ²Universidad de Oviedo, Spain*

11:00 a.m. – 11:20 a.m.

T05.7: A Silicon based Multi-Tens MHz Gate Driver IC for GaN Power Devices
Takafumi Akagi, Shohei Miyano, Seiya Abe, Satoshi Matsumoto, *Kyushu Institute of Technology, Japan*

11:20 a.m. – 11:40 a.m.

T05.8: Shaping Switching Waveforms in a 650 V GaN FET Bridge-Leg using 6.7 GHz Active Gate Drivers
Jeremy J.O. Dalton², Jianjing Wang², Harry C.P. Dymond², Dawei Liu², Dinesh Pamunuwa², Bernard Stark², Neville McNeill³, Simon Hollis¹, *¹IBM Research, United States; ²University of Bristol, United Kingdom; ³University of Strathclyde, United Kingdom*

11:40 a.m. – 12:00 p.m.

T05.9: Isolated Gate Driver for SiC MOSFETs with Constant Negative off Voltage
Qinsong Qian¹, Juzheng Yu¹, Junjie Zhu¹, Weifeng Sun¹, Yangbo Yi², *¹Southeast University, China; ²Wuxi Chipown Microelectronics Co.,Ltd, China*

8:30 a.m. – 12:00 p.m.

T06: Control of DC-DC Converters

ROOM 23

Track: Control

SESSION CHAIRS:

Jaber Abu Qahouq, *University of Alabama*

Hrishikesh Nene, *Texas Instruments, Inc.*

8:30 a.m. – 8:50 a.m.

T06.1: Hardware Efficient Auto-Tuned Linear-Gain based Minimum Deviation Digital Controller for Indirect Energy Transfer Converters
Shadi Dashmiz², Behzad Mahdavihah², Aleksandar Prodic², Brent McDonald¹, *¹Texas Instruments Inc., United States; ²University of Toronto, Canada*

8:50 a.m. – 9:10 a.m.

T06.2: Method for Online Battery AC Impedance Spectrum Measurement using DC-DC Power Converter Duty-Cycle Control
Zhiyong Xia, Jaber Abu Qahouq, *University of Alabama, United States*

- 9:10 a.m. – 9:30 a.m.
T06.3: Low-Complexity, High Frequency Parametric System Identification Method for Switched-Mode Power Converters
 Harald Gietler¹, Christoph Unterrieder¹, Andreas Berger¹, Robert Priewasser¹, Michael Lunglmayr², ¹Infinion Technologies AG, Austria; ²Johannes Kepler University Linz, Austria
- 9:30 a.m. – 9:50 a.m.
T06.4: A Constant-Frequency Parabolic-Modulation-based Sliding Mode Controller for Buck Converters
 Wenlong Qi, Sinan Li, Siew-Chong Tan, Shu-Yuen Ron Hui, *University of Hong Kong, Hong Kong*
- 9:50 a.m. – 10:10 a.m.
T06.5: Novel Input Current Ripple Compensation Technique for Capacitor-Less Dual-Half-Bridge Converter
 Changkyu Bai², Byeongcheol Han², Dong-Young Huh¹, Jung-Hwan Choi¹, Jin S. Lee², Minsung Kim², Soo-Hong Kim¹, ¹LG Innotek, Korea, South; ²Pohang University of Science and Technology, Korea, South
- 10:40 a.m. – 11:00 a.m.
T06.6: Tightly Regulated Dual-Output Half-Bridge Converter using PFM-APWM Hybrid Control Method
 Hwapyeong Park, Mina Kim, Jeehoon Jung, *Ulsan National Institute of Science and Technology, Korea, South*
- 11:00 a.m. – 11:20 a.m.
T06.7: Digital Geometric-Sequence Control (GSC) Approach for Dual-Active-Bridge Converters
 Iman Askarian², Majid Pahlevani², Alireza Bakhshai¹, ¹Queen's University, Canada; ²University of Calgary, Canada
- 11:20 a.m. – 11:40 a.m.
T06.8: Hybrid Control Strategy to Extend the ZVS Range of a Dual Active Bridge Converter
 Vishnu Mahadeva Iyer, Srinivas Gulur, Subhashish Bhattacharya, *North Carolina State University, United States*
- 11:40 a.m. – 12:00 p.m.
T06.9: Fully-Integrated Digital Average Current-Mode Control 12V-to-1.xV Voltage Regulator Module IC
 Timur Vekslender, Eli Abramov, Yevgeny Lazarev, Mor Mordechai Peretz, *Ben-Gurion University of the Negev, Israel*

8:30 a.m. – 12:00 p.m.

T07: Converters for Renewable Energy

ROOM 24

Track: Renewable Energy Systems

SESSION CHAIR:

Xiong Li, *Texas Instruments, Inc.*

- 8:30 a.m. – 8:50 a.m.
T07.1: A Resonant Double Stage Flyback Microinverter for PV Applications
 Rasedul Hasan, Saad Mekhilef, *University of Malaya, Malaysia*
- 8:50 a.m. – 9:10 a.m.
T07.2: A Three-Port Converter based DC Grid-Connected PV System with Autonomous Output Voltage Sharing Control
 Yangjun Lu¹, Hongfei Wu¹, Xiaofeng Dong¹, Yan Xing¹, Kai Sun², ¹Nanjing University of Aeronautics and Astronautics, China; ²Tsinghua University, China
- 9:10 a.m. – 9:30 a.m.
T07.3: An Asymmetrical Three-Level Dual-Input Bidirectional DC/AC Converter with Improved Conversion Efficiency for Vehicle-to-Grid Application
 Lei Zhu¹, Hongfei Wu¹, Tiantian Mu¹, Fan Yang¹, Xudong Ma², ¹Nanjing University of Aeronautics and Astronautics, China; ²Southeast University, China
- 9:30 a.m. – 9:50 a.m.
T07.4: Grid Tied Solar Micro-Converter with Optimizer-Mode Operation for Weak-Grid Operation
 Naila Ramzan, Zeinab Jamal Khan, Palwasha Naseer, Arooj Akbar, Nauman Zaffar, *Lahore University of Management Sciences, Pakistan*
- 9:50 a.m. – 10:10 a.m.
T07.5: A Fast and Accurate Maximum Power Point Tracker for a Multi-Input Converter with Wide Range of Soft-Switching Operation for Solar Energy Systems
 Kajanan Kanathipan, Sanjida Moury, John Lam, *York University, Canada*
- 10:40 a.m. – 11:00 a.m.
T07.6: A Fixed-Frequency Bidirectional Resonant DC-DC Converter Suitable for Wide Voltage Range
 Yanfeng Shen¹, Huai Wang¹, Frede Blaabjerg¹, Ahmed Al Durra², Xiaofeng Sun³, ¹Aalborg University, Denmark; ²Petroleum Institute, U.A.E.; ³Yanshan University, China

11:00 a.m. – 11:20 a.m.

T07.7: Parallel Balancing Converter for Serially Connected Batteries StringOr Kirshenboim¹, Yoav Dickstein¹, Alex Shvarchov¹, Mor Mordechai Peretz¹, Ilya Zeltser², ¹*Ben-Gurion University of the Negev, Israel*; ²*Rafael Advanced Defense Systems Ltd., Israel*

11:20 a.m. – 11:40 a.m.

T07.8: Loss Analysis of Flyback Type Snubber with Nonlinear Magnetic Properties for 10kV IGBT ApplicationsSiamak Shirmohammadi¹, Amreena Lama Lyngdoh¹, Yongsug Suh¹, Gookmin Kwon², Hyun-Cheol Choi², Young-Hoon Jang², ¹*Chonbuk National University, Korea, South*; ²*Dawonsys Company, Korea, South*

11:40 a.m. – 12:00 p.m.

T07.9: Optimised Conversion for a Low-Voltage Low-Power Energy Harvesting Powered SensorDavid Newell, Maeve Duffy, *National University of Ireland Galway, Ireland*

8:30 a.m. – 12:00 p.m.

T08: Lower Power Applications

ROOM 25

Track: Power Electronics Applications

SESSION CHAIRS:

Olivier Trescases, *University of Toronto*Jeff Nilles, *Texas Instruments, Inc.*

8:30 a.m. – 8:50 a.m.

T08.1: A Universal Topology based on Buck-Boost Converter with Optimal Resistive Impedance Tracking for Energy Harvesters in Battery Powered ApplicationsMahmoud Shousha, Dragan Dinulovic, Martin Haug, *Würth Elektronik eiSos GmbH, Germany*

8:50 a.m. – 9:10 a.m.

T08.2: Taking Advantage of the Output Voltage Ripple of a Two-Phase Buck Converter to Perform Quadrature Amplitude Modulation for Visible Light CommunicationJuan Rodríguez², Diego G. Lamar², Javier Sebastian², Pablo F. Miaja¹, ¹*European Space Agency, Netherlands*; ²*Universidad de Oviedo, Spain*

9:10 a.m. – 9:30 a.m.

T08.3: Two-Stage Sinusoidal Generator with Calibration and Pulse Train Amplitude Feedback for Ultrasonic ApplicationsMichael Evzelman², Hongjie Wang², Regan Zane², Xiaoliang Zhao¹, ¹*Intelligent Automation Incorporation, United States*; ²*Utah State University, United States*

9:30 a.m. – 9:50 a.m.

T08.4: A Modular and Reconfigurable Battery SystemFa Chen, Wei Qiao, Liyan Qu, *University of Nebraska-Lincoln, United States*

9:50 a.m. – 10:10 a.m.

T08.5: Toward Dynamic Programming-based Management in Reconfigurable Battery PacksNi Lin, Song Ci, *University of Nebraska-Lincoln, United States*

10:40 a.m. – 11:00 a.m.

T08.6: Structurally Supportive RF Power Inverter for a CubeSat Electrothermal Plasma Micro-Thruster with PCB InductorsWei Liang², Luke Raymond², Juan Rivas Davila², Christine Charles¹, Rod Boswell¹, ¹*Australian National University, Australia*; ²*Stanford University, United States*

11:00 a.m. – 11:20 a.m.

T08.7: A 10MHz, 40V-to-5V Clock-Synchronized AOT Hysteretic Converter with Programmable Soft Start Technique for Automotive USB ChargersXugang Ke, Kang Wei, D. Brian Ma, *University of Texas at Dallas, United States*

11:20 a.m. – 11:40 a.m.

T08.8: Highly Efficient Linear Power Amplifier for Driving Fast Slew Rate Capacitive LoadsMiroslav Vasic², Eric Boere¹, Oscar Garcia², Pedro Alou², Jesús Angel Oliver², Jens Eltze¹, José Antonio Cobos², ¹*Apex Microtechnology, United States*; ²*Universidad Politécnica de Madrid, Spain*

11:40 a.m. – 12:00 p.m.

T08.9: Linear Motion System Cable Elimination via Multiphase Capacitive Power Transfer through Sliding Journal BearingsJiejian Dai, Skyler Hagen, Daniel Ludois, *University of Wisconsin-Madison, United States*

9:30 a.m.

Spouse and Guest Tour “Treasures of Tampa by Water and Land” (Registration Required)

departs

MARRIOTT – MEETING ROOM 4

12:00 p.m. – 5:00 p.m.

Exhibit Hall Open

EXPOSITION (WEST/EAST HALL)

1:30 p.m. – 2:00 p.m.

Exhibitor Seminars – Session #1

(for detailed information see page 176)

STMICROELECTRONICS

Digital Control IC for PFC and L-C Resonant Converter

ROOM 1/2

PLEXIM

Real-time simulation using the PLECS RT Box

ROOM 11

MOUSER ELECTRONICS WITH TEXAS INSTRUMENTS

Wireless Power Telemetry

ROOM 13

MERSEN

Safety and Reliability for Power Electronics

ROOM 14

VENABLE INSTRUMENTS

Portable Frequency Response Analyzer for Field Application Engineers

ROOM 22

DANFOSS SILICON POWER GMBH

Gamechanging Power Modules by Danfoss

ROOM 23

COGNIPOWER

The Origins and Implications of Predictive Energy Balancing (PEB)

ROOM 24

RENESAS ELECTRONICS AMERICA

Simplifying Li-ion Battery Powered BLDC Motor Driver Design

ROOM 25

2:15 p.m. – 2:45 p.m.

Exhibitor Seminars – Session #2

(for detailed information see page 179)

STMICROELECTRONICS

Synchronous Rectification in PoE Bridge for Improved Efficiency

ROOM 1/2

UNITED CHEMI-CON, INC

State of Art for Automotive Application Capacitor

ROOM 11

POWERREX INC.

7th Generation IGBT Modules Featuring Lower Losses and Higher Reliability

ROOM 13

MAGNETICS

New Material Performance and Analysis of E-U Geometries

ROOM 14

SIMPLIS TECHNOLOGIES, INC

Performing AC Analyses on PFC Converters

ROOM 22

EXXELIA USA

High Power Solutions

ROOM 23

LINEAR TECHNOLOGY

Designing & Optimizing Power Supplies in Several Simple Steps with the LTpowerCAD Design Tool

ROOM 24

ZES ZIMMER

Latest Trends in Precision Power Analyzers and Sensors

ROOM 25

3:00 p.m. – 3:30 p.m.

Exhibitor Seminars – Session #3

(for detailed information see page 182)

INFINEON TECHNOLOGIES

Gate-Driver ICs Enabling Highly Efficient Power Management Systems

ROOM 1/2

MICROMETALS, INC.

Online Design Tools for MHz Inductors

ROOM 11

TUESDAY

TUESDAY

MOUSER ELECTRONICS WITH TDK CORPORATION
OF AMERICA AND PANASONIC INDUSTRIAL
DEVICES

**GaN Based Power Electronics and New
Requirements for Passive Components**

ROOM 13

PANASONIC CORPORATION

X-GaN Reliability and Robust Design

ROOM 14

OPAL-RT TECHNOLOGIES

**Lab-Scale MMC Test Bench for Power
Hardware-in-the-Loop (PHIL) Application**

ROOM 22

DIALOG SEMICONDUCTOR

**High Efficiency Inductor-Less Power
Converter Technology**

ROOM 23

TAIYO KOGYO CO., LTD

**Introduction to Optimal PCBs for Next Generation
Power Electronics**

ROOM 24

SCHUNK HOFFMANN CARBON TECHNOLOGIES AG

**Graphite-Based Solutions for (Power)
Electronics Cooling**

ROOM 25

3:45 p.m. – 4:15 p.m.

Exhibitor Seminars – Session #4

(for detailed information see page 185)

RIDLEY ENGINEERING INC

New Design Tools for Power Supplies

ROOM 1/2

KEMET ELECTRONICS

**Design Tools for Selecting Your
Passive Components**

ROOM 11

MYWAY PLUS

**Integrated Digital Platform for Power Electronics
Model Based Design
“All-in-One package for Advanced R&D”**

ROOM 13

ARTIC SAND TECHNOLOGIES INC.

**Next Generation DC-DC Converter Architecture
Brings Significant Improvements in Efficiency
& Size**

ROOM 14

FTCAP GMBH

Capacitor Solutions for Severe Conditions

ROOM 22

ABSTRACT POWER ELECTRONICS
**Primate Power™ Sources Use SiC Devices to
Improve Efficiency & Response Time**

ROOM 23

WOLVERINE TUBE INC. – MICROCOOL DIVISION
MicroCool Presentation

ROOM 24

PACIFIC SOWA CORPORATION C/O EPSON ATMIX
CORPORATION

**High U Super Low Core Loss Nanocrystalline
Power “KUAMET NCI”**

ROOM 25

5:00 p.m. – 6:30 p.m.

Rap Sessions

(for detailed information see page 132)

**R01: Power Electronic Topologies – Do We Need More
or Any Benefit to New Ones?**

ROOM 15/16

**R02: Do We Need to Progress Towards GHz Switching
in High Power Systems and Applications?**

ROOM 18/19

**R03: 3D Printing and Power Supply on Chip
(PwrSoC)/Power Supply in Package (PSiP)
vs. Discrete Designs**

ROOM 20/21



7:00 a.m. – 8:00 a.m.

Presenter Breakfast

BALLROOM A

8:00 a.m. – 3:00 p.m.

Registration

2ND FLOOR CONCOURSE

8:00 a.m. – 9:00 a.m.

Spouse and Guest Breakfast

MARRIOTT – MEETING ROOM 4

8:00 a.m. – 11:00 a.m.

Spouse and Guest Hospitality Room Open

MARRIOTT – MEETING ROOM 4

8:30 a.m. – 10:10 a.m.

IS05: Mobile Applications

ROOM 15/16

SESSION CHAIR:

Peter Miller, *Texas Instruments, Inc.*

IS05.1: Significant Efficiency Improvements for Linear DC-DC Converters Based on Supercapacitor Energy Recovery

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

IS05.2: Cascaded Fly-Back
Chris Notsch, *Infineon Technologies Austria AG, Austria*

IS05.3: Emerging USB-PD/Type-C Standard Places New Demands on Power Supplies
Rahul Joshi, Shyam Dujari, Ishminder Dhanjal, *Power Integrations, United States*

9:45 a.m. – 10:10 a.m.

IS05.4: State-of-the-Art Mobile Charging: Topologies, Technologies and Performance
Tom Ribarich, Stephen Oliver, *Navitas Semiconductor, United States*

8:30 a.m. – 10:10 a.m.

IS06: Regulatory and Compliance Considerations for Power Electronics

ROOM 14

SESSION CHAIRS:

Kevin Parmenter, *Excelsys Technologies*

Jim Spangler, *Independent*

8:30 a.m. – 8:55 a.m.

IS06.1: EMI Filter Safety
Herbert Blum, *Schurter Electronics, Switzerland*

8:55 a.m. – 9:20 a.m.

IS06.2: Mitigating EMI Problems & Filter Selection
Rafik Stepanian, *Inter-Technical, LLC, United States*

9:20 a.m. – 9:45 a.m.

IS06.3: Design Considerations for Power Supplies in High-Altitude Applications
Kevin Parmenter, *Excelsys Technologies, United States*

9:45 a.m. – 10:10 a.m.

IS06.4: What Doesn't a Power Supply Have to Comply with These Days
Sinziana Cionca, Christopher Siegl, *Excelsys Technologies Ltd, Ireland; Excelsys Technologies Ltd, United States*

8:30 a.m. – 10:10 a.m.

IS07: Offline Power Supplies

ROOM 13

SESSION CHAIR:

Chris Jones, *Artesyn Embedded Technologies*

IS07.1: Cross Regulation Challenges of Multi-Output Power Supplies
David Chen, *Power Integrations, United States*

IS07.2: Extremely Low Ripple Ballast Topology for High Power Discharge Lamps
Ekrem Karaman, *Warner Power, United States*

9:20 a.m. – 9:45 a.m.

IS07.3: Analytic Expressions for Currents in the CCM PFC Stage

Colin Gillmor, *Texas Instruments, Ireland*

9:45 a.m. – 10:10 a.m.

IS07.4: Design for Manufacturability – A Paradigm Shift

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

8:30 a.m. – 10:10 a.m.

IS08: Transactive Energy and the Electric Power Grid

ROOM 11

SESSION CHAIR:

Martin Fornage, *Enphase Energy*

8:30 a.m. – 8:55 a.m.

IS08.1: The Drive to Transactive Energy: Building the Enabling Network for DER Participation

Paul Heitmann, *Businovation LLC, United States*

8:55 a.m. – 9:20 a.m.

IS08.2: Transacting Electricity within Buildings with Local Power Distribution

Bruce Nordman, *Lawrence Berkeley Lab, United States*

9:20 a.m. – 9:45 a.m.

IS08.3: An Architecture to Enable Mega-Scale Transactive Energy Systems

Kenneth A. Loparo, *Case Western Reserve University* and Ryan May, *Intwine Connect, LLC*

9:45 a.m. – 10:10 a.m.

IS08.4: History and Implications of Emerging Transactive Energy Systems

Don Hammerstrom, *Pacific Northwest National Laboratory, United States*

8:30 a.m. – 10:10 a.m.

T09: High Power AC-DC Converters

ROOM 1/2

Track: AC-DC Converters

SESSION CHAIRS:

Davide Giacomini, *Infineon Technologies*

Xin Zhang, *IBM T.J. Watson Research Center*

8:30 a.m. – 8:50 a.m.

T09.1: New 1000V SiC MOSFETs Enable Improved Efficiency, Density, and Cost Tradeoff Space for PFCs

Adam Barkley, Marcelo Schupbach, Binod Agrawal, Scott Allen, *Wolfspeed / Cree, United States*; *Wolfspeed / Cree, India*

8:50 a.m. – 9:10 a.m.

T09.2: 99.3% Efficient Three-Phase Buck-Type All-SiC Swiss Rectifier for DC Distribution Systems

Lukas Schrittwieser², Michael Leibl², Michael Haider², Friedrich Thöny², Johann Walter Kolar², Thiago Soeiro¹, ¹ABB, *Switzerland*; ²Eidgenössische Technische Hochschule Zürich, *Switzerland*

9:10 a.m. – 9:30 a.m.

T09.3: Analysis of Three-Phase Rectifier Systems with Controlled DC-Link Current Under Unbalanced Grids

Dinesh Kumar², Pooya Davari¹, Firuz Zare³, Frede Blaabjerg¹, ¹Aalborg University, *Denmark*; ²Danfoss Power Electronics A/S, *Denmark*; ³University of Queensland, *Australia*

9:30 a.m. – 9:50 a.m.

T09.4: An Isolated Medium-Voltage AC/DC Power Supply based on Multicell Converter Topology

Yugo Kashihara, Yuji Nemoto, Wang Qichen, Satoru Fujita, Ryuji Yamada, Yasuhiro Okuma, *Fuji Electric Co., Ltd., Japan*

9:50 a.m. – 10:10 a.m.

T09.5: A 500 kHz, 3.3 kW Boost PFC with Low Loss Coupled Auxiliary ZVT Circuit

Siddharth Kulasekaran, Nikhil Korada, Raja Ayyanar, *Arizona State University, United States*

8:30 a.m. – 10:10 a.m.

T10: Non-isolated DC-DC Converters

ROOM 18/19

Track: DC-DC Converters

SESSION CHAIRS:

Cahit Gezgin

Ayman Fayed, *Ohio State University*

8:30 a.m. – 8:50 a.m.

T10.1: New ZVT Topology for Switched Inductor High Gain Boost

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

8:50 a.m. – 9:10 a.m.

T10.2: High-Efficiency High-Power-Density 48/1V Sigma Converter Voltage Regulator Module

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

9:10 a.m. – 9:30 a.m.

T10.3: A Novel Quasi-SEPIC High-Voltage Boost DC-DC Converter

Yam Siwakoti¹, Mohsen Soltani¹, Frede Blaabjerg¹, Ali Mostaan², ¹*Aalborg University, Denmark*; ²*Iranian Central Oil Field Company, Iran*

9:30 a.m. – 9:50 a.m.

T10.4: Design of Area-Efficient Multiple-Output Switched-Capacitor DC-DC Converters

Zhe Hua, Hoi Lee, *University of Texas at Dallas, United States*

9:50 a.m. – 10:10 a.m.

T10.5: Low-Volume Hybrid Tap-Connected SC-Buck Converter with Shared Output Capacitor

Tim McRae, Nenad Vukadinović, Aleksandar Prodić, *University of Toronto, Canada*

8:30 a.m. – 10:10 a.m.

T11: Power Converter Topologies

ROOM 20

Track: Motor Drives and Inverters

SESSION CHAIRS:

Liming Liu, *ABB USCRC*

Frede Blaabjerg, *Aalborg University*

8:30 a.m. – 8:50 a.m.

T11.1: An Asymmetrical Multi-Level Dual-Input Dual-Buck Inverter for Multi-Source Interface Applications

Fan Yang, Hongjuan Ge, Jingfan Yang, Runyun Dang, Hongfei Wu, *Nanjing University of Aeronautics and Astronautics, China*

8:50 a.m. – 9:10 a.m.

T11.2: Multiple-Output ZCS Resonant Inverter for Multi-Coil Induction Heating Appliances

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

9:10 a.m. – 9:30 a.m.

T11.3: A Minimized DC-Bus Capacitor with Active Combinational Decoupling Method for DC-AC Application

Xiaofeng Lyu, Yanchao Li, Ze Ni, Dong Cao, *North Dakota State University, United States*

9:30 a.m. – 9:50 a.m.

T11.4: Demonstration of a 50 kW and 100 kHz SiC High Power Density Converter with Gate Assisted Circuit

Shan Yin², King Jet Tseng¹, Yong Liu¹, Rejeki Simanjorang³, Chandana J. Gajanayake³, ¹*Nanyang Technological University, Singapore*; ²*Nanyang Technological University / Rolls-Royce Singapore Pte. Ltd., Singapore*; ³*Rolls-Royce Singapore Pte. Ltd., Singapore*

9:50 a.m. – 10:10 a.m.

T11.5: Comprehensive Evaluation of Interleaved Zero Current Switching Inverter against Interleaved Hard Switching Inverters in Terms of Efficiency, Power Density and EMI Spectrum

Yingzhuo Chen, Arvind Shanmuganaath Sathyanarayanan, Balaji Narayanasamy, Wenda Feng, Fang Luo, *Ohio State University, United States*

8:30 a.m. – 10:10 a.m.

T12: Power Device Reliability

ROOM 21

Track: Devices and Components

SESSION CHAIRS:

Tim McDonald, *Infineon*

Rolando Burgos, *Virginia Polytechnic Institute and State University*

8:30 a.m. – 8:50 a.m.

T12.1: First Automotive Reliability Assessment and Drive-Train Performance of Large-Area 900V, 10mOhm SiC MOSFETs

Jeff Casady, Brett Hull, Jon Zhang, Don Gajewski, Gangyao Wang, Scott Allen, John Palmour, Kraig Olejniczak, *Wolfspeed / Cree, United States*

8:50 a.m. – 9:10 a.m.

T12.2: Robustness of SiC MOSFET Under Avalanche Conditions

Ilyas Dchar², Marion Zolkos², Cyril Buttay¹, Hervé Morel¹, ¹*Institut National des Sciences Appliquées de Lyon, France*; ²*SuperGrid Institute, France*

9:10 a.m. – 9:30 a.m.

T12.3: Prognosis of Power MOSFET in Continuous Time Framework

Moinul Shahidul Haque, Seungdeog Choi, *University of Akron, United States*

9:30 a.m. – 9:50 a.m.

T12.4: Lifetime Prediction of IGBT Modules Based on Linear Damage Accumulation

Ui-Min Choi, Frede Blaabjerg, Ke Ma, *Aalborg University, Denmark*

9:50 a.m. – 10:10 a.m.

T12.5: Large Scale Test Bed for In-Circuit Reliability Testing of Silicon Carbide Diodes and MOSFETs Emulating Real Life Voltage and Current Stress

Gin Sheh, Xuning Zhang, Levi Gant, Kevin Matocha, Kiran Chatty, Sujit Banerjee, *Monolith Semiconductor Inc., United States*

8:30 a.m. – 10:10 a.m.

T13: Design Optimization for High Reliability

ROOM 22

Track: System Integration

SESSION CHAIRS:

John Vigars, *Allegro Microsystems*

Ernie Parker, *Crane Aerospace & Electronics*

8:30 a.m. – 8:50 a.m.

T13.1: A Turn-Off Delay Time Measurement and Junction Temperature Estimation Method for IGBT

Lei Li, Puqi Ning, Xuhui Wen, Yaohua Li, Qiongquan Ge, Dong Zhang, Xiang Tai, *Chinese Academy of Sciences, China*

8:50 a.m. – 9:10 a.m.

T13.2: Switching Performance Comparison of 1200 V and 1700 V SiC Optimized Half Bridge Power Modules with SiC Antiparallel Schottky Diodes versus MOSFET Intrinsic Body Diodes

Daniel Martin, W. Austin Curbow, Brett Sparkman, Lauren Kegley, Ty McNutt, *Wolfspeed / Cree, United States*

9:10 a.m. – 9:30 a.m.

T13.3: Impacts of Ripple Current to the Loading and Lifetime of Power Semiconductor Device

Ke Ma², Ui-Min Choi¹, Frede Blaabjerg¹, ¹*Aalborg University, Denmark*; ²*Shanghai Jiao Tong University, China*

9:30 a.m. – 9:50 a.m.

T13.4: A New Optically-Isolated Power Converter for 12 V Gate Drive Power Supplies Applied to High Voltage and High Speed Switching Devices

Masanori Ishigaki², Simon Fafard¹, Denis Masson¹, Matthew Wilkins³, Christopher Valdivia³, Karin Hinzer³, ¹*Azastra Opto, Canada*; ²*Toyota Research Institute of North America, United States*; ³*University of Ottawa, Canada*

9:50 a.m. – 10:10 a.m.

T13.5: Thermal Characterization of an IGBT Power Module with On-Die Temperature Sensors

Badr El Boudour Bidouche², Yvan Avenas², Mouslim Essakili², Laurent Dupont¹, ¹*Institut Français des Sciences et Technologies des Transports, de l'Aménagement et des Réseaux, France*; ²*Université Grenoble Alpes, France*

8:30 a.m. – 10:10 a.m.

T14: Reliability

ROOM 23

Track: Manufacturing, Quality, and Business Issues

SESSION CHAIR:

Jim Marinos, *Payton America Inc.*

8:30 a.m. – 8:50 a.m.

T14.1: Failure Prediction using Low Stability Phenomenon of Digitally Controlled SMPS by Electrolytic Capacitor ESR Degradation

Hiroshi Nakao², Yu Yonezawa¹, Yoshiyasu Nakashima¹, Fujio Kurokawa³, ¹*Fujitsu Laboratories LTD., Japan*; ²*Fujitsu Laboratories LTD. / Nagasaki University, Japan*; ³*Nagasaki University, Japan*

8:50 a.m. – 9:10 a.m.

T14.2: A Cost Effective Magnetic/Electronic Design for the Water Pump Application Drive: Analysis, Design, and Experimentation

Ahmed Abdelrahman, Mohamed Youssef, *University of Ontario Institute of Technology, Canada*

9:10 a.m. – 9:30 a.m.

T14.3: Defining Humidity Test Duration for Microinverter Reliability Assessment: A Physics-of-Failure Approach

Arvind Vasani, Laszlo Laskai, Milan Ilic, *Empower Micro Systems, United States*

9:30 a.m. – 9:50 a.m.

T14.4: Proactive Fault-Tolerant IGBT-based Power Converters for Mission Critical Applications in MW Range

Victor N. Ferreira², Braz J. Cadoso Filho², Anderson V. Rocha¹, ¹*Centro Federal de Educação Tecnológica de Minas Gerais, Brazil*; ²*Universidade Federal de Minas Gerais, Brazil*

9:50 a.m. – 10:10 a.m.

T14.5: Controller Robustness Analysis of Grid-Tied AC-Stacked PV Inverter System Considering Manufacturing Inaccuracies

Hamidreza Jafarian, Mehrdad Biglarbegian, Babak Parkhideh, *University of North Carolina at Charlotte, United States*

8:30 a.m. – 10:10 a.m.

T15: Batteries for Renewable Energy

ROOM 24

Track: Renewable Energy Systems

SESSION CHAIR:

Haoyu Wang, *ShanghaiTech University*

8:30 a.m. – 8:50 a.m.

T15.1: Battery Energy Storage Emulation in a Converter-based Power System Emulator

Jessica Boles, Yiwei Ma, Wenchao Cao, Leon M. Tolbert, Fred Wang, *University of Tennessee, United States*

8:50 a.m. – 9:10 a.m.

T15.2: A Correlation based Detection Method for Internal Short Circuit in Battery Packs

Bing Xia¹, Yunlong Shang², Truong Nguyen³, Chris Mi¹, ¹*San Diego State University, United States*; ²*Shandong University and San Diego State University, United States*; ³*University of California, San Diego, United States*

9:10 a.m. – 9:30 a.m.

T15.3: Electro-Thermal Modeling of High-Performance Lithium-Ion Energy Storage Systems including Reversible Entropy Heat

Stefan Skoog, *Chalmers University of Technology, Sweden*

9:30 a.m. – 9:50 a.m.

T15.4: A High-Fidelity Hybrid Lithium-Ion Battery Model for SOE and Runtime Prediction

Kaiyuan Li¹, Boon Hee Soong¹, King Jet Tseng², ¹*Nanyang Technological University, Singapore*; ²*Singapore Institute of Technology, Singapore*

9:50 a.m. – 10:10 a.m.

T15.5: Cell-Level Hybrid Architectures for Active Balancing of Serially-Connected Batteries

Nadav Dahan¹, Mor Mordechai Peretz¹, Ilya Zeltser², ¹*Ben-Gurion University of the Negev, Israel*; ²*Rafael Advanced Defense Systems Ltd., Israel*

8:30 a.m. – 10:10 a.m.

T16: LED Applications

ROOM 25

Track: Power Electronics Applications

SESSION CHAIRS:

Jim Spangler, *Spangler Prototype Inc.*

Sombuddha Chakraborty, *Texas Instruments, Inc.*

- 8:30 a.m. – 8:50 a.m.
- T16.1: A New Bleeder Circuit for TRIAC Dimmable LED Driver based on Single-Stage Topology with a Capacitor Input Rectifier**
Mitsuhiro Kadota², Hiroyuki Shoji², Hiroyuki Hirose¹, Atsushi Hatakeyama¹, ¹*Hitachi Appliances, Inc., Japan;* ²*Hitachi, Ltd., Japan*
- 8:50 a.m. – 9:10 a.m.
- T16.2: An Integrated Multilevel Converter with Sigma Delta Control for LED Lighting**
Daniel L. Gerber², Mitchell Kline², Seth R. Sanders², Chengrui Le¹, Peter R. Kinget¹, ¹*Columbia University, United States;* ²*University of California, Berkeley, United States*
- 9:10 a.m. – 9:30 a.m.
- T16.3: A High Power Factor LED Driver based on Improved Forward-Flyback without Electrolytic Capacitor**
Hanjing Dong², Xiaogao Xie¹, Huaizhong Chen², Zheliang Jin², ¹*Hangzhou Dianzi University, China;* ²*Zhejiang Industry Polytechnic College, China*
- 9:30 a.m. – 9:50 a.m.
- T16.4: A Switched-Capacitor-based Current Compensator for Mitigating the Effect of Long Cable Connecting between LED Driver and Light Source**
Ryan Shun-Cheung Yeung, John Yau-Chung Chan, Rui Zhou, Henry Shu-Hung Chung, Norman Chung-Fai Tse, *City University of Hong Kong, Hong Kong*
- 9:50 a.m. – 10:10 a.m.
- T16.5: On the Role of the Power Electronics on Visible Light Communication**
Javier Sebastián², Daniel G. Aller², Juan Rodríguez², Diego G. Lamar², Pablo F. Miaja¹, ¹*European Space Agency, Netherlands;* ²*Universidad de Oviedo, Spain*

10:00 a.m. – 2:00 p.m.

Exhibit Hall Open

EXPOSITION (WEST/EAST HALL)

10:30 a.m. – 11:00 a.m.

Exhibitor Seminars – Session #5

(for detailed information see page 188)

HITACHI AMERICA, LTD
Next High Power Density Dual Module with Next Generation Chip Beneficial in Low Inductance Application

ROOM 1/2

TYPHOON HIL, INC
Controller Hardware-in-the-Loop (CHIL) Nanosecond Resolution “Flight Simulator” for Future Microgrids

ROOM 11

COILCRAFT, INC.
New Power Inductor Selection Process for Best Power Converter Performance

ROOM 13

TELEDYNE LECROY
Using the Teledyne LeCroy Motor Drive Analyzer to Optimize Motor/Drive Performance During a Single Semiconductor Device Switching Period

ROOM 14

WURTH
Exploring and Designing in PoE Magnetics

ROOM 20

TRANSPHORM, INC.
How to Design with GaN in an Hour or Less

ROOM 21

SP CONTROL TECHNOLOGIES
The Innovation in SP Control Technologies

ROOM 22

11:15 a.m. – 11:45 a.m.

Exhibitor Seminars – Session #6

(for detailed information see page 191)

SEMIKRON

Power Converter Development: Reducing Time to Market

ROOM 1/2

IWATSU ELECTRIC

Power Loss Measurement for High Phase Angle Magnetics Core

ROOM 11

EFFICIENT POWER CONVERSION CORPORATION

GaN Transistors for Efficient Power Conversion

ROOM 13

SBE, INC.

Advancements in DC Link Design for the Next Gen Inverters

ROOM 14

ZIPALOG, INC

System and Fault Scenario Analysis for Power Management IC's

ROOM 20

POWERSIM INC.

Integrating PSIM & SPICE for System Level to Device Level Simulation

ROOM 21

SYNOPTIS, INC.

Saber Periodic AC (PAC) Analysis and Power MOSFET Tool

ROOM 22

ALTAIR

Multiphysics Modeling – Optimizing current input to cancel torque ripple

ROOM 23

12:00 p.m.-12:30 p.m.

Exhibitor Seminars – Session #7

(for detailed information see page 194)

LTEC CORPORATION

Improve New Product Positioning, Reduce Time to Market, Protect Your IP through Benchmarking and Deep Analysis

ROOM 1/2

MICROCHIP TECHNOLOGY, INC.

Using Core Independent Peripherals (CIPs) to Build a Custom Control

Presented by: Keith Curtis

ROOM 11

2:00 p.m. – 5:25 p.m.

IS09: Silicon and WBG Power Devices for High Frequency Topologies

ROOM 15/16

SESSION CHAIRS:

Ritu Sodhi, *Empower Semiconductor*

Tim McDonald, *Infineon Technologies*

2:00 p.m. – 2:25 p.m.

IS09.1: Standardization for Wide Bandgap Devices: GaNSPEC DWG

Stephanie Butler, *Texas Instruments, United States*

2:25 p.m. – 2:50 p.m.

IS09.2: Silicon Technologies Enabling High Frequency Operation in SMPS

David Jauregui, *Texas Instruments, United States*

2:50 p.m. – 3:15 p.m.

IS09.3: Moore's Law Is Alive with GaN

Alex Lidow, *Efficient Power Conversion Corporation, United States*

3:15 p.m. – 3:40 p.m.

IS09.4: GaN Power ICs at 1 MHz+: Topologies, Technologies and Performance

Dan Kinzer, *Navitas Semiconductor, United States*

4:10 p.m. – 4:35 p.m.

IS09.5: Fast Charging EV with the Latest 1kV 3rd Generation SiC MOSFET

John Mookken, *Wolfspeed, United States*

4:35 p.m. – 5:00 p.m.

IS09.6: Towards Medium Voltage (3.3 –15kV) SiC Devices

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

5:00 p.m. – 5:25 p.m.

IS09.7: Heterogeneously Integrated Power Stages Enable Breakthrough Power Density and Speed

Greg Miller, *Sarda Technologies, United States*

2:00 p.m. – 5:25 p.m.

IS10: Server Power Topics

ROOM 14

SESSION CHAIRS:

Wisam Moussa, *Infineon Technologies*

Nick Gruendler, *Celestica*

2:00 p.m. – 2:25 p.m.

IS10.1: Re-Evaluating 48 VIN Server Architectures with High Performance GaN Transistors

David Reusch, John Glaser, Alex Lidow, *Efficient Power Conversion Corporation*

2:25 p.m. – 2:50 p.m.

IS10.2: Cost and Accuracy Optimized VR Thermal Sensing Methodology for Server Platform

Wei Shen, Jiangqi He, Weixia Liang, Yuehong Fan, Joy Yuan, Jinsong Zhu, *Intel corporation, United States; Intel Corporation, China*

2:50 p.m. – 3:15 p.m.

IS10.3: Current Sharing: the New Challenge in Enterprise Server Power Supply

Mark Muccini, Mehran Mirjafari, Pat Gharpure, Stuart Berke, Lei Wang, *Dell EMC, United States*

3:15 p.m. – 3:40 p.m.

IS10.4: AC Inrush/Re-Rush Current: How to Address It in Power Supply

Mark Muccini, Mehran Mirjafari, Pat Gharpure, Lei Wang, *Dell EMC, United States*

4:10 p.m. – 4:35 p.m.

IS10.5: Seamless On-Line Firmware Updates in Digitally Controlled Power Supplies with Advanced Digital Signal Controllers

Sabarish Kalyanaraman, Alex Dumais, Ramesh Kankanala, *Microchip Technology Inc, United States; Microchip Technology Inc, India*

4:35 p.m. – 5:00 p.m.

IS10.6: Increasing the Power Density and Efficacy of Datacenters using a Two-Stage Solution for 48V Power Distribution

Rohan Samsi, Qian Ouyang, Jinghai Zhou, *Monolithic Power Systems, United States*

5:00 p.m. – 5:25 p.m.

IS10.7: Optimizing Power Entry Protection in the +48V Datacenter

Marcus O Sullivan, *Analog Devices, United States*

2:00 p.m. – 5:25 p.m.

IS11: Vehicle Electrification – Not Just the Powertrain

ROOM 13

SESSION CHAIRS:

Ralph Taylor, *Delphi*

Fred Weber, *Future Technology Worldwide*

2:00 p.m. – 2:25 p.m.

IS11.1: Electrified Transportation Challenges

Shahram Zarei, *Ford Motor Co., United States*

2:25 p.m. – 2:50 p.m.

IS11.2: Wireless Power Transfer: A Developers Guide

John Miller¹, Andy Daga², Bruce Long², Peter Schrafel², ¹J-N-J Miller Design Svcs PLLC, *United States; ²Momentum Dynamics Corp., United States*

2:50 p.m. – 3:15 p.m.

IS11.3: Which Way for Wireless Power: High Q or High K?

Bruce Long, John Miller, Andrew Daga, Peter Schrafel, *Momentum Dynamics, United States*

3:15 p.m. – 3:40 p.m.

IS11.4: Electrification of the Auxiliary Accessories in Electric Drive Vehicles (EDV's)

Davide Giacomini¹, Jonas Gronvall², ¹Infineon Italy s.r.l., *Italy; ²Infineon Technologies AG, Germany*

4:10 p.m. – 4:35 p.m.

IS11.5: 12V / 48V Hybrid Vehicle Technology

Steven Kowalec, *Continental, United States*

4:35 p.m. – 5:00 p.m.

IS11.6: Electric Drive Technologies Research Roadmap Update

Burak Ozpineci, *ORNL, United States*

5:00 p.m. – 5:25 p.m.

IS11.7: Waste Heat Recuperation for Passenger Vehicles

Jim Salvador, *GM, United States*

2:00 p.m. – 5:25 p.m.

IS12: IGBTs / Gate Drives

ROOM 11

SESSION CHAIR:

Alex Craig, *ON Semiconductor*

2:00 p.m. – 2:25 p.m.

IS12.1: Choosing the Right IGBT Module for Mil/Aerospace Applications

Paul Schimel, *IR HiRel, United States*

2:25 p.m. – 2:50 p.m.
IS12.2: Addressing Challenges in Modelling and Measuring IGBT's Power Losses in Industrial and Domestic Applications
 Leon Zhang, Vittorio Crisafulli, *ON Semiconductor, China*;
ON Semiconductor, Germany

2:50 p.m. – 3:15 p.m.
IS12.3: Direct Pressed Die Technology: Increased Power Density and Reliability in Standard Power Module Packages
 Stefan Häuser, *SEMİKRON Elektronik GmbH & Co. KG, Germany*

3:15 p.m. – 3:40 p.m.
IS12.4: EV/HEV Market Impact on Packaging Technology
 Mattin Grao Txapartegi, *Yole Développement, France*

4:10 p.m. – 4:35 p.m.
IS12.5: Navigating through Quality Traps of Circuit Design using Resistors in Series to High Voltage Diodes
 Wolfgang Frank, *Infineon Technologies Germany, Germany*

4:35 p.m. – 5:00 p.m.
IS12.6: Silicon on Isolator Gate Driver Technology, Its Features and Advantages
 David Divins, *Infineon Technologies, United States*

5:00 p.m. – 5:25 p.m.
IS12.7: High-Speed GaN Gate-Drivers
 Mike Wens, Jef Thoné, *MinDCet NV, Belgium*

2:00 p.m. – 5:30 p.m.

T17: High Frequency DC-DC Converters

ROOM 1/2

Track: DC-DC Converters

SESSION CHAIRS:

Olivier Trescases, *University of Toronto*

Xin Zhang, *IBM T.J. Watson Research Center*

2:00 p.m. – 2:20 p.m.
T17.1: High-Efficiency High-Power-Density 380V/12V DC/DC Converter with a Novel Matrix Transformer
 Chao Fei, Fred C. Lee, Qiang Li, *Virginia Polytechnic Institute and State University, United States*

2:20 p.m. – 2:40 p.m.
T17.2: A High-Frequency High-Step-Down Converter with Coupled Inductor for Low Power Applications
 Xiaonan Zhao, Chih-Shen Yeh, Lanhua Zhang, Jih-Sheng Lai, *Virginia Polytechnic Institute and State University, United States*

2:40 p.m. – 3:00 p.m.
T17.3: Active Clamp Flyback using GaN Power IC for Power Adapter Applications
 Lingxiao Xue, Jason Zhang, *Navitas Semiconductor, United States*

3:00 p.m. – 3:20 p.m.
T17.4: On-Chip Inductor DCR Self-Calibration Technique for High Frequency Integrated Multiphase Switching Converters
 Bumkil Lee², Minkyu Song¹, D. Brian Ma², ¹*Linear Technology Inc., United States*; ²*University of Texas at Dallas, United States*

3:20 p.m. – 3:40 p.m.
T17.5: A 12-Volt-Input Hybrid Switched Capacitor Voltage Regulator based on a Modified Series-Parallel Topology
 Christopher Schaefer, Jason Stauth, *Dartmouth College, United States*

4:10 p.m. – 4:30 p.m.
T17.6: Evaluation of Gate Drive Overvoltage Management Methods for Enhancement Mode Gallium Nitride Transistors
 David Reusch, Michael de Rooij, *Efficient Power Conversion Corp, United States*

4:30 p.m. – 4:50 p.m.
T17.7: High-Frequency ZVS Ćuk Converter for Automotive LED Driver Applications Using Planar Integrated Magnetics
 Alihossein Sepahvand², Montu Doshi¹, Wahid Yousefzadeh¹, James Patterson¹, Khurram K. Afridi², Dragan Maksimović², ¹*Texas Instruments Inc., United States*; ²*University of Colorado Boulder, United States*

4:50 p.m. – 5:10 p.m.
T17.8: Analysis and Design of Resonant Rectifier for High-Frequency DC-DC Converters
 Kyung-Hwan Lee, Jung-Ik Ha, *Seoul National University, Korea, South*

5:10 p.m. – 5:30 p.m.
T17.9: Analysis, Design, and Performance Evaluation of Asymmetrical Half-Bridge Flyback Converter for Universal-Line-Voltage-Range Applications
 Laszlo Huber, Milan M. Jovanović, *Delta Products Corporation, United States*

2:00 p.m. – 5:30 p.m.

T18: Magnetics

ROOM 18/19

Track: Devices and Components

SESSION CHAIRS:

Stephan Carlsen, *Raytheon Co*

Matt Wilkowski, *Altera*

- 2:00 p.m. – 2:20 p.m.
T18.1: High Frequency, Single/Dual Phases, Large AC/DC Signal Power Characterization for Two Phase On-Silicon Coupled Inductors
Cristina Fernandez², Zoran Pavlović, Santosh Kulkarni¹, Paul McCloskey¹, Cian O'Mathuna¹, ¹Tyndall National Institute and University College Cork, Ireland; ²Universidad Carlos III de Madrid, Spain
- 2:20 p.m. – 2:40 p.m.
T18.2: Analysis and Reduction of the Near Magnetic Field Radiation from Magnetic Inductors
Boyi Zhang, Shuo Wang, *University of Florida, United States*
- 2:40 p.m. – 3:00 p.m.
T18.3: Electrical Shielding of MV/MF Transformers Subjected to High dv/dt PWM Voltages
Thomas Guillod, Florian Krismer, Johann Walter Kolar, *Eidgenössische Technische Hochschule Zürich, Switzerland*
- 3:00 p.m. – 3:20 p.m.
T18.4: Techniques of the Modeling, Measurement and Reduction of Common Mode Noise for a Multi-Winding Switching Transformer
Yiming Li², Huan Zhang², Shuo Wang², Honggang Sheng¹, Srikanth Lakshmikanthan¹, Choon Ping Chng¹, ¹Google Inc., United States; ²University of Florida, United States
- 3:20 p.m. – 3:40 p.m.
T18.5: High-Q Resonator with Integrated Capacitance for Resonant Power Conversion
Phyo Aung Kyaw, Aaron Stein, Charles Sullivan, *Dartmouth College, United States*
- 4:10 p.m. – 4:30 p.m.
T18.6: Multi-Domain Design of Inverter-Side Inductor for LCL Filter with 50kW 60 kHz High Power Density Converter
Yong Liu¹, Kye-Yak See¹, Rejeki Simanjanrang³, Shan Yin², Chin-Foong Tong⁴, Arie Nawawi⁴, Jih-Sheng Lai⁵, ¹Nanyang Technological University, Singapore; ²Nanyang Technological University / Rolls-Royce Singapore Pte. Ltd., Singapore; ³Rolls-Royce Singapore Pte. Ltd., Singapore; ⁴Rolls-Royce Singapore Pte. Ltd. / Nanyang Technological University, Singapore

4:30 p.m. – 4:50 p.m.

T18.7: High-Frequency Transformer Design for the Soft-Switching Solid State Transformer (S4T)

Hao Chen, Deepak Divan, *Georgia Institute of Technology, United States*

4:50 p.m. – 5:10 p.m.

T18.8: An AC Resistance Optimization Method Applicable for Inductor and Transformer Windings with Full Layers and Partial Layers

Zhan Shen¹, Zhiguang Li², Long Jin³, Huai Wang¹, ¹Aalborg University, Denmark; ²Guodian Nanjing Automation Co., Ltd., China; ³Southeast University, China

5:10 p.m. – 5:30 p.m.

T18.9: Printed Circuit Board Planar Current Transformer for GaN Active Diode

Godwin Kwun Yuan Ho, Yaoran Fang, M.H. Pong, Shu-Yuen Ron Hui, *University of Hong Kong, Hong Kong*

2:00 p.m. – 5:30 p.m.

T19: Multilevel Converters

ROOM 20

Track: Motor Drives and Inverters

SESSION CHAIRS:

Mohammed Agamy, *GE Global Research*

Suman Debnath, *Oak Ridge National Laboratory*

2:00 p.m. – 2:20 p.m.

T19.1: A New Five-Level Nested Neutral Point Clamped (NNPC) Voltage Source Converter

Mehdi Narimani¹, Bin Wu³, Navid Zargari², ¹McMaster University, Canada; ²Rockwell Automation, Canada; ³Ryerson University, Canada

2:20 p.m. – 2:40 p.m.

T19.2: Switched-Capacitor Multilevel Inverters for High Frequency AC Microgrids

Raghu Raman S., Yuanmao Ye, Ka Wai Eric Cheng, *Hong Kong Polytechnic University, Hong Kong*

2:40 p.m. – 3:00 p.m.

T19.3: A Hybrid Multilevel Inverter Employing Series-Parallel Switched-Capacitor Unit

Yat Chi Fong, Yuanmao Ye, Raghu Raman S., Ka Wai Eric Cheng, *Hong Kong Polytechnic University, Hong Kong*

3:00 p.m. – 3:20 p.m.

T19.4: An Improved Ripple Suppression Method Based on Flying-Capacitor Modular Multilevel Converter for High Performance MV Drivers

Ze Wang², Kaiwen Liao², Kai Zhang², Xin Huang², Zenghui Kong¹, ¹China Ship Development and Design Center, China; ²Huazhong University of Science and Technology, China

3:20 p.m. – 3:40 p.m.
T19.5: Power and Frequency Controllable Multi-Level MHz Inverter with Soft Switching
 Hamed Tebianian, John Quaicoe, Benjamin Jeyasurya,
Memorial University of Newfoundland, Canada

4:10 p.m. – 4:30 p.m.
T19.6: Design of a GaN-based, 9-Level Flying Capacitor Multilevel Inverter with Low Inductance Layout
 Tomas Modeer, Christopher Barth, Nathan Pallo, Won Ho Chung, Thomas Foulkes, Robert C.N. Pilawa-Podgurski,
University of Illinois Urbana-Champaign, United States

4:30 p.m. – 4:50 p.m.
T19.7: Carrier based Three-Level PWM for Improving Flying Capacitor Balancing of Nested Neutral-Point-Clamped (NNPC) Converter
 Hao Tian, Yun Wei Li, *University of Alberta, Canada*

4:50 p.m. – 5:10 p.m.
T19.8: Phase Current Reconstruction of Three-Level Neutral-Point-Clamped(NPC) Inverter with a Neutral Shunt Resistor
 Jae-Jun You, Jun-Hyung Jung, Chang-Hwan Park, Jang-Mok Kim, *Pusan National University, Korea, South*

5:10 p.m. – 5:30 p.m.
T19.9: Multiple Device Open Circuit Fault Diagnosis for Neutral-Point-Clamped Inverters
 Marina Sital-Dahone², Aparna Saha², Yilmaz Sozer², Augustin Mpanda¹, ¹ESIEE Amiens, France; ²University of Akron, United States

2:00 p.m. – 5:30 p.m.

T20: Grid-Connected Inverter Control

ROOM 21

Track: Power Electronics for Utility Interface

SESSION CHAIRS:

Ali Khajehoddin, *University of Alberta*

Babak Parkhideh, *University of North Carolina Charlotte*

2:00 p.m. – 2:20 p.m.
T20.1: H-Bridge Transformerless Inverter with Common Ground for Single-Phase Solar-Photovoltaic System
 Yam Siwakoti, Frede Blaabjerg, *Aalborg University, Denmark*

2:20 p.m. – 2:40 p.m.
T20.2: Analysis of an Offset Error on a Single-Phase Grid-Connected Inverter based on a Proportional-Resonant Controller
 Gwang Hyun Shin, Seon-Hwan Hwang, Jae-Suk Lee,
Kyungnam University, Korea, South

2:40 p.m. – 3:00 p.m.
T20.3: Improving Weak Grids Adaptability of LCL-Filtered Grid-Connected Converters with Delay-Compensated Capacitor-Voltage Feedforward Control
 Xiaoqiang Li², Jingyang Fang², Yi Tang², Yiwen Geng¹, Xiaojie Wu¹, ¹China University of Mining and Technology, China; ²Nanyang Technological University, Singapore

3:00 p.m. – 3:20 p.m.
T20.4: A Robust Grid Current Controller with Grid Harmonic and Filter Resonance Damping Capabilities using a Closed-Loop Admittance Shaping
 Jorge Pérez², Santiago Cóbreces², Xiongfei Wang¹, Frede Blaabjerg¹, Robert Griñó³, ¹Aalborg University, Denmark; ²Universidad de Alcalá, Spain; ³Universitat Politècnica de Catalunya, Spain

3:20 p.m. – 3:40 p.m.
T20.5: Compensation of Dead Time Effects in Grid-Tied Single-Phase Inverter using SOGI
 Eun-Soo Kim, Ui-Seok Seong, Jae-Suk Lee, Seon-Hwan Hwang, *Kyungnam University, Korea, South*

4:10 p.m. – 4:30 p.m.
T20.6: An Adaptive Algorithm for Grid-Connected Inverter to Suppress Current Harmonics and Instabilities Due to Grid Impedance and Distortion
 Jinming Xu, Qiang Qian, Binfeng Zhang, Huizhen Wang, Shaojun Xie, *Nanjing University of Aeronautics and Astronautics, China*

4:30 p.m. – 4:50 p.m.
T20.7: Analysis and Optimization of BCM Peak Current Mode Control Techniques for Microinverters
 Seyed Milad Tayebi², Nasser Kutkut¹, Issa Batarseh², ¹Advanced Charging Technologies / University of Central Florida, United States; ²University of Central Florida, United States

4:50 p.m. – 5:10 p.m.
T20.8: Systematic Design of Grid-Current-based Active Damping for Grid-Connected LCL Filters
 Mahmoud Gaafar², Gamal Dousoky³, Emad Ahmed¹, Masahito Shoyama², ¹Aswan University, Egypt; ²Kyushu University, Japan; ³Minia University, Egypt

5:10 p.m. – 5:30 p.m.
T20.9: A Multi-Loop Controller for LCL-Filtered Grid-Connected Converters Integrated with a Hybrid Harmonic Compensation and a Novel Virtual Impedance
 Yonghwan Cho, Maziar Mobarrez, Subhashish Bhattacharya, *North Carolina State University, United States*

2:00 p.m. – 5:30 p.m.

T21: Device Modeling & Simulation

ROOM 22

Track: Modeling and Simulation

SESSION CHAIRS:

Marco Meola, *Integrated Device Technology*

Hadi Malek, *Ford Motor Company*

2:00 p.m. – 2:20 p.m.

T21.1: Estimating Switching Losses for SiC MOSFETs with Non-Flat Miller Plateau Region

Bharat Agrawal², Matthias Preindl¹, Berker Bilgin², Ali Emadi², ¹*Columbia University, United States*; ²*McMaster University, Canada*

2:20 p.m. – 2:40 p.m.

T21.2: Modeling of a Silicon-Carbide MOSFET with Focus on Internal Stray Capacitances and Inductances, and its Verification

Yasushige Mukunoki¹, Takeshi Horiguchi¹, Yasushi Nakayama¹, Akinori Nishizawa¹, Yuta Nakamura², Kentaro Konno², Masaki Kuzumoto², Hirofumi Akagi², ¹*Mitsubishi Electric Corporation, Japan*; ²*Tokyo Institute of Technology, Japan*

2:40 p.m. – 3:00 p.m.

T21.3: A Physically based Scalable SPICE Model for Silicon Carbide Power MOSFETs

Canzhong He², James Victory¹, Mehrdad Baghaie Yazdi², Kwangwon Lee², Martin Domeij², Fredrik Allerstam², Thomas Neyer², ¹*Fairchild Semiconductor / ON Semiconductor, Germany*; ²*ON Semiconductor, United States*; ²*ON Semiconductor, Sweden*; ²*ON Semiconductor, Germany*

3:00 p.m. – 3:20 p.m.

T21.4: A Physics-based Compact Gallium Nitride Power Semiconductor Device Model for Advanced Power Electronics Design

Ramchandra Kotecha, Yuzhi Zhang, Arman Rashid, Nan Zhu, Tom Vrotsos, H. Alan Mantooth, *University of Arkansas, United States*

3:20 p.m. – 3:40 p.m.

T21.5: Analysis of the dv/dt Transient of Enhancement-Mode GaN FETs

Edward Jones, Zheyu Zhang, Fred Wang, *University of Tennessee, United States*

4:10 p.m. – 4:30 p.m.

T21.6: Quasi-Square Wave Converters-Modeling and Performance Benefits of GaN over Silicon

Saurav Bandyopadhyay, Jeffrey Morroni, *Texas Instruments Inc., United States*

4:30 p.m. – 4:50 p.m.

T21.7: Effects of Parasitic Parameters on Electromagnetic Interference of Power Electronic Modules

Atanu Dutta, Simon Ang, *University of Arkansas, United States*

4:50 p.m. – 5:10 p.m.

T21.8: Reliability Study and Modelling of IGBT Press-Pack Power Modules

Hongyao Long², Mark Sweet², Ekkanath Madathil S. Narayanan², Gangru Li¹, ¹*IXYS Westcode Ltd, United Kingdom*; ²*University of Sheffield, United Kingdom*

5:10 p.m. – 5:30 p.m.

T21.9: Bayesian Remaining Useful Lifetime Prediction of Thermally Aged Power MOSFETs

Mehrdad Heydarzadeh, Serkan Dusmez, Mehrdad Nourani, Bilal Akin, *University of Texas at Dallas, United States*

2:00 p.m. – 5:30 p.m.

T22: Control Strategies for Inverters & Motor Drives

ROOM 23

Track: Control

SESSION CHAIRS:

Bilal Akin, *University of Texas at Dallas*

Serkan Dusmez, *Texas Instruments, Inc.*

2:00 p.m. – 2:20 p.m.

T22.1: Rotor Position Estimation of PMSM Using Square-Wave Voltage Injection with Asymmetric Space Vector Modulation

Hang Zhang², Weiguo Liu², Zhe Chen³, Guangzhao Luo², Jianxing Liu¹, Dongdong Zhao², ¹*Harbin Institute of Technology, China*; ²*Northwestern Polytechnical University, China*; ³*Technische Universität München, Germany*

2:20 p.m. – 2:40 p.m.

T22.2: Compensation of Dead-Time Effects Based on Revised Repetitive Controller for PMSM Drives

Zhuangyao Tang, Bilal Akin, *University of Texas at Dallas, United States*

2:40 p.m. – 3:00 p.m.

T22.3: Fault-Tolerant Controller Architecture for Cascaded Multi-Level Converters

Ali Azidehak¹, Mark Hwang¹, Rajat Agarwal¹, Subhashish Bhattacharya¹, Nima Yousefpoor², ¹*North Carolina State University, United States*; ²*Quanta Technology, United States*

- 3:00 p.m. – 3:20 p.m.
T22.4: Cascaded Bridgeless Totem-Pole Multilevel Converter with Model Predictive Control for 400 V DC-Powered Data Centers
 Yuzhi Zhang, Ramchandra Kotecha, H. Alan Mantooth, Juan Balda, Yue Zhao, Chris Farnell, *University of Arkansas, United States*
- 3:20 p.m. – 3:40 p.m.
T22.5: Discrete State-Space Voltage Controller for Voltage Source Inverters with LC Filter Based on Direct Pole-Zero Placement Design
 Hyeon-Sik Kim, Hyun-Sam Jung, Seung-Ki Sul, *Seoul National University, Korea, South*
- 4:10 p.m. – 4:30 p.m.
T22.6: Reduced Order Generalized Integrators with Phase Compensation for Three-Phase Active Power Filter
 Chuan Xie², Kai Li², Xin Zhao¹, Juan Carlos Vásquez¹, Josep M. Guerrero¹, ¹*Aalborg University, Denmark*; ²*University of Electronic Science and Technology of China, China*
- 4:30 p.m. – 4:50 p.m.
T22.7: Observer-based Predictive Current Controller for Grid-Connected Single-Phase Wind Converter
 Haider Mohomad A R, Saleh A Saleh, Liuchen Chang, Riming Shao, Shuang Xu, *University of New Brunswick, Canada*
- 4:50 p.m. – 5:10 p.m.
T22.8: Variable Switching Point Predictive Current Control of Quasi-Z-Source Inverters
 Ayman Ayad², Petros Karamanakos¹, Ralph Kennel², ¹*Tampere University of Technology, Finland*; ²*Technische Universität München, Germany*
- 5:10 p.m. – 5:30 p.m.
T22.9: A Modified Division-Summation Digital Control for Grid-Connected Inverter with Wide Inductance Variation of LCL Filter
 Tsai-Fu Wu, Mitradatta Misra, Li-Chiun Lin, Yen-Hsiang Huang, *National Tsing Hua University, Taiwan*

2:00 p.m. – 5:30 p.m.

T23: Renewable Energy System Considerations

ROOM 24

Track: Renewable Energy Systems

SESSION CHAIR:

Xiong Li, *Texas Instruments, Inc.*

- 2:00 p.m. – 2:20 p.m.
T23.1: Discharge Rate Balancing Control Strategy Based on Dynamic Consensus Algorithm for Energy Storage Units in AC Microgrids
 Yajuan Guan, Lexuan Meng, Chendan Li, Juan Carlos Vásquez, Josep M. Guerrero, *Aalborg University, Denmark*
- 2:20 p.m. – 2:40 p.m.
T23.2: Smart Resistor: Dynamic Stabilization of Constant Power Loads in DC Microgrids with High Bandwidth Power Converters and Energy Storage
 Karun Arjun Potty, Eric Bauer, He Li, Boxue Hu, Jin Wang, *Ohio State University, United States*
- 2:40 p.m. – 3:00 p.m.
T23.3: FRT Capability of Single-Phase Grid-Connected Inverter with Minimized Interconnected Inductor
 Satoshi Nagai, Keisuke Kusaka, Jun-Ichi Itoh, *Nagaoka University of Technology, Japan*; *Nagaoka University of Technology, Japan*
- 3:00 p.m. – 3:20 p.m.
T23.4: Current and Rotor Position Sensor Fault Detection and Isolation for Permanent Magnet Synchronous Generators in Wind Applications
 Haibo Li, Liyan Qu, Wei Qiao, Chun Wei, *University of Nebraska-Lincoln, United States*
- 3:20 p.m. – 3:40 p.m.
T23.5: Generation Cost Minimization based Distributed Coordination Control in DC Microgrids
 Mohamed Zaery, Emad Mohamed Ahmed, Mohamed Orabi, *Aswan University, Egypt*
- 4:10 p.m. – 4:30 p.m.
T23.6: A Fast and Accurate MPPT Control Technique using Boundary Controller for PV Applications
 Yang Zhou, Carl Ngai Man Ho, Ken King Man Siu, *University of Manitoba, Canada*

4:30 p.m. – 4:50 p.m.
T23.7: Proposal of a Control Scheme for an Active Filter on PV Micro-Inverter Applications
 Marcus Anderson A. Bezerra, Jorge Luiz L. W. Oliveira Jr., Paulo Praça, Demercil Oliveira Jr., Luiz Henrique S.C. Barreto, *Universidade Federal do Ceará, Brazil*

4:50 p.m. – 5:10 p.m.
T23.8: Analysis and Optimization of a High-Efficiency Residential Energy Harvesting System with Dual Half-Bridge Converter
 Shuang Zhao, Janviere Umuhoza, Yuzhi Zhang, Joe Moquin, Chris Farnell, H. Alan Mantooth, *University of Arkansas, United States*

5:10 p.m. – 5:30 p.m.
T23.9: Lifetime Evaluation of PV Inverters Considering Panel Degradation Rates and Installation Sites
 Ariya Sangwongwanich, Yongheng Yang, Dezso Sera, Frede Blaabjerg, *Aalborg University, Denmark*

2:00 p.m. – 5:30 p.m.

T24: Medium/High Power Applications

ROOM 25

Track: Power Electronics Applications

SESSION CHAIRS:

Kent Wanner, *John Deere*

Serkan Dusmez, *Texas Instruments, Inc.*

2:00 p.m. – 2:20 p.m.
T24.1: High Power PWM Amplifier with Coupling Inductor based Parallel Structure for Magnetic Resonance Imaging
 Lixi Chen¹, Tao Zhang², Jianping Xu¹, ¹*Southwest Jiaotong University, China*; ²*University of Electronic Science and Technology of Chengdu, China*

2:20 p.m. – 2:40 p.m.
T24.2: High Power and Low Voltage Power Supply for Low Frequency Pulsed Load
 Xinze Huang, Xinbo Ruan, Fangjun Du, Fei Liu, Li Zhang, *Nanjing University of Aeronautics and Astronautics, China*

2:40 p.m. – 3:00 p.m.
T24.3: An Intelligent IGBT Module for Quasi-Resonant Converter Applications
 Wonjin Cho, Bum-Seok Suh, Son Tran, *Alpha and Omega Semiconductor, United States*; *Alpha and Omega Semiconductor, Korea, South*

3:00 p.m. – 3:20 p.m.
T24.4: Control Scheme and Characteristics Analysis of Three-Phase Series Resonant Converter Suitable for Contactless Slipring System
 Xin Chen², Qianhong Chen², Guangming He², Xiaoyong Ren², Siu-Chung Wong¹, ¹*Hong Kong Polytechnic University, China*; ²*Nanjing University of Aeronautics and Astronautics, China*

3:20 p.m. – 3:40 p.m.
T24.5: A Phase-Shift Dual-Frequency Selective Harmonic Elimination for Multiple AC Loads in a Full Bridge Inverter Configuration
 Chongwen Zhao, Daniel Costinett, *University of Tennessee, United States*

4:10 p.m. – 4:30 p.m.
T24.6: Novel Control Architecture for Programmable Electronic AC Load to Achieve Harmonic Load Profiles
 Zhi Geng, Dazhong Gu, Tianqi Hong, Jiaxin Teng, Dariusz Czarkowski, *New York University Tandon School of Engineering, United States*

4:30 p.m. – 4:50 p.m.
T24.7: High Frequency Transformer Design for Modular Power Conversion from Medium Voltage AC to 400V DC
 Shishuo Zhao, Qiang Li, Fred C. Lee, *Virginia Polytechnic Institute and State University, United States*

4:50 p.m. – 5:10 p.m.
T24.8: Modelling and Design of Active Thermal Controls for Power Electronics of Motor Drive Applications
 Ionut Vernica, Frede Blaabjerg, Ke Ma, *Aalborg University, Denmark*

5:10 p.m. – 5:30 p.m.
T24.9: Modeling and Damping Strategy for Active Power Oscillation of Static Var Generator
 Jianjun Sun², Ying He², Jinwu Gong², Xiaoming Zha², Wei Hu¹, ¹*State Grid Hubei Electric Power Company Electric Power Research Institute, China*; ²*Wuhan University, China*

7:00 p.m.-10:00 p.m.

“Little Havana” Evening Social Event

(Ticket Required)

CURTIS HIXON WATERFRONT PARK

Visit the APEC Registration desk for a walking map to the park. Limited bus transportation will also be available starting at 6:45 p.m. departing from the Tampa Convention Center.

7:00 a.m. – 8:00 a.m.

Presenter Breakfast

BALLROOM A

8:00 a.m. – 12:00 p.m.

Registration

2ND FLOOR CONCOURSE

8:00 a.m. – 9:00 a.m.

Spouse and Guest Breakfast

MARRIOTT – MEETING ROOM 4

8:00 a.m. – 11:00 a.m.

Spouse and Guest Hospitality Room Open

MARRIOTT – MEETING ROOM 4

8:30 a.m. – 11:30 a.m.

IS13: GaN Topics and Applications

ROOM 15/16

SESSION CHAIR:

Peter Di Maso, *GaN Systems*

IS13.1: Advancements in Reliability Evaluation of eGaN® Fets and ICs Demonstrates Readiness for Mainstream Adoption

Chris Jakubiec, Robert Strittmatter, *Efficient Power Conversion Corporation, United States*

IS13.2: Deadtime Losses in eGaN® Fets and Silicon MOSFETs – How Freedom from Reverse Recovery Can Cut Your Losses

John Glaser, David Reusch, *Efficient Power Conversion Corporation*

IS13.3: System-Level Reliability Validation of GaN Devices for Power Management

Sandeep Bahl, Lixing Fu, Jungwoo Joh, Angela Lam, Anup Sasikumar, *TI, United States*

9:45 a.m. – 10:10 a.m.

IS13.4: Preventing GaN Device VHF Oscillation

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

10:40 a.m. – 11:05 a.m.

IS13.5: Gan E-HEMTs Enable Innovation in Power Switching Applications

Peter Di Maso, Lucas Lu, *GaN Systems Inc., Canada*

11:05 a.m. – 11:30 a.m.

IS13.6: Low Cost Digital Totem Pole PFC with Single Shunt Current Sensing and Differential AC Voltage Sensing

Wei Wu, *Infineon Technologies North America, United States*

8:30 a.m. – 11:30 a.m.

IS14: Isolation Barrier Technologies for Power Electronics

ROOM 14

SESSION CHAIRS:

Kevin Parmenter, *Excelsys Technologies*

Jim Spangler, *Independent*

8:30 a.m. – 8:55 a.m.

IS14.1: Gate Driver Selection

Mitchell Van Ochten, *ROHM Semiconductor, United States*

8:55 a.m. – 9:20 a.m.

IS14.2: Isolation in Industrial Motor Drives

Xiong Li, Anant Kamath, *Texas Instruments, United States*

9:20 a.m. – 9:45 a.m.

IS14.3: Next-Generation GaN Isolators for High Frequency, High Efficiency Power Conversion

Stephen Oliver, Marco Giandalia, *Navitas Semiconductor, United States*

9:45 a.m. – 10:10 a.m.

IS14.4: Logic Level Signal Isolation Technology Review

Mark Cantrell, *Analog Devices Inc., United States*

10:40 a.m. – 11:05 a.m.

IS14.5: Importance of Measuring Parasitic Capacitance in Isolated Gate Drive Applications

Wolfgang Frank, *Infineon Technologies Germany, Germany*

11:05 a.m. – 11:30 a.m.

IS14.6: Mitigating Common Mode Transient Effects with Best in Class Isolators

Rudye McEllothian, *Silicon Laboratories*

8:30 a.m. – 11:30 a.m.

IS15: Industrial Power Applications of Silicon Carbide Semiconductors

ROOM 13

SESSION CHAIR:

Jim LeMunyon, *PowerAmerica*

8:30 a.m. – 8:55 a.m.

IS15.1: Rugged 1.2 KV SiC MOSFETs Fabricated in High-Volume 150mm CMOS Fab

Sujit Banerjee, Kevin Matocha, Xuning Zhang, Gin Sheh, Levi Gant, *Monolith Semiconductor Inc., United States*

8:55 a.m. – 9:20 a.m.

IS15.2: Life Testing of Wolfspeed Industry Standard Modules

Mrinal Das, Marcelo Schupbach, Adam Barkley, *Wolfspeed, A Cree Company, United States*

9:20 a.m. – 9:45 a.m.

IS15.3: Market and Technology Roadmaps for Silicon Carbide Technology

John Muth, *PowerAmerica, United States*

9:45 a.m. – 10:10 a.m.

IS15.4: SiC MOSFETs and Power Modules for Industrial Applications

John Palmour, *Wolfspeed, United States*

10:40 a.m. – 11:05 a.m.

IS15.5: 200 kW 1050 VDC SiC Dual Inverter for Heavy-Duty Vehicles

Brij N. Singh, *John Deere, Inc., United States*

11:05 a.m. – 11:30 a.m.

IS15.6: Silicon Carbide Device-Based Commercial PV Inverters

Peter Liu, *Toshiba International, United States*

8:30 a.m. – 11:30 a.m.

IS16: Energy Harvesting

ROOM 11

SESSION CHAIR:

Mike Hayes, *Tyndall National Institute*

8:30 a.m. – 8:55 a.m.

IS16.1: The Reality about Energy Harvesting

Lorandt Fölkel, *Würth Elektronik eiSos, Germany*

8:55 a.m. – 9:20 a.m.

IS16.2: Chip Scale TEG and its Use for a Wireless Machine Health Monitoring System

Baoxing Chen, Jane Cornett, *Analog Devices, Inc., United States*

9:20 a.m. – 9:45 a.m.

IS16.3: Energy Harvesting with Thin-Film GaAs Solar Cells

Rodney Amen, *Alta Devices, United States*

9:45 a.m. – 10:10 a.m.

IS16.4: Ultra Low Power Energy Harvesting and Power Management IC (PMIC) Design

Seamus O'Driscoll, *Tyndall National Institute, Ireland*

10:40 a.m. – 11:05 a.m.

IS16.5: IoT – Power Challenge – How Low Can We Go?

Ajinder Singh, *Texas Instruments, United States*

11:05 a.m. – 11:30 a.m.

IS16.6: Interactive Energy Harvesting Demonstrations

Mike Hayes, *Tyndall National Institute, Ireland*

8:30 a.m. – 11:20 a.m.

T25: DC-DC Converter Applications

ROOM 1/2

Track: DC-DC Converters

SESSION CHAIRS:

Hoi Lee, *University of Texas at Dallas*

Lingxiao Xue, *Navitas Semiconductor*

8:30 a.m. – 8:50 a.m.

T25.1: A Novel PCB Winding Transformer with Controllable Leakage Integration for a 6.6kW 500kHz High Efficiency High Density Bi-Directional On-Board Charger

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

8:50 a.m. – 9:10 a.m.

T25.2: Design and Implementation of a Low-Cost and Compact Floating Gate Drive Power Circuit for GaN-based Flying Capacitor Multi-Level Converters

Zichao Ye², Yutian Lei², Wen-Chuen Liu², Pradeep S. Shenoy¹, Robert C.N. Pilawa-Podgurski², ¹*Texas Instruments Inc., United States*; ²*University of Illinois Urbana-Champaign, United States*

9:10 a.m. – 9:30 a.m.

T25.3: A 5-Level Flying Capacitor Multi-Level Converter with Integrated Auxiliary Power Supply and Start-Up

Andrew Stillwell, Robert C.N. Pilawa-Podgurski, *University of Illinois Urbana-Champaign, United States*

9:30 a.m. – 9:50 a.m.

T25.4: A Robust Dynamic Voltage Scaling Scheme for FPGAs with IR Drop CompensationShuze Zhao, Ibrahim Ahmed, Armina Khakpour, Vaughn Betz, Olivier Trescases, *University of Toronto, Canada*

9:50 a.m. – 10:10 a.m.

T25.5: A Current-Feed Single-Switch Forward Resonant DC Transformer (DCX) with Secondary Diode-ClampingWei Qin, Jinxu Yang, Kai Qiu, Xinke Wu, *Zhejiang University, China*

10:40 a.m. – 11:00 a.m.

T25.6: LLC Resonant Converter with Variable Resonant Inductor for Wide LED Dimming RangeWeizhong Ma, Xiaogao Xie, Shuai Jiang, *Hangzhou Dianzi University, China*

11:00 a.m. – 11:20 a.m.

T25.7: A Dual Coupled Inductors-based High Step-up/ Step-Down Bidirectional DC-DC Converter for Energy Storage SystemMeng Zhang¹, Yan Xing¹, Hongfei Wu¹, Haibing Hu¹, Xudong Ma², ¹*Nanjing University of Aeronautics and Astronautics, China*; ²*Southeast University, China*

8:30 a.m. – 11:20 a.m.

T26: Renewable Energy Using Advanced Devices

ROOM 18/19

Track: Renewable Energy Systems

SESSION CHAIRS:

Laszlo Balogh, *ON Semiconductor*

8:30 a.m. – 8:50 a.m.

T26.1: Development of a Two-Stage Transformerless Grid-Tied Photovoltaic Inverter System using SiC DevicesAbhijit Datta, Rajesh Farswan, Baylon G. Fernandes, *Indian Institute of Technology Bombay, India*

8:50 a.m. – 9:10 a.m.

T26.2: GaN based Transformer-Less Microinverter with Extended-Duty-Ratio Boost and Doubly Grounded Voltage Swing InverterJinia Roy, Yinglai Xia, Raja Ayyanar, *Arizona State University, United States*

9:10 a.m. – 9:30 a.m.

T26.3: Comparison of GaN and Si-based Photovoltaic Power Conversion Circuits using Various Maximum Power Point Tracking AlgorithmsRoshan Kini, Andrew Sellers, Michael Hontz, Rafiul Kabir, Raghav Khanna, *University of Toledo, United States*

9:30 a.m. – 9:50 a.m.

T26.4: A GaN based Doubly Grounded, Reduced Capacitance Transformer-Less Split Phase Photovoltaic Inverter with Active Power DecouplingYinglai Xia, Jinia Roy, Raja Ayyanar, *Arizona State University, United States*

9:50 a.m. – 10:10 a.m.

T26.5: Forward Dual-Active-Bridge Solid State Transformer for a SiC-based Cascated Multilevel Converter Cell in Solar ApplicationsThiago Parreiras², Alysson Machado², Fernando Amaral², Gideon Lobato², José Brito¹, Braz Cardoso F.², ¹*COELBA S.A., Brazil*; ²*Universidade Federal de Minas Gerais, Brazil*

10:40 a.m. – 11:00 a.m.

T26.6: Split-Winding Type Three Limb Core Structured HF Transformer for Integrating PV and Energy Storage(ES)Ritwik Chattopadhyay, Ghanshyamsinh Gohil, Subhashish Bhattacharya, *North Carolina State University, United States*

11:00 a.m. – 11:20 a.m.

T26.7: A Modular Silicon Carbide (SiC)-based Single-Stage Three-Phase AC/DC Step-Up Medium Voltage Converter with Extended Soft-Switching Operations for DC Grid in Wind SystemsMehdi Abbasi, John Lam, *York University, Canada*

8:30 a.m. – 11:20 a.m.

T27: Power Modules

ROOM 20

Track: Devices and Components

SESSION CHAIRS:

Douglas Hopkins, *North Carolina State University*Jared Hornberger, *Wolfspeed, A Cree Company*

8:30 a.m. – 8:50 a.m.

T27.1: A Phase-Leg IGBT Module using DBC Substrate without Ag Finish by Pressureless Sintering of Nanosilver PasteHaidong Yan¹, Yun-Hui Mei¹, Xin Li¹, Gang Chen¹, Guo-Quan Lu², ¹*Tianjin University, China*; ²*Virginia Polytechnic Institute and State University, United States*

8:50 a.m. – 9:10 a.m.

T27.2: A Current Sensorless IGBT Junction Temperature Extraction Method via Parasitic Parameters between Power Collector and Auxiliary CollectorWei Shi², Xiang Wang², Yu Zhou², Haoze Luo², Wuhua Li², Xiangning He², Jun Ma¹, Guodong Chen¹, Ye Tian¹, Enxing Yang¹, ¹*Shanghai Electric, China*; ²*Zhejiang University, China*

9:10 a.m. – 9:30 a.m.

- T27.3: Hybrid Si IGBT-SiC Schottky Diode Modules for Medium to High Power Applications**
Leif Amber, Kevork Haddad, *SEMIKRON Inc, United States*

9:30 a.m. – 9:50 a.m.

- T27.4: Medium Voltage Power Module based on SiC JFETs**
Xueqing Li, Hao Zhang, Anup Bhalla, *United Silicon Carbide, Inc., United States*

9:50 a.m. – 10:10 a.m.

- T27.5: Performance of a 1.2kV, 288A Full-SiC MOSFET Module based on Low Inductance Packaging Layout**
Liang Qiao¹, Xu Yang¹, Yu Ren¹, Fan Zhang¹, Laili Wang², Xin Ma¹, Shenhua Zhang¹, ¹*Xi'an Jiaotong University, China*; ²*Xi'an Jiaotong University / Sumida Corporation, China*

10:40 a.m. – 11:00 a.m.

- T27.6: Series-Connected GaN Transistors for Ultra-Fast High-Voltage Switch (>1kV)**
Jaume Roig¹, German Gomez¹, Filip Bauwens¹, Basil Vlachakis¹, Juan Rodriguez², Maria Rodriguez Rogina², Alberto Rodriguez², Diego G. Lamar², ¹*ON Semiconductor, Belgium*; ²*Universidad de Oviedo, Spain*

11:00 a.m. – 11:20 a.m.

- T27.7: Paralleling GaN E-HEMTs in 10kW-100kW Systems**
Juncheng Lu, Di Chen, *GaN Systems Inc, Canada*

8:30 a.m. – 11:20 a.m.

T28: Packaging Innovation for High Reliability

ROOM 21

Track: System Integration

SESSION CHAIRS:

John Vigars, *Allegro Microsystems*Ernie Parker, *Crane Aerospace & Electronics*

8:30 a.m. – 8:50 a.m.

- T28.1: Design of a Low Parasitic Inductance SiC Power Module with Double-Sided Cooling**
Fei Yang², Zhenxian Liang¹, Zhiqiang Wang¹, Fred Wang², ¹*Oak Ridge National Laboratory, United States*; ²*University of Tennessee, United States*

8:50 a.m. – 9:10 a.m.

- T28.2: Novel Cooling Technology to Reduce Thermal Impedance and Thermomechanical Stress for SiC Application**
Borong Hu¹, Zheng Zeng¹, Weihua Shao¹, Qing Ma¹, Hai Ren¹, Hui Li¹, Li Ran¹, Zhijun Li², ¹*Chongqing University, China*; ²*Global Power Technology (Beijing) Co. Ltd., China*

9:10 a.m. – 9:30 a.m.

- T28.3: Thermal Design of a Dual Sided Cooled Power Semiconductor Module for Hybrid and Electric Vehicles**
Yangang Wang, Yun Li, Xiaoping Dai, Shiwu Zhu, Steve Jones, Guoyou Liu, *Dynex Semiconductor Ltd., China*; *Dynex Semiconductor Ltd., United Kingdom*

9:30 a.m. – 9:50 a.m.

- T28.4: A New Multi-Functional Compact IPM for Low Power Industrial Application**
Yazhe Wang¹, Kosuke Yamaguchi¹, Kiyoto Watabe¹, Tomofumi Tanaka¹, Mike Rogers², Eric R. Motto², ¹*Mitsubishi Electric Corporation, Japan*; ²*Powerex Inc., United States*

9:50 a.m. – 10:10 a.m.

- T28.5: 300 W 4Q PV Inverter using New High Density Control Integrated Circuits**
Tanya Gachovska, Gabriel Scarlatescu, Chris Gerolami, Tudor Lipan, Nikolay Radimov, Christian Cojocar, Peter Preston-Thomas, Mihai Varlan, *Solantra Semiconductor Corp., Canada*

10:40 a.m. – 11:00 a.m.

- T28.6: Low-Temperature, Organics-Free Sintering of Nanoporous Copper for Reliable, High-Temperature and High-Power Die-Attach Interconnections**
Kashyap Mohan, Ninad Shahane, Pulugurtha M. Raj, Antonia Antoniou, Vanessa Smet, Rao Tummala, *Georgia Institute of Technology, United States*

11:00 a.m. – 11:20 a.m.

- T28.7: Silver Sintering Die Attach Process for IGBT Power Module Production**
Yimin Zhao¹, Paul Mumby-Croft¹, Steve Jones¹, Xiaoping Dai¹, Zechun Dou², Yafei Wang², Feng Qin², ¹*Dynex Semiconductor Ltd., United Kingdom*; ²*Zhuzhou CRRC Times Electric Co. Ltd, China*



8:30 a.m. – 11:20 a.m.

T29: Systems & Components Modeling & Simulation

ROOM 22

Track: Modeling and Simulation

SESSION CHAIRS:

Martin Ordonez, *University of British Columbia*

Marco Meola, *Integrated Device Technology*

- 8:30 a.m. – 8:50 a.m.
- T29.1: Investigation and Simulation Model Results of High Density Wireless Power Harvesting and Transfer Method**
Jaber Abu Qahouq, Zhigang Dang, *University of Alabama, United States*
- 8:50 a.m. – 9:10 a.m.
- T29.2: Modeling of Wireless Power System with Giant Magnetostrictive Material Load under Multi-Field Coupling**
Xuling Chen, Xinglei Gong, *Nanjing University of Aeronautics and Astronautics, China*
- 9:10 a.m. – 9:30 a.m.
- T29.3: A Novel Equivalent Circuit Thermal Model for Integrated Power Modules**
Wenbo Liu¹, Yan-Fei Liu¹, Laili Wang³, Doug Malcolm²,
¹Queen's University, Canada; ²Sumida Corporation, Canada;
³Xi'an Jiaotong University / Sumida Corporation, Canada
- 9:30 a.m. – 9:50 a.m.
- T29.4: Verification of Control Design and Implementation for Power Supplies by FPGA-in-the-Loop Simulation**
Misha Kumar, Laszlo Huber, Milan M. Jovanović,
Delta Products Corporation, United States
- 9:50 a.m. – 10:10 a.m.
- T29.5: A Neural Network based Method for Instantaneous Power Estimation in Electric Vehicles' Li-Ion Batteries**
Ala Hussein, *Yarmouk University, Jordan*
- 10:40 a.m. – 11:00 a.m.
- T29.6: Modeling of Domestic Induction Heating Systems with Non-Linear Saturable Loads**
Javier Serrano², Jesús Acero², Ignacio Lope¹, Claudio Carretero², José Miguel Burdío², Rafael Alonso²,
¹BSH Home Appliances Group, Spain; ²Universidad de Zaragoza, Spain
- 11:00 a.m. – 11:20 a.m.
- T29.7: Simplified Modeling of Ultracapacitors for Bidirectional DC-DC Converter Applications**
Saichand Kasicheyanula, Vinod John, *Indian Institute of Science, India*

8:30 a.m. – 11:20 a.m.

T30: Control of Motor Drives II

ROOM 23

Track: Motor Drives and Inverters

SESSION CHAIRS:

Bulent Sarioglu, *University of Wisconsin-Madison*

Ali Bazzi, *University of Connecticut*

- 8:30 a.m. – 8:50 a.m.
- T30.1: Simple Analytical Derivation of Magnetic Flux Profile Eliminating Source Current Ripple and Torque Ripple of Switched Reluctance Motors for Electric Vehicle Propulsion**
Takayuki Kusumi, Takuto Hara, Kazuhiro Umetani, Eiji Hiraki, *Okayama University, Japan*
- 8:50 a.m. – 9:10 a.m.
- T30.2: Stator-Current-based MRAS Observer for the Sensorless Control of the Brushless Doubly-Fed Induction Machine**
Guanguan Zhang², Jian Yang², Mei Su², Weiyi Tang², Frede Blaabjerg¹, ¹Aalborg University, Denmark; ²Central South University, China; ²Central South University, China
- 9:10 a.m. – 9:30 a.m.
- T30.3: A New LMS based Algorithm to Suppress Dead-Time Effects in PMSM V/f Drives**
Zhuangyao Tang, Bilal Akin, *University of Texas at Dallas, United States*
- 9:30 a.m. – 9:50 a.m.
- T30.4: Performance Analysis of Grid Connected Induction Motor using Floating H-Bridge Converter**
Reaz Ul Haque², Siyu Leng¹, Ian Smith², John Salmon²,
¹Petroleum Institute, U.A.E.; ²University of Alberta, Canada
- 9:50 a.m. – 10:10 a.m.
- T30.5: Performance Evaluation of Electronic Inductor based Adjustable Speed Drives with Respect to Line Current Interharmonics**
Hamid Soltani¹, Pooya Davari¹, Frede Blaabjerg¹, Firuz Zare², ¹Aalborg University, Denmark; ²University of Queensland, Australia
- 10:40 a.m. – 11:00 a.m.
- T30.6: Novel Frequency Determination Method for Dynamic Magnet Temperature Estimation of a Five Phase PMA-SynRM using Signal Injection Method**
Joseph Herbert, Akm Arafat, Seungdeog Choi, *University of Akron, United States*

11:00 a.m. – 11:20 a.m.

T30.7: Permanent-Magnet-Free-Synchronous Motor with Self-Excited Wound-Field Technique Utilizing Space Harmonics

Masahiro Aoyama², Toshihiko Noguchi¹, ¹Shizuoka University, Japan; ²Suzuki Motor Corporation, Japan

8:30 a.m. – 11:20 a.m.

T31: DC-DC Conversion & Other Transportation Applications

ROOM 24

Track: Transportation Power Electronics

SESSION CHAIRS:

Kent Wanner, *John Deere*

Navid Zargari, *Rockwell Automation*

8:30 a.m. – 8:50 a.m.

T31.1: A Model-based Buck-Type Active Filter using Proportional-Resonant Controller and GaN HEMTs

Allan Taylor², Juncheng Lu², Hua Kevin Bai², Alan Brown¹, Matt McAmmond¹, ¹Hella Corporate Center USA Inc., United States; ²Kettering University, United States

8:50 a.m. – 9:10 a.m.

T31.2: A Low Cost Gate Driver with Dynamic Turn-Off Transient Control for HEV/EV Traction Inverter Application

Yan Zhou, Lihua Chen, Shuitao Yang, Fan Xu, Mohammed Khorshed Alam, *Ford Motor Company, United States*

9:10 a.m. – 9:30 a.m.

T31.3: A DLL/PLL based Multi-Phase Interleaved DC-DC Converter with Digital Off-Time Control and Active Series Balancing for Electric Vehicles

Steven Chung, Shuze Zhao, Olivier Trescases, *University of Toronto, Canada*

9:30 a.m. – 9:50 a.m.

T31.4: Vehicle Side Predictive Power-Flow Control of Bidirectional WPT System for EV Ancillary Services

Ahmed Mohamed, Tarek Youssef, Osama Mohammed, *Florida International University, United States*

9:50 a.m. – 10:10 a.m.

T31.5: An Automatic Battery Equalizer based on Forward and Flyback Conversion for Series-Connected Battery Strings

Yunlong Shang³, Bing Xia¹, Chenghui Zhang², Naxin Cui², Jufeng Yang¹, Chris Mi¹, ¹San Diego State University, United States; ²Shandong University, China; ³Shandong University and San Diego State University, China

10:40 a.m. – 11:00 a.m.

T31.6: Balancing Strategy of Lithium-Ion Batteries based on Change Rate of SOC

Yang Yang, Zhi-Liang Zhang, Dong-Jie Gu, Xiang Cheng, *Nanjing University of Aeronautics and Astronautics, China*

11:00 a.m. – 11:20 a.m.

T31.7: Bi-Directional PSFB DC-DC Converter with Unique PWM Control Schemes and Seamless Mode Transitions using Enhanced Digital Control

Hrishikesh Nene², Toshiyuki Zaitzu¹, ¹Omron Corporation, Japan; ²Texas Instruments Inc., United States

8:30 a.m. – 11:20 a.m.

T32: Power Electronic Applications

ROOM 25

Track: Power Electronics Applications

SESSION CHAIRS:

Mike Seeman, *Eta One Power*

Hanh-Phuc Le, *University of Colorado Boulder*

8:30 a.m. – 8:50 a.m.

T32.1: A Novel Distributed Control Strategy for Modular Multilevel Converters

Shunfeng Yang¹, Yi Tang¹, Michael Zagrodnik², Gupta Amit², Peng Wang¹, ¹Nanyang Technological University, Singapore; ²Rolls-Royce Singapore Pte. Ltd., Singapore

8:50 a.m. – 9:10 a.m.

T32.2: Modulation Strategy for Highly Reliable Cascade H-Bridge Inverter based on Discontinuous PWM

Youngjong Ko¹, Markus Andresen¹, Giampaolo Buticchi¹, June-Seok Lee², Marco Liserre¹, ¹Christian-Albrechts-Universität zu Kiel, Germany; ²Korea Railroad Research Institute, Korea, South

9:10 a.m. – 9:30 a.m.

T32.3: A High Frequency Isolated Resonant Gate Driver for SiC Power MOSFET with Asymmetrical On/Off Voltage

Juzheng Yu², Qinsong Qian², Peng Liu², Weifeng Sun², Shengli Lu², Yangbo Yi¹, ¹Chipown Microelectronics, China; ²Southeast University, China

9:30 a.m. – 9:50 a.m.

T32.4: A Comparative Analysis of Two Approaches in EER based Envelope Tracking Power Supplies

Vladan Lazarevic², Miroslav Vasic², Oscar Garcia², Qian Jin¹, Pedro Alou², Jesús Angel Oliver², José Antonio Cobos², ¹Nanjing University of Aeronautics and Astronautics, China; ²Universidad Politécnica de Madrid, Spain

9:50 a.m. – 10:10 a.m.
T32.5: Equivalency Analysis of Primary Series- and Series-Parallel-Compensated Contactless Resonant Converter
 Wei Gao², Qianhong Chen², Yuchuan Geng², Xiaoyong Ren², Siu-Chung Wong¹, ¹Hong Kong Polytechnic University, China; ²Nanjing University of Aeronautics and Astronautics, China

10:40 a.m. – 11:00 a.m.
T32.6: A Simple and Accurate Efficiency Measurement Method for Power Converters
 Arun Kadavelugu, Harish Suryanarayana, Liming Liu, Zach Pan, Christopher Belcastro, Esa-Kai Paatero, *ABB, United States; ABB, Finland*

11:00 a.m. – 11:20 a.m.
T32.7: Comparative Evaluation of IPT Resonant Circuit Topologies for Wireless Power Supplies of Implantable Mechanical Circulatory Support Systems
 Oliver Knecht, Johann Walter Kolar, *Eidgenössische Technische Hochschule Zürich, Switzerland*

11:30 a.m. – 2:00 p.m.

Dialogue Session

(for detailed information see page 136)

BALLROOM B/C

2:00 p.m. – 5:25 p.m.

IS17: Silicon Carbide Device Applications

ROOM 15/16

SESSION CHAIR:

David Levett, *Infineon Technologies*

2:00 p.m. – 2:25 p.m.
IS17.1: SiC MOSFET Performance in a Bidirectional DC-DC Converter
 Luigi Abbatelli, Vittorio Giuffrida, *STMicroelectronics, Italy*

2:25 p.m. – 2:50 p.m.
IS17.2: Driving Silicon Carbide Power Modules: Efficiency & Reliability
 Nitesh Sathesh, *AgileSwitch, United States*

2:50 p.m. – 3:15 p.m.
IS17.3: New DIPIPM™ Featuring High Threshold Voltage SiC MOSFETs
 Michael Rogers, *Powerex, United States*

3:15 p.m. – 3:40 p.m.
IS17.4: Advanced SiC MOSFET Technologies for Power Circuit Applications
 Rahul Radhakrishnan, Richard Woodin, *Global Power Technologies Group, United States*

4:10 p.m. – 4:35 p.m.
IS17.5: SiC Trench MOSFETs and Intelligent Power Modules (IPMs)
 Kengo Ohmori², Nobuhiro Hase², Yuji Ishimatsu¹, ¹ROHM Co., Ltd., Japan; ²ROHM Semiconductor, United States

4:35 p.m. – 5:00 p.m.
IS17.6: Module and PCB Layout and Design to Optimize Performance of SiC Trench Gate MOSFETs
 David Levett¹, Maximilian Slawinski², ¹Infineon North America, United States; ²Infineon Technologies Germany, Germany

5:00 p.m. – 5:25 p.m.
IS17.7: Strategic Guidance to Accelerate Large-Scale Adoption of Wide Band Gap Power Semiconductors
 Victor Veliadis, *North Carolina State University*

2:00 p.m. – 5:25 p.m.

IS18: Capacitor Technologies for Evolving Power Electronic Applications

ROOM 14

SESSION CHAIRS:

Ralph Kerrigan, *NWL, Inc.*

Fred Weber, *Future Technology Worldwide*

2:00 p.m. – 2:25 p.m.
IS18.1: Dry Film Capacitors for High-Frequency Power Electronics
 Joseph A. Bond, *Electronic Concepts Inc., United States*

2:25 p.m. – 2:50 p.m.
IS18.2: Embedding Aluminum Polymer Elements
 James Lewis, *KEMET Electronics Corporation, United States*

2:50 p.m. – 3:15 p.m.
IS18.3: Metallized Polypropylene Capacitors for Electrification of Larger Vehicles
 Ralph Kerrigan, *NWL, United States*

3:15 p.m. – 3:40 p.m.
IS18.4: Aluminum Electrolytic vs. Polymer – Two Technologies – Various Opportunities
 Pierre Lohrber, *Würth Elektronik eiSos GmbH & Co. KG, Germany*

4:10 p.m. – 4:35 p.m.

IS18.5: Ceramic Capacitors with Base Metal Electrodes for Power Electronics ApplicationsAbhijit Gurav, *KEMET Electronics Corporation, United States*

4:35 p.m. – 5:00 p.m.

IS18.6: Downhole Tools in the Oilfield Services Industry: Transformation to Improve ReliabilityRobert Haywood, *W.L. Gore & Associates, Inc., United States*

5:00 p.m. – 5:25 p.m.

IS18.7: Benefits of Million Times Larger Capacitance in EDLCs: Supercapacitor Assisted Novel Circuit TopologiesNihal Kularatna, *The University of Waikato, New Zealand*

2:00 p.m. – 5:25 p.m.

IS19: Circuits and Applications

ROOM 13

SESSION CHAIR:

Laszlo Balogh, *ON Semiconductor*

2:00 p.m. – 2:25 p.m.

IS19.1: Design of Multi-MHz Series Capacitor Buck Converters used as Voltage RegulatorsPradeep Shenoy, *Texas Instruments, United States*

2:25 p.m. – 2:50 p.m.

IS19.2: How to Choose the Best Pulse Load Surface Mount Resistors?Breno Albuquerque, *Vishay Intertechnology, Inc., United States*

2:50 p.m. – 3:15 p.m.

IS19.3: Wireless Power Class E Amplifier using a eGaN® FET and eGaN Gate Driver ICYuanzhe Zhang, Michael de Rooij, *Efficient Power Conversion*

3:15 p.m. – 3:40 p.m.

IS19.4: Fast Switching Transistors Extend Applications for Wireless Power Across All MarketsLarry Spaziani¹, Paul Mitcheson², Geoff Haynes¹, Sam Aldhafer², George Kkelis², Juan Arteaga², David Yates², ¹*GaN Systems, United Kingdom*; ¹*GaN Systems, Canada*; ²*Imperial College London, United Kingdom*

4:10 p.m. – 4:35 p.m.

IS19.5: Position & Features of Wireless Power Coil MattersRaghu Narayanan, *Würth Elektronik eiSos, United States*

4:35 p.m. – 5:00 p.m.

IS19.6: 7 Design Tips for Selection of Power InductorsAlexander Gerfer, *Würth*

2:00 p.m. – 5:25 p.m.

IS20: Energy Management – Smart Microgrid

ROOM 11

SESSION CHAIRS:

Dustin Becker, *Independent*Ed Herbert, *Independent*

2:00 p.m. – 2:25 p.m.

IS20.1: What is a Micro-Grid?Dusty Becker¹, Alexis Kwasinski², ¹*Power Sources Manufacturers Association, United States*; ²*University of Pittsburgh, United States*

2:25 p.m. – 2:50 p.m.

IS20.2: The Objectives of Energy Management in Micro GridsEric Gallant, *GS Battery Inc., United States*

2:50 p.m. – 3:15 p.m.

IS20.3: Current and Future Applications for the Smart Micro-GridBharat Shah, -, *United States*

3:15 p.m. – 3:40 p.m.

IS20.4: Smart Grid Security: Is Your Smart Grid Secured?Patrick Le Fèvre, *Powerbox, Sweden*

4:10 p.m. – 4:35 p.m.

IS20.5: Micro Grids – Test & Compliance Challenges for Distributed Energy Resource (DER) ManufacturersMike Hawes, *Keysight Technologies, Inc., United States*

4:35 p.m. – 5:00 p.m.

IS20.6: Energy Storage is more than Batteries and CapacitorsJohathan Kimball, *Missouri University of Science and Technology, United States*

5:00 p.m. – 5:25 p.m.

IS20.7: Connecting the Dots: How Inverters Have, Can, and Should Be Used for Ancillary ServicesDonny Zimmanck, *Enphase, United States*

2:00 p.m. – 5:30 p.m.

T33: Active Var & Harmonic Compensation

ROOM 1/2

Track: Power Electronics for Utility Interface

SESSION CHAIRS:

Yunwei Li, *University of Alberta*

Martin Ordóñez, *University of British Columbia*

2:00 p.m. – 2:20 p.m.

T33.1: A Novel LCL-Filtered Single-Phase Half-Bridge Distributed Static Compensator with DC-Link Filter Capacitors and Reduced Passive Component Parameters

Jingyang Fang, Xiaoqiang Li, Yi Tang,
Nanyang Technological University, Singapore

2:20 p.m. – 2:40 p.m.

T33.2: An Improved Method of SAPF for Harmonic Compensation and Resonance Damping with Current Detection of Power Capacitors and Linear/Nonlinear Loads

Yuxiao Zhang¹, Ke Dai¹, Xinwen Chen¹, Yong Kang¹,
Ziwei Dai², ¹*Huazhong University of Science and
Technology, China*; ²*Rensselaer Polytechnic Institute,
United States*

2:40 p.m. – 3:00 p.m.

T33.3: Design of a Center-Point-Clamped AC-AC Converter based Power-Line Conditioner

Pankaj Kumar Bhowmik, Somasundaram Essakiappan,
Madhav Manjrekar, *University of North Carolina at
Charlotte, United States*

3:00 p.m. – 3:20 p.m.

T33.4: Harmonic Analysis and Mitigation of Low-Frequency Switching Voltage Source Inverter with Series LC Filtered VSI

Haofeng Bai, Xiongfei Wang, Poh Chiang Loh, Frede
Blaabjerg, *Aalborg University, Denmark*

3:20 p.m. – 3:40 p.m.

T33.5: A Transformerless Reduced Switch Counts Three-Phase APF-Assisted Smart EV Charger

Wajahat Tareen, Saad Mekhilef, Mutsuo Nakaoka,
*University of Malaya, Pakistan; University of Malaya,
Japan; University of Malaya, Algeria*

4:10 p.m. – 4:30 p.m.

T33.6: A Soft-Switching Dynamic VAR Compensator

Hao Chen, Deepak Divan, *Georgia Institute of
Technology, United States*

4:30 p.m. – 4:50 p.m.

T33.7: Alternative Breed of Three-Phase Four-Wire Shunt Compensators based on Cascaded Transformer with Single DC-Link

Gregory A. de Almeida Carlos¹, Cursino Brandão
Jacobina³, Euzeli C. dos Santos Jr.², ¹*Federal Institute of
Alagoas, Brazil*; ²*Indiana University – Purdue University,
United States*; ³*Universidade Federal de Campina
Grande, Brazil*

4:50 p.m. – 5:10 p.m.

T33.8: Enhanced Fractional-Order Repetitive Control for Three-Phase Active Power Filter

Chuan Xie², Kai Li², Xin Zhao¹, Juan Carlos Vásquez¹,
Josep M. Guerrero¹, ¹*Aalborg University, Denmark*;
²*University of Electronic Science and Technology of
China, China*

5:10 p.m. – 5:30 p.m.

T33.9: DC Link Voltage Balancing Technique for Cascaded H-Bridge Multilevel Converter with Selective Harmonic Current Mitigation-PWM

Amirhossein Moeini, Shuo Wang, *University of Florida,
United States*

2:00 p.m. – 5:30 p.m.

T34: DC-DC Converter Control Methods

ROOM 18/19

Track: DC-DC Converters

SESSION CHAIRS:

Jason Stauth, *Dartmouth*

David Reusch, *Efficient Power Conversion Corporation*

2:00 p.m. – 2:20 p.m.

T34.1: A New Adaptive Output Voltage Controller for Fast Battery Charger

Kai-Hui Chen, Tsong-Juu Liang, Bin-Kun Huang,
National Cheng Kung University, Taiwan

2:20 p.m. – 2:40 p.m.

T34.2: Improved Dynamics in DC-DC Converters for IoT Applications with Repetitive Load Profiles using Self-Calibrated Preemptive Current Control

David King Wai Li², Zhe Gong², Matthias Rose¹, Henk
Jan Bergveld¹, Olivier Trescases², ¹*NXP Semiconductors,
Netherlands*; ²*University of Toronto, Canada*

- 2:40 p.m. – 3:00 p.m.
T34.3: Modulation Strategy for Wide-Range ZVS Operation of a Three-Level Three-Phase Dual Active Bridge DC-DC Converter
 Nico Baars, Jordi Everts, Korneel Wijnands, Elena Lomonova, *Technische Universiteit Eindhoven, Netherlands*
- 3:00 p.m. – 3:20 p.m.
T34.4: Control Methods to Achieve Soft-Transition of Gains for a Variable (n/m)X Converter
 Deepak Gunasekaran¹, Gujing Han², Fang Zheng Peng¹, ¹Michigan State University, United States; ²Wuhan Textile University/Michigan State University, China
- 3:20 p.m. – 3:40 p.m.
T34.5: Unequal PWM Control for a Current-Fed DC-DC Converter for Battery Application
 Deshang Sha, Xiao Wang, Yaxiong Xu, *Beijing Institute of Technology, China*
- 4:10 p.m. – 4:30 p.m.
T34.6: A Family of Series-Resonant DC-DC Converter with Fault-Tolerant Capability
 Levy Costa, Giampaolo Buticchi, Marco Liserre, *Christian-Albrechts-Universität zu Kiel, Germany*
- 4:30 p.m. – 4:50 p.m.
T34.7: Sliding Mode Control of Bi-Directional Dual Active Bridge DC/DC Converters for Battery Energy Storage Systems
 Yoon-Cheul Jeung, Dong-Choon Lee, *Yeungnam University, Korea, South*
- 4:50 p.m. – 5:10 p.m.
T34.8: Design and Evaluation of a Reconfigurable Stacked Active Bridge DC/DC Converter for Efficient Wide Load-Range Operation
 Rose Abramson¹, Samantha Gunter¹, David Otten¹, Khurram K. Afridi², David Perreault¹, ¹Massachusetts Institute of Technology, United States; ²University of Colorado Boulder, United States
- 5:10 p.m. – 5:30 p.m.
T34.9: An Enhanced Adaptive Frequency Locked Loop for Variable Frequency Controls
 Syed Bari, Qiang Li, Fred Lee, *Virginia Polytechnic Institute and State University, United States*

2:00 p.m. – 5:30 p.m.

T35: Control Strategies for Power Converters

ROOM 20

Track: Motor Drives and Inverters

SESSION CHAIRS:

Mahshid Amirabadi, *Northeastern University*

Hui Li, *Florida State University*

- 2:00 p.m. – 2:20 p.m.
T35.1: An Improved Resonant Frequency based LCL Filter Design Method for Grid-Connected Inverters
 Tsai-Fu Wu, Mitradatta Misra, Li-Chiun Lin, Chih-Wei Hsu, *National Tsing Hua University, Taiwan*
- 2:20 p.m. – 2:40 p.m.
T35.2: An Optimized Switching Scheme for DC-Link Current Ripple Reduction in Three-Level T-Type Inverter
 In Jung Won¹, Kyo-Beum Lee¹, Yongsoo Cho², ¹Ajou University, Korea, South; ²LG Electronics, Korea, South
- 2:40 p.m. – 3:00 p.m.
T35.3: Fault-Tolerant Control Strategy for T-Type Three-Level Inverter with Neutral-Point Voltage Balancing
 Jie Chen, Alian Chen, Xiangyang Xing, Chenghui Zhang, *Shandong University, China*
- 3:00 p.m. – 3:20 p.m.
T35.4: Power Decoupling Method for Single-Phase Buck-Boost Inverter with Energy-based Control
 Shuang Xu, Liuchen Chang, Riming Shao, Haider Mohomad A R, *University of New Brunswick, Canada*
- 3:20 p.m. – 3:40 p.m.
T35.5: Integrated Isolated Power Converter using Active Rectification and Closed-Loop CRM Control for Secondary Side Regulation in E-Meters
 Yingping Chen, Xugang Ke, D. Brian Ma, *University of Texas at Dallas, United States*
- 4:10 p.m. – 4:30 p.m.
T35.6: Zero-Voltage-Switching SPWM Method for Three-Phase Four-Wire Inverter
 Ning He, Yingfeng Zhu, Dehong Xu, *Zhejiang University, China*
- 4:30 p.m. – 4:50 p.m.
T35.7: Inductor Feedback ZVT based, Low THD Single Phase Full Bridge Inverter with Hybrid Modulation Technique
 Yinglai Xia, Raja Ayyanar, *Arizona State University, United States*

4:50 p.m. – 5:10 p.m.

- T35.8: Indirect Voltage Control of a Stand-Alone Inverter**
Subhajyoti Mukherjee, Pourya Shamsi, Mehdi Ferdowsi,
*Missouri University of Science and Technology,
United States*

5:10 p.m. – 5:30 p.m.

- T35.9: High-Frequency Pulsating DC-Link Three-Phase Inverter without Electrolytic Capacitor**
Montiê A. Vitorino, Luciano F. S. Alves, Italo Roger F. M. P. da Silva, Maurício B. R. Corrêa, Gutemberg G. dos Santos, *Universidade Federal de Campina Grande, Brazil*

2:00 p.m. – 5:30 p.m.

T36: Converter Modeling & Analysis

ROOM 21

Track: Modeling and Simulation

SESSION CHAIRS:

Chris Bridge, *SIMPLIS Technologies, Inc.*Sheldon Williamson, *University of Ontario Institute of Technology*

2:00 p.m. – 2:20 p.m.

- T36.1: Modeling and Analysis of Droop based Hybrid Control Strategy for Parallel Inverters in Islanded Microgrids**
Shike Wang, Zeng Liu, Jinjun Liu, Baojin Liu, Xin Meng, Ronghui An, *Xi'an Jiaotong University, China*

2:20 p.m. – 2:40 p.m.

- T36.2: Reduced Order Modeling Method of Inverter-based Microgrid for Stability Analysis**
Yelun Peng², Zhikang Shuai², John Shen³, Jun Wang², Chunming Tu², Ying Cheng¹, ¹Hunan Electric Power Maintenance Corporation, China; ²Hunan University, China; ³Illinois Institute of Technology, United States

2:40 p.m. – 3:00 p.m.

- T36.3: An Efficient Impedance Stability Analysis Method for High-Frequency Stability of Hybrid Networking Islanded-Microgrid**
Wei Zhao, Lei Qi, Xiaofeng Sun, Xin Li, *Yanshan University, China*

3:00 p.m. – 3:20 p.m.

- T36.4: Accurate Mathematical Steady-State Models of Arm and Line Harmonic Characteristics for Modular Multilevel Converter**
Fangzhou Zhao, Guochun Xiao, Min Liu, Shuai Su, Daoshu Yang, Fujian Li, *Xi'an Jiaotong University, China*

3:20 p.m. – 3:40 p.m.

- T36.5: A Cascaded Hybrid Phase Shift-PWM and Asymmetric Selective Harmonic Mitigation-PWM Modulation Technique for Grid-Tied Converter to Reduce the Switching Frequency and Meet the Grid Current Harmonic Requirement**
Amirhossein Moeini, Shuo Wang, *University of Florida, United States*

4:10 p.m. – 4:30 p.m.

- T36.6: The Unified Model and Optimal Operation Analysis for a Modular Multilevel Converter**
Lang Huang², Xu Yang², Fan Zhang², Peng Xu², Xin Ma², Tao Liu¹, Xiang Hao¹, Weizeng Liu¹, ¹TBEA Xinjiang Sunoasis Co.,Ltd., China; ²Xi'an Jiaotong University, China

4:30 p.m. – 4:50 p.m.

- T36.7: Simplified Carrier-based Modulation Scheme for Three-Phase Three-Switch Rectifier for DC Fast Charging Applications**
Janamejaya Channegowda, Najath Azeez, Sheldon Williamson, *University of Ontario-Institute of Technology, Canada*

4:50 p.m. – 5:10 p.m.

- T36.8: Dynamical Modeling of Boost-Type Power Factor Corrector with Power Semiconductor Filter for Input Current Shaping**
Chung Pui Tung, Henry Shu-Hung Chung, *City University of Hong Kong, Hong Kong*

5:10 p.m. – 5:30 p.m.

- T36.9: Application-Focused Modeling Procedure for 1.2kV SiC MOSFET's**
Ali Shahabi², Andrew Lemmon², Sujit Banerjee¹, Kevin Matocha¹, ¹Monolith Semiconductor Inc., United States; ²University of Alabama, United States

2:00 p.m. – 5:30 p.m.

T37: Control Applications

ROOM 22

Track: Control

SESSION CHAIRS:

Bilal Akin, *University of Texas at Dallas*Jaber Abu Qahouq, *University of Alabama*

2:00 p.m. – 2:20 p.m.

- T37.1: An Enhanced Control Design Scheme for Multiple-Input Converters based on Time-Sharing Switching**
Ruichen Zhao⁴, Sheng Yang Yu³, Shunlong Xiao², Ke Xu¹, ¹AR Devices, United States; ²Texas A&M University, United States; ³Texas Instruments Inc., United States; ⁴University of Texas at Austin, United States

- 2:20 p.m. – 2:40 p.m.
T37.2: Adaptability of Weighted Average Current Control to the Weak Grid Considering the Effect of Grid-Voltage Feedforward
 Jianjun Sun², Yi Wang², Jinwu Gong², Xiaoming Zha², Shangsheng Li¹, ¹Wuhan Keliyuan Electric Co. Ltd., China; ²Wuhan University, China
- 2:40 p.m. – 3:00 p.m.
T37.3: A Decentralized Control Strategy with DC Fault Handling Capability for Smart DC Buildings
 Amin Ghazanfari, Yasser A.-R. I. Mohamed, *University of Alberta, Canada*
- 3:00 p.m. – 3:20 p.m.
T37.4: State Observer Design for a High Frequency Distributed Power System
 Nikhil Kumar, Debanjan Chatterjee, Ankit Gupta, Sudip. K Mazumder, *University of Illinois Chicago, United States*
- 3:20 p.m. – 3:40 p.m.
T37.5: Containment and Consensus-based Distributed Coordination Control for Voltage Bound and Reactive Power Sharing in AC Microgrid
 Renke Han¹, Lexuan Meng¹, Giancarlo Ferrari Trecate³, Ernane Antônio Alves Coelho², Juan Carlos Vásquez¹, Josep M. Guerrero¹, ¹Aalborg University, Denmark; ²Universidade Federal de Uberlândia, Brazil; ³Università degli Studi di Pavia, Italy
- 4:10 p.m. – 4:30 p.m.
T37.6: A New Active Gate Driver for Improving the Switching Performance of SiC MOSFET
 Alejandro Paredes, Hamidreza Ghorbani, Vicent Sala, Efrén Fernández, Luis Romeral, *Universitat Politècnica de Catalunya, Spain*
- 4:30 p.m. – 4:50 p.m.
T37.7: Optimized dv/dt, di/dt Sensing for a Digitally Controlled Slope Shaping Gate Driver
 Johannes Groeger¹, Alexis Schindler¹, Bernhard Wicht¹, Karl Norling², ¹Hochschule Reutlingen / Robert Bosch GmbH, Germany; ²Infineon Technologies Austria AG, Austria
- 4:50 p.m. – 5:10 p.m.
T37.8: 10ns Variable Current Gate Driver with Control Loop for Optimized Gate Current Timing and Level Control for In-Transition Slope Shaping
 Alexis Schindler¹, Benno Koeppel², Bernhard Wicht¹, Johannes Groeger¹, ¹Hochschule Reutlingen / Robert Bosch GmbH, Germany; ²Infineon Technologies AG, Germany
- 5:10 p.m. – 5:30 p.m.
T37.9: A Method for Online Ageing Detection in SiC MOSFETs
 Feyzullah Erturk, Bilal Akin, *University of Texas at Dallas, United States*

2:00 p.m. – 5:30 p.m.

T38: Grid-Tied Renewable Energy

ROOM 23

Track: Renewable Energy Systems

SESSION CHAIR:

Xiaoqiang Guo, *Yanshan University*

- 2:00 p.m. – 2:20 p.m.
T38.1: Low Voltage Ride-Through of Two-Stage Grid-Connected Photovoltaic Systems through the Inherent Linear Power-Voltage Characteristic
 Yongheng Yang¹, Ariya Sangwongwanich¹, Hongpeng Liu², Frede Blaabjerg¹, ¹Aalborg University, Denmark; ²Harbin Institute of Technology, China
- 2:20 p.m. – 2:40 p.m.
T38.2: Performance Comparison of Single-Phase Transformerless PV Inverter Systems
 Yuba Raj Kafle¹, Graham E. Town¹, Guochun Xiao², Samir Gautam², ¹Macquarie University, Australia; ²Xi'an Jiaotong University, China
- 2:40 p.m. – 3:00 p.m.
T38.3: Analysis of Smart Inverter Functions of Decentralized Grid-Connected AC-Stacked PV Inverter Architecture
 Hamidreza Jafarian², Namwon Kim², Babak Parkhideh², Johan Enslin¹, ¹Clemson University, United States; ²University of North Carolina at Charlotte, United States
- 3:00 p.m. – 3:20 p.m.
T38.4: A Single Phase Transformer-Less String Inverter with Integrated Magnetics and Active Power Decoupling
 Jinia Roy, Raja Ayyanar, *Arizona State University, United States*
- 3:20 p.m. – 3:40 p.m.
T38.5: An Active Capacitor Converter for Improving Robustness of the LCL-Type Grid-Connected Inverter against Grid Impedance Variation
 Qingfeng Zhou¹, Xuehua Wang¹, Xinbo Ruan², Yu Teng¹, Fuxin Liu², ¹Huazhong University of Science and Technology, China; ²Nanjing University of Aeronautics and Astronautics, China
- 4:10 p.m. – 4:30 p.m.
T38.6: Model Predictive Control for Single Phase T-Type Neutral Point Clamping LCL-Filtered Inverters
 Qiang Qian, Shaojun Xie, Jinming Xu, Kunshan Xu, Lin Ji, Binfeng Zhang, *Nanjing University of Aeronautics and Astronautics, China*

4:30 p.m. – 4:50 p.m.
T38.7: Robust Control and Design based on Impedance-based Stability Criterion for Improving Stability and Harmonics Rejection of Inverters in Weak Grid
 Jiming Xu, Bin Feng Zhang, Qiang Qian, Xiaoli Meng, Shaojun Xie, *Nanjing University of Aeronautics and Astronautics, China*

4:50 p.m. – 5:10 p.m.
T38.8: Modeling and Oscillation Analysis of Flexible Multi-Terminal HVDC System
 Yuchao Liu¹, Jian Wu¹, Ali Raza², Dianguo Xu¹,
¹Harbin Institute of Technology, China; ²University of Lahore, Pakistan

5:10 p.m. – 5:30 p.m.
T38.9: Sensorless Active Damping Strategy for Parallel Interleaved Voltage Source Power Converters with LCL Filter
 Javier Samanes, Eugenio Gubía, *Universidad Pública de Navarra, Spain*

2:00 p.m. – 5:30 p.m.

T39: High Power Charging & Control Technology for Vehicular Power Systems

ROOM 24

Track: Transportation Power Electronics

SESSION CHAIRS:

John Vigars, *Allegro Microsystems*

Yingying Kuai, *Caterpillar Inc.*

2:00 p.m. – 2:20 p.m.
T39.1: FEA Assisted Design and Optimization for a Highly Efficient 22 kW Inductive Charging System for Electric Vehicles with Large Air Gap and Output Voltage Variation
 Janosch Marquart, Falk Kyburz, Clemens Mathis, Kurt Schenk, *University of Applied Sciences NTB Buchs, Switzerland*

2:20 p.m. – 2:40 p.m.
T39.2: Design and Control of Inductive Power Transfer System for Electric Vehicles Considering Wide Variation of Output Voltage and Coupling Coefficient
 Minkook Kim², Dong-Myoung Joo², Byoung Kuk Lee², Dong-Gyun Woo¹, ¹Hyundai Motor Company, Korea, South; ²Sungkyunkwan University, Korea, South

2:40 p.m. – 3:00 p.m.
T39.3: Synergetic Optimization of Efficiency and Stray Magnetic Field for Planar Coils in Inductive Power Transfer using Matrix Calculation
 Ming Lu, Khai Ngo, *Virginia Polytechnic Institute and State University, United States*

3:00 p.m. – 3:20 p.m.
T39.4: Frequency-Division Power Sharing and Hierarchical Control Design for DC Shipboard Microgrids with Hybrid Energy Storage Systems
 Zheming Jin, Lexuan Meng, Juan Carlos Vásquez, Josep M. Guerrero, *Aalborg University, Denmark*

3:20 p.m. – 3:40 p.m.
T39.5: A High Efficiency and Compact Inductive Power Transfer System Compatible with Both 3.3kW and 7.7kW Receivers
 Fei Lu⁴, Hua Zhang², Tianze Kan³, Heath Hofmann⁴, Ying Mei¹, Li Cai¹, Chris Mi³, ¹LG Electronics China R&D Center, China; ²Northwestern Polytechnical University, China; ³San Diego State University, United States; ⁴University of Michigan, United States

4:10 p.m. – 4:30 p.m.
T39.6: A >98% Efficient >150 kRPM High-Temperature Liquid-Cooled SiC VFD for Hybrid-Electric Turbochargers
 Troy Beechner, Andrew Carpenter, *Mainstream Engineering, United States*

4:30 p.m. – 4:50 p.m.
T39.7: Half-Bridge Full-Bridge AC-DC Resonant Converter for Bi-Directional EV Charger
 Behnam Kouski, Praveen Jain, Alireza Bakhshai, *Queen's University, Canada*

4:50 p.m. – 5:10 p.m.
T39.8: Bi-Directional On-Board Charger Architecture and Control for Achieving Ultra-High Efficiency with Wide Battery Voltage Range
 Bin Li, Fred C. Lee, Qiang Li, Zhengyang Liu, *Virginia Polytechnic Institute and State University, United States*

5:10 p.m. – 5:30 p.m.
T39.9: Design Method for Low Radiated Emission of 85 kHz Band 44 kW Rapid Charger for Electric Bus
 Masatoshi Suzuki, Kenichirou Ogawa, Fumi Moritsuka, Tetsu Shijo, Hiroaki Ishihara, Yasuhiro Kanekiyo, Koji Ogura, Shuichi Obayashi, Masaaki Ishida, *Toshiba Corporation, Japan*

2:00 p.m. – 5:30 p.m.

T40: Wireless Power Applications

ROOM 25

Track: Power Electronics Applications

SESSION CHAIRS:

Indumini Ranmuthu, *Texas Instruments, Inc.*

David Reusch, *Efficient Power Conversion Corporation*

2:00 p.m. – 2:20 p.m.

T40.1: A Maximum Power Point Tracking Control Scheme for Magnetically Coupled Resonant Wireless Power Transfer System by Cascading SEPIC Converter at the Receiving Side

Yong Yang, Fuxin Liu, Xuling Chen, *Nanjing University of Aeronautics and Astronautics, China*

2:20 p.m. – 2:40 p.m.

T40.2: Optimization of Coils for a Three-Phase Magnetically Coupled Resonant Wireless Power Transfer System Oriented by the Zero-Voltage-Switching Range

Xiewei Fu, Fuxin Liu, Xuling Chen, *Nanjing University of Aeronautics and Astronautics, China*

2:40 p.m. – 3:00 p.m.

T40.3: Modeling and Analysis of Phase-Shift Controlled LCL Resonant Converter in Wireless Charging Systems

Hao Feng, Tao Cai, Shanxu Duan, Xiaoming Zhang, Hongsheng Hu, *Huazhong University of Science and Technology, China*

3:00 p.m. – 3:20 p.m.

T40.4: Analytical Method for Mutual Inductance and Optimum Frequency Calculation in a Series-Series Compensated Inductive Power Transfer System

Yabiao Gao², Zion Tse², Antonio Ginart¹, ¹*Kennesaw State University, United States*; ²*University of Georgia, United States*

3:20 p.m. – 3:40 p.m.

T40.5: High-Q Self-Resonant Structure for Wireless Power Transfer

Aaron Stein, Phyo Aung Kyaw, Charles Sullivan, *Dartmouth College, United States*

4:10 p.m. – 4:30 p.m.

T40.6: Six Degrees of Freedom Wide-Range IPT for Multiple IoT by DQ Rotating Magnetic Field

Jin S. Choi¹, Eun S. Lee¹, Byeung G. Choi¹, Seung H. Han², Chun T. Rim¹, ¹*Korea Advanced Institute of Science and Technology, Korea, South*; ²*Teslas Co., Ltd., Korea, South*

4:30 p.m. – 4:50 p.m.

T40.7: Evaluation of H-Bridge and Half-Bridge Resonant Converters in Capacitive-Coupled Wireless Charging

Weiqiang Chen², Paul Han¹, Ali Bazzi², ¹*Glastonbury High School, United States*; ²*University of Connecticut, United States*

4:50 p.m. – 5:10 p.m.

T40.8: Single-Stage 6.78 MHz Power-Amplifier Design using High-Voltage GaN Power ICs for Wireless Charging Applications

Lingxiao Xue, Jason Zhang, *Navitas Semiconductor, United States*

5:10 p.m. – 5:30 p.m.

T40.9: ZVS-PWM Bridgeless Active Rectifier-Applied GaN-HFET Zero Voltage Soft-Switching Multi-Resonant Converter for Inductive Power Transfers

Tomokazu Mishima, Eitaro Morita, *Kobe University, Japan*



modeling and control of bidirectional converters, in particular the DAB converter is given accordingly. This professional education seminar is suitable for intermediate- or advanced-level researchers, engineers and students in power electronics field, who are interested in reversible DC-DC converters.

S02: Silicon Carbide MOSFETs – A Deep Dive to Accelerate Your Next Power Converter Design Session

Track: SiC

Sujit Banerjee, Kevin Matocha, Xuning Zhang
ROOM 15/16

Silicon Carbide (SiC) MOSFETs improve the power density of various converters by shrinking the size of passive components and improving the power conversion efficiency. This seminar presents an in-depth summary of SiC MOSFETs to accelerate a power converter design with these devices. It will provide a brief survey of devices available today from various suppliers and examples of improvements they enable in power converters. A brief introduction to internal device structure and principle of operation of planar vs trench MOSFETs will be provided to understand the differences. Reliability of SiC MOSFETs will be discussed in detail explaining various stress tests that are done by manufacturers to ensure reliability. Detailed static and dynamic characteristics, thermal performance and device ruggedness will be discussed and related to datasheet parameters. Gate driving techniques are also discussed from the aspects of driving voltage selection, protection design and gate driver EMI noise propagation control. Design examples are presented to verify the benefit of using SiC device in system size/weight/ cost reduction compared with Si devices. A customized in-circuit reliability test for real application emulation will be proposed and its implementation will be explained.

S03 Direct Digital Compensator Design for Power Electronics

Track: Control

Hamish Laird
ROOM 18/19

This presentation, aimed at intermediate to advanced level power engineers, details a simple yet powerful method to design the compensators for digitally controlled power converters. Firstly a library of digital control blocks is presented. These blocks include the integrator, high pass filter, low pass filter and the phase lead and phase lag blocks. Each of the blocks can be implemented as a simple pole zero combination that allows the familiar and powerful frequency domain loop

shaping control design approach to be used with a fully digitally controlled power converters. For each block the form and design equations are presented in detail along with a number of examples. The aim of this approach is to avoid the analogue design translated to digital controller approach. The design of a number of digital compensators of controllers for a variety of different power converters is then presented and the results compared with traditional analogue translation approaches. The library of direct digital controller design building blocks is then detailed along with how and when to use each block.

S04 High Power Si & SiC Module Technology & Application Considerations

Track: Components & Systems

John Donlon, Eric Motto, Toshiya Nakano
ROOM 24/25

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

S05 EMI Causes, Measurement, and Reduction Techniques for Switch-Mode Power Converters

Track: EMI & Reliability

Michael Schutten
ROOM 20/21

This seminar provides a comprehensive introduction for engineers desiring a fundamental understanding of electromagnetic interference (EMI) issues associated with switch-mode power converters, and also for experienced engineers eager

for a detailed understanding of EMI noise creation mechanisms and design fixes for power converters. The seminar begins with an introduction to the fundamental EMI coupling mechanisms and their electrical properties. The concept of impedance mismatch is presented as a basis to understand filtering theory. Differential-mode (DM) and common mode (CM) separation and filtering approaches are derived, with measurement and separation techniques presented. DM & CM measurement and reduction techniques are presented using an experimental fly-back converter example. Converter layout techniques and principles are derived, and experimentally confirmed. The seminar presents how DM and CM currents are created in power converters, with layout and construction techniques to minimize the need for costly filtering. Several practical EMI reduction techniques and construction methods are provided throughout the seminar.

S06 Practical Design of Wireless Electric Vehicles: Dynamic & Stationary Charging Technologies

Track: Wireless Charging & Magnetics

Chun T. Rim
ROOM 22/23

The analysis and design of wireless charging electric vehicles (WEVs) is extensively covered in this seminar. First, dynamic charging of roadway-powered electric vehicles (RPEVs) is widely explored. The research and development heritage of RPEVs is fully reviewed, including on-line electric vehicles (OLEVs), firstly commercialized in 2013. Practical design issues such as coil structure, resonant circuits, lateral tolerance, efficiency, EMF cancel, and commercialization issues are discussed in detail. Second, stationary charging of plug-in hybrid EVs (PHEVs) and battery EVs (BEVs) is explained. Innovative design examples for large tolerances and low EMF are also provided in detail. Magnetic mirror models (IM3) and gyrator models are introduced for the advanced audiences. Intended audiences include entry and intermediate levels.

Sunday, March 26

2:30 p.m. – 6:00 p.m.

S07A Comprehensive Introduction to Implementing a Fully Digital LLC Resonant Converter

Track: Design

Joel Steenis, Alex Dumais
ROOM 13/14

The purpose of this presentation is to provide an in-depth introduction to an LLC resonant converter using a digital implementation. The presenters will cover all the necessary steps to develop the control system for a fully digital LLC converter operating in the inductive region. The presentation will start by introducing the concept of an LLC and its theory of operation, show a design methodology based on the fundamental harmonic analysis (FHA), show three methods of deriving a small signal model – the envelope model, the extended describing function (EDF), and system identification (system ID), show how controller design for the LLC differs from controller design for most DC-to-DC converters, then conclude with a thorough discussion of the digital implementation. 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 an adaptive algorithm that facilitates uniform loop gain over the operating region. Attendees who do not have experience with digital power or designing resonant converters should be able to leverage this material to develop their own digital LLC platform with a reduced time to market.

S08 Practical Implementation of SiC Power Devices on Using Best Practices with a Focus on Electrification of Motor Vehicles

Track: SiC

Edgar Ayerbe, Adam Barkley
ROOM 15/16

This PES focuses on practical implementation of SiC power device technology utilizing the latest techniques and best practices for high performance and reliable power designs. The seminar will use the electrification of transportation as a practical example of various topologies commonly being used in designs today. The seminar will highlight three specific examples where SiC devices provide system-level advantages: (1) 20kW 380/480V AC/DC PFC circuit; (2) 20kW isolated DC/DC LLC circuit; (3) 480V motor drive. The seminar is

intended for intermediate audiences with a good understanding of power electronics wanting to find out if SiC MOSFET technology could help address their design challenges. The seminar covers the following topics: 1) Difference between SiC MOSFET, Si MOSFET and highspeed IGBT: how to down-select amongst them for a give application. 2) High frequency power electronics system with SiC MOSFET: advantages and challenges. 3) SiC MOSFET: What should you know about them (types of SiC MOSFETs, gate drive, protections, reliability: gate oxide, short-circuit, body diode, V_{th} shift, power cycle, thermal shock, cost: present and future). 4) Circuit design aspects to consider when using SiC MOSFET at high frequency (dv/dt and di/dt control implications, protections, EMI, PCB design, magnetic component and how to achieve cost reductions). 5) Use of composite SiC MOSFET reliability data to construct a fully predictive lifetime model for known wear-out mechanisms. Lastly, the highlighted topics will be reviewed once again when discussing the design and testing of following three hardware prototypes: a) 20hp 380/480V motor drive, b) 20kW 380/480V PFC, and c) 20kW isolated DC/DC. In the end, the attendee will gain practical knowledge of SiC MOSFET technology and how it can be used in three different EV relevant hardware examples.

S09 Small-Signal Stability and Subsystem Interactions in Distributed Power Systems with Multiple Converters (I): DC Systems and 1-Phase AC Systems

Track: Control

Dushan Borojevich, Jinjun Liu, Paolo Mattavelli
ROOM 18/19

One of the major developing trends of distributed power systems, no matter in stand-alone form or in public grid form, is that more and more electronic power converters are adopted for the purpose of power conditioning or performance improving. This will lead to quite a few technical challenges, one of them being the system small-signal stability issue, which is caused by the dynamic interactions among subsystems/converters and is quite different from the stability issue with conventional power grids. A review of existing analytical approaches to deal with this issue is presented, including traditional power system approach and some power electronics background approaches proposed recently. It turns out that the impedance-based approach is an appropriate analytical approach for such stability issue. An in-depth review of existing and recent work of impedance-based approach for DC systems is then delivered. Topics that will be covered include impedance-based stability criterion for 2 cascaded subsystems and corresponding load specification and stability monitoring methods, stability criteria for 2 parallel subsystems, stability criteria for multiple subsystems, and how to handle situa-

tions when interactions through communications also exist. Finally how these methods and techniques can be extended to 1-phase AC systems will be introduced in detail too. Level of intended audience shall be intermediate or above.

S10 Advanced Packaging Technologies for Fully Exploiting Attributes of WBG Power Electronics

Track: Components & Systems

Zhenxian Liang
ROOM 24/25

The wide bandgap (WBG) power semiconductors, such as SiC and GaN, can process electric power with smaller die area and less power losses. In turn, it will ultimately lead to superior power conversion with higher efficiency, compact volume and low cost. However, the packages of these devices bring parasitic effects to limit their superior power switching features – high current density, high switching speed and high operation temperature. These limitations can be characterized by a set of technical metrics such as electric parasitic impedance, thermal impedance, thermo-mechanical properties, etc. A set of innovative techniques in SiC power module packaging, focused on improvements of these technical parameters, have been developed to promote successfully application of the WBG power semiconductors. The technical advances include integrating gate driver, integrated direct cooling, threedimensional (3-D) planar interconnection, and integrated, double sided direct cooling. The further integration of these features into one packaging process improves the manufacturability of highly integrated power electronics systems. The comprehensive improvements in module's electrical, thermal performance and manufacturability help utilize fully the attributes provided exclusively by the WBG power semiconductors. The technical advancements lead to cost-effective, high efficiency, high power density in power conversion systems. This seminar is aimed at providing the fundamental and specific knowledge for professionals to design, manufacture, use, apply, or specify advanced WBG power electronics modules and systems.

S11 Introduction to EMC

Track: EMI & Reliability

Darryl Ray
ROOM 20/21

This seminar provides an introduction to EMC engineering for electronic equipment. Compliance to the relevant EMC regulations is required to sell electronic equipment in many geographies. There are many subtleties dealing with EMC that can make a significant difference in the electromagnetic

emissions and immunity performance of electronic equipment. EMC design is often considered as magic. This course however will aim to demystify the magic and present a number of proven design methods that will enable a product to achieve compliance to the relevant standards and minimize strange and often unreproducible problems experienced in the field. The seminar will provide an overview of the various EMC standards, design basics, testing issues and troubleshooting.

S12 High-Frequency Magnetics Design, Measurement and Modeling

Track: Wireless Charging & Magnetics

Ray Ridley

ROOM 22/23

This seminar will present an in-depth discussion of the issues involved in designing magnetics components for high-frequency power supplies. It will cover both fundamentals and advanced concepts of rugged transformer and inductor design, highlighting the areas that need work if the industry is to keep up with semiconductor advances. Topics will include core loss, winding loss, saturation, frequency response measurements, circuit modeling, leakage inductance, winding layout arrangements, and materials. The usually-difficult topic of proximity loss will be greatly simplified with some new circuit models that make results accessible to even beginning designers. The course is recommended to all levels of engineers who work with switching power supplies at power levels from less than 1 W to 100 kW.

Monday, March 27

8:30 a.m. – 12:00 p.m.

S13 Input Filter Interactions with Switching Regulators

Track: Design

Christophe Basso

ROOM 13/14

ElectroMagnetic Interference (EMI) filters are an essential part of a power supply structure. Designed to filter out switching noise and build an isolation barrier between the noisy converter and the power source, its impact on the converter's performance is often overlooked. If naturally-present damping elements often hide potential problems, the interaction of the filter and the switching converter is a reality which shall be considered at the first stage of power supply design. Failure to understand and counteract filter effects at an early design stage can affect the converter overall performance and stability in particular. This seminar will start by explaining why teaming an inductive filter with a switching converter can be a problem and how some of the closed-loop parameters are impacted. Fast Analytical Circuits Techniques will be applied along the seminar and briefly introduced as one of the tools used by the author. Optimum damping techniques will then be explained in a second part, exemplified with a design example. Finally, practical experiments will show damping at work on a typical case. Using mathematical analysis and different tools such as SPICE and Mathcad®, the author maintains a permanent link between theory and practical reality. Balancing analytical aspects and real case examples, the seminar targets an audience with an intermediate background in the presented subject.

S14 SiC Power Devices and MV Power Converter Application

Track: SiC

Subhashish Bhattacharya, Victor Veliadis

ROOM 15/16

The tutorial will stress in-depth the advantages of SiC over other power electronic materials, and will introduce SiC devices currently developed for power applications. ESD, high-voltage testing, and packaging considerations will be outlined. SiC JFETs, MOSFETs, BJTs, IGBTs, Thyristors, and Schottky, Junction Barrier Schottky, and PiN diodes will be discussed with an emphasis on their performance advantages over those of their Si counterparts. Aspects of device fabrication will be taught with an emphasis on the processes that do not carry over from the mature Si manufacturing world and are thus tailored to SiC. Device reliability will be reported through



exemplary hard switching and unclamped inductive load results. Prototype SiC-based power electronics systems will be shown and their numerous advantages will be articulated. The opportunities for HV SiC devices for MV Power Converters and utility applications and the challenges to apply these HV SiC devices successfully will be presented in-depth with SiC device voltage ranges from 1200 V to 1700 V MOSFETs, and HV 10 kV – 15 kV MOSFETs, JBS diodes, and 15 kV SiC IGBTs. The potential and challenges of the HV 10-15 kV devices to enable MV power conversion systems, including MV motor drives, FACTS and MVDC grids will be explored. Challenges in adopting these HV SiC devices for MV power conversion in terms of magnetics, capacitors, and insulation materials will be discussed. This tutorial is intended for entry level and intermediate audiences.

S15 Current Mode Control and Modeling- 3 Decades of Progress

Track: Control

Fred Lee
ROOM 18/19

The presentation starts with a review of the history of development of current mode control and various modeling attempts. The topic of modeling for current mode control, although seemingly settled, still left many unsolved issues. In light of recent surge of interest in constant on-time variable frequency control for improved light load efficiency and V2 control for its fast transients and simplicity, the existing modeling tools were not quite suitable for these popular controls. The desire for more unified approach of modeling has motivated Dr. Jian Li to attack this difficult modeling task with an entirely different approach, i.e. from a continuous time framework using the extended describing function techniques. The developed modeling is accurate beyond switching frequency and is applicable to constant frequency peak current/valley mode control, average current mode, charge control as well as variable frequency constant Ton and Constant Toff control. Furthermore a reduced-order model was presented with pin-point accuracy at half of the switching frequency. The model was further simplified by Dr. Ying Yi Yang into a unified equivalent circuit model, namely, “three-terminal current-mode control cell” which can be applied any converter topologies employing a current mode control. More recently, his modeling approach has been further extended by Dr. Shuilin Tien to V2 control employing Constant Ton and Constant frequency controls.

S16 Google Little Box Reloaded – How to Achieve 200 W/in³ and Beyond

Track: Components & Systems

Johann W. Kolar, Dominik Neumayr, Dominik Bortis
ROOM 24/25

The GOOGLE Little Box Challenge was aiming to build the worldwide smallest air-cooled 2kVA DC/AC converter, created a huge interest in the power electronics community, and resulted in a massive performance improvement compared to state-of-the-art technology systems. This seminar explains the approach selected by the authors along with a detailed discussion and comparative evaluation of the concepts presented by other finalists. First, the target specifications of the challenge are explained and basic options available for the realization of the main power circuit topology, the buffering of the power pulsation with twice the output frequency, the EMI filter and the modulation and control of the converter stages are discussed. Subsequently, GaN and SiC power semiconductor technology are evaluated for the power switches including hints for accurate soft-switching loss measurements. Furthermore, the realization of high-frequency inductors with multi-airgap magnetic cores and low high-frequency loss winding arrangements is detailed. In this context also the increase of the core losses by mechanical stress resulting from the cutting process is discussed. In a next step, the mechanical designs of several finalists are presented including details of the heat management. Subsequently, the corresponding power density and efficiency figures are comparatively evaluated. Finally, based on a multi-objective optimization “absolute” performance barriers as e.g. resulting for ideal switches are analyzed and technological requirements concerning active and passive components as well as cooling and integration technologies mandatory for enabling further performance improvements are identified. The seminar would like to convey the main results and findings of the GOOGLE Little Box Challenge and is tailored to serve the interests of a broad audience with academic or industrial background.

S17 Design for Reliability: from Components to Systems

Track: EMI & Reliability

Francesco Iannuzzo, Frede Blaabjerg, Huai Wang
ROOM 20/21

The aim of this tutorial is to give a framework of the design for reliability process of power electronic systems, together with 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 semi-

conductor modules and capacitors used in power electronic converters, testing of power components, and the specific design for reliability procedure for power electronic systems. A case study on the design for reliability of a fuel cell inverter is also presented. Finally, cutting edge active thermal control and condition monitoring principles of power converters will conclude the tutorial. The approaches presented 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. Researchers and engineers who seek the basic knowledge for entering in this field, ranging from component level to system level, from physic of failure to statistical analysis are the main target audience of the seminar. Prerequisites are: power electronics basics and statistics basics.



S18 High Frequency Planar Magnetics for Power Conversion

Track: Wireless Charging & Magnetics

Ziwei Ouyang, William Gerard Hurley
ROOM 22/23

Today, high efficiency and high power density converters are fundamental to the continued profitable growth of the telecommunications, automotive, aerospace and data processing industries. High-frequency operation can lead to a reduction in magnetics size and an increase in power density. The momentum towards high efficiency, high frequency, and high power density in power supplies limits wide use of conventional wire-wound magnetic component structures. Planar magnetics fabrication and assembly processes have several advantages over conventional magnetics:

- Low profile — planar magnetic components has a lower profile than their wire wound counterparts due to the fabrication process;
- Automation — based on advanced computer aided manufacturing techniques;
- High power densities — planar inductors and transformers are spread out and this gives them a bigger surface-to-volume ratio than conventional components, this enhances the thermal performance;
- Predictable parasitics — with planar magnetics, the windings are precise and consistent, yielding magnetic designs with highly controllable and predictable characteristic parameters.

Planar magnetic components take advantage of microelectronic processing. In general the number of turns in planar device tends to be limited by the manufacturing process. The low profile tends to lead to a larger footprint compared with its conventional counterpart. Planar magnetic components are particularly suited to wireless power transfer because of their low profile. In multilayer devices the interlayer capacitance introduces resonance at high frequencies. This seminar covers the basic analytical model of planar structures based on impedance method, and also includes several design considerations such as high frequency winding resistance, high frequency leakage inductance, winding capacitance and magnetic core loss etc.

Monday, March 27

1:30 p.m. – 5:00 p.m.

BALLROOM B/C

This year's plenary provides an exciting look at both where power electronics is headed as well as where it has been from a distinguished line up of presenters. Ahmad Bahai's presentation discusses how today's power management solutions offer powerful new optimization tools for the power system designer, including an increased focus on system flexibility. He continues with examination of the state of semiconductor power management technology and provides some predictions for how the world of power electronics may evolve over the coming years. Conor Quinn continues this view toward the future with his presentation of the 2017 PSMA Power Technology Roadmap. Conor discusses both predictions at component and topology level for power conversion and driving trends and metrics within power applications. Vatché Voperian takes us back to the roots of modern power electronics with his presentation on the historical development of the PWM switch model. He presents the foundational work that preceded its discovery, using some of the original artifacts, and the advances in control and modelling that followed.

After Intermission, Shuai Jiang and Xin Li present the 48V data center power architecture that Google has deployed to address efficiency and scalability for this application where the demand for data is driving power needs ever higher. In addition to the 48V-to-POL technology underlying this approach, the presentation covers other key system level considerations and areas for future exploration. Hamish Laird's presentation looks at how the focus on minimizing the financial cost of power loss in high power converters is now migrating to high volume, low power applications. He examines the implication of this shift on how the gap between the design and control of high and low power converters is shrinking. The plenary session concludes with Ljubisa Stevanovic's presentation of advances in the reliability and power ratings of SiC devices over the last few years. He shows how these devices have enabled power modules capable of deployment in MW scale solar and PV applications, and discusses the financial benefits derived from the higher efficiency they allow.

Power Semiconductor Technology – Flexibility for Tomorrow's Solution

1:30 p.m. – 2:00 p.m.



SPEAKER:

Ahmad Bahai

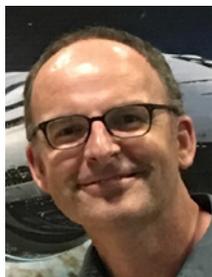
TI, Chief Technologist and Sr. VP

The demand for smart, high-efficiency power management is outpacing the average growth rate of the semiconductor industry. Advanced power switching technologies, new power semiconductor materials, power monitoring and control technologies, and new system adaptive power optimization techniques are providing system designers with new and powerful tools to optimize power system solutions. Of course, solution size, efficiency, and cost are well-established metrics for power technology advances and trends for these metrics are discussed. System flexibility, also an important consideration, is more difficult to quantify in general. However, we see new technologies emerging now in which flexibility is a key system goal. USB Power Delivery (USB-PD), for example, provides system-level power control capability that allows a great deal of flexibility for interconnected systems to negotiate power flow based on available power providers and the needs of connected power consumers. And as system power availability and power needs change over time, USB-PD allows system power flow to be optimized on the fly. Hence, we see new capabilities emerging in which power may be utilized more flexibly and effectively for specific system use cases and configurations. This talk examines the state of semiconductor power technology from multiple perspectives, including materials, devices, and systems; and provides some predictions for how the world of power electronics may evolve over the coming years.

APEC[®]
2017

Empowering the Electronics Industry: A Power Technology Roadmap

2:00 p.m. – 2:30 p.m.



SPEAKER:

Conor Quinn

*Artesyn Embedded Technologies &
PSMA, PSMA Power Technology
Roadmap Co-Chair*

Every 2 years, the Power Sources Manufacturers Association (PSMA) publishes its Power Technology Roadmap. This release of this cycle's roadmap coincides with APEC 2017. The theme for this version is "Empowering the Electronics Industry" and the presentation will focus on newer and emerging roles for power electronics circuits and technologies. This is a time when our industry has an opportunity to showcase the technologies behind the curtain. The growth of the alternative energy industry, the internet as it is used today, the proliferation of mobile devices and many other technologies wouldn't be possible without continued advances in power conversion technology. This presentation will highlight the technological advances in power electronics that empower these applications and set the stage for more advances to come.

A Historical Perspective on the Development of the PWM Switch Model

2:30 p.m. – 3:00 p.m.



SPEAKER:

Vatché Vorperian

*Jet Propulsion Laboratory,
Principal Engineer & Fellow
of the IEEE*

In this presentation, I will talk about the earliest instances in the published literature that I am aware of, which include the works of Cuk, Landsman,

Meares and Tymersky among others, of the appearance of a sub-circuit of a dc-to-dc converter as a building block of dc-to-dc converters and its connection to the conversion ratio of that converter. I will then present the subsequent emergence of the PWM switch as the smallest sub-circuit of a converter with invariant structural and electrical characteristics which bestow it with an invariant equivalent circuit model. To render the model of the PWM switch easily accessible to all those studying power electronics, from the beginning it was promoted by pointing out its similarity to the model of the transistor and its utilization in amplifier circuit analysis since both, the PWM switch and the transistor, are three-terminal

non-linear devices. From a pedagogical point of view, the idea has caught on well and today the model of the PWM switch is being taught at Universities and to industry. Some examples of the application of the PWM switch model to the analysis of modern converters such the coupled SEPIC and Cuk converters will be presented.

Break

3:00 p.m. – 3:30 p.m.

Google 48V Power Architecture

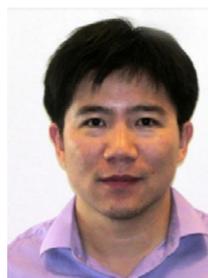
3:30 p.m. – 4:00 p.m.



SPEAKERS:

Shuai Jiang

*Google, Sr. DC-DC Power Architect
for Data Centers*



Xin Li

*Google, Technical Lead Manager
for Power Team*

Global data center/cloud power market is exploding at over 10 percent annually to an estimation of 2 trillion kWh by 2020. Efficient power delivery from utility to the point of load could result in an astronomical amount of energy and expenditure savings. Today's datacenter payloads generally use traditional 12V for sub-rack power distributions, but the exponentially increased distribution losses jeopardizes efficiency and scalability as power grows rapidly. Google has deployed a compelling 48V rack ecosystem in its data centers for several years, which promised to provide better efficiency, performance and scalability for more power-hungry computing systems enabled by high-end CPUs, accelerators and ASICs. The 48V to point-of-load conversion technology is one of the key enablers. Beyond the fundamental goals of higher efficiency, higher density and faster response for voltage regulator designs, some other key metrics should also be considered; such as the electrical and physical interaction between the voltage regulator and the motherboard system, implication of integration and power integrity, criticalness of design scalability, cost and ease of design, are some other essential elements driving the directions of technology evolution as well. In this presentation, we will explore together with you the 48V system architectures, 48V-to-PoL conversion technologies and challenges, and future exploration opportunities.

The Gap Between High Power and Low Power Converters And How it is Closing

4:00 p.m. – 4:30 p.m.



SPEAKER:

Hamish Laird

ELMG Digital Power, Inc., CTO

Large power converters have in the past had different constraints to small power converters. The first is that large converters have a lower surface area to volume ratio. The second is that capitalized cost of the lifetime

power losses dominates the total cost of ownership. The third constraint is that the large converter control is necessarily constrained by the grid that it is connected to. Looking at the differences between the high power area and low power area there are now big leaps in efficiency that have brought the two together in terms of the problems that are being encountered. There are now grid or other converter interaction issues, low control margin converters and large converter behavior change with operating point at power levels as low as 500W. In order to manage these issues, techniques from the high power converter space are now useful and necessary. The presentation will explore the gap between high power and low power and the techniques that are useful to fill the gap.



From SiC MOSFET Devices to MW-scale Power Converters

4:30 p.m. – 5:00 p.m.



SPEAKER:

Ljubisa Stevanovic

GE Global Research, CTO Silicon Carbide Works

This presentation will provide an overview of GE's vertically integrated activities from SiC devices and modules to converters for MW-scale industrial applications. GE has developed

a new generation of high performance SiC MOSFETs with voltage ratings from 1.2 to 3.3kV and current ratings up to 100A per die. Significant progress has been made towards the goal of demonstrating the MOSFET reliability comparable to mature silicon IGBTs. Extensive stress testing has also mapped out the device's safe operating area, including avalanche capability, short circuit ruggedness, body diode surge and stability, and terrestrial cosmic radiation hardness. In addition, a portfolio of low inductance half-bridge modules has been developed and optimized for fast-switching SiC MOSFETs. By taking advantage of the MOSFET's body diode, the modules do not require anti-parallel diodes, saving cost and floor-space for additional MOSFETs. When compared to silicon modules with the same mechanical footprint and voltage ratings (e.g. 1.7kV), the SiC modules deliver twice as much current (500Arms), even when operating at three times higher switching frequency (7.5kHz). Such performance advantage is also due in part to robust gate drivers with fast control and protection features. These efforts have culminated with the launch of the World's first MW-scale all-SiC product at the Solar Power International tradeshow in September 2016. The 2.5MW utility scale SiC PV Inverter offers the best in class 99.0% EU weighted efficiency, delivering between 1 and 2% more energy to customers. The single-stage inverter features a simple two-level topology switching at 8kHz and offers higher reliability due to reduced parts count.

Tuesday, March 28

5:00 p.m. – 6:00 p.m.

R01: Power Electronic Topologies – Do We Need More or Any Benefit to New Ones?

ROOM 15/16

MODERATOR:

Kevin Parmenter, *Excelsys*

SPEAKERS:

- > Babak Fahimi, *University of Texas at Dallas*
- > Diarmuid Hogan, *Excelsys*
- > Dan Jitaru, *Rompower*
- > Johan Kolar, *ETH Zurich*
- > Dragan Maksimovic, *University of Colorado*
- > Bob Mammano, *Texas Instruments Retiree*
- > Ray Ridley, *Ridley Engineering*

While the signal level electronics experienced substantial size reduction and compactness, power electronics field has not reached to the same level of improvements just yet. New power electronics architectures are usually proposed in order to reduce the cost, weight, and volume of the power electronic converters while adding more functionalities and improving efficiency. This rap session will discuss the recent power electronics architecture inventions and the future possibilities and limitations that our industry may experience. Although some opponents express that new inventions in power electronics topologies can never end, some defenders argue that we are at the edge of physical limitations in power electronics innovations and new topologies may not be the key for improvement. This panel will also provide an insight if we need more topologies or if we need to invest more on the power electronics materials, packaging, thermal management, etc. in order to achieve the ideal power converter.

R02: Do We Need to Progress Towards GHz Switching in High Power Systems and Applications?

ROOM 18/19

MODERATOR:

Alix Paultre, *Power Systems Design Editorial Director*

SPEAKERS:

- > David Levett, *Infineon*
- > Eric R. Motto, *Mitsubishi/Powerex*
- > Ty McNutt, *CREE/Wolfspeed*
- > Gene Sheridan, *Navitas Semiconductor*

High frequency switching has always been attractive since it can reduce the volume and weight of the power electronic converter components. Particularly, magnetic components such as inductors and high-frequency isolation transformers and filter sizes can be significantly reduced. However, for the mainstream power converter applications, there is an inverse relationship between the switching frequency capability and the power rating. This rap session will discuss if we need to progress towards GHz switching frequencies or if there are physical limitations that would prevent high-frequency devices being ideal candidates for high power applications.



Dialogue Session

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

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

Thursday, March 24

11:30 a.m. – 2:00 p.m.

BALLROOM B/C

D01: AC-DC Converters II

Track: AC-DC Converters

CHAIR:

Haihua Zhou, *Infineon Technologies*

D01.1: Current Sensorless Control for Dual-Boost Full-Bridge PFC Converter

Hung-Chi Chen, Che-Yu Lu, Chien-Fu Chen,
National Chiao Tung University, Taiwan

D01.2: Novel Voltage-Mode Control for DCM/CCM Boundary PFC Boost Converters Achieves High Efficiency and Low THD

Giovanni Gritti, Claudio Adragna, *STMicrolabs, Italy*

D01.3: Analysis and Design of a Single-Stage Buck-Type AC-DC Adaptor

Ying-Ting Huang², Chia-Hao Li², Yaow-Ming Chen²,
Yung-Ping Tong¹, *Lite-On Technology Corporation, Taiwan*; ²*National Taiwan University, Taiwan*

D01.4: Improved Hybrid Rectifier for 1-MHz LLC-based Universal AC-DC Adaptor

Yang Chen, Hongliang Wang, Yan-Fei Liu,
Queen's University, Canada

D01.5: A Special Application Criterion of Nine-Switch Converter with Improved Thermal Performance

Kawsar Ali, Pritam Das, Sanjib Kumar Panda, *National University of Singapore, Singapore*

D01.6: Implementing Low Power Consumption in Standby Mode in the Case of Power Supplies with Power Factor Correction

Kevin Martín², Pablo F. Miaja³, Diego G. Lamar², Javier Sebastián², Santiago Álvarez¹, *¹Santiago Engineering Design Ltd., Hong Kong; ²Universidad de Oviedo, Spain; ³University of Oviedo, Spain*

D01.7: Real DC Capacitor-Less Active Capacitors

Yunting Liu, Fang Zheng Peng, *Michigan State University, United States*

D01.8: Design, Implementation and Analysis of an Advanced Digital Controller for Active Virtual Ground-Bridgeless PFC

Ken King Man Siu³, Yuanbin He², Carl Ngai Man Ho³, Henry Shu-Hung Chung², River Tin-Ho Li¹, *¹ABB, China; ²City University of Hong Kong, Hong Kong; ³University of Manitoba, Canada*

D01.9: Isolated Matrix Current Source Rectifier in Discontinuous Conduction Mode

Dongdong Lan, Pritam Das, *National University of Singapore, Singapore*

D01.10: Design and Implementation of a 1.3 kW, 7-Level Flying Capacitor Multilevel AC-DC Converter with Power Factor Correction

Intae Moon, Carl Haken, Erik Saathoff, Ethan Bian, Yutian Lei, Shibin Qin, Derek Chou, Steven Sedig, Won Ho Chung, Robert C.N. Pilawa-Podgurski, *University of Illinois Urbana-Champaign, United States*

D01.11: An Isolated, Bridgeless, Quasi-Resonant ZVS-Switching, Buck-Boost Single-Stage AC-DC Converter with Power Factor Correction (PFC)

Markus Scherbaum¹, Manfred Reddig¹, Ralph Kennel³, Manfred Schlenk², *¹Hochschule Augsburg, Germany; ²Infineon Technologies AG, Germany; ³Technische Universität München, Germany*

D01.12: A Control Architecture for Low Current Distortion in Bridgeless Boost Power Factor Correction Rectifiers

Usama Anwar, Robert Erickson, Dragan Maksimović, Khurram K. Afridi, *University of Colorado Boulder, United States*

D02: Miscellaneous Topics in DC-DC Converters I

Track: DC-DC Converters

CHAIR:

Liming Liu, *ABB USCRC*

D02.1: Multilevel Modular Switched-Capacitor Resonant Converter with Voltage Regulation

Yanchao Li, Boris Curuvija, Xiaofeng Lyu, Dong Cao, *North Dakota State University, United States*

D02.2: Design and Magnetics Optimization of LLC Resonant Converter with GaN

Runruo Chen, Paul Brohlin, Don Dapkus, *Texas Instruments Inc., United States*

D02.3: Asymmetrical (n/m)X DC-DC Converter for Finer Voltage Regulation

Gujing Han², Deepak Gunasekaran¹, Liang Qin³, Fang Zheng Peng¹, ¹*Michigan State University, United States*; ²*Wuhan Textile University/Michigan State University, China*; ³*Wuhan University, China*

D02.4: A Bidirectional Push-Pull DC-DC Converter with PWM Plus Phase-Shift Control Strategy

Shouxiang Li², Keyue Smedley², Kang Xiangli¹, ¹*Northwestern Polytechnical University, China*; ²*University of California, Irvine, United States*

D02.5: High Step-Up Isolated DC-DC Converter with Multi-Cell Diode-Capacitor Network

Yan Zhang², Xinying Li², Zhuo Dong², Yan-Fei Liu¹, Jinjun Liu², ¹*Queen's University, Canada*; ²*Xi'an Jiaotong University, China*

D02.6: A Wire-Embedded Converter Used for Wearable Devices

Mofan Tian¹, Naizeng Wang¹, Kangping Wang¹, Haiyang Jia¹, Zhenwei Li¹, Xu Yang¹, Laili Wang², ¹*Xi'an Jiaotong University, China*; ²*Xi'an Jiaotong University / Sumida Corporation, China*

D02.7: Quantization Mechanisms in Digital LLC Converters for Battery Charging Applications

Ya-Qi Wu¹, Zhi-Liang Zhang¹, Han-Dong Gui², Dong-Jie Gu¹, ¹*Nanjing University of Aeronautics and Astronautics, China*; ²*University of Tennessee, United States*

D02.8: SiC-MOSFET Composite Boost Converter with 22 kW/L Power Density for Electric Vehicle Application

Hyeokjin Kim¹, Hua Chen¹, Dragan Maksimovic¹, Robert Erickson¹, Zach Cole², Brandon Passmore², Kraig Olejniczak², ¹*University of Colorado Boulder, United States*; ²*WolfSpeed / Cree, United States*

D02.9: A Low-Volume Multi-Phase Interleaved DC-DC Converter for High Step-Down Applications with Auto-Balancing of Phase Currents

Samuel Da Silva Carvalho, S. M. Ahsanuzzaman, Aleksandar Prodić, *University of Toronto, Canada*

D02.10: 2-MHz GaN PWM Isolated SEPIC Converters
Zhi-Wei Xu, Zhi-Liang Zhang, Ke Xu, Zhou Dong, Xiaoyong Ren, *Nanjing University of Aeronautics and Astronautics, China*

D02.11: High Step-Up Full Bridge DC-DC Converter with Multi-Cell Diode-Capacitor Network
Yan Zhang², Xinying Li², Zheyu Miu², Kunal Kundanam², Jinjun Liu², Yan-Fei Liu¹, ¹*Queen's University, Canada*; ²*Xi'an Jiaotong University, China*

D02.12: A Resonant Modular Multilevel DC-DC Converter with Zero Current Switching for MVDC Application
Yanchao Li, Xiaofeng Lyu, Dong Cao, *North Dakota State University, United States*

D02.13: Analysis on Half-Bridge LLC Resonant Converter by using Variable Inductance for High Efficiency and Power Density Server Power Supply
Yeonho Jeong², Gun-Woo Moon², Jae-Kuk Kim¹, ¹*Inha University, Korea, South*; ²*Korea Advanced Institute of Science and Technology, Korea, South*

D02.15: 5V-to-4V Integrated Buck Converter for Battery Charging Applications with an On-Chip Decoupling Capacitor

Gabriel Gabian, Benjamin Blalock, Daniel Costinett, *University of Tennessee, Argentina*; *University of Tennessee, United States*

D02.16: Highly Efficient and Reliable DC-DC Converter for Smart Transformer

Levy Costa, Giampaolo Buticchi, Marco Liserre, *Christian-Albrechts-Universität zu Kiel, Germany*

D02.17: High-Efficiency Multiphase DC-DC Converters for Powering Processors with Turbo Mode based on Configurable Current Sharing Ratios and Intelligent Phase Management

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

D02.18: 2 W Gate Drive Power Supply Design with PCB-Embedded Transformer Substrate

Bingyao Sun, Rolando Burgos, Dushan Boroyevich, *Virginia Polytechnic Institute and State University, United States*

D02.19: EMI Characterization of a GaN Switched-Capacitor based Partial Power RF SEPIC

Junjian Zhao, Di Han, Yehui Han, *University of Wisconsin-Madison, United States*

D02.20: Planar Transformers with No Common Mode Noise Generation for Flyback and Forward Converters

Mohammad Ali Saket, Martin Ordenez, Navid Shafiei, *University of British Columbia, Canada*

D02.21: Enhanced Power Efficiency DC-DC Converters with dsPIC Digital Controller for HVDC

Hisashi Yamanaka, Shotaro Karasuyama, Shogo Hirota, Yoichi Ishizuka, Hideaki Domoto, Takuya Sasamura, Hayato Yamaoka, *Nagasaki University, Japan*

D02.23: Auto-Tuning of Hybrid Ripple-based Constant On-Time Control for Fast Load Transients and Dynamic Voltage Transitions of Multiphase Voltage Regulators
Brian Cheng, Mike Drenzo, *Texas Instruments Inc., United States*

D02.24: Short Circuit Fault Diagnosis for Interleaved DC-DC Converter using DC-Link Current Emulator
Elham Pazouki, Alex De Abreu-Garcia, Yilmaz Sozer, *University of Akron, United States*

D03: Miscellaneous Topics in DC-DC Converters II

Track: DC-DC Converters

CHAIR:

Khurram Afridi, *University of Colorado Boulder*

D03.1: A 12V-to-0.9V Active-Clamp Forward Converter Power Block with Planar Transformer, Standing Slab Inductor and Direct Edge Solder to Motherboard
Xin Zhang, Andrew Ferencz, Todd Takken, Bai Nguyen, Paul Coteus, *IBM, United States*

D03.2: A High Step-Down Dual Output Non-Isolated DC/DC Converter
Ayan Mallik, Alireza Khaligh, *University of Maryland, United States*

D03.3: An Inductor-Less Hybrid Step-Down DC-DC Converter Architecture for Future Smart Power Cable
Gab-Su Seo, Hanh-Phuc Le, *University of Colorado Boulder, United States*

D03.4: A Time-Length Compensation Algorithm for Sub-Harmonic Oscillation Elimination in Digital Controlled Primary-Side Regulation Flyback Converter
Chong Wang, Shen Xu, Shengli Lu, Weifeng Sun, *Southeast University, China*

D03.5: Design Optimization and Performance Evaluation of High-Power, High-Frequency, Bidirectional Buck-Boost Converter with SiC MOSFETs
Yuri Panov, Yungtaek Jang, Milan M. Jovanović, Brian T. Irving, *Delta Products Corporation, United States*

D03.6: An Average Input Current Sensing Method of LLC Resonant Converters for Precise Overload Protection
Jian Chen¹, Takahide Sato², Koji Yano², Hironobu Shiroyama¹, Makoto Owa¹, Masayuki Yamadaya¹, ¹*Fuji Electric Co., Ltd., Japan*; ²*Yamanashi University, Japan*

D03.7: GaN-based High Efficiency Bidirectional DC-DC Converter with 10 MHz Switching Frequency
Kristian Kruse, Mads Elbo, Zhe Zhang, *Danmarks Tekniske Universitet, Denmark*

D03.8: Wide-Input-Voltage-Range Dual-Output GaN-based Isolated DC-DC Converter for Aerospace Applications
Xingye Liu, Rolando Burgos, Bingyao Sun, Dushan Boroyevich, *Virginia Polytechnic Institute and State University, United States*

D03.9: Soft-Switched Bidirectional Buck-Boost Converters
Yungtaek Jang, Milan M. Jovanović, *Delta Products Corporation, United States*

D03.11: Conducted Common Mode Noise Reduction for Boost Converters using Leakage Inductance of Coupled Inductor
Katsuya Nomura¹, Takashi Kojima¹, Atsuhiko Takahashi¹, Yoshiyuki Hattori¹, Kaoru Torii², ¹*Toyota Central R&D Labs., Inc., Japan*; ²*Toyota Motor Corporation, Japan*

D03.13: A Voltage Doubler Circuit to Extend the Soft-Switching Range of Dual Active Bridge Converters
Zian Qin, Yanfeng Shen, Huai Wang, Frede Blaabjerg, *Aalborg University, Denmark*

D03.14: A ZVS PWM Control Strategy with Balanced Capacitor Current for Half-Bridge Three-Level DC/DC Converter
Dong Liu, Fujin Deng, Zhe Chen, *Aalborg University, Denmark*

D03.15: 48V to 12V Isolated Resonant Converter with Digital Controller
Osvaldo Zambetti¹, Mattia Colombo¹, Salvatore D'angelo¹, Stefano Saggini², Roberto Rizzolatti², ¹*STMicroelectronics, Italy*; ²*Università degli Studi di Udine, Italy*

D03.16: A Novel Three-Phase LLC Resonant Converter with Integrated Magnetics for Lower Turn-Off Losses and Higher Power Density
Mostafa Noah³, Shota Kimura³, Shun Endo³, Masayoshi Yamamoto³, Jun Imaoka¹, Kazuhiro Umetani², Wilmar Martinez⁴, ¹*Kyushu University, Japan*; ²*Okayama University, Japan*; ³*Shimane University, Japan*; ⁴*Universidad Nacional de Colombia, Colombia*

D03.17: High Step-Up Z-Source DC-DC Converter with Flyback and Voltage Multiplier
Arash Torkan, Mehrdad Ehsani, *Texas A&M University, United States*

D03.18: Bidirectional High Voltage Conversion Ratio DC/DC Converter with Full ZVS Range
Jianliang Chen, Deshang Sha, Xiaozhong Liao, *Beijing Institute of Technology, China*

D03.20: A Reconfigurable Series Resonant DC-DC Converter for Wide-Input and Wide-Output Voltages
Yanfeng Shen¹, Huai Wang¹, Zian Qin¹, Frede Blaabjerg¹, Ahmed Al Durra², ¹*Aalborg University, Denmark*; ²*Petroleum Institute, U.A.E.*

D03.21: High Power Density High Efficiency Wide Input Voltage Range LLC Resonant Converter Utilizing E-Mode GaN Switches

Ahmadreza Amirahmadi, Moshe Domb, Eric Persson, *Infineon Technologies AG, United States*

D03.22: A Hybrid Bidirectional DC-DC Converter for Dual-Voltage Automotive Systems

Shouxiang Li², Keyue Smedley², Diego Reis Caldas¹, Yan Watanabe Martins¹, ¹CAPES Foundation / Ministry of Education of Brazil, Brazil; ²University of California, Irvine, United States

D03.23: ZVS Operation Range Analysis of Three-Level Dual Active Bridge DC-DC Converter with Phase-Shift Control

Li Jin, Bangyin Liu, Shanxu Duan, *Huazhong University of Science and Technology, China*

D03.24: A 48V:2V Flying Capacitor Multilevel Converter using Current-Limit Control for Flying Capacitor Balance

Jan Rentmeister, Jason Stauth, *Dartmouth College, United States*

D04: Power Electronics for Utility Interface

Track: Power Electronics for Utility Interface

CHAIR:

Ali Khajehoddin, *University of Alberta*

D04.1: An Integrated Inverter Output Passive Sinewave Filter for Eliminating Both Common and Differential Mode PWM Motor Drive Problems

Todd Shudarek, Tin Luu, *MTE Corporation, United States*

D04.2: Leakage Current Reduction of Z-Source Four-Leg Inverter for Transformerless PVsystem

Xiaoqiang Guo, Ran He, *Yanshan University, China*

D04.3: A 320kV Hybrid HVDC Circuit Breaker based on Thyristors Forced Current Zero Technique

Lei Feng¹, Ruifeng Gou², Xiaoping Yang², Feng Wang¹, Fang Zhuo¹, Shuhuai Shi¹, ¹Xi'an Jiaotong University, China; ²Xi'an XD Power Systems Co., Ltd, China

D04.4: A Semi-Two-Stage Dual-Buck Transformerless PV Grid-Tied Inverter

Tao Zhu, Li Zhang, Ranran Gao, Litao Qu, *Hohai University, China*

D04.5: Open-End Unidirectional Topologies with Reduced Controlled Switch Count

Reuben Palmer R. de Sousa, Cursino Brandão Jacobina, *Universidade Federal de Campina Grande, Brazil*

D04.6: A Unidirectional Snubber Less Partially Soft-Switched High Frequency Link Three Phase Inverter

Anirban Pal, Kaushik Basu, *Indian Institute of Science, Bangalore, India*

D04.7: HVDC Converter Transformer Saturation in Hybrid AC/DC System Caused by Coupled Transmission Lines

Shuoting Zhang, Yalong Li, Bo Liu, Xiaojie Shi, Leon M. Tolbert, Fred Wang, *University of Tennessee, United States*

D04.8: Analysis and Implementation of a Bridgeless Sepic AC/DC Converter with Power Factor Correction and Extended Gain

Yi-Hung Liao, Jia-Yi Jhu, *National Penghu University of Science and Technology, Taiwan*

D04.9: Virtual RLC Active Damping for Grid-Connected Inverters with LCL Filters

Qicheng Huang, Kaushik Rajashekara, *University of Houston, United States*

D04.10: A Unified AC-DC Microgrid Architecture for Distribution of AC and DC Power on the Same Line

Akshatha Shetty, Arun Nair, Abhijith V.S, Baylon G. Fernandes, *Indian Institute of Technology Bombay, India*

D04.11: A Prototype of Modular Multilevel Converter with Integrated Battery Energy Storage

Zhe Wang, Hua Lin, Yajun Ma, Tao Wang, *Huazhong University of Science and Technology, China*

D04.12: Control and Performance Analysis Methodology for Scale-Up of MMC Submodules for Back-to-Back HVDC Applications

Mohammed Alharbi, Maziar Mobarrez, Subhashish Bhattacharya, *North Carolina State University, United States*

D04.14: Estimation of Parameters in Single Phase Grid Connected and Stand-Alone Inverter System

Subhajyoti Mukherjee, Pourya Shamsi, Mehdi Ferdowsi, *Missouri University of Science and Technology, United States*

D04.15: Resonant Controller based Power-Angle Synchronization Control in Low Voltage Grids

Subhajyoti Mukherjee, Pourya Shamsi, Mehdi Ferdowsi, *Missouri University of Science and Technology, United States*

D04.16: A Novel Bi-Directional AC/DC Converter used for Energy Storage Systems (ESSs)

Snehal Bagawade¹, Hossein Mousavian¹, Praveen Jain¹, Majid Pahlevani², ¹Queen's University, Canada; ²University of Calgary, Canada

D04.17: Design of a SiC-based Modular Multilevel Converter for Medium Voltage DC Distribution System

Jianghui Yu, Rolando Burgos, Niloofar Rashidi Mehrabadi, Dushan Boroyevich, *Virginia Polytechnic Institute and State University, United States*

D04.18: A Control Scheme of Three Phase Solid State Transformer for PV Generation based on Improved Voltage-Tracking Method of DC Links

Xin Ma², Xu Yang², Fan Zhang², Lang Huang², Zhi Li¹, Haijun Song¹, ¹TBEA Xinjiang Sunoasis Co.,Ltd., China; ²Xi'an Jiaotong University, China

D04.19: Single-Phase AC-DC-AC Current Source Converter with Reduced DC-Link Oscillation

Louelson A. Costa, Montiê A. Vitorino, Maurício B. R. Corrêa, Universidade Federal de Campina Grande, Brazil

D04.20: A Modified Symmetric and Asymmetric Multilevel Power Inverter with Reduced Number of Power Switches Controlled by MPC

Mostafa Mosa¹, Robert S. Balog¹, Haitham Abu-Rub², Malik Elbuluk³, ¹Texas A&M University, United States; ²Texas A&M University at Qatar, Qatar; ³University of Akron, United States

D05: Operation & Control of Motor Drives

Track: Motor Drives and Inverters

CHAIRS:

Navid Zargari, Rockwell Automation

Yilmaz Sozer, University of Akron

D05.1: Indirect Matrix Converter DTC for Induction Motor using a Single Current Sensor

Brahim Metidji, Brahim Metidji, Université de Boumerdes - Université de M'hamed Bougara, Algeria

D05.2: Optimal Generalized Overmodulation for Multiphase PMSM Drives

Paul Young, Matthias Preindl, Columbia University, United States

D05.3: Optimal Reset Controller Designed for Induction Machine Drive with Hardware in the Loop Test

Jianyang Zhai¹, Youyi Wang¹, Xiong Liu², ¹Nanyang Technological University, Singapore; ²Rolls-Royce Singapore Pte. Ltd., Singapore

D05.4: Speed-Sensorless Drive for Induction Machines using a Novel Hybrid Observer

Jia Li, Anup Thapa, Keith Corzine, Clemson University, United States

D05.5: Improved Loss Model and Loss Minimization Control Strategy for Linear Induction Machine

Dong Hu, Wei Xu, Renjun Dian, Yi Liu, Huazhong University of Science and Technology, China

D05.6: Multistep Model Predictive Control for Permanent Magnet Synchronous Machine

Jianqiao Zou¹, Wei Xu¹, Yi Liu¹, Chaoxu Mu², ¹Huazhong University of Science and Technology, China; ²Tianjin University, China

D05.7: Torque Ripple Suppression Method for Brushless DC Motor based on Instantaneous-Bus-Voltage Control Strategy

Cong Gu, Xiaolin Wang, Zhiquan Deng, Nanjing University of Aeronautics and Astronautics, China

D05.8: Observer-based Estimation Improvement for Servo Control of PMSM with Binary-Type Hall Sensors

Qinan Ni, Ming Yang, Jiang Long, Dianguo Xu, Harbin Institute of Technology, China

D05.9: Torque Ripple and Copper Loss Minimization for a Family of Mutually Coupled Switched Reluctance Machines

Jin Ye, Forest Hensley, San Francisco State University, United States

D05.10: A Novel Predictive Current Control for Open-End Winding Induction Motor Drive with Reduced Computation Burden and Enhanced Zero Sequence Current Suppression

Bohang Zhu², Kaushik Rajashekara², Hajime Kubo¹, ¹Meidensha Corporation, Japan; ²University of Texas at Dallas, United States

D05.11: Regenerated Energy Recycling between Two Motors of Asynchronous Mode Driven by Hexagonal Cascaded Multilevel Converter

Pan Wang², Fei Liu¹, Jinwu Gong¹, Wenjun Liu¹, Feiyang Zhu¹, Zhe Chen¹, ¹Wuhan University, China; ²Wuhan University / Wuhan Electric Power Technical College, China

D05.12: Dynamic Decoupling Control Method for PMSM Drive with Cross-Coupling Inductances

Kahyun Lee, Jung-Ik Ha, Seoul National University, Korea, South

D05.13: On-Line Fault Diagnosis of Multi-Phase Drives using Self-Recurrent Wavelet Neural Networks with Adaptive Learning Rates

Niloofar Torabi, Vivek Meenakshi Sundaram, Hamid A. Toliyat, Texas A&M University, United States

D05.14: Design and Implementation of Position Sensorless Starting Control in Industrial Drives with Output Filter and Transformer for Oil/Pump Applications

Jingbo Liu, Jingya Dai, Semyon Royak, Peter Schmidt, Ehsan Al-Nabi, Thomas Nondahl, Rockwell Automation, United States

D05.15: Fault Tolerance Performance of Two Hybrid Six-Phase Drive Systems under Single-Phase Open-Circuit Fault Operation

Victor Melo², Cursino Brandão Jacobina², Nady Rocha¹, Edgar Filho², ¹Universidade Federal da Paraíba, Brazil; ²Universidade Federal de Campina Grande, Brazil

D05.16: Common-Mode Resonance Suppression for Parallel CSC-fed High Power Medium Voltage Drives with Multilevel Modulation

Li Ding, Zhongyi Quan, Yun Wei Li, University of Alberta, Canada

- D05.17: Stabilization Method of Current Regulator for Electric Vehicle Motor Drive Systems under Motor Parameter Mismatch Conditions**
Masakazu Kato, Jun-Ichi Itoh, *Nagaoka University of Technology, Japan*
- D05.18: A New Design of Selective Harmonic Elimination for Adjustable Speed Operation of AC Motors in Mining Industry**
Alex-Sander Amável Luiz¹, Braz de Jesus Cardoso Filho², ¹*Centro Federal de Educação Tecnológica de Minas Gerais, Brazil;* ²*Universidade Federal de Minas Gerais, Brazil*
- D05.19: An Improved High-Performance Open-Loop V/f Control Method for Induction Machines**
Zhe Zhang, Yiqi Liu, Ali Bazzi, *University of Connecticut, United States*
- D05.20: Minimum Torque Ripple Pulse Width-Modulation with Reduced Switching Frequency for Multi-Megawatt Motor Drive**
Hyun-Sam Jung², Chaeun Hwang², Hyeon-Sik Kim², Seung-Ki Sul², An Heewon¹, Hyunjae Yoo¹, ¹*Samsung Heavy Industries, Korea, South;* ²*Seoul National University, Korea, South*
- D05.21: A 650 V Three-Phase 1.5 kW BLDC Motor Driver with Integrated Charge Pump**
Valentijn De Smedt, Jef Thoné, Mike Wens, *MinDCet NV, Belgium*
- D05.23: Effect of Distributed Airgap in the Stator for Acoustic Noise Reduction in Switched Reluctance Motors**
Yusuf Yasa³, Didem Tekgun³, Yilmaz Sozer³, John Kutz¹, Joshua Tylenda², ¹*DCS Corporation, United States;* ²*United States Army, United States;* ³*University of Akron, United States*

D06: Converter Topologies & Control

Track: Motor Drives and Inverters

CHAIRS:

Zheyu Zhang, *University of Tennessee*

Robert Balog, *Texas A&M University*

- D06.1: 5 kW Bidirectional Grid-Connected Drive using Silicon-Carbide Switches: Control**
Alireza Kouchaki², Radu Lazar¹, Jacob Pedersen², Morten Nyman², ¹*Danfoss Drives, Denmark;* ²*University of Southern Denmark, Denmark*
- D06.2: Control and Design of a Four-Switch Inverter with Reduced Low-Frequency Input Current Ripple and Capacitance Requirement: a Comparative Study**
Youjie Shi, Bangyin Liu, Shanxu Duan, *Huazhong University of Science and Technology, China*

- D06.3: Impact of Application of SiC Devices in Motor Drive on EMI**
Zhihao Fang, Dong Jiang, Zewei Shen, Ronghai Qu, *Huazhong University of Science and Technology, China*
- D06.4: Feedback Linearization based Current Control Strategy for Modular Multilevel Converters**
Shunfeng Yang¹, Yi Tang¹, Zhu Xu³, Michael Zagrodnik², Gupta Amit², Peng Wang¹, ¹*Nanyang Technological University, Singapore;* ²*Rolls-Royce Singapore Pte. Ltd., Singapore;* ³*Southwest Jiaotong University, China*
- D06.6: Control of the Hybrid Modular Multilevel Converter in Motor Drive Applications**
Shaoze Zhou, Mingxu Guan, Binbin Li, Shaocong Zhou, Dianguo Xu, *Harbin Institute of Technology, China*
- D06.7: DC-Link Capacitor Voltage Balancing Technique for Phase-Shifted PWM-based Seven-Switch Five-Level ANPC Inverter**
Lei Kou, Hongliang Wang, Yan-Fei Liu, Paresh C. Sen, *Queen's University, Canada*
- D06.8: Application of the Time-Frequency Analysis using Wavelet Transform to Harmonics Analysis in the Power Conversion Systems**
Hiroki Nagano¹, Ryota Kimikado¹, Masakazu Michihira¹, Keiji Akamatsu², Makoto Ozone², Takaaki Norisada², ¹*Kobe City College of Technology, Japan;* ²*Panasonic Corporation, Japan*
- D06.9: Topology of Modified Switched-Capacitor Z-Source Inverters with Improved Boost Capability**
Anh-Vu Ho¹, Si-Gyeong Yang², Tae-Won Chun², Hong-Hee Lee², ¹*Eastern International University, Vietnam;* ²*University of Ulsan, Korea, South*
- D06.10: DC Voltage Control of a Reduced Switching Losses Converter for High Speed Drives**
Vito Giuseppe Monopoli, Pierluigi Sidaella, Francesco Cupertino, *Politecnico di Bari, Italy*
- D06.11: Simple Algorithm with Fast Dynamics for Cascaded H-Bridge Multilevel Inverter based on Model Predictive Control Method**
Ro Chan¹, Jaehoon Baek², Sangshin Kwak¹, ¹*Chung-ang University, Korea, South;* ²*Korea Railroad Research Institute, Korea, South*
- D06.12: Common-Mode Voltage Suppression based on Auxiliary Leg for Three-Level NPC Inverters**
Quoc Anh Le, Dong-Choon Lee, *Yeungnam University, Korea, South*
- D06.13: Dual Buck-Boost Inverter**
Ashraf Ali Khan¹, Honnyong Cha¹, Fazal Akbar¹, Kim Kisu¹, Jih-Sheng Lai², ¹*Kyungpook National University, Korea, South;* ²*Virginia Polytechnic Institute and State University, United States*

D06.14: Experimental Evaluation of a 1 kW, Single-Phase, 3-Level Gallium Nitride Inverter in Extreme Cold Environment

Christopher Barth², Juan Colmenares¹, Thomas Foulkes², Keith Coulson², Jesus Sotelo², Tomas Modeer², Nenad Miljkovic², Robert C.N. Pilawa-Podgurski², ¹*KTH Royal Institute of Technology, Sweden*; ²*University of Illinois Urbana-Champaign, United States*

D06.15: A Segmented Power Distribution Control System based on Hybrid Regenerative Cascaded Multilevel Converter

Pan Wang², Fei Liu¹, Xiaoming Zha¹, Feiyang Zhu¹, Jinwu Gong¹, Kun Feng¹, ¹*Wuhan University, China*; ²*Wuhan University / Wuhan Electric Power Technical College, China*

D06.16: Cascaded Modular H7 Current Source Inverter

Weiqi Wang¹, Feng Gao¹, Yudun Li², ¹*Shandong University, China*; ²*State Grid Shandong Electric Power Research Institute, China*

D06.17: A Compact 110 kVA, 140°C Ambient, 105°C Liquid Cooled, All-SiC Inverter for Electric Vehicle Traction Drives

Kraig Olejniczak, Tom Flint, David Simco, Sergei Storkov, Brad McGee, Robert Shaw, Brandon Passmore, Kenny George, W. Austin Curbow, Ty McNutt, *Wolfspeed / Cree, United States*

D06.18: Comprehensive Comparison of THD and Common Mode Leakage Current of Bipolar, Unipolar and Hybrid Modulation Schemes for Single Phase Grid Connected Full Bridge Inverters

Yinglai Xia, Raja Ayyanar, *Arizona State University, United States*



D07: Devices & Reliability

Track: Devices and Components

CHAIRS:

Yvan Avenas, *Univ Grenoble Alps*

Christina Dimarino, *Virginia Polytechnic Institute and State University*

D07.1: A Temperature-Independent Method for Monitoring the Degradation of Bond Wires in IGBT Modules based on Transfer Characteristics

Yingzhou Peng, Pengju Sun, Luowei Zhou, Xiong Du, Jie Cai, *Chongqing University, China*

D07.3: Failure Mechanism Analysis of a Discrete 650V Enhancement Mode GaN-on-Si Power Device with Reverse Conduction Accelerated Power Cycling Test

Sungyoung Song, Stig Munk-Nielsen, Christian Uhrenfeldt, Ionut Trintis, *Aalborg University, Denmark*

D07.4: A Lifetime Extension Strategy for Power Devices in the Wind Power Converters based on the Distribution Characteristics of Consumed Lifetime

Jun Zhang¹, Xiong Du¹, Cheng Zeng¹, Pengju Sun¹, Heng-Ming Tai², ¹*Chongqing University, China*; ²*University of Tulsa, United States*

D07.5: Miniaturized Design of a Piezoelectric Thermal Sensor Optimized for the Integration to Wide Bandgap Power Modules Operating at High Temperatures

Min-Ki Kim, Sang Won Yoon, *Hanyang University, Korea, South*

D07.6: Dynamic Junction Temperature Estimation via Built-in Negative Thermal Coefficient (NTC) Thermistor in High Power IGBT Modules

Yu Zhou², Wei Shi², Junsong Tang², Xiang Wang², Wuhua Li², Xiangning He², Chaoshan Zhang¹, Zhuozhi Li¹, ¹*Xi'an Kaitian Power Electronics Technical Co., Ltd., China*; ²*Zhejiang University, China*

D07.7: Reliability of SiC Power MOSFETs under High Repetitive Pulse Current Conditions

Vamsi Mulpuri, Seungdeog Choi, *University of Akron, United States*

D07.8: Protection and Temperature-Dependent Switching Characterization of Latest Generation 10 kV SiC MOSFETs

Shiqi Ji, Sheng Zheng, Zheyu Zhang, Fred Wang, Leon M. Tolbert, *University of Tennessee, United States*

D07.9: Detection of Aging Related IGBT Bond-Wire Lift-Off using Spread Spectrum Time Domain Reflectometry (SSTDR)

Swagat Das², Faisal Khan², Mohammed Khorshed Alam¹, Preetham Goli², ¹*Ford Motor Company, United States*; ²*University of Missouri-Kansas City, United States*

D08: Devices & Components

Track: Devices and Components

CHAIRS:

Jean-Luc Schanen, *University of Grenoble*

Dong Cao, *North Dakota State University*

D08.1: A Novel Active Gate Driver for Static and Dynamic Current Balancing of Parallel-Connected IGBTs

Ying Chen, Fang Zhuo, Wenjie Pan, Fan Zhang, Lei Feng, *Xi'an Jiaotong University, China*

D08.2: Balancing of Peak Currents between Paralleled SiC MOSFETs by Source Impedances

Yincan Mao², Zichen Miao², Khai Ngo², Chi-Ming Wang¹, ¹*Toyota Motor Engineering & Manufacturing, United States*; ²*Virginia Polytechnic Institute and State University, United States*

D08.3: Thyristors for Commutation of Current Impulse with Extremely High Amplitude

Anatoly Chernikov², Vladimir Goncharenko¹, Alexandr Mizintsev¹, Dmitry Titushkin², Alexey Surma², ¹*NIEFA-ENERGO, LLC, Russia*; ²*Proton-Electrotex, Russia*

D08.4: DC Link Bus Design for High Frequency, High Temperature Converters

Josh Stewart, Jason Neely, Jarod Delhotal, Jack Flicker, *Sandia National Laboratories, United States*

D08.5: Impacts of Unbalanced Grid Voltages on Lifetime of DC-Link Capacitors of Back-to-Back Converters in Wind Turbines with Doubly-Fed Induction Generators

Holger Jedtberg¹, Marius Langwasser¹, Rongwu Zhu¹, Giampaolo Buticchi¹, Thomas Ebel², Marco Liserre¹, ¹*Christian-Albrechts-Universität zu Kiel, Germany*; ²*FTCAP GmbH, Germany*

D08.6: A Novel Solid-State DC-Breaker based on Cascaded SiC MOSFETs

Yu Ren¹, Xu Yang¹, Liang Qiao¹, Fan Zhang¹, Laili Wang², ¹*Xi'an Jiaotong University, China*; ²*Xi'an Jiaotong University / Sumida Corporation, China*

D08.7: Fuse Modeling for Reliability Study of Power Electronic Circuits

Amir Sajjad Bahman, Francesco Iannuzzo, Frede Blaabjerg, *Aalborg University, Denmark*

D08.8: Common Source Inductance Introduced Self-Turn-On in MOSFET Turn-Off Transient

Wen Zhang, Zheyu Zhang, Fred Wang, Daniel Costinett, Leon M. Tolbert, Benjamin Blalock, *University of Tennessee, United States*

D08.9: Trade-Off between Switching Loss and Common Mode EMI Generation of GaN Devices-Analysis and Solution

Di Han, Silong Li, Woongkul Lee, Wooyoung Choi, Bulent Sarlioglu, *University of Wisconsin-Madison, United States*

D09: Magnetic Components

Track: Devices and Components

CHAIRS:

Stephan Carlsen, *Raytheon Company*

Edward Herbert, *Power Sources Manufacturers Association*

D09.1: Analysis and Design of Tubular Coils for Wireless Inductive Power Transfer Systems

Jesús Acero², Javier Serrano², Claudio Carretero², Ignacio Lope¹, José Miguel Burdío², ¹*BSH Home Appliances Group, Spain*; ²*Universidad de Zaragoza, Spain*

D09.2: Realization of High-Current Variable AC Filter Inductors using Silicon Iron Powder Magnetic Core

Yusi Liu, H. Alan Mantooth, Juan Balda, Chris Farnell, *University of Arkansas, United States*

D09.3: A Step-by-Step Guide to Extracting Winding Resistance from an Impedance Measurement

Benedict Foo, Aaron Stein, Charles Sullivan, *Dartmouth College, United States*

D09.4: A Compensation Winding Structure for Balanced Three-Phase Coupled Inductor

Le Yang, Shuo Wang, *University of Florida, United States*

D09.5: New Method for Error Compensation in High Frequency Loss Measurement of Powder Cores

Farideh Javidi Niroumand², Morten Nymand², Andrew J. Forsyth¹, ¹*University of Manchester, United Kingdom*; ²*University of Southern Denmark, Denmark*

D09.6: Control on Coercivity of Fe/Co and Co/Fe Ferromagnetic Bilayers by Thermal Annealing

Xiaowei Hou, Dacheng Ni, Fei Wang, Lianguang Zheng, *Ningbo CRRC Times Transducer Technology Co., LTD., China*

D09.7: Next Generation Ferrite Material for SiC & GaN Applications

Herbert Jungwirth, Michael Schmidhuber, Michael Baumann, *SUMIDA Components & Modules GmbH, Germany*

D10: Packaging & Design Optimization

Track: System Integration

CHAIRS:

Ernie Parker, *Crane Aerospace & Electronics*

John Vigars, *Allegro Microsystems*

- D10.2: A 3D Stacked Step-Down Intergrated Power Module**
Wenbo Liu¹, Yan-Fei Liu¹, Laili Wang³, Doug Malcolm²,
¹Queen's University, Canada; ²Sumida Corporation, Canada; ³Xi'an Jiaotong University / Sumida Corporation, Canada
- D10.3: Two Core Implementation of Coupled Inductor for Parallel Three-Phase Power Converters**
Sungjae Ohn, Xuning Zhang, Rolando Burgos, Dushan Boroyevich, *Virginia Polytechnic Institute and State University, United States*
- D10.4: DC-Link RMS Current Reduction by Increasing Paralleled 3-Phase Inverter Module Number for Segmented Traction Drive**
Xiaofeng Lyu, Haolin Zhou, Boris Curuvija, Dong Cao, *North Dakota State University, United States*
- D10.5: Active Hot Spot Cooling of GaN Transistors with Electric Field Enhanced Jumping Droplet Condensation**
Thomas Foulkes², Junho Oh², Patrick Birbarah², Jason Neely¹, Nenad Miljkovic², Robert C.N. Pilawa-Podgurski², ¹Sandia National Laboratories, United States; ²University of Illinois Urbana-Champaign, United States
- D10.6: High-Frequency Modulated Secondary-Side Self-Powered Isolated Gate Driver for Full Range PWM Operation of SiC Power MOSFETs**
Jorge Garcia¹, Emre Gurpinar², Alberto Castellazzi²,
¹Universidad de Oviedo, Spain; ²University of Nottingham, United Kingdom
- D10.7: Distributed μ -STATCOM for Voltage Support and Harmonic Mitigation on Low Voltage Networks**
Ehab Shoubaki², Somasundaram Essakiappan², Pankaj Kumar Bhowmik², Madhav Manjrekar², Johan Enslin², Stuart Laval¹, Aleksandar Vukojevic¹, Jason Handley¹, ¹Duke Energy, United States; ²University of North Carolina at Charlotte, United States
- D10.8: Impact of Cable and Motor Loads on Wide Bandgap Device Switching and Reflected Wave Phenomenon in Motor Drives**
Balaji Narayanasamy, Arvind Shanmuganaath Sathyanarayanan, Amol Deshpande, Fang Luo, *Ohio State University, United States*

D11: Component Modeling & Simulation

Track: Modeling and Simulation

CHAIR:

Fei Gao, *Universite de technologie de Belfort-Montbéliard*

- D11.1: Non-Ideal Model of the Common Mode Choke for EMI Filters**
Illia Manushyn¹, Lucas Monogios Koleff², Gerd Griepentrog¹, ¹Technische Universität Darmstadt, Germany; ²Universidade de São Paulo, Brazil
- D11.2: Battery Life Estimation Model and Analysis for Electronic Buses with Auxiliary Energy Storage Systems**
Ramdev Kanapady, Kim Kyle, Jason Lee, *Eaton Corporation, United States*
- D11.3: A Simple and Upgradable Autonomous Battery Aging Evaluation and Test System with Capacity Fading and AC Impedance Spectroscopy Measurement**
Zhiyong Xia, Jaber Abu Qahouq, Evan Phillips, Rachel Gentry, *University of Alabama, United States*
- D11.4: Optimization of Transmitter Magnetic Structures for Roadway Applications**
Emanuel Marques, André Mendes, *Universidade de Coimbra, Portugal*
- D11.5: A Fast Electro-Thermal Co-Simulation Modeling Approach for SiC Power MOSFETs**
Lorenzo Ceccarelli, Amir Sajjad Bahman, Francesco Iannuzzo, Frede Blaabjerg, *Aalborg University, Denmark*
- D11.6: Analysis and Practical Method of Determining WBG FET Switching Losses Associated with Nonlinear Coss**
Rais Miftakhutdinov, *Texas Instruments Inc., United States*
- D11.8: Probability-based Circuit Breaker Modeling for Power System Fault Analysis**
Chengwei Lei¹, Weisong Tian⁵, Yucheng Zhang⁴, Ruiyun Fu³, Ruting Jia², Robb Winter⁵, ¹California State University, Bakersfield, United States; ²California State University, Northridge, United States; ³Mercer University, United States; ⁴Old Dominion University, United States; ⁵South Dakota School of Mines and Technology, United
- D11.9: Time-Domain Modeling of Constant Phase Element for Simulation of Lithium Batteries under Arbitrary Charging and Discharging Current Profiles**
Chun Sing Cheng, Henry Shu-Hung Chung, Ricky Wing-Hong Lau, *City University of Hong Kong, Hong Kong*
- D11.10: Diagnostic Cell for Large-Scale Battery Bank**
Alex Chun-For Liu¹, Henry Shu-Hung Chung¹, Wenguan Wang¹, Ricky Wing-Hong Lau¹, Jun Zhang², ¹City University of Hong Kong, Hong Kong; ²Sun Yat-sen University, China

D11.11: Device Identification from Mixture of Measurable Characteristics

Michihiro Shintani, Kazuki Oishi, Rui Zhou, Masayuki Hiromoto, Takashi Sato, *Kyoto University, Japan*

D11.12: Review of SiC MOSFET based Three-Phase Inverter Lifetime Prediction

Ze Ni, Xiaofeng Lyu, Om Yadav, Dong Cao, *North Dakota State University, United States*

D12: Modeling and Analysis of Circuits & Systems

Track: Modeling and Simulation

CHAIR:

Santanu Mishra, *Indian Institute of Technology Kanpur*

D12.1: A Finite Differential Method based Compact Thermal Model in PSPICE

Puqi Ning, Xuhui Wen, Yaohua Li, Qiongxuan Ge, *Chinese Academy of Sciences, China*

D12.2: Coupled Inductor based Multi-Phase Buck Converter for Magnet Power Supply

Hwasoo Seok³, Sooa Kim³, Won-Shik Choi¹, Min-Jae Kim², Jin S. Lee³, Minsung Kim³, ¹Agency for Defense Development, Korea, South; ²LS Industrial Systems, Korea, South; ³Pohang University of Science and Technology, Korea, South

D12.3: Optimized Configuration of DC Bias Current Suppression Resistors in HVDC based on MOFPSO

Zhouyu Zhong, Shengqi Zhang, Jianfeng Zhao, *Southeast University, China*

D12.4: Instability Analysis of Enhancement-Mode GaN based Half-Bridge Circuits

Kangping Wang¹, Mofan Tian¹, Laili Wang², Xu Yang¹, ¹Xi'an Jiaotong University, China; ²Xi'an Jiaotong University / Sumida Corporation, China

D12.5: Model-based Determination of Closed-Loop Input Impedance for Dual Active Bridge Converters

Jacob Mueller, Jonathan Kimball, *Missouri University of Science and Technology, United States*

D12.6: Small Signal Modeling of Dual-Edge PWM Modulator with Fixed Clock Frequency

Yi Huang, Chun Cheung, Keerthi Varman Anna Jayaprakash, *Intersil Corporation, United States*

D12.7: Analytical Exploration of Conduction Power Losses for Stacked Multicell Converters

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

D12.8: Study of the Predictive Capability of Modular Multilevel Converter Simulation Models under Parametric and Model Form Uncertainty

Niloofer Rashidi Mehrabadi, Rolando Burgos, Christopher Roy, Jianghui Yu, Dushan Boroyevich, *Virginia Polytechnic Institute and State University, United States*

D12.9: Modeling a Hysteretic Modulator's PFM and PWM Modes

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

D12.10: Generalized Averaging Modeling and Control Strategy for Three-Phase Dual-Active-Bridge DC-DC Converters with Three Control Variables

Zhuoqiang Li, Yue Wang, Ling Shi, Jun Huang, Yao Cui, Wanjun Lei, *Xi'an Jiaotong University, China*

D13: Control for Power Electronics & Energy Systems

Track: Control

CHAIRS:

Hrishikesh Nene, *Texas Instruments, Inc.*

Indumini Ranmuthu, *Texas Instruments, Inc.*

D13.2: A UVLO with Zero Static Power Consumption Power-on Reset Circuit in HVIC

Kinam Song, Wonhi Oh, Jinkyu Choi, *ON Semiconductor, Korea, South*

D13.4: Ripple Minimizing Digital Controller for Flying Capacitor DC-DC Converters based on Dynamic Mode Levels Switching

Neenad Vukadinović², Aleksandar Prodić², Brett Miwa¹, Cory B. Arnold¹, Michael W. Baker¹, ¹Maxim Integrated, United States; ²University of Toronto, Canada

D13.5: Model Predictive Control of a Grid-Connected Inverter to Reduce Current Ripples and Computation Loads

Hyun Chul Moon¹, June-Seok Lee², June-Hee Lee¹, Kyo-Beum Lee¹, ¹Ajou University, Korea, South; ²Korea Railroad Research Institute, Korea, South

D13.6: Optimized Control Strategy for Minimum Ohmic Loss of Dual Active Bridge Converter

Anping Tong², Lijun Hang¹, Guojie Li², ¹Hangzhou Dianzi University, China; ²Shanghai Jiao Tong University, China

D13.7: A New Maximum Power Point Tracking Method for Photovoltaic Applications based on Finite Control Set Model Predictive Control

Hamid Mahmoudi², Parvin Moamaei¹, Mohsen Aleenejad², Reza Ahmadi², ¹Southern Illinois University, United States; ²University of Kansas, United States

D13.8: Simple Hardware Implementation of an Adaptive Mixed Signal Current Programmed Mode Control for Near Minimum Deviation Transient Response

Tim McRae, Aleksandar Prodić, *University of Toronto, Canada*

D13.9: Steady-State Analysis of the Inductor Current Behavior and Requirements for the Control of a Single-Inductor Multiple-Input Single-Output DC-DC Power Converter

Yuan Cao, Jaber Abu Qahouq, *University of Alabama, United States*

D13.10: Fast Average Current Mode Control of Dual-Active-Bridge DC-DC Converter using Cycle-by-Cycle Sensing and Self-Calibrated Digital Feedforward

Miad Nasr², Shahab Poshtkouhi², Nikolay Radimov¹, Christian Cojocar¹, Olivier Trescases², ¹*Solanro Semiconductor Corp., Canada*; ²*University of Toronto, Canada*

D13.12: Predictive Set Point Modulation Technique to Enhance the Dynamic Response of a Power System

Hooman Ghaffarzadeh, Ali Mehrizi-Sani, *Washington State University, United States*

D13.13: A Control Method of Digital Active EMI Filter

Junpeng Ji¹, Wenjie Chen¹, Zhuobin Gu², Xu Yang¹, Xingxia Zhang², ¹*Xi'an Jiaotong University, China*; ²*Xi'an University Of Technology, China*

D13.14: Active Thermal Control of a DC/DC GaN-based Converter

Pramod Kumar Prasobhu, Vivek Raveendran, Giampaolo Buticchi, Marco Liserre, *Christian-Albrechts-Universität zu Kiel, Germany*

D13.15: Active Gate Control in Half-Bridge Inverters using Programmable Gate Driver ICs to Improve Both Surge Voltage and Switching Loss

Hidemine Obara¹, Keiji Wada¹, Koutaro Miyazaki², Makoto Takamiya², Takayasu Sakurai², ¹*Tokyo Metropolitan University, Japan*; ²*University of Tokyo, Japan*

D13.16: Droop-Free Distributed Control with Event-Triggered Communication in DC Micro-Grid

Renke Han¹, Nelson Leonardo Diaz Aldana¹, Lexuan Meng¹, Josep M. Guerrero¹, Qiuye Sun², ¹*Aalborg University, Denmark*; ²*Northeastern University, China*

D13.17: Adaptive Control Strategy for Ultracapacitor based Bidirectional DC-DC Converters

Saichand Kasichayanula, Vinod John, *Indian Institute of Science, India*

D13.18: Large & Small Signal Modeling of Dual Active Bridge Converter using Improved First Harmonic Approximation

Suyash Sushilkumar Shah, Subhashish Bhattacharya, *North Carolina State University, United States*

D13.19: Automated Calculation of the Compensator based on the Online Identification of the Plant Operating in Closed Loop

Cristina Fernandez, Pablo Zumel, Marlon Alberto Granda, Marina Sanz, Antonio Lazaro, Andres Barrado, *Universidad Carlos III de Madrid, Spain*

D13.20: Compensation Control Algorithm for IPM Machines Considering Temperature Effects based on Online Multi-Parameter Estimation

Silong Li, Di Han, Bulent Sarioglu, *University of Wisconsin-Madison, United States*

D13.21: Wireless Networked Dynamic Control Testbed for Power Converters in Smart Home Applications

S M Rakiul Islam, Shawn Maxwell, Sung-Yeul Park, Shaobo Zheng, Tao Gong, Song Han, *University of Connecticut, United States*

D13.22: Smallest Control Invariant Set and Error Boundaries of FCS-MPC for PMSM

Xiaoqing Yong, Matthias Preindl, *Columbia University, United States*

D13.23: Fast Transient Current Control for Three-Phase Dual-Active-Bridge DC-DC Converters with Variable Duty Cycles

Zhuoqiang Li, Yue Wang, Yao Cui, Ling Shi, Jun Huang, Wanjun Lei, *Xi'an Jiaotong University, China*

D14: DC Renewable Energy

Track: Renewable Energy Systems

CHAIR:

Xiaoqiang Guo, *Yanshan University*

D14.1: Improved Battery Modeling Approach Considering Operating Scenarios for HEV/EV Applications

Jufeng Yang², Bing Xia², Yunlong Shang³, Wenxin Huang¹, Chris Mi², ¹*Nanjing University of Aeronautics and Astronautics, China*; ²*San Diego State University, United States*; ³*Shandong University and San Diego State University, United States*

D14.3: Forward-Flyback Resonant Converter for High-Efficient Medium-Power Photovoltaic Applications

Oscar Andres Montes, Sungho Son, Sooa Kim, Hwasoo Seok, Jin S. Lee, Minsung Kim, *Pohang University of Science and Technology, Korea, South*

D14.4: Online Estimation of Capacity Fade and Impedance of Lithium-Ion Batteries based on Impulse Response Technique

Zhuo Yang, Devendra Patil, Babak Fahimi, *University of Texas at Dallas, United States*

D14.5: Non-Isolated Parallel Balancing Converter for Serially Connected Batteries String

Or Kirshenboim¹, Mor Mordechai Peretz¹, Ilya Zeltser², ¹*Ben-Gurion University of the Negev, Israel*; ²*Rafael Advanced Defense Systems Ltd., Israel*

- D14.6: Enhanced Digital PI Control with State-Variable Feedback Loop for DC Electric Springs**
Yun Yang, Siew-Chong Tan, Shu-Yuen Ron Hui,
University of Hong Kong, Hong Kong
- D14.8: Implementation of Distributed Power Balancing Strategy with a Layer of Supervision in a Low-Voltage DC Microgrid**
Maziar Mobarrez, Subhashish Bhattacharya, Daniel Fregosi, *North Carolina State University, United States*
- D14.9: High-Efficiency Bidirectional DC-DC Converter with High Voltage Conversion Ratio**
Min-Kwon Yang, Myung-Chul Lee, Woo-Young Choi,
Chonbuk National University, Korea, South
- D14.10: Maximum Power Point Tracking Control of a High Power DC-DC Converter for PV Integration in MVDC Distribution Grids**
Jingxin Hu, Philipp Joebges, Rik W. De Doncker,
Rheinisch-Westfälische Technische Hochschule Aachen, Germany
- D14.12: Distributed Control for Modular Plug-and-Play Subpanel Photovoltaic Converter System**
Yue Zheng¹, Yuan Li³, Su Sheng¹, Brad Scandrett²,
Brad Lehman¹, ¹*Northeastern University, United States;*
²*PowerFilm, INC, United States;* ³*Sichuan University, China*
- D14.13: Differentiation of ECM and Noise Model/Data Rejection for High-Capacity and High-Power Cell according to the Electrical Characteristics**
Hyunjun Lee², Joungghu Park², Jonghoon Kim¹,
¹*Chungnam National University, Korea, South;*
²*Soongsil University, Korea, South*
- D14.14: Control of Bidirectional DC/DC Converters in Reconfigurable, Modular Battery Systems**
Muhammad Muneeb Ur Rehman², Fan Zhang¹,
Regan Zane², Dragan Maksimovic¹, ¹*University of Colorado Boulder, United States;* ²*Utah State University, United States*
- D14.15: Model Predictive Control of Multi-String PV Systems with Battery Back-up in a Community DC Microgrid**
Shunlong Xiao, Mohammad B. Shadmand, Robert S. Balog, *Texas A&M University, United States*
- D14.16: A Decentralized Voltage Regulation Method for DC Distribution System with Self-Consumption Characteristic**
Moonhyun Lee², Woojin Choi¹, Jih-Sheng Lai², Bo-Hyung Cho¹, ¹*Seoul National University, Korea, South;* ²*Virginia Polytechnic Institute and State University, United States*
- D14.17: Coupled Inductor based ZVS High Step-Up DC/DC Converter in Photovoltaic Applications**
Cheng Li, Haoyu Wang, *ShanghaiTech University, China*

D15: AC Renewable Energy

Track: Renewable Energy Systems

CHAIR:

Haoyu Wang, *ShanghaiTech University*

- D15.1: Decentralized Voltage Restoration Method for Droop Controlled Parallel Operation Inverters in AC Microgrid**
Satoshi Sawano², Fumiiki Yoneda², Atsushi Okita²,
Masahiro Makino², Jun-Ichi Itoh¹, ¹*Nagaoka University of Technology, Japan;* ²*Panasonic Corporation, Japan*
- D15.2: An Experimental Study of MAF-SRF-PLL with Comb Compensator**
Menxi Xie¹, Canyon Zhu¹, Liqun He¹, Huiqing Wen²,
¹*Soochow University, China;* ²*Xi'an Jiaotong-Liverpool University, China*
- D15.3: SRF-PLL with in-Loop Differentiator Decouple Filter for Unbalanced Three-Phase Systems**
Menxi Xie¹, Canyon Zhu¹, Yong Yang¹, Huiqing Wen²,
¹*Soochow University, China;* ²*Xi'an Jiaotong-Liverpool University, China*
- D15.4: Distributed Maximum Power Point Tracking using Model Predictive Control for Solar Photovoltaic Applications**
Sally Sajadian, Reza Ahmadi, *University of Kansas, United States*
- D15.5: Dynamic Performance Analysis of Paralleled Virtual Synchronous Generators under Grid-Connected and Islanded Mode**
Zhenxiang Wang, Hao Yi, Jiaqi Wu, Fang Zhuo, Feng Wang, Zhirong Zeng, *Xi'an Jiaotong University, China*
- D15.6: Close Loop Control to Bidirectional Isolated Single Stage DAB with Resonant Circuit DC/AC Converter to Connection of Batteries to the Single Phase Grid**
Damian Sal y Rosas, David Frey, Jean-Luc Schanen, Jean-Paul Ferrieux, *Université Grenoble Alpes, France*
- D15.8: An Adaptive Control Strategy for Power Balance and the Intermittency Mitigation in Battery-PV Energy System at Residential DC Microgrid Level**
Janviere Umuhzoza, Yuzhi Zhang, Shuang Zhao, H. Alan Mantooth, *University of Arkansas, United States*
- D15.9: A State-of-Charge Balance Method for Distributed Energy Storage Units in Microgrid**
Qingfeng Wu, Xiaofeng Sun, Yanan Wang, Xin Li, Chunjiang Zhang, *Yanshan University, China*
- D15.10: Pulse Width Amplitude Modulation based Single-Phase Quasi-Z-Source Photovoltaic Inverter with Energy Storage Battery**
Yushan Liu³, Baoming Ge², Yichang Wu¹, Panagiotis Kakosimos³, Haitham Abu-Rub³, ¹*China Unicom Fuxin Branch, China;* ²*Texas A&M University, United States;* ³*Texas A&M University at Qatar, Qatar*

D15.11: Active and Reactive Power Control Method for Three-Phase PV Module-Integrated Converter based on a Single-Stage Inverter

Amir Moghadasi¹, Arman Sargolzaei², Masood Moghaddami¹, Arif Sarwat¹, Kang Yen¹,
¹Florida International University, United States;
²Florida Polytechnic University, United States

D15.12: Anti-Windup Predictive Current Controller Applied to a DFIG-based Wind Turbine under Low DC-Link Voltage

Samuel Vieira Dias, Tobias Rafael FF. Neto, Laurinda Lucia N. Dos Reis, Bismark Claire Torrico, Jose Carlos Teles Campos, *Universidade Federal do Ceará, Brazil*

D15.13: Adaptive Proportional-Resonant Controller based Reactive Power Control for Wind Energy Conversion Systems

Snehal Bagawade¹, Suzan Eren¹, Praveen Jain¹, Majid Pahlevani², ¹Queen's University, Canada;
²University of Calgary, Canada

D15.14: Microgrid Reliability Analysis under Distributed Degradation of Semiconductor Power Switch Modules through a New Stochastic Hybrid System Modeling

Mohammad Noor Bin Shaheed, Seungdeog Choi, Adam Long, *University of Akron, United States*

D16: Transportation Power Electronics

Track: Transportation Power Electronics

CHAIRS:

Navid Zargari, *Rockwell Automation*

Hadi Malek, *Ford Motor Company*

D16.1: Experimental Determination of Inverter Losses and Sound Consequences of using DPWM in an HEV

Andreas Andersson, Torbjörn Thiringer, *Chalmers University of Technology, Sweden*

D16.2: Inductive Power Transfer for Electric Bicycles Charging based on Variable Compensation Capacitor

Yang Chen, Ruikun Mai, Youyuan Zhang, Yong Li, Zhengyou He, *Southwest Jiaotong University, China*

D16.3: Design of a Secondary Side Regulated LLC based Integrated PEV Onboard Charger with Full ZVS Range

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

D16.4: Determining Coil Distance of Cross-Segmented IPT System for Constant Output Voltage

Mingkai Yang², Yanling Li², Ruikun Mai², Zhengyou He², Bin Wang¹, ¹China Railway Construction Heavy Industry Co.Ltd, China; ²Southwest Jiaotong University, China

D16.5: A Three-Phase Wireless Charging System for Lightweight Autonomous Underwater Vehicles

Tianze Kan¹, Ruikun Mai², Patrick Mercier³, Chris Mi¹,
¹San Diego State University, United States; ²Southwest Jiaotong University, China; ³University of California, San Diego, United States

D16.6: Mitigating Power Systems Variability in More Electric Aircraft Utilizing Power Electronics Implemented Dynamic Thermal Storage

Yue Cao, Matthew Williams, Philip Krein, Andrew Alleyne, *University of Illinois Urbana-Champaign, United States*

D16.7: Comparison of Passive Shields for Coils in Inductive Power Transfer

Ming Lu, Khai Ngo, *Virginia Polytechnic Institute and State University, United States*

D16.8: A Switched-Coupling-Capacitor Equalizer for Series-Connected Battery Strings

Yunlong Shang³, Fei Lu⁴, Bing Xia¹, Chenghui Zhang², Naxin Cui², Chris Mi¹, ¹San Diego State University, United States; ²Shandong University, China; ³Shandong University and San Diego State University, China; ⁴University of Michigan, United States

D16.9: High Power Factor Z-Source Resonant Wireless Charger

Hulong Zeng, Fang Zheng Peng, *Michigan State University, United States*

D16.10: Practical Aspects of Direct Bypass of Boost Converter in Traction Inverter Applications

Mohammed Khorshed Alam, Lihua Chen, Yan Zhou, Fan Xu, Shuitao Yang, *Ford Motor Company, United States*

D16.11: Efficiency Optimization for Wireless Dynamic Charging System with Overlapped DD Coil Arrays

Yeran Liu, Ruikun Mai, Pengfei Yue, Yong Li, Zhengyou He, *Southwest Jiaotong University, China*

D16.12: A Novel Zero Voltage Switching Inductive Power Transfer Topology using Current-Fed Converter for EV Battery Charging Applications

Suwendu Samanta, Akshay Kumar Rathore, *Concordia University, Canada*

D16.13: A Novel Protection Scheme for DC Electrical Railway Systems using High-Frequency Signal Injection

Amr Ibrahim, Hassan Abdelgaber, Matthew G. Granger, Yilmaz Sozer, Alex De Abreu-Garcia, *University of Akron, United States*

D16.14: A Voltage Stress Optimization Method of Capacitive Power Transfer Charging System

Bo Luo, Ruikun Mai, Yangqi Chen, Youyuan Zhang, Zhengyou He, *Southwest Jiaotong University, China*

D17: AC-DC, DC-AC, Grid and LED Applications

Track: Power Electronics Applications

CHAIRS:

Tilak Gopalarathnam, *LG Technology Center America*

Jim Moss, *Texas Instruments, Inc.*

D17.2: Effects of Circuit Nonlinearities on Dynamic Dead Time Optimization for a Three-Phase Microinverter

Seyed Milad Tayebi², Nasser Kutkut¹, Issa Batarseh²,
¹*Advanced Charging Technologies / University of Central Florida, United States*; ²*University of Central Florida, United States*

D17.3: An Adaptive Discontinuous Pulse Width Modulation (DPWM) Method for Three Phase Inverter

Fangcheng Liu, Kai Xin, Yunfeng Liu, *Huawei Technologies Co., Ltd, China*

D17.4: A Unity Power Factor Single-Stage Contactless Power Transfer System using Variable Frequency-Phase Shift Control

Xiaowei Sun, Guangzhu Wang, Xuan Wang, *Shandong University, China*

D17.5: An IGCT Anode Current Detecting Method based on Rogowski Coil

Hong Zeng, Xiulin Chen, Shunbiao Zhang, Yongshan Huang, Sanhu Wang, Fuguang Wang, Bin Liu, Danhua Hu, Honglin Tan, *CRRC Zhuzhou Institute Co.,Ltd., China*

D17.6: Experimental Validation of Linear AC LED Driver with Quantitative Design Method

Yuichi Noge², Hiroyuki Fuse¹, Takeshi Shimizu³,
¹*Tokyo Institute of Technology, Japan*; ²*Tokyo Metropolitan College of Industrial Technology, Japan*; ³*Yokohama National University, Japan*

D17.8: Modeling, Analysis and Design of a Dual-Input ZVS DC/DC Converter

Liang Yu, Haoyu Wang, *ShanghaiTech University, China*

D17.9: Active Elimination of DC Bias Flux in Series DC Active Filter Coupling Transformer

Richard Beddingfield, David Storelli, Subhashish Bhattacharya, *North Carolina State University, United States*

D17.10: Off-Line Buck LED Driver for Series Connected LED Segments

Jong-Bok Baek, Su-Yong Chae, *Korea Institute of Energy Research, Korea, South*

D17.11: Individual DC Voltage Balancing Method at Zero Current Mode for Cascaded H-Bridge based Static Synchronous Compensator

Zezhou Yang³, Jianjun Sun³, Shangsheng Li², Zhiqiang Liao³, Gangqiang Du¹, Xiaoming Zha³, Jiawen Fu³,
¹*Dongfang Electronics Co., Ltd., China*; ²*Wuhan Keliyuan Electric Co. Ltd., China*; ³*Wuhan University, China*

D17.12: Performance Analysis of RCD and MOV Snubber Circuits in Low-Voltage DC Microgrid System

Feiyang Zhu, Fei Liu, Wenjun Liu, Kun Feng, Xiaoming Zha, *Wuhan University, China*

D17.13: Advanced Control Strategies for Balancing LED Usage of AC LED Driver

Seung-Woo Baek², Soo-Bin Han¹, Hag-Wone Kim³, Su-Yong Chae¹, Jong-Bok Baek¹, ¹*Korea Institute of Energy Research, Korea, South*; ²*Korea Institute of Energy Research / Korea National University of Transportation, Korea, South*; ³*Korea National University of Transportation, Korea, South*

D17.14: Delta Interconnected Hybrid Three-Leg Converters

Edgard Fabricio¹, Cursino Brandão Jacobina², Maurício B. R. Corrêa², Reuben Palmer R. de Sousa², ¹*Instituto Federal da Paraíba, Brazil*; ²*Universidade Federal de Campina Grande, Brazil*

D17.15: An Unidirectional Single-Phase AC-DC-AC Three-Level Three-Leg Converter

Nustenil Marinus², Cursino Brandão Jacobina², Nady Rocha¹, Reuben Palmer R. de Sousa²,
¹*Universidade Federal da Paraíba, Brazil*; ²*Universidade Federal de Campina Grande, Brazil*

D17.16: Isolated Single-Phase AC Grid Connected Converter with Small Inductors and Capacitors for Micro-Inverters

Hiroki Watanabe, Jun-Ichi Itoh, *Nagaoka University of Technology, Japan*

D17.17: Stand-Alone Low-Cost Wave Energy Generation with Energy Storage Integration

Prathamesh Kamat, Samir Hazra, Subhashish Bhattacharya, *North Carolina State University, United States*

D17.18: A Simplified Control Strategy to Precisely Control the Reactive Power through Bi-Directional Switching in Single Phase Bidirectional AC/DC Converter for V2G Techniques

Maohang Qiu, Min Chen, Bo Liu, Lei Jing, *Zhejiang University, China*

D17.19: Buck-Type Wide-Range Dimmable LED Driver

Po-Yen Lin², Tsorng-Juu Liang³, Che-Wei Chang¹, Kai-Hui Chen³, Bin-Kun Huang³, ¹*Macrobloc, Inc., Taiwan*; ²*National Cheng Kung University, Taiwan*; ³*National Cheng Kung University, Taiwan*

D17.20: High Performance Multiple String LED Driver with Flexible and Wide Range PWM Dimming Capability

Mohammad Tahan, Tingshu Hu, *University of Massachusetts Lowell, United States*

D18: Power Electronics Applications

Track: Power Electronics Applications

CHAIRS:

Hoi Lee, *University of Texas at Dallas*

Yingying Kuai, *Caterpillar Inc.*

D18.1: Stabilization and Performance Preservation of DC-DC Cascaded Systems by Diminishing Output Impedance Magnitude

Ahmed Aldhaferi, Amir Etemadi, *George Washington University, United States*

D18.2: A Novel Resonant-Linear Hybrid Converter Applied in Microwave Wireless Power Transmission System

Ruian Tan, Ke Jin, *Nanjing University of Aeronautics and Astronautics, China*

D18.3: Design and Implement an Adaptive Position Adjustment Coupler for Coil-Misaligned Inductive Contactless Power Transfer System

Pingan Tan², Liangwei Ye², Saiqi Cao², Bo Zhang¹,
¹South China University of Technology, China;
²Xiangtan University, China

D18.4: 6.78 MHz Self-Oscillating Parallel Resonant Converter based on GaN Technology

Ricardo Bonache-Samaniego¹, Carlos Olalla¹, Luis Martínez-Salamero¹, Dragan Maksimovic²,
¹Universitat Rovira i Virgili, Spain; ²University of Colorado Boulder, United States

D18.5: An Optimal Parameters Design Methodology of Series-Series Resonant Tank of Wireless Power Transmission System for Battery Charging

Yongbin Jiang¹, Yue Wang¹, Junwen Liu¹, Xiufang Hu¹, Shiyuan Yin¹, Zhang Wang¹, Laili Wang², ¹Xi'an Jiaotong University, China; ²Xi'an Jiaotong University / Sumida Corporation, China

D18.6: MHz Frequencies, kW, 30 cm Gap Wireless Power Transfer with Low Air Gap Flux Density and High Efficiency using Surface Spiral Winding Coils

Cong Deng, Guangqi Zhu, Robert Lorenz, *University of Wisconsin-Madison, United States*

D18.7: Real-Time Integratable Isolated Voltage Monitoring Unit of Semiconductor Power Switch to Improve Power Converter Reliability

Hui-Chen Yang¹, Kye-Yak See¹, King Jet Tseng¹, Rejeki Simanjorang², ¹Nanyang Technological University, Singapore; ²Rolls-Royce Singapore Pte. Ltd., Singapore

D18.8: High Performance Boost Inverter Featuring GaN-based Devices for Electro Surgical Units

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

D18.9: Evaluation of Maximum System Efficiency and Maximum Output Power in Two-Coil Wireless Power Transfer System by using Modeling and Experimental Results

Yuan Cao, Jaber Abu Qahouq, *University of Alabama, United States*

D18.10: Unregulated Bus Operation of Server-to-Virtual Bus Differential Power Processing for Data Centers

Enver Candan², Pradeep S. Shenoy¹, Robert C.N. Pilawa-Podgurski², ¹Texas Instruments Inc., United States; ²University of Illinois Urbana-Champaign, United States

D18.11: Analysis of a Low Power, High Voltage and High Gain Capacitor Charger with Output Sourcing Behavior

Ilya Zeltser, *Rafael Advanced Defense Systems Ltd., Israel*

D18.12: A Battery Equalizer with Zero-Current Switching and Zero-Voltage Gap among Cells based on Three-Resonant-State LC Converters

Yunlong Shang², Naxin Cui¹, Qi Zhang¹, Chenghui Zhang¹,
¹Shandong University, China; ²Shandong University and San Diego State University, China

D18.13: High Frequency GaN-based Ultrasound Pulse Generator for High Energy Delivery

Han Peng¹, Juan Sabate¹, Kieran Wall², ¹GE Global Research, United States; ²GE Healthcare, Norway

D18.14: A Novel Dual Voltage Source Converter for Magnetic Material Characterization with Trapezoidal Excitation

Richard Beddingfield, David Storelli, Subhashish Bhattacharya, *North Carolina State University, United States*

D18.15: Performance Comparison of Two Controllers for a Modular Voltage Balancing Circuit

Atrin Tavakoli, Ian Smith, Ali Khajehoodin, John Salmon, *University of Alberta, Canada*

D18.16: Omnidirectional Wireless Power Transfer for Portable Devices

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

D18.17: A Single Stage AC/RF Converter for Wireless Power Transfer Applications

Ling Jiang², Daniel Costinett², Aly Fathy², Songnan Yang¹, ¹Intel Corporation, United States; ²University of Tennessee, United States

D18.19: Impact of GaN HEMT Dynamic On-State Resistance on Converter Performance

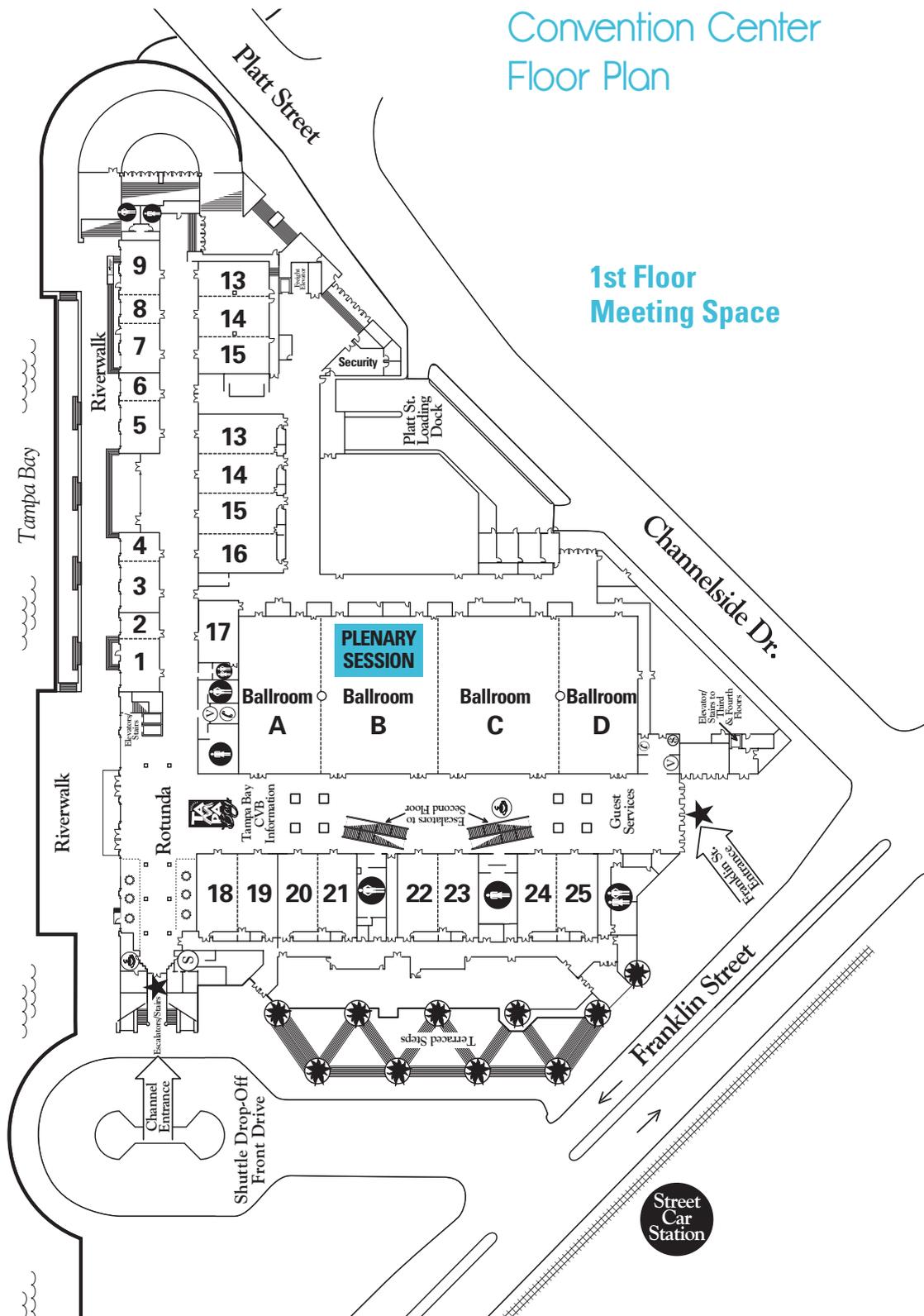
Yichen Cai, Andrew J. Forsyth, Rebecca Todd, *University of Manchester, United Kingdom*

Dialogue Sessions Floor Plan



Convention Center Floor Plan

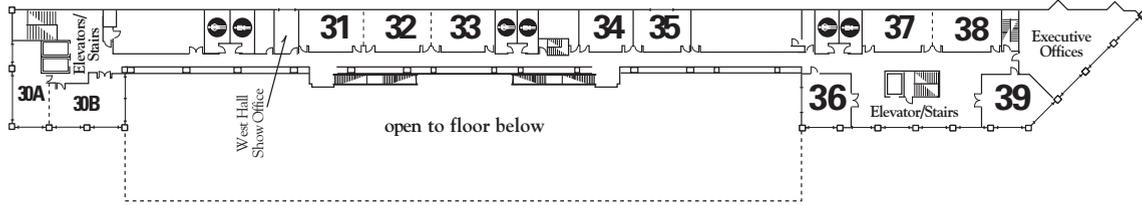
1st Floor Meeting Space



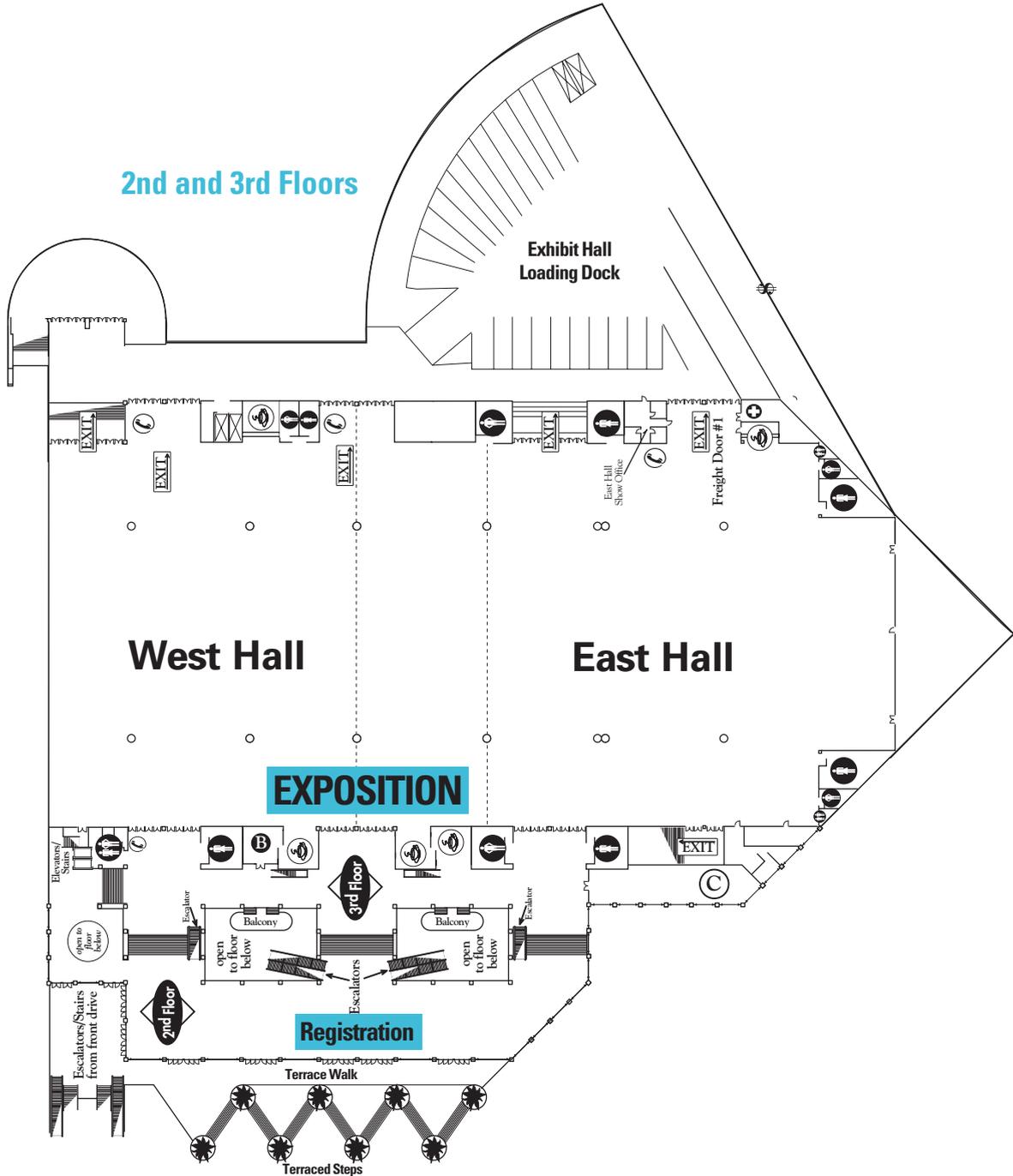
CONVENTION CENTER
FLOOR PLAN

CONVENTION CENTER
FLOOR PLAN

4th Floor



2nd and 3rd Floors





2017 Exhibitor Directory

2017 EXHIBITOR DIRECTORY

The APEC 2017 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 26th 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 2017. In addition, a special thanks goes to our eight 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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Our Partners

DIAMOND



PLATINUM



SILVER



Exposition Information

The Exposition will open on Monday, March 27 when the Plenary Session concludes.

Exposition Hours

Monday, March 27	5:00 p.m. – 8:00 p.m.
Tuesday, March 28	12:00 p.m. – 5:00 p.m.
Wednesday, March 29	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.

Exposition Functions

EXHIBIT HALL WELCOME RECEPTION

A Welcoming Reception will be held in the Exhibit Hall on Monday, March 27, from 5:00 p.m. until 8:00 p.m. Come join us for a Taste of Tampa! Registered spouses and guests are welcome.

EXPOSITION LUNCH AND BREAKS

Lunch will be served in the Exhibit Hall on Tuesday from 12:00 – 1:30 pm and on Wednesday from 12:00 p.m. – 2:00 p.m. free of charge to all who have access to the exhibit hall.

On Tuesday afternoon from 2:30 p.m. – 3:30 p.m., we will be having an ice cream social in the Exhibit hall.

The Wednesday morning coffee break will be served in the Exhibit Hall from 10:00 a.m. to 11:00 a.m.

Exposition & Giveaway

During all three days of the Exposition we will be giving away over \$3000 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 exposition.

Exhibitor Seminars

Exhibitor Seminars – Session #1

Tuesday, March 28 – 1:30 p.m. – 2:00 p.m.

STMicroelectronics

ROOM 1/2

Digital Control IC for PFC and L-C Resonant Converter

PRESENTED BY: Gianni Vitale

Digitally controlled combo IC delivers high performance in a 90W adapter with Transition Mode PFC and Primary Side Regulated L-C resonant based DC-DC stage.

Plexim

ROOM 11

Real-time Simulation using the PLECS RT Box

PRESENTED BY: Kris Eberle

Plexim develops and markets tools for the design of power electronic systems. The company's software PLECS is for complete system-level modeling. The RT Box is a new real-time simulation platform designed for Hardware-in-the-Loop (HIL) testing of a control system and Rapid Control Prototyping (RCP). This presentation will explore an example design life cycle for a solar inverter system application. The workflow uses PLECS for model development in conjunction with the RT Box to verify a real controller. Discretized code for the power stage will be generated and deployed onto the RT Box to test a TI C2000-based control system.

Mouser Electronics with Texas Instruments

ROOM 13

Wireless Power Telemetry

PRESENTED BY: George Lakkas and Cameron LaFollette,
Texas Instruments

Imagine checking parameters and fault statuses for your power system wirelessly on your smartphone.

No Server, Storage, or Switch Chassis to open, no meters to hook up for measurement of the power supply parameters like input/output voltage, current, power, or temperature. No GUI to launch and no PC/tablet needed to read the data. Imagine having "touchless" checking of system power health as you stand in front of your server and switch rack and read the data on your smartphone app. The implementation is here now. Join us as we review Texas Instrument's p.m.Bus power supply, FRAM data logging and NFC proximity monitoring project to see how you can implement this capability.

Mersen

ROOM 14

Safety and Reliability for Power Electronics

PRESENTED BY: Kian Sanjari and Jason Gibson

Session presents Mersen's commitment to develop industry-leading technologies to improve efficiency and reliability of power electronics equipment.

Key topics are:

- An Overview of Fast Acting Power Semiconductor Protection Fuses, plus an introduction to innovative hybrid DC overcurrent protection devices for EV applications.
- Air and Liquid Cooling solutions to provide thermal protection for semiconductor components. Efficient cooling is key to long term reliability and performance of fast switching semiconductor 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.

Venable Instruments

ROOM 22

Portable Frequency Response Analyzer for Field Application Engineers

PRESENTED BY: Michael Gray

Venable Instruments introduces the portable Model 5140 Frequency Response Analyzer for field applications.

In this seminar, Venable will walk through the steps to measure and display Bode or Nyquist plots, analyzing the data for stability. An actual design example for a power supply will be shown. Measuring components or networks and creating complex models using Venable RLC software will also be demonstrated.

The Model 5140 is a scaled-down, economically-priced version of its lab instrument predecessors. The 2-channel, 4 lb. FRA measures up to 100V Peak (AC+DC), with increased built-in protection not found with other portable units.

Danfoss Silicon Power GmbH

ROOM 23

Gamechanging Power Modules by Danfoss

PRESENTED BY: Ole Muhlfeld

Nowadays, power grids need sufficient extra capacity to meet short-duration peaking demand and reliability requirements. Battery energy storage systems (BESS) help to provide this power and facilitate the integration of variable wind and solar resources. Conversion efficiency of BESS is key for cost attractiveness and customer acceptance. Danfoss Silicon Power offers experience in designing and manufacturing of power modules for this industry. Within this seminar, Danfoss introduces a small-size, three-level SiC power module to accomplish the mission for BESS applications and grid-connected renewable.

Cognipower

ROOM 24

The Origins and Implications of Predictive Energy Balancing (PEB)

PRESENTED BY: Tom Lawson

The development process for PEB is described, from the initial concept to details of implementation. Strengths and weaknesses of PEB are considered. Once the principles are appreciated, PEB becomes another tool in the designer's toolbox. How does PEB change the preferred approach to switched mode power conversion challenges? A single-stage AC/DC converter with PFC is shown as an example.

Renesas Electronics America

ROOM 25

Simplifying Li-ion Battery Powered BLDC Motor Driver Design

PRESENTED BY: Tad Keeley

This seminar will describe a simplified robust solution for battery power BLDC motor drive applications. We will show how to utilize Renesas Lithium Ion (Li-ion) Battery Management IC in conjunction with a BLDC Motor Control and Driver IC. We will explore enhancements to the functionality and performance which includes authentication features to ensure Li-ion battery safety. The BLDC Motor Control and Driver IC is a single package solution which incorporates features for both sensor and sensor-less control for a three-phase BLDC motor. We will discuss advanced features such as self-aligned dead-time generator and programmable gate current adjustment.

Exhibitor Seminars – Session #2

Tuesday, March 28 – 2:15 p.m. – 4:15 p.m.

STMicroelectronics

ROOM 1/2

Synchronous Rectification in PoE Bridge for Improved Efficiency

PRESENTED BY: Rosario Attansio

Synchronous rectification in PoE bridge significantly improved available power to the devices and reduced thermal issues.

United Chemi-Con, Inc

ROOM 11

State of Art for Automotive Application Capacitor

PRESENTED BY: Mr. Tony Olita and Mr. Toshi Furukawa

Introduction of full line up for advanced automotive application and the strategic products.

Technical presentation about short duration of 2 ~3 times higher than the rated ripple current to demonstrate how to meet the durability of 15 years vehicle operation.

Typical EPS application will be discussed by using the thermal model of the products from the system design viewpoint and demonstrate the cost effective solution.

Powerrex Inc.

ROOM 13

7th Generation IGBT Modules Featuring Lower Losses and Higher Reliability

PRESENTED BY: Eric R. Motto

This presentation will review Mitsubishi's newest industrial IGBT modules featuring revolutionary high reliability packaging and state-of-the-art high efficiency 7th generation power chips. Modules with current ratings ranging from 75A to 1000A and voltage ratings of 650V, 1200V and 1700V will be presented. The new modules employ packages with industry standard outlines that utilize matched CTE materials to eliminate solder layers and provide a dramatic improvement in thermal cycling reliability.

Magnetics

ROOM 14

New Material Performance and Analysis of E-U Geometries

PRESENTED BY: Sam Davis

A comparison of Inductance, Watt Loss, and DC Bias performance differences seen over geometry. The study is intended to aid in geometry selection when choosing cores for high current inductors. Specific geometries include E-core, U-core, and round leg U-core test sets. Also a comparison of one and two leg winding configurations on the U-core sets. Updates to Magnetics material offerings will also be discussed.

SIMPLIS Technologies, Inc

ROOM 22

Performing AC Analyses on PFC Converters

PRESENTED BY: Christopher Bridge and Tom Wilson

Because the SIMPLIS Periodic Operating Point (POP) & AC analyses are performed at a single operating frequency, performing AC analyses on time-domain simulation models of PFC converters is challenging, since the circuit typically has no true steady-state when the line voltage is sinusoidal. In this seminar, we present and compare the results of three methods for measuring the loop gain, input and output impedance of a PFC converter generated with either an AC line voltage or a DC input employing either the SIMPLIS POP & AC analysis or the SIMPLIS DVM Multi-tone AC analysis.

Exxelia USA

ROOM 23

High Power Solutions

PRESENTED BY: James Tabbi

Exxelia is a global designer and manufacturer of high-reliability passive components and high-precision electromechanical solutions, with extensive experience in providing extremely reliable standard and custom high power solutions for power electronics, power generation and energy storage. The presentation will detail Exxelia's high power solutions with a focus on metallized and impregnated polypropylene and polyester Film capacitors; the new range of high voltage ceramic capacitors manufactured from a new ceramic dielectric material; long life-time, miniature and low ESR aluminum capacitors; and power transformers and inductors including water cooling products that keep your electronics cool when things get hot!

Linear Technology

ROOM 24

Designing & Optimizing Power Supplies in Several Simple Steps with the LTpowerCAD Design Tool

PRESENTED BY: Sam Young, Senior Applications Engineer, Linear Technology Corp.

System boards today have an increasing number of power rails and supplies. It is often more efficient and cost effective to design a customized onboard power solution for a given application. To simplify the design task and improve design quality and productivity, the LTpowerCAD[®] design tool package will be introduced in this presentation. The system level LTpowerPlanner[®] tool helps system engineers to plan and optimize a power management system. The converter design tool further enables engineers to design and optimize each power supply in five simple steps with good results. The LTspice[®] tool provides powerful simulation capability for details.

ZES ZIMMER

ROOM 25

Latest Trends in Precision Power Analyzers and Sensors

PRESENTED BY: Robert Emerson

This presentation will critically examine the increasing requirements placed on DC & AC power measuring systems and equipment in light of advancing technology in research and applications. Subjects covered will include high-frequency switching, efficiency, uncertainty characterization, impact of synchronization, waveform analysis, regulations and more.



Exhibitor Seminars – Session #3

Tuesday, March 28 – 3:00 p.m. – 3:30 p.m.

Infineon Technologies

ROOM 1/2

Gate-Driver ICs Enabling Highly Efficient Power Management Systems

PRESENTED BY: Hubert Baierl

Gate-Driver ICs used in SMPS are crucial links between control ICs and MOSFETs where gate-driving voltage, current and robustness requirements exceed control IC's capabilities. Gate-Driver ICs are key to attain high power-density and consistent robustness of the power supply solution. This session focuses on critical requirements of gate-driver ICs from an application perspective and highlights gate-driver IC solutions from Infineon. The audience will benefit from this session by gaining an understanding of the selection criteria to choose the right gate-driver IC solution for their particular use-case.

Micrometals, Inc.

ROOM 11

Online Design Tools for MHz Inductors

PRESENTED BY: Christopher Oliver

New online inductor design software will be discussed and demonstrated. The software is a free tool that functions within a web-based interface. The software will help the user select the most appropriate inductor powder core material and winding based on the application conditions that are provided by the user. The available core materials are well suited for applications with operating frequencies ranging from 50/60 Hz up to 25 MHz or higher. The software calculations include many non-linear effects, enabling accurate modelling of inductor performance. The demonstration will focus on designs in the MHz range.

Mouser Electronics with TDK Corporation of America and Panasonic Industrial Devices

ROOM 13

GaN Based Power Electronics and New Requirements for Passive Components

PRESENTED BY: Peter Di Maso, *Product Line Management – GaN Systems* and D. Matthew Reynolds, *Senior Marketing Manager – EPCOS Inc., A TDK Group Company*

GaN Systems e-mode GaN transistors are powering many of the electronics that are resulting in size, weight and cost

reduction while saving energy. Applications include wireless charging, data center power supplies, industrial motor drives, energy storage systems, automotive traction inverters, and on-board EV battery chargers. More compact, higher frequency designs require new characteristics for passive components like magnetics and capacitors. TDK Ceralink capacitors are essential in meeting those needs. While less capacitance is required due to higher frequency, current ratings per microfarad, resonant frequency, and maximum temperature all need to increase significantly, and are uniquely fulfilled by this new technology.

Panasonic Corporation

ROOM 14

X-GaN Reliability and Robust Design

PRESENTED BY: Tom Higuchi

The characteristics of GaN FETs to achieve high efficiency, downsizing and new topologies are well known. A less well known, though of very high interest benefit is the Reliability of GaN FETs for the Power Electronics market. Panasonic's HD-GIT FET achieves not only the JEDEC standard of static testing, but also beyond the JEDEC standard with dynamic testing. Panasonic will present how the counter measure to Current Collapse, proof of 10 year aging, Gate Robust design and so on was achieved.

OPAL-RT Technologies

ROOM 22

Lab-Scale MMC Test Bench for Power Hardware-in-the-loop (PHIL) Application

PRESENTED BY: Christophe Brayet Eng. p.m.P

OPAL-RT provides a complete Power Hardware-in-the-Loop (PHIL) solution for the entire V-Cycle Development to help engineers develop and test new MMC control algorithms (Rapid Control Prototyping, RCP).

The new OP1200 Lab-Scale MMC Test Bench is dedicated for research into innovative HVDC, AAC, FACTS, STATCOM and other interconnections that require flexible hardware architecture and allows testing of new topologies and switch configurations.

Using the complete software simulation environment RT-LAB MATLAB/Simulink® and XILINX System Generator with built-in models, this turnkey test bench is safe, easy-to-use and ideal for control development of MMC systems with Microgrid real-time simulation.

Dialog Semiconductor

ROOM 23

High Efficiency Inductor-less Power Converter Technology

PRESENTED BY: Patrick Fournier

Current trends in mobile devices like slimmer design and longer battery life is demands compact PCB design with less low profile components, improved power efficiency to address thermal challenges and increased reliability. In this session, a standalone high current inductor-less power management IC (DA9313) from Dialog Semiconductor will be introduced. DA9313 is suitable for applications supplied by voltages from 5V to 10.5V. It integrates industry's first inductor-less power converter. It provides best in-class efficiency over a very wide range of output current. Participants will gain knowledge on how to effectively use this solution to minimize PCB board space, increase efficiency, and reduce thermal stress in their design.

Taiyo Kogyo Co., Ltd

ROOM 24

Introduction to Optimal PCBs for Next Generation Power Electronics

PRESENTED BY: Ms. Mai Izumi

We will introduce High Current PCB which can run 1000A as PCB suitable for higher power handling power devices like latest SiC and Combination PCB which can solve both high current handling and fine pitches caused by miniaturization of the power device as PCB suitable for latest GaN.

We will also introduce Copper Inlay PCB which is suitable for countermeasures against heat of components like latest SiC and GaN.

Schunk Hoffmann Carbon Technologies AG

ROOM 25

Graphite-Based Solutions for (Power) Electronics Cooling

PRESENTED BY: Dr. Sandra Reisinger

Schunk Hoffmann Carbon Technology provides two graphite-based solutions for the electronics cooling industry.

The composite material, Aluminium Graphite, combines the low coefficient of thermal expansion, low density, and ready

machinability of graphite with the excellent thermal properties of aluminium to create an ideal thermal management material for high-reliability applications. Customized parts in various quantities and different platings are readily produced.

Our new, innovative phase change material is a novel approach to latent heat storage units. Its self-encapsulating nature means no additional casing is required. Its expand-to-shape production process allows for custom designs at attractive cost with optimal thermal properties.

Exhibitor Seminars – Session #4

Tuesday, March 28 – 3:45 p.m. – 4:15 p.m.

Ridley Engineering Inc

ROOM 1/2

New Design Tools for Power Supplies

PRESENTED BY: Dr. Ray Ridley

The new SPICELaunch feature of POWER 4-5-6 fully automates spice model generation, greatly accelerating your design process with revolutionary new accuracy for magnetics.

Powerful new tools are now available to generate realistic winding loss models for transformers and inductors. Define your magnetics winding structure, and with the push of a button, advanced spice models are generated. This allows any engineer to take advantage of proximity loss analysis without having to do any difficult math. The results are profound – winding losses can be ten times higher than predicted with conventional models and you can see this early in your design cycle.

KEMET Electronics

ROOM 11

Design Tools for Selecting Your Passive Components

PRESENTED BY: Wilmer Companioni

The electronics industry is highly competitive and fast-paced. To keep up with the demands of the market, engineers and designers must push cycle times down without sacrificing quality. For component manufactures, it is no longer enough to provide just components and datasheets. For anyone using components, design and simulation tools are essential in staying competitive and responsive. KEMET has developed a set of design tools that engineers can rely on and assist with their needs.

Myway Plus

ROOM 13

Integrated Digital Platform for Power Electronics Model Based Design

“All-in-One package for Advanced R&D”

PRESENTED BY: Noriyasu Matsuno

Myway Plus Corporation is known as the most popular R&D tool and inverter provider in Japan, placing full emphasis focusing on only Power Electronics. Introducing PE-Expert4, the control and measurement platform with user friendly GUI for C programming and FPGA design, it's perfectly suitable for advanced Power Electronics applications, such as motor control and analysis, MMC (Multi Module Converter) with multiple many gate controls and any type of complex system. In addition, measurement features such as power meter and oscilloscope are integrated in a single box coming with scripting functions so that most of the operations can be automated to optimize various parameters.

Artic Sand Technologies Inc.

ROOM 14

Next Generation DC-DC Converter Architecture Brings Significant Improvements in Efficiency & Size

PRESENTED BY: Stephen Allen

Arctic Sand will introduce ground breaking new DC-DC converters using a unique power architecture based on IP originating from MIT, which provides dramatic improvements in efficiency, solution footprint, profile, EMI, and ripple compared with traditional power solutions today. Arctic Sand will present their first products using this technology – LED boosts for LCD displays for notebooks, tablets and smartphones – that typically halve the power losses, and enable ultra-thin platforms. We will also explain some of the fundamentals of the architecture, and present examples of where Arctic Sand will be employing the technology and the significant advantages over existing solutions.

FTCAP GmbH

ROOM 22

Capacitor Solutions for Severe Conditions

PRESENTED BY: Dr. Thomas Ebel

A clear trend in power electronics is to increase the power density of the passive components. That means to increase

the ripple current load or to increase lifetime and/or to operate the components at higher switching frequencies.

FTCAP has developed new concepts e.g. cubic axial capacitors with entire laser welded Al-metal housing to increase significant the ripple current load, having a 28% bigger surface and allowing a better heat sink connection and a significant lifetime enhancement.

The patented Fischer-Link concept reduces the parasitic inductances to a minimum value below 10 nH/capacitor, allowing low loss operation at higher switching frequencies.

Abstract Power Electronics

ROOM 23

Primate Power™ Sources Use SiC Devices to Improve Efficiency & Response Time

PRESENTED BY: Jeff Reichard

High efficiency, high bandwidth power sources are what engineers need in the labs and what OEMs can use to improve products. Primate Power™ achieves this and more with the use of SiC devices. Reduced losses allow for higher switching speeds that improve load and source management. The Primate Power™ Sources are compact, rugged and versatile with power ranges of 4 kW through 300 kW and voltages up to 690 VAC / 1200 VDC. Abstract Power Electronics introduces the power source that is ideal for testing batteries and high-speed motors, simulating grids, and much more.

Wolverine Tube Inc. – MicroCool Division

ROOM 24

MicroCool Presentation

PRESENTED BY: Mike Holland

Wolverine Tube has been in business for 100 years providing innovative thermal solutions to the automotive and HVAC industries with enhanced copper tube. The MicroCool® Division has leveraged the company's proprietary MDT technology to produce novel cold plates and integrated base plates for optimal liquid cooling solutions for the Electronics Industry.

Pacific Sowa Corporation C/O Epson Atmix Corporation

ROOM 25

High U Super Low Core Loss Nanocrystalline Power "KUAMET NC1"

PRESENTED BY: Masahito Yoshizawa

Epson Atmix KUAMET® series is high performing amorphous powder. NC1 is nanocrystalline powder. The u increases by 10% and core loss decreases by 25% 9A4 is amorphous powder with 15% higher saturation properties. They contribute to longer battery life, prevention of a fever and downsizing in devices.

**Compared to our conventional amorphous powder.*

Exhibitor Seminars – Session #5

Wednesday, March 29 – 10:30 a.m. – 11:00 a.m.

Hitachi America, Ltd

ROOM 1/2

next High Power Density Dual Module with Next Generation Chip Beneficial in Low Inductance Application

PRESENTED BY: Katsuaki Saito

In this presentation, next generation IGBT technologies suitable for next generation packaging with low inductance are shown. Hitachi have shown nHPD2; "next High Power Density Dual" can reduce inductances by 75% that can eliminate undesirable oscillation which realizes the benefit of wide band gap semiconductors. IGBT structure having low feedback capacitance can improve the trade-off relation between low switching loss and switching dv/dt especially in the low inductance circuit. Furthermore, the resulting benefits of SiC SBD in nHPD2 combined with the next generation small feedback capacitance IGBT are explored.

Typhoon HIL, Inc

ROOM 11

Controller Hardware-in-the-Loop (CHIL) nanosecond resolution "flight simulator" for future Microgrids

PRESENTED BY: Dr. Ivan Celanovic, Co-Founder and Director of 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 in complex ways. Indeed, grid is becoming a true cyber physical system with a layered architecture comprising both power processing and control and communications. In this talk we will present a new approach to power electronics and power system controls testing and validation based on ultra-high fidelity Controller Hardware-in-the-Loop (CHIL) real-time simulation.

Coilcraft, Inc.

ROOM 13

New Power Inductor Selection Process for Best Power Converter Performance

PRESENTED BY: Len Crane

Coilcraft introduces powerful enhancements to the highly popular web-based suite of power inductor selection and analysis tools. New data-driven views of power inductor performance enable designers to rapidly and effectively optimize converter performance. The Coilcraft tools provide for quick selection based on desired parameters and enhanced graphical results for analysis under a variety of operating conditions. This seminar demonstrates the use of the new tool features for optimizing inductor selection and understanding performance in realistic application conditions.

Teledyne LeCroy

ROOM 14

Using the Teledyne LeCroy Motor Drive Analyzer to Optimize Motor/Drive Performance During a Single Semiconductor Device Switching Period

PRESENTED BY: Ken Johnson,
Director of Marketing, Product Architect

Optimization of control systems and drive performance requires calculation of power activity during very short time periods that correspond to the power semiconductor device switching period. The Teledyne LeCroy Motor Drive Analyzer (MDA) provides such power analysis with correlation of power activities to typical control system signals. This session will showcase testing done using the MDA for variable flux electric machine analysis, volt-second sensing control analysis in a Deadbeat-Direct Torque and Flux (Motor) Control (DB-DTFC) and comparison of dynamic losses for various DTFC and Vector field-oriented controlled (FOC) surface and interior permanent magnet motors (SPM and IPM).

Wurth

ROOM 20

Exploring and Designing in PoE Magnetics

PRESENTED BY: Stephen Scharlman

The need for both sourcing power and filtering radiated noise from either the system or the surroundings to ensure high quality data signal places a large focus Ethernet's primary magnetic component, the LAN transformer. The importance of understanding and selection of magnetic component in high speed Ethernet communication is critical while design in the application. We'll discuss these situations in the PoE Magnetics course

Transphorm, Inc.

ROOM 21

How to Design with GaN in an Hour or Less

PRESENTED BY:

Philip Zuk, *Sr. Director, Technical Marketing, Transphorm*
Gaetan Campeau, *President, Telcodium Inc.*

Welcome to the GaN Revolution! Gallium Nitride (GaN) is the recognized solution to the industry's power density challenge, delivering over 99 percent efficiency and reducing energy loss by more than 40 percent, but is not without its challenges. GaN leader Transphorm, along with power supply manufacturer Telcodium, will address critical power design requirements and complexities. Further, they will introduce innovative techniques and tools built on Transphorm's JEDEC-qualified GaN FETs that dramatically reduce design time, giving designers the unprecedented ability to develop any switch mode power supply across a range of power levels—in an hour or less. Join the revolution!

SP Control Technologies

ROOM 22

The innovation in SP Control Technologies

PRESENTED BY: Jose Maria Molina

The challenge for the Power Electronic designers is developing power systems with higher power densities in each generation, as well as robustness, safety and, the most difficult requirement, within the shortest time. Sp Control Technologies proposes a software to design and implement your controls in a very fast way and without changing your hardware. This software is the SpTool and will allow you to test all your ideas very efficiently. Great innovations always start with small changes and here you have one opportunity.

Exhibitor Seminars – Session #6

Wednesday, March 29 – 11:15 a.m. – 11:45 a.m.

Semikron

ROOM 1/2

Power Converter Development: Reducing Time to Market

PRESENTED BY: Paul Drexhage, SEMIKRON Inc.

For Project and Engineering Managers, the task of overseeing the development of a power electronics converter in an aggressive time frame can be daunting. Fortunately, new standardized building blocks are bringing us closer to “plug and play” systems that not only reduce development time but are also aimed at cost-effective volume production. Come see a power semiconductor manufacturer's view on development costs, processes, and a universal control solution from National Instruments catering to systems from 50kW to 10MW+.

IWATSU ELECTRIC

ROOM 11

Power Loss Measurement for High Phase Angle Magnetics Core

PRESENTED BY: Ryu Nagahama

High-frequency transformers used in switching power supplies and DC-DC converters suffer current leakage, which increases as the handled frequency increases. The causes of the leakage include hysteresis loss and eddy-current loss. The heat generated by lost current causes the temperature of the equipment to rise, making it difficult to reduce the size of equipment. Measuring core loss of soft magnetic parts provides the best solution to minimizing loss and enabling further reductions in equipment size. For the development of magnetic material, IWATSU measurement, has a solution of BH analyzer.

Efficient Power Conversion Corporation

ROOM 13

GaN Transistors for Efficient Power Conversion

PRESENTED BY: Alex Lidow, Ph.D.

In a post-silicon world, GaN is taking power conversion to the next level. Gallium nitride transistors are rapidly being designed into many power conversion applications. This seminar will provide an update on the state-of-the-art in GaN transistor technology, highlighting the latest generation of EPC enhancement-mode GaN products and end-use applications including high power density DC-DC converters, high frequency envelope tracking, LiDAR, and wireless power transfer.

SBE, Inc.

ROOM 14

Advancements in DC Link Design for the Next Gen Inverters

PRESENTED BY: Michael Brubaker

Inverter power density is limited by the size of the DC link capacitor required. The SBE Power Ring Film Capacitor™ offers a novel annular form factor with a much higher ampere per micro-Farad rating than conventional film “cans”. When integrated with an optimized bus structure as a “surface mount” capacitor, very low inductance can be achieved to allow faster switching. This topology approach provides more power per dollar spent on solid state switches and is an enabling technology for utilizing next generation silicon carbide devices. An overview of the SBE technology advantage will be presented along with various product examples.

Zipalog, Inc

ROOM 20

System and Fault Scenario Analysis for Power Management IC's

PRESENTED BY: Felicia James

Designing integrated circuits for today's complex power electronics systems poses numerous challenges to successfully address system requirements. Much of the focus during design is addressing the chip performance during normal operation. However, designing circuitry that meets requirements for expected behavior during fault scenarios requires significant design expertise and can easily compromise normal parametric performance. Power systems with complex loads and sources pose interesting challenges for the design engineer and the simulators that help analyze the design. This session will examine approaches to evaluate common fault scenarios such as system opens and shorts and harness faults during analog integrated circuit design.

Powersim Inc.

ROOM 21

Integrating PSIM & SPICE for System Level to Device Level Simulation

PRESENTED BY: Albert Dunford

This session will introduce key features in the new PSIM release, especially the new SPICE engine. The new release allows designers to use the same schematic and environment for both device and system level simulations. With the robust PSIM engine, one can carry out studies and proof of concept

quickly in terms of topology, energy storage, and control needs. With the SPICE engine, one can utilize industry SPICE models and study switching transients, gate drive requirements, parasitic interactions, and other device level phenomena. Other features, such as InstaSPIN support for sensorless motor control, will also be presented.

Synopsys, Inc.

ROOM 22

Saber Periodic AC (PAC) analysis and Power MOSFET Tool

PRESENTED BY: Alan Courtay

Saber, a leading circuit simulator, addresses the engineering needs of the power electronic community with two new features:

1. PAC is a simulation analysis producing Bode plots for non-linear switching circuits that allows the stability of SMPS regulation loops to be analyzed without the need for averaged models.
2. The new power MOSFET tool quickly generates accurate models from datasheets and is applicable to Silicon Carbide. Static and dynamic behaviors are accurately matched over a range of temperatures, including gate charge characteristic, body diode reverse recovery, switching characteristics and thermal impedance.

Altair

ROOM 23

Multiphysics Modeling – Optimizing current input to cancel torque ripple

PRESENTED BY: Philippe Wendling

Torque ripples and cogging torques lead to vibrations in machines. Noise generated by these vibrations, especially in the automotive industry, need to be addressed and limited if not eliminated. Through a multi parameters and multi constraints optimization in a multidisciplinary environment, topology and signal are optimized to cancel torque ripple. The workflow of such optimization is presented in this session.

Exhibitor Seminars – Session #7

Wednesday, March 29 – 12:00 p.m. – 1:00 p.m.

LTEC Corporation

ROOM 1/2

Improve New Product Positioning, Reduce Time to Market, Protect Your IP Through Benchmarking and Deep Analysis

PRESENTED BY: Louis Burgyan

A time-efficient and cost-effective methodology to generate competitive product/market intelligence through reverse engineering and benchmarking, pursued in close collaboration with participating companies active in the field of power electronics, vehicle electrification, wide bandgap semiconductors, communication, and consumer electronics sectors, is described. Actual examples highlighting the multiple benefits of the approach both in terms of product definition, positioning, market timing, and patent portfolio development and protection are highlighted. The various ways of collaborative engagements with the engineering community in the early phase of product development, when access to product/market intelligence is critical, are discussed.

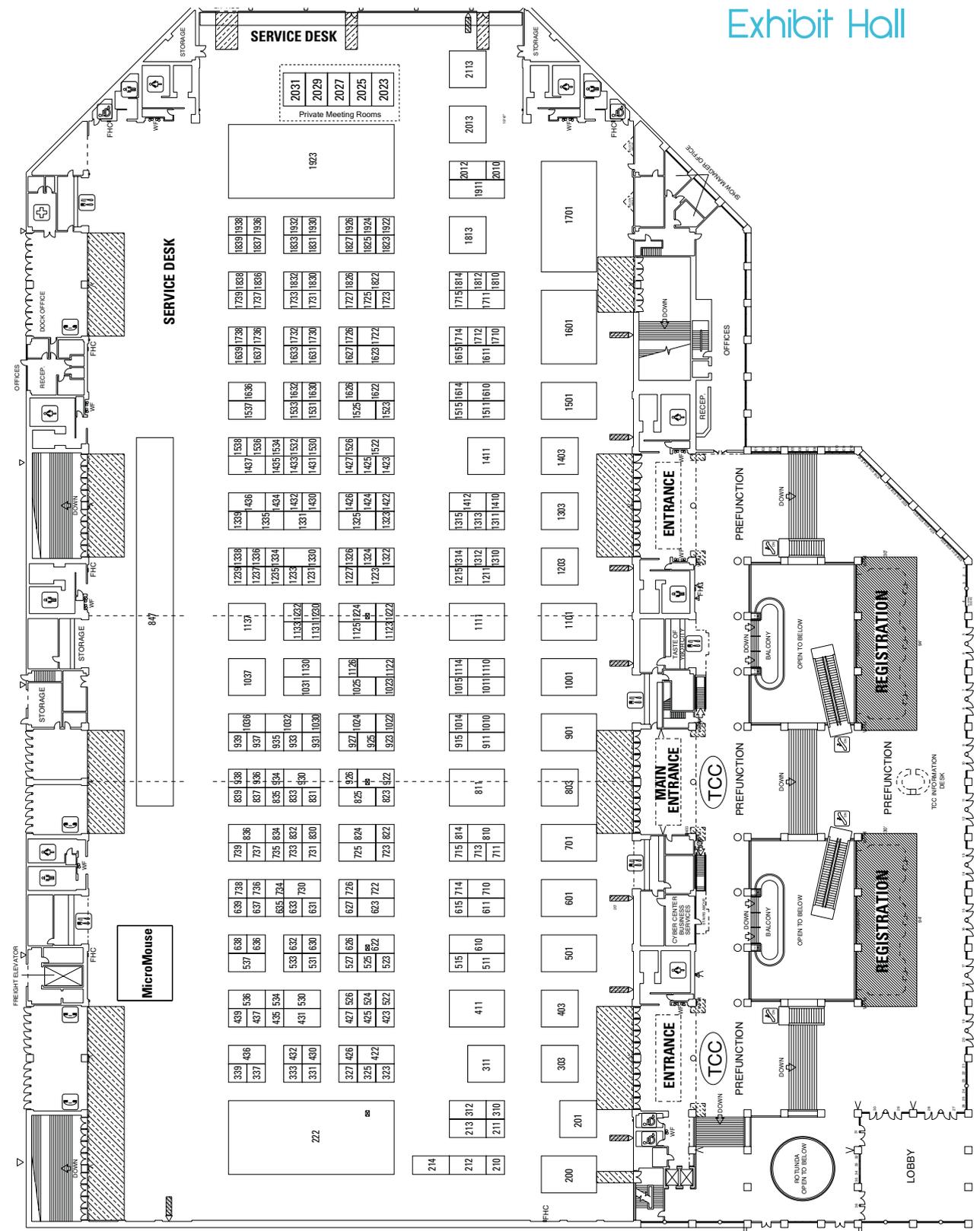
Microchip Technology, Inc.

ROOM 11

Using Core Independent Peripherals (CIPs) to Build a Custom Control

PRESENTED BY: Keith Curtis

Microcontrollers have revolutionized switch mode power in recent years and now Core Independent Peripherals (CIPs) are set to revolutionize microcontrollers used in switching power supplies. CIPs will accomplish this by making it possible to design custom autonomous switching power supply controllers on-chip. This presentation will discuss the various CIPs and how they can be combined to produce a variety of custom controls. Also included are several examples of optional extras such as trouble shooting options, current limit, continuous/discontinuous switching, Soft-start, and Constant on time configurations. Finally, the presentation will include a discussion of the Microchip Code Configurator tool and how it simplifies the design and implementation of CIP designs.



Exhibitor Listing

as of 2.1.17

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AKG of America, Inc.	1239
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Typhoon HIL, Inc.	630
United Chemi-Con	1010
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VAC Magnetics, LLC	922
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Versatile Power	734
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Yole Developpement & System Plus Consulting	839
ZES ZIMMER Inc.	832
ZEZ-SILKO	325
Zhuzhou CRRC Times Electric Co., Ltd	501
Zipalog	2010

Exhibitor Company Descriptions

5S Components Booth 1437

630 Fifth Ave
 East McKeesport, PA 15035
 USA
www.5SComponents.com

5S Components a Master Distributor of Power Electronic Components and Services represents the following Best-In-Class Partner Companies/Products:

ABB Power Semiconductors & Current/Voltage Sensors
 ICAR Power Electronic Capacitors* Danotherm Power Resistors* Power Integrations(PI) IGBT Gate Drives* Astrol Technical Power Assemblies.

Come by our booth for the latest product updates!

Aavid Thermalloy Booth 431

1 Aavid Cir
 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 1733

B-1-101, Hong Xing Hong Business Building, Beiqiji
 Beijing, 102209
 China
www.abcstone.com.cn

ABC Trading Beijing Co., Ltd. is the specialist of reliable and quick measuring techniques, which characterize non linear features of soft magnetic materials under sinusoidal and pulse excitation, to design, optimize and model power inductive components

Abstract Power Electronics Booth 524

N57 W39463 State Rd 16
Oconomowoc, WI 53066
USA
www.AbsPE.com

Abstract Power Electronics specializes in SiC based high frequency converters of many configurations that are customizable for OEMs. We also offer Primate Power – rugged, compact, efficient power sources. They are bi-directional, used to simulate grids, test batteries, and more.

AC POWER CORP. (Preen) Booth 526

192 Technology Dr
Suite S
Irvine, CA 92618
USA
www.preenpower.com

Established in 1989 Preen have become a major manufacturer of AC and DC Power Sources and Static Type Frequency Converters. Preen is considered to be the world leading manufacturer of large capacity power sources widely used in industrial and military testing applications.

ACME Electronics Corporation Booth 327

No. 2, Fuqian Zast Rd
Zengjiang St, Zast Square
Guangzhou-Zengcheng,
China
www.acme-ferrite.com.tw

Our corporate philosophy is rooted firmly in achieving and maintaining MANUFACTURING EXCELLENCE through the efficient production of the highest quality products for our customers.

Acopian Power Supplies Booth 725

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 939

17711 Mitchel N
Irvine, CA 92614
USA
www.adaptivepower.com

APS offers an extensive line of AC and DC power equipment to support a wide range of power test applications. Markets served include production test, household appliance and consumer product manufacturing, defense, commercial aviation, telecommunications, industrial manufacturing and compliance testing.

Adelser Booth 1130

2200 Gateway Centers Blvd
Suite 213
Morrisville, NC 27560
USA
www.adelser.com

ADELSEER is designing, producing or refurbishing power electronics stacks from kW to MW. With more than 40 years of experience in power electronics, ADELSEER is able to provide advanced support to our customers for any type of inverter or rectifier.

Advanced Cooling Technologies, Inc. ... Booth 723

1046 New Holland Ave
Lancaster, PA 17601
USA
www.1-act.com

Advanced Cooling Technologies, Inc. (ACT) is a premier thermal management solutions company. Under our ISO9001 and AS9100 certifications, we design and manufacture products for diverse applications including satellite thermal control, commercial/military electronics cooling and temperature calibration. In addition, our responsive, customer-focused team provides innovative engineering and advanced research and development services for clients worldwide.

Agile Magnetics Booth 1432

24 Chenell Dr
Concord, NH 03301
USA
www.agilemagco.com

Agile Magnetics is a world-class designer and manufacturer of custom magnetic components of all types, frequencies, and power levels; providing designs that are optimized for size, efficiency, and cost; and executing manufacturing with extraordinary quality and delivery reliability.

AgileSwitch, LLC Booth 836

2002 Ludlow St, #4
Philadelphia, PA 19103
USA
www.AgileSwitch.com/home.html

AgileSwitch is a pioneer in Intelligent Gate Drivers and Stack Electronics for IGBT and WBG Devices providing industry leading performance. Software configurability and patented switching techniques allows for easy adaptation to both standard and complex applications alike.

AKG of America, Inc. Booth 1239

7315 Oakwood St
Mebane, NC 27302
USA
www.akg-america.com

AKG develops and produces custom engineered heat transfer products for: trains, buses, cars, agricultural & construction machinery, large engines, power electronics, gensets, wind turbines and aircraft. AKG has an international reputation for producing heat transfer products with high performance, extreme reliability and superior quality.

All Flex Flexible Circuits and Heaters . . . Booth 1833

1705 Cannon Ln
Northfield, MN 55057
USA
www.allflexinc.com

An industry leading flexible circuit and heater manufacturer providing prototype in high volumes with component assembly. Flex circuits include single-sided, double-sided, multilayer, long Maxi-Flex with fine line capability. Quick turn custom and stock polyimide and silicone rubber heaters. Has provided flexible solutions to the medical, aerospace, military, and industrial markets for 25 years.

Allstar Magnetics Booth 1631

6205 NE 63rd St
Vancouver, WA 98661
USA
allstarmagnetics.com

Allstar Magnetics uses its depth of knowledge of all things magnetic to streamline critical elements of the customer's product lifecycle. In doing so, Allstar has developed into the leader in next generation distribution services. We look forward to working with you.

Alpha & Omega Semiconductor Booth 1025

475 Oakmead Pkwy
Sunnyvale, CA 94085
USA
www.asomd.com

AOS is a designer, developer and global supplier of power semiconductor products, which are aimed at applications such as portable computers, flat panel TVs, LED lighting, smart phones, battery packs, consumer and industrial motor controls, and power supplies for TVs, computers, servers and telecommunications equipment.

Alpha Assembly Solutions Inc. Booth 1232

300 Atrium Dr
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 1615

3151 Jay St, 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.

Altair Booth 1222

1820 E Big Beaver Rd
Troy, MI 48083
USA
www.altair.com/

Altair is focused on the development of simulation technology for the design of power electronics systems, providing leading electromagnetic simulation software for problems from low to high frequencies, coupled with systems level analysis tools to generate optimized & high-performance products.

Ametherm, Inc. Booth 1426

961 Fairview Dr
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 Co., Ltd. Booth 1739

600-4, Wonsan-Ri, Hasung-Myun
Gimpo-Si, Gyeo 415-887
South Korea
www.amoscore.com/

Amorphous cores are the ideal solutions for implementing energy storage(Solar & wind Inverter) chokes in several types of SMPS even in high frequency and high power ranges for increasing the power efficiency.

Amorphous cores as a soft magnetic component are made by iron based thin amorphous ribbon(divided to Fe amorphous, Nanocrystalline & cobalt) with a high saturation magnetic flux density, 1.56T and low core loss.

Amphenol Interconnect Products Booth 1511

20 Valley St
Endicott, NY 13760
USA
www.amphenol-gis.com/products/power

Amphenol offers many different options to customer for Power Distribution for many markets ranging from traditional Datacom applications to Data Centers and many industrial applications including EV Applications to Alternate Energy.

Analog Devices Booth 213

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

Anhui Specialsun Electronic Technology Co., Ltd. Booth 1936

Lingji Ave #58, Industrial Park, Mingguang City
Anhui, China
Ming guang, An hui, 239400
China
www.sps-elec.com

Specialsun Electronic Technology is a professional and modernized manufacturer of diode and bridge rectifier with great R&D support, flexible production capacity and worldwide sales network. We has always pursued the science and technology for first, integrity-based business philosophy.

Anpec Electronics Booth 1630

9890 Irvine Center Dr
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 814

2600 ANSYS Dr
Canonsburg, PA 15137
USA
www.ansys.com

ANSYS is the global leader in engineering simulation. We help the world's most innovative companies deliver radically better products to their customers. By offering the best and broadest portfolio of engineering simulation software, we help them solve the most complex design challenges and engineer products limited only by imagination.

Apex Microtechnology Booth 1736

5980 N Shannon Rd
Tuscon, AZ 85741
USA
www.apexanalog.com

Apex Microtechnology offers industry-leading power analog innovation for applications requiring high precision control of current, voltage and speed in the industrial, defense and aerospace, medical, and semiconductor capital equipment markets.

Arctic Sand Technologies Inc. Booth 432

25 Burlington Mall Rd
Suite 416
Burlington, MA 01803
USA
www.arcticsand.com

Arctic Sand is developing ground breaking DC-DC power management ICs using a unique patented power architecture based on IP from MIT. The technology brings significant increases in efficiency and reduction in size for next generation mobile and datacom applications.

AVX Booth 1024

1 AVX Blvd
Fountain Inn, SC 29644
USA
www.avx.com

AVX is a leading manufacturer & supplier of electronic passive components and interconnect solutions offering a broad range of devices including capacitors, resistors, filters, couplers, timing and circuit protection devices and connectors which are found in many electronic devices worldwide.

Baknor Thermal Management Booth 636

5225 Orbitor Dr
Suite 2
Mississauga, ON L4W 4Y8
Canada
www.baknor.com

Thermal management solutions to achieve performance for your power electronic designs. Our extensive knowledge of what is required in cooling power components weighs various trade offs and factors such as costs, packaging, manufacturability, efficiency, and reliability. Let Baknor help dissipate your heat. Baknor also provides Bus Bar solutions.

BH Electronics Booth 738

12219 Wood Lake Dr
Burnsville, MN 55337
USA
www.bhelectronics.com/

BH Electronics is a world class leader in the Design, Manufacture and Distribution of Magnetic Components & Assemblies for Communication, Instrumentation, Medical, Military, Aerospace, Video/Audio Signal Distribution plus other Industries. High Frequency, High Temperature, High Voltage Isolation + Intrinsically Safe designs.

Bomatec International Corp. Booth 533

400 Finchdene SQ
Unit 6
Toronto, ON M1X 1E2
Canada
www.bomatec.com

Cores and Chokes by Nanocrystalline and amorphous material, Ferrite, Sendust, MPP, FeSi, FeNi, FeCoV, CoFeNi and other soft magnetics

Brownsburg Elektronik Booth 430

741 Lowe St
Lachute, Quebec, J8HHN9
Canada
www.bei.net

Transformers • Coils • Inductors Custom Designs • Quick Delivery

CAEN Technologies Booth 1838

1140 Bay St
Suite 2C
Staten Island, NY 10305
USA
www.caenels.com

Unipolar or true-bipolar power supplies with output ranges from amps to tens of Kiloamps, watts to Megawatts. Universal digital platform (FPGA / dual-ARM core / DSP / Linux) for applications and custom designs. DCCT current sensors and complete digital current measurement system produce accuracy to < 50 ppm, with full ranges up to 1000A.

CalRamic Technologies, LLC Booth 1712

Mfg. Facility
5462 Louie Ln
Reno, NV 89511
USA
www.calramic.com

High Voltage Ceramic Capacitors, 500V to 30,000V manufactured in the United States for a variety of applications from Geothermal, Medical, Commercial, and Military Aerospace, Pulse Power, and Hi-Rel Space. Low quantities to high quantities, Commercial to Custom orientations.

Celem Power Capacitors Booth 527

212 High Tech Village
 P.O. Box 39109 Jerusalem
 9139002
 Israel
www.celem.com

Celem develops and manufactures Power capacitors for Induction Heating and Wireless Power Transfer. Celem excels in high frequency and medium frequency high power applications. Celem was established over 50 years ago and has unique patented designs for special power applications.

Central Semiconductor Corp. Booth 1133

145 Adams Ave
 Hauppauge, NY 11788
 USA
www.centalsemi.com

Since 1974 Central Semiconductor has manufactured innovative discrete semiconductors used in end products worldwide. Products currently include standard and custom small signal transistors, bipolar power transistors, MOSFETs, diodes, rectifiers, protection devices, current limiting diodes, bridge rectifiers, thyristors, and silicon carbide devices.

Chroma Systems Solutions, Inc. Booth 722

19772 Pauling
 Foothill Ranch, CA 92704
 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 515

3217 Phoenixville Pike
 Malvern, PA 19355
 USA
www.cognipower.com

CogniPower has developed and patented improved control methods for switched-mode power converters (SMPCs). These methods can be applied to any SMPC for better performance, speed, efficiency and economy. Further, unconditionally stable controls enable new topologies for additional gains.

Coil Winding Specialist, Inc. Booth 1626

353 West Grove Ave
 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, Inc. Booth 1211

1102 Silver Lake Rd
 Cary, IL 60013
 USA
www.coilcraft.com

Coilcraft is a leading global supplier of magnetic components including high performance RF chip inductors, power magnetics and filters. In addition to a large selection of standard components, Coilcraft also designs and builds custom magnetics to fit a customer's exact electrical requirements.

Columba Industries Corporation Booth 531

3950 North Lake Shore Dr
 Suite 1304
 Chicago, IL 60613
 USA
www.columbaindustries.com

Columba Industries Corporation is a full-service precision metal (heat sink, die cast, CNC machining, springs, etc.) manufacturer and representative for FSP-Powerland LED drivers. We also provide turn-key new product development for start-up companies, and for customers who wants to accelerate growth and gain competitive advantage in their markets.

Cornell Dubilier Electronics Booth 1315

140 Technology Pl
 Liberty, SC 29657
 USA
www.cde.com

CDE is dedicated to advancing capacitor technology for new applications. The company combines innovative products with engineering expertise to provide reliable solutions for inverters, wind/solar power, electric vehicles, power supplies, motor drives, HVAC, motors, welding, aerospace, telecom, medical equipment and UPS systems.

Cosmo Ferrites Limited Booth 835

Jabi, Distt. Solan
 Parwanoo, H.P. 173209
 India
www.cosmoferrites.com

We are the manufacturer of MN-ZN soft ferrite parts from India exporting since last 25 years to all over the world. Also can support you with wound components.

CPS Technologies Booth 523

111 South Worcester St
 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 CP

Cradle North America Inc. Booth 735

50 Chestnut St
 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 and scFLOW (general purpose unstructured mesh), scSTREAM (general purpose Cartesian mesh), and HeatDesigner (Cartesian mesh for electronics).

Cramer Magnetics Booth 1126

401 N Progress Dr
 Saukville, WI 53080
 USA
www.cramerco.com

Cramer Magnetics specializes in the design and manufacture of custom high frequency wire wound and planar magnetic components for switch mode power supply applications.

CUI Inc. Booth 311

20050 SW 112th Ave
 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

Danfoss Silicon Power GmbH Booth 1522

Husumer Strasse 251
 Flensburg, Schl 24941
 Germany
www.siliconpower.danfoss.com

Danfoss Silicon Power is a global acting manufacturer of customer-specified power modules. We meet customer's exact requirements within automotive, renewables and industrial applications. Our dedicated experts develop outstanding solutions through extensive technological knowledge and innovative mindset.

Datatronics Booth 1314

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.

Dau Thermal Solutions Booth 1425

1657 East Park Dr
 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, etc.

Dean Technology, Inc. Booth 1427

P.O. Box 700968
 Dallas, TX 75370
 USA
www.deantechnology.com

Dean Technology specializes in the manufacture of high voltage electronic components, assemblies and power supplies. Its three product lines (HVCA, CKE, and HVPSI) include high voltage diodes, rectifiers, capacitors, MOVs, power supplies, test equipment, and custom assemblies for all needs.

Delta Products Corporation Booth 337

46101 Fremont Blvd
 Fremont, CA 94538
 USA
www.cyntec.com

Cyntec (a Delta Products subsidiary) is dedicated to continuously developing new materials, processes, and integration technologies to provide power module and component products/solutions which contribute to space-saving and high performance designs that are environmentally-friendly.

Denka Booth 1827

2540 N 1st St
 Suite 290
 San Jose, CA 951318986
 USA
www.denka.co.jp/eng/

Denka is a leading global electronics manufacturer in the automotive and power industries. We provide high performance thermal management products: TIM and insulated metal substrates (Aluminum/Silicon Nitrides and HITPLATE) used in ECU, LED headlights, converters/inverters and power modules for EV/HEV.

Dexter Magnetic Technologies Booth 1430

1050 Morse Ave
 Elk Grove Village, IL 60007
 USA
www.dextermag.com

Dexter Magnetic Technologies is your essential magnetic partner. Our growing supply chain offers the most diverse offerings of current magnetic materials available. Our experienced engineers and support staff can help you choose the correct components for your needs.

Dialog Semiconductor Booth 1037

675 Campbell Technology Pkwy
 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 537

701 Brooks Ave S
 Thief River Falls, MN 56701
 USA
www.digikey.com

Digi-Key Electronics, based in Thief River Falls, Minn., is a global, full-service distributor of both prototype/design and production quantities of electronic components, offering more than 5 million products from over 650 quality name-brand manufacturers with 1.3 million products in stock.
www.digikey.com

Dino-Lite Scopes Booth 1731

19803 Hamilton Ave
 Suite 200
 Torrance, CA 90502
 USA
www.dinolite.us

Dino-Lite portable digital microscopes and eyepiece cameras provide high-quality microscopy video interfacing to PC and MAC. Most models provide 10x-220x magnification with features such as measurement and adjustable polarizer. The included software makes it easy to take snapshots, record videos, manipulate images, save and email discoveries.

Dongguan Mentech Optical & Magnetic Co., Ltd. Booth 435

16995 Del Monte Ave
 Apt 125
 Morgan Hill, CA 95037
 USA
www.mnc-tek.com

Dongguan Mentech Optical & Magnetic Co., Ltd. Mentech is a privately owned enterprise, engaged in the R&D and manufacturing of magnetic and optical components/modules, quickly becoming an industry leader.

Ducati Energia **Booth 1726**

Via M. E Lepido, 182
Bologna, 40132
Italy
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 736**

5735 W Las Positas
Suite 100
Pleasanton, CA 94588
USA
www.eaton.com/electronics

Eaton offers a range of electronics products that include power magnetics, circuit protection and supercapacitors. These products serve customers in transportation, back-up power storage, mining and construction. To learn more about Eaton's complete line of electronics solutions, please visit www.eaton.com/electronics.

EBG Resistors **Booth 1423**

460 Spruce St
P.O. Box 519
Middletown, PA 17057
USA
www.ebg-us.com

EBG a leading manufacturing resource for standardized and customized high voltage (to 100kV), high power (to 2000W), Non-Inductive Thick Film resistors. Producing resistors for over 30 years for smart grid, drives, aerospace, medical, and many industrial and commercial applications.

ECI **Booth 923**

53 Main Line Dr
P.O. Box 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 1324**

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Waterbury, CT 06705
USA
www.filmcapacitors.com

EFC/Wesco is a North American based manufacturer of standard and custom film capacitors. We are a leading supplier for the power electronics, instrumentation, and surge suppression markets. Products include Metallized, Film/Foil, RC Networks, EMI Suppression, DC Link, High Voltage and High Current capacitors.

Efficient Power Conversion Corporation (EPC) **Booth 530**

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 530, EPC is showing GaN-based applications including wireless charging, LiDAR, high-speed communications, and high power density DC-DC converters.

Egston System Electronics Eggenburg ... **Booth 631**

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.

Electro Technik **Booth 1537**

P.O. Box 18802
Clearwater, FL 33762
USA
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 1611

3366 Pomona Blvd
 Pomona, CA 91768
 USA
www.electrocube.com

Electrocube is a manufacturer of high grade power electronic passive components for over 56 years. Including Film Capacitors – High Temp & DC Link, RC Networks, Audio Capacitors, Hi Rel EMI Filters, High Freq. Foil Transformers, TRUs and Current Transformers. We have also acquired Bishop Electronics, Bishop Capacitors By Electrocube.

Electronic Concepts, Inc. Booth 1011

526 Industrial Way W
 Eatontown, NJ 07724
 USA
www.ecicaps.com

Electronic Concepts is a recognized and respected name in the electronic component industry. We offer a unique combination of resources including: vertically integrated manufacturing, modern and automated production, and broad engineering expertise. It is with these elements that allow us to design film capacitors that set the industry standard. ECI has the flexibility to handle any film capacitor requirement, with a commitment to quality and support.

Electronic Systems Packaging, LLC Booth 626

1175 W Mahalo Place
 Rancho Dominguez, CA 90220
 USA
www.espbus.com

Electronic Systems Packaging (ESP) was established in Southern California in the late 1970's. Manufacturing custom laminated busbars both off-the-shelf and custom designs to OEM and defense industries. ESP can provide quick-turn-around prototypes to highvolume production at competitive pricing.

Elna Magnetics Booth 1422

203 Malden Turnpike
 Saugerties, NY 12477
 USA
www.elnamagnetics.com

Authorized distributor for Ferroxcube, Magnetics, Fair Rite, EPCOS, Metglas, Finemet, Micrometals, Leadertech, MMG, TSF & Manufacturing services providing unparalleled machining services for gapping and custom magnetic cores. If its in a catalog we cansupply it. If its not in a catalog we can machine it to your specifications.

EMWORKS Booth 1831

7709 Cordner St
 LaSalle, QC H4E2S1
 Canada
www.emworks.com

EMWorks develops and sells EM simulation software. Its flagship products, EMS and HFWorks are used for numerous low and high frequency EM applications.

Exar Corporation Booth 511

48720 Kato Rd
 Fremont, CA 94538
 USA
www.exar.com

Exar's mission is to leverage our extensive analog and mixed-signal portfolio, experience and IP to deliver leading-edge application specific technology solutions to target markets where operational excellence and reliability are valued. We service the Industrial, Infrastructure, Automotive, and Audio/Video markets by acting as an extension of the customer's own technology organization and singularly focusing on exceeding customer expectations.

Exxelia Booth 623

1221 N Highway 17-92
 Longwood, FL 32750
 USA
www.exxeliausa.com

Exxelia is a leading designer and manufacturer of high-reliability passive components. Exxelia's products are commonly used for power electronics, power generation, energy storage, and signal filtering functions in demanding domains: Defense, Aviation, Space, Energy, Transportation, Medical, Telecom and Industrial applications.

Fair-Rite Products Booth 931

1 Commercial Row
 P.O. Box 288
 Wallkill, NY 12589
 USA
www.fair-rite.com

Fair-Rite is a leader in the ferrite industry committed to quality. We will DESIGN your custom components utilizing our machine shop, DEVELOP a robust process, and DELIVER a cost-effective solution. For all of your needs, Fair-Rite is Your Signal Solution.

Fastron Americas **Booth 1924**

1500 Lake Shore Dr
Suite 310
Columbus, OH 43204
USA
www.fastrongroup.com

Fastron is a leading global manufacturer of high performance power and RF inductors for the automotive, medical, and lighting industries. Our manufacturing facilities are ISO 14001, 9001, and ISO/TS 16949 certified. Stop by and see our new high voltage inductors.

Ferroxcube USA, Inc. **Booth 1123**

1200 Golden Key Circle
Suite 233
El Paso, TX 79925
USA
www.ferroxcube.com

Leader in soft ferrite technology. FERROXCUBE provides customers the highest level of support in the development of your new innovative designs. Our competencies cover soft ferrite cores, materials, and accessories. They are developed to meet today's demanding high-frequency, low-loss requirements.

Focused Test, Inc. **Booth 437**

1965 N 57th Ct
Suite 106
Boulder, CO 80301
USA
www.focusedtest.com

FTCAP GmbH **Booth 1233**

Carl-Benz-Strasse 1
Husum, 25813
Germany
<https://www.ftcap.de/>

FTCAP has more than 65 years of experience in the development and production of capacitors used in diverse industries. The product spectrum includes both film and aluminium electrolytic capacitors.

Fuji Electric Corp. of America **Booth 1224**

50 Northfield Ave
Edison, NJ 08837
USA
www.americas.fujielectric.com

Fuji Electric delivers high-performance power semiconductors for energy, automotive, information technology, and industrial applications. Our extensive product line includes MOSFETs, IGBT (Modules and Discretes), IPM (Intelligent Power Modules), PIM (Power Integrated Modules), Diodes: Fast Recovery, High Speed, and Schottky.

GAN Systems **Booth 1501**

1145 Innovation Dr
Suite 101
#501
Ottawa, ON K2K 3G8
Canada
www.gansystems.com

GaN Systems' 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. A fabless power semiconductor company, GaN Systems is headquartered in Ottawa, Canada.

Gaotune Technologies Co., Ltd. **Booth 1837**

801 # Changhong Building High-tech Park
Shenzhen, GD 518000
China
www.gaotune.com

Gaotune Technologies is a leading manufactory of the Amorphous cores and Nanocrystalline cores located in China. Most of our customers come from Europe and North America, including Siemens, ABB, Coilcrafter etc.

Main products: Amorphous&NanocrystallineC-core, E-core and Block core. Nanocrystalline Ring Core and Rectangular Cores (Plastic case or Epoxy coating)

Global Power Technologies Group **Booth 1823**

20692 Prism Place
Lake Forest, CA 92630
USA
www.gptechgroup.com

Global Power Technologies Group is a manufacture of following SiC Products.

Custom SiC Chips & Wafers * SiC Epitaxial Wafers in 100mm 150mm and 200 mm * SiC Bare Die in SBD and Mosfets * SiC Disc. Schottky Diodes * SiC Disc. MOSFET's * SiC Modules * Hybrid: IGBT& SiC SBD Modules * SiC Auto. OBC's

GLOBALFOUNDRIES Booth 1632

2600 Great America Way
 Santa Clara, CA 95054
 USA
www.globalfoundries.com

GLOBALFOUNDRIES is the world's first full-service semiconductor foundry with a truly global footprint. With operations in Singapore, Germany and the United States, GLOBALFOUNDRIES is the only foundry that offers the flexibility and security of manufacturing centers spanning three continents.

GMW Associates Booth 927

955 Industrial Rd
 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 1334

608 Johnson Ave
 Suite 7
 Bohemia, NY 11716
 USA
www.goodarksemi.com

Good-Ark Semiconductor is a leading global discrete semiconductor manufacturer that offers a wide variety of surface mount, through-hole and wafer devices with superior quality and reliability at competitive costs.

Gowanda Electronics Booth 310

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.

Guang Dong FengMing Electronic Tech. Co., LTD. Booth 427

Lot 6-5, BeiJiao Industry Parl, ShunDe,
 FoShan City, Guangdong, 528311
 China
www.bm-cap.com

FengMing company own modern industrial productive base, covering a area of 30,000 square meter, the value of equipment is about 90 million, the total investment sum is over 100 million, staffs more than one thousand, the annual productive ability is about 700 million Capacitor.

Helix Semiconductors Booth 1338

800 Charcot Ave
 Suite 104
 San Jose, CA 95131
 USA
www.semitrex.com

Disruptively efficient AC-DC, PoE-to-low voltage, and Solar up-converter ICs use capacitance Semitrex's unique AC-DC and PoE-LVDC ICs offer significant efficiency improvements for things that are always connected to AC Mains or 48VDC (PoE, Telecom) and have varying power demand or spend a lot of time in Standby. Applications which benefit cover the spectrum from IoT endpoint sensors and gateways.

Hengdian Group DMEGC Magnetics Co., LTD. Booth 1022

c/o ASL Technologies Inc.
 14568 Rutledge Sq
 San Diego, CA 92128
 USA
www.chinaDMEGC.com

Leading soft ferrite producer in China that produce Mn-Zn, Ni-Zn, Power Iron and allow power cores to support all of your ferrite need.

Heraeus Electronic Materials Division Booth 1335

24 Union Hill Rd
 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 Booth 1412

225 Hammond Ave
 Fremont, CA 94539
 USA
www.hesse-mechatronics.com

Hesse Mechatronics is a global leader in wire bonding technology and ultrasonic interconnection for power electronics. Hesse has application labs in Clinton, MA, Raleigh, NC (at NC State), Tempe, AZ and Irvine, CA (at University California-Irvine).

Himag Planar Magnetics, Ltd. Booth 522

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 1636

85 W Arlington Heights Rd
 Suite 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 1911

3550 NW 115th Ave
 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 20 years of experience in Power Electronics Solutions; offering from High Power Thyristors, Diodes, GTOs, IGBTs, IGCT

Hoi Luen Electrical Manufacturer Co., Ltd. Booth 333

Unit 4 G/F, Transport City Building
 No.1-7 Shing Wan Road, Shat
 Hong Kong
www.Hoiluen.com

Hoi Luen group is the premier supplier for FIW, triple insulated wire, magnet wire, tinned copper wire, power cord and cable assembly.

With 30 years of establishment, we are the nominated supplier for various global brands. Contact us for reliable and cost effective power solutions.

Holy Stone International Booth 1533

41700 Iry St
 Suite D
 Murrieta, CA 92562
 USA
www.holystonecaps.com

Holy Stone Enterprise Company, Ltd. (HolyStone International) is a Taiwan based manufacturer of high technology Multi-layer Ceramic Capacitors. Although Holy Stone produces a full line of MLCC's we are best known for High Voltage, Safety Certified, High Cap/Voltage and other specialty ceramic capacitors.

HVR Advanced Power Components . . . Booth 1311

2090 Old Union Rd
 Cheektowaga, NY 14227
 USA
www.hvrpc.com

HVR provides cost-effective engineered solutions for high-stress resistor applications. Application areas include: Industrial, T&D, High Voltage Pulsed Power, Research, Transportation, and Medical. Our solid composition resistors provide a solution for high voltage, non-inductive and high peak power resistive applications.

IAS (IEEE Industry Applications Society) Booth 210

445 Hoes Ln
Piscataway, NJ 08854
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 1114

1165 Allgood Rd
Suite 20
Marietta, GA 30062
USA
www.icecomponents.com

ICE is a leading provider of components for the power industry. Our programmable current sensors feature low cost, easy assembly and high creepage. We also provide custom and standard magnetic components and power assemblies for a wide range of markets.

Illinois Capacitor Booth 1313

3757 W Touhy Ave
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 2017: Rechargeable Coin Cell Batteries & Conduction Cooled Capacitors.

Indium Corporation. Booth 525

34 Robinson Rd
Clinton, NY 13323
USA
www.indium.com

Indium Corporation develops and manufactures solder materials used primarily in the electronics and power electronics assembly industries. We offer lead(Pb)-containing and lead-free solutions for die attach, heat-spreader attach and thermal interface materials.

Infineon Technologies Americas Corp . . Booth 901

640 N McCarthy Blvd
Milpitas, CA 95035
USA
www.infineon.com

Infineon Technologies is a world leader in semiconductor solutions that make life easier, safer and greener. Visit us at booth 901 for the latest energy-savings and high power density enabling technologies and solutions.

Infolytica Corporation Booth 1015

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 much more. Our tools support VHDL-AMS for use in multi-domain system simulations and Hardware in the loop (HIL).

Intepro Systems Booth 731

14712-A Franklin Ave
Tustin, CA 92780
USA
www.inteproate.com

Intepro supplies Automated Test systems to manufacturers all over the world to test power electronics used in a wide range of applications. Our knowledge and expertise in moving and measuring power makes our systems unparalleled for characterization of power components, environmental stress screening, production test and repair across all industries.

Inter Outstanding Electronics Inc (IOE) Booth 1812

TWN/53-5 Zhen Shan ,Po Cheng Rd
Yuan Shan Hsiang, I-La 246
Taiwan
www.ioeinc.com.tw

Inter Outstanding Electronics Inc (IOE) was founded in Taiwan in 1982 and we offer expertise in marketing, design and manufacturing of power and audio transformer, toroid transformer, ferrite transformer, ignition coils, and many other coil windings. The company now employs over 400 employees both in China and Taiwan. Quality is always been our core value and we commit to this legendary to exceed customer's needs.

Intertape Polymer Group Booth 833

100 Paramount Dr
Suite 300
Sarasota, FL 34232
USA
www.itape.com

Intertape Polymer Group is a North American based manufacturer offering electrical insulating tapes, electronic tapes, industrial tapes, carton sealing tapes, and coated fabrics to end user manufacturers and repair facilities.

ITELCOND SRL Booth 1836

Viale de Gasperi, 36
Bareggio (MI), Mila 20010
Italy
www.itelcond.it

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. We have the UL certification for the electrolytic capacitors.

ITG Electronics, Inc. Booth 439

175 Clearbrook Rd
Elmsford, NY 10523
USA
www.itg-electronics.com

ITG ELECTRONICS, Inc. (formerly Inter-Technical, LLC) introduces its custom EMI Filters for commercial and military applications. Together with the company's experienced engineering and manufacturing of custom inductors and transformers, ITG presents a strong line up for many applications.

IWATSU Electric Co.,Ltd. Booth 1722

7-41,1-chome Kugayama
Suginami-ku,, Toky 168-8511
Japan
www.iti.iwatsu.co.jp/index_e.html

We manufacture a wide range of electronic testing equipment such as semiconductor curve tracers, B-H analyzers, highvoltage isolated measurement system to cover various types of demands from industries and research for energy-efficient power managements.

J&D Electronics Co., Ltd Booth 1737

#B-401, Dosim Knowledge Industry Center
234 Deokso-ro, Wabu-eup
Namyangju-si, 12275
Republic of Korea
www.hqsensing.com/

J&D Electronics is one of the global leaders providing innovative and high quality solutions for measuring electrical parameters. The main products, Current and Voltage sensors, are used for various applications such as power distribution monitoring.

JARO Thermal Booth 312

6600 Park of Commerce Blvd
Boca Raton, FL 33487
USA
www.jarothermal.com

JARO Thermal is the world leader in thermal management, since 1976. With primary focus on AC and DC brushless fans, as well as the design and manufacture of aluminum & copper heatsinks, die-cast heatsinks, heatpipes, cpu coolers, & radio faceplates.

JFE Steel Corporation Booth 422

Hibiya Kokusai Bldg. 2-3
Uchisaiwai-cho, 2chome, Chiyoda-ku
Tokyo
Japan
www.jfe-steel.co.jp/en/index.html

JFE Steel Corporation, as an only producer in the world, exhibits the highest grade non-oriented electrical steel which is called "Super Core" with high saturation magnetic flux density and low iron loss in the high-frequency range. (Booth 422)

Jianghai America Inc Booth 1030

15920 A Halliburton Rd
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 1235

15191 Bledsoe St
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 1436

1441 44th St N
 Fargo, ND 58102
 USA
 www.JohnDeere.com/ElectronicSolutions

John Deere Electronic Solutions (JDES) strives to further John Deere's global business by developing rugged and reliable electronic components and systems that thrive in the most extreme environments. To enhance innovation, expertise and competitiveness, JDES provides custom and off-the-shelf electronics and power electronics for original equipment manufacturers worldwide.

Jovil Universal LLC. Booth 1932

10 Precision Rd
 Danbury, CT 06810
 USA
 www.jovil.com

Manufacturer of Toroidal Type Winding Machines. Manufacturer of Fatigue Ductility Flex Tester for testing flexible ductility of flexible PC, copper foil, aluminum foil and other non-ferrous foils. Recommended in IPC standards and procedures.

Kanthal Global, Sandvik Heating Technology USA Booth 834

495 Commerce Dr
 Suite 7
 Amherst, NY 14228
 USA
 www.kanthal.com/global

Kanthal/Global manufactures Non-Inductive High Voltage Bulk Ceramic Resistors, Disk Washer Resistors and Max Cap Capacitors. We are recognized as a renowned brand. Our products are sold into nearly every market and industry. Our offering includes design, engineering services and testing.

Kaschke Components GMBH Booth 1227

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.

KDM Zhejiang NBTM Keda Magnetolectricity Co. Ltd. Booth 1614

525 Quyuan Rd N
 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), and High Flux (KH).

KEMET Booth 1813

2835 Kemet Way
 Simpsonville, SC 18045
 USA
 www.kemet.com

KEMET Electronics is a leading global supplier of electronic components. We offer our customers the broadest selection of capacitor technologies in the industry, 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 1730

Gallarate 21013
 Italy
 www.kendeil.com

Kendeil is leading producer of power electronic capacitors for wind and solar inverter applications, motor drives, UPS, aluminum foil for electrolytic capacitors.

All products meet highest international standards in performances and quality. Locations in Italy, France, India, with worldwide netsale.

KEPCO, Inc. Booth 1534

131-38 Sanford Ave
 Flushing, NY 11355
 USA
www.kepcopower.com

Kepeco is a leading supplier of Bipolar Magnet Power Supplies, AC/DC Instrumentation Power Supplies, Low-Noise Linear Supplies, Fault Tolerant, N+1 Redundant Supplies, Electronic Loads, DIN Rail, Medical and OEM Supplies. Kepeco also provides integrated, turn key DC power systems.

Keysight Technologies Booth 411

5301 Stevens Creek Blvd
 Santa Clara, CA 95051
 USA
www.keysight.com

Keysight Technologies is the world's leading electronic measurement company, transforming today's measurement experience through innovations in wireless, automotive and energy, and software solutions. Keysight's focus on measurement helps scientists, researchers, and engineers address their toughest challenges with precision and confidence.

Kikusui America, Inc. Booth 1231

2975 Bowers Ave
 Suite 307
 Santa Clara, CA 95051
 USA
www.kikusuiamerica.com

KIKUSUI AMERICA, INC., a subsidiary of Kikusui Electronics Corporation was founded October 1, 2004. Kikusui provides a wide variety of High-Quality and Reliable Electronic Measuring Instruments, DC and AC Power Supplies, Electronic Loads, and Safety Test Equipment. Made in Japan since 1951.

KITAGAWA INDUSTRIES**America, Inc.** Booth 1331

2325 Paragon Dr
 Suite 10
 San Jose, CA 95131
 USA
www.kgs-ind.com

KGS America: global provider of EMC, thermal, vibration, and plastic components. KGS's solution products include absorbers, gaskets, ferrites, shielding, and TIMs; all are engineered around current and upcoming trends. Applications include mobile devices, medical devices, power supplies, wearable gear, and cars.

Knowles Capacitors Booth 739

2777 Rte 20 E
 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. The markets we serve include medical implantable and equipment, military, aerospace/avionics, EMI filtering, oil, instrumentation, industrial control, optical networks, telecom and automotive.

Kulicke & Soffa Industries Booth 936

1821 E Dyer Rd
 Suite 200
 Santa Ana, CA 92705
 USA
www.kns.com

Kulicke & Soffa (K&S) is a leading provider of semiconductor packaging and electronic assembly solutions supporting the global automotive, consumer, communications, computing and industrial segments.

LEM USA, Inc. Booth 1526

11665 W Bradley Rd
 Milwaukee, WI 53224
 USA
www.lem.com

Lenco Electronics, Inc. Booth 339

1330 S Belden St
 McHenry, IL 60050
 USA
www.lenco-elect.com

Inductor and Transformer manufacturer, Lenco Electronics can custom design or build to your exact specifications. Lenco manufactures Inductors and Transformers using a variety of magnetic core materials such as ferrites, iron powder, laminations and amorphous alloy. Common conductor materials used in our manufacturing process include magnet wire, Litz wire, aluminum and copper foil.

Linear Technology Corporation Booth 1411

1630 McCarthy Blvd
 Milpitas, CA 95035
 USA
www.linear.com

Linear Technology Corporation has been designing, manufacturing and marketing a broad line of high performance analog integrated circuits for major companies worldwide for three decades. The Company's products provide an essential bridge between our analog world 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.

Lodestone Pacific Booth 1323

4769 E Wesley Dr
 Anaheim, CA 92807
 USA
www.lodestonepacific.com

Lodestone Pacific has offered high quality components to the magnetic segment of the worldwide electronics industry for 25 years. We have facilities in USA, Hong Kong and China, and the experience and skills to support a diverse supply chain.

LTEC Corporation Booth 1339

2880 Zanker Rd
 Suite 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. LTEC helps its customers overcome intellectual property (patent) research, analysis, and protection challenges.

MAGDEV Ltd. Booth 1637

Unit 23 Ash Industrial Estate
 Kembrey Park
 Swindon, SN5 8JN
 U.K.
www.magdev.co.uk

When magnetism matters 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 937

424, Teheran-ro
 Gangnam-gu
 Seoul, 135-738
 Korea
www.magnachip.com/

MagnaChip is a Korea-based designer and manufacturer of analog and mixed-signal semiconductor products for high-volume consumer, communication, industrial and computing applications. MagnaChip owns a portfolio of more than 3,500 registered and pending patents, and has extensive engineering, design and manufacturing process expertise resulting from its 30-year operating history.

Magna-Power Electronics Booth 1622

39 Royal Rd
 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

Magnetic Metals Corporation Booth 1715

1900 Hayes Ave
 Camden, NJ 08105
 USA
www.magneticmetals.corp.com

Magnetic Metals offers tape wound toroidal and cut cores, value added contract manufacturing winding and assembly services including a range of GFCI, ALCI and AFCI components. Established in 1942, Magnetic Metals AS9100C and ISO 9001 certified to service industrial, commercial and defense clients worldwide.

Magnetics Booth 1023

110 Delta Dr
 Pittsburgh, PA 15238
 USA
www.mag-inc.com

Magnetics is a leading manufacturer and supplier of soft magnetic components, including powder cores, ferrite cores, and tape wound cores, for the international electronics industry.

Malico Inc. Booth 1830

5, Ming-Lung Rd
 Yangmei, 32663
 Taiwan
www.malico.com

ISO9001, 14001, TS16949 Certified. Malico has over 30 years experience in manufacturing HeatSinks and Metal Components. We are committed in providing best quality product and service to all customers. Stop by at our booth today!

Martin's Electronic Devices & Instruments (MEDI) Booth 1336

39/2067 Manikkiri Cross Rd
 Ernakulam, Coch 682016
 India
www.medielectronics.com

MEDI is R&D company involved in the design and development of power electronic solutions. Our expertise is in handling high current/ high voltage; companies can outsource their R&D requirements to us, we design to bespoke needs.

Mentor Graphics Corporation Booth 1531

8005 SW Boeckman Rd
 Wilsonville, OR 97070
 USA
www.mentor.com/micred

The MicReD Power Tester Range combines active power cycling with non-destructive failure diagnosis, via thermal transient test technology, to enhance reliability & lifetime prediction studies of IGBTs & power semiconductors. Accurate thermal measurement, T3Ster, & simulation software, FloTHERM, support product development.

Mersen Booth 1303

374 Merrimac St
 Newburyport, MA 01950
 USA
ep.mersen.com

Mersen is global design, engineering and manufacturing leader in cooling and heatsink technology, laminated bus bar & semiconductor protection fuses, making power electronics applications safe, reliable and profitable

Mesago PCIM GmbH Booth 1424

Rotebuehlstrabe 83-85
 Stuttgart, 70178
 Germany
www.pcim-europe.com

PCIM Europe is the international leading exhibition and conference for power electronics and its applications. From the latest developments of power semiconductors, passive components, products for thermal management, new materials, sensors as well as servo-technology and the wide area of power quality and energy-management – PCIM Europe offers a comprehensive, focused and compact presentation of products all under one roof!

Methode Power Solutions Group Booth 810

1700 Hicks Rd
 Rolling Meadows, IL 60008
 USA
www.methode.com/power.html#.WlzlTBsrJhE

As a global power distribution and thermal management solutions provider, Methode Power Solutions designs and manufactures innovative products that meet the requirements of a variety of high-demand applications. Visit booth #810 to learn more about Methode's Power!

MH&W International Corp. Booth 1826

575 Corporate Dr
 Mahwah, NJ 07430
 USA
www.mhw-intl.com

MH&W is a distributor of magnetic core materials including soft ferrites for transformers, CMC and inductors, powder cores for inductors, Cool Blue cores for control of EMI/RFI in VFD/motor systems and thermal interphase films and pads.

Microchip Technology, Inc. Booth 403

2355 W Chandler Blvd
 Chandler, AZ 85224
 USA
www.microchip.com

Microchip Technology Inc. is a leading provider of microcontroller, mixed-signal, analog and Flash-IP solutions, providing low-risk product development, lower total system cost and faster time to market for thousands applications worldwide.

Micrometals, Inc. Booth 1322

5615 E La Palma Ave
 Anaheim, CA 92807
 USA
www.Micrometals.com & www.MicrometalsAPC.com

New online inductor design software will be discussed and demonstrated. The software is a free tool that functions within a web-based interface. The software will help the user select the most appropriate inductor powder core material and winding based on the application conditions that are provided by the user. The available core materials are well suited for applications with operating frequencies ranging from 50/60 Hz up to 25 MHz or higher. The software calculations include many non-linear effects.

MK Magnetics Inc Booth 822

17030 Muskrat Ave
 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.

Monolith Semiconductor Inc. Booth 536

408 Fannin Ave
 Round Rock, TX 78664
 USA
www.monolithsemi.com

Monolith Semiconductor is a fabless supplier of high-voltage Silicon Carbide diodes and MOSFETs manufactured in an automotive qualified 150mm silicon CMOS foundry. Monolith is partnered with Littelfuse and committed to providing industry leading SiC products and customer support.

Monolithic Power Systems, Inc. Booth 1403

79 Great Oaks Blvd
 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, and Automotive.

MORNSUN AMERICA LLC Booth 933

13 Country Club Ln
 Suite C
 Milford, MA 01757
 USA
www.mornsunamerica.com

Mornsun America LLC, a leading manufacturer of DC-DC, AC-DC converter, isolation amplifier 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 driver, PV/ Renewable energy, Smart Grid & Energy Storage, IoT, medical and automotive devices and other commercial applications.

Mouser Electronics, Inc. Booth 1822

1000 N Main St
 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.

MPS Industries, Inc. Booth 627

19210 S Vermont Ave
 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.

MS Power GmbH Booth 1732

Mergenthalerallee 23A
 65760 Eschborn, Deutschland
www.mspowergroup.com

MS Power GmbH, headquartered in Eschborn, Germany, is recognized for manufacturing high quality products. Current products portfolio mainly covers the range of Bi-Polar semiconductor chips and discrete in forms of Stud Screw Fit Diodes/Thyristors, Capsule Devices and Modules.

MTL Distribution Booth 726

23167 Temescal Canyon Rd
 Corona, CA 92883
 USA
www.mtldistribution.com

With 28 years of experience, MTL is an authorized distributor of magnetic cores and associated hardware for Magnetics Inc and powder iron toroid cores for Micrometals. 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.

Myway Plus Corporation Booth 632

Yokohama Hanasaki Bldg 6-145 Hanasaki-cho,
 Nishi-ku, Yokohama-shi
 Kanagawa, 220 0022
 Japan
www.myway.co.jp/en/index.html

Integrated Digital Platform for Power Electronics Model Based Design 'All-in-One package for Advanced R&D'

NAC Semi Booth 1926

1790 Commeree Ave
 St. Petersburg, FL 33716
 USA
www.nacsemi.com

NAC Semi is a global electronic component design services & distribution company. Our linecard supports the needs of customers in the high-power market by representing companies such as Fuji Electric, Dynex, AgileSwitch, Mornsun, SanRex, Jianghai Capacitor, and others.

National Magnetics Group/Ceramic Magnetics, Inc. Booth 823

1210 Win Dr
 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 seamless

NEC TOKIN America Inc. Booth 1230

2460 N 1st St
 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 1215

130 North Main St
 Lisbon, NH 03585
 USA
www.newenglandwire.com

We design & manufacture the most advanced wire & cable in the industry with short lead times, rapid prototyping & unparalleled customer service. Serving a full range of industries, we specialize in custom designs--ultra-flexible, miniature/microminiature, multiconductor & coaxial cables, braids and Litz constructions & hybrid configurations. We manufacture each order to meet unique performance characteristics or exacting specification.

Newtons4th Ltd. Booth 426

3115-P N Willke Rd
 Arlington Heights, IL 60004
 USA
www.newtons4th.com

Power Analyzers, Swept Frequency Response (Gain/Phase) Analyzers, Vector Voltmeters, Phase-meters, LCR meters, True RMS Voltmeters, Harmonic Analyzers, Selective Level Meters, Wideband Current Shunts, Wideband Amplifiers, designed and manufactured using innovative techniques and state-of-the art technology to offer precision performance/accuracy and ease of use at highly competitive prices.

NH Research, Inc. Booth 611

16601 Hale Ave
Irvine, CA 92606
USA
www.nhresearch.com

NH Research is the technology leader supplying power testing instrumentation AC Grid-Simulators, AC & DC Power Sources, Electronics Loads and Power Meters as well as complete functional-test systems for battery (EV/HEV/ESS), on-grid solar, LED, medical, military and power conversion applications

Nichicon (America) Corporation Booth 1330

927 E State Parkway
Schaumburg, IL 60173
USA
www.nichicon-us.com

A dominant manufacturer in the capacitor industry, Nichicon is sought after time and time again for its superior capacitor selection and performance. Manufacturers of Aluminum Electrolytic Capacitors, Film Capacitors, Conductive Polymer Capacitors, and Electric Double Layer Capacitors. #nichicon-power2017

NORWE Inc. Booth 1131

P.O. Box 2511
North Canton, OH 44720
USA
www.norwe.com

NORWE is a leading manufacturer of standard and custom designed thermoplastic bobbins for ferrite cores & laminations, SMD components and accessories. All products comply with the RoHS & REACH. NORWE is certified according to DIN EN ISO 9001:2008, to DINEN ISO 14001:2009 and to UL 746D.

NWL, Inc. Booth 1922

312 Rising Sun Rd
Bordentown, NJ 08054
USA
www.nwl.com

A leading manufacturer of AC and DC film capacitors for industrial and military applications. With 92,000 sq feet of U.S. production capacity, we provide both standard and engineered solutions, including water-cooled, air-cooled, oil-filled and dry-type capacitors.

NXP Semiconductors Booth 1122

6501 William Cannon Dr W
Austin, TX 78735
USA
www.nxp.com

Ohmite MFG Booth 1610

Bella Vista PK
Warrenville, IL 60555
USA
www.ohmite.com

Ohmite has been the leading provider of resistive products for over 90 years. Ohmite offers a full complement of resistors and heatsinks for high current, high voltage, and high energy applications.

ON Semiconductor/Fairchild Booth 1001

2300 W Buckskin Rd
Pocatello, ID 83201
USA
www.onsemi.com

ON Semiconductor drives energy efficient innovations, empowering customers to reduce energy use. The company is a leading supplier of semiconductor-based solutions, offering a comprehensive portfolio of energy efficient power management, analog, sensors, logic, timing, connectivity, discrete, SoC and custom devices.

OPAL-RT TECHNOLOGIES Booth 1326

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 research.

Oztek Corp Booth 1633

11 Continental Blvd
Merrimack, NH 3054
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 830**

10 Anson Rd
#13-11 International Plaza
Singapore
www.atmix.co.jp

Epson Atmix KUAMETÂ® is high performing amorphous powder. NC1 is nanocrystalline, whose permeability increases by 10% and core loss decreases by 25% compared to 6B2. 9A4 has 15% higher saturation properties. They contribute to longer battery life and downsizing.

**Paktron Capacitors,
Division of Pancon Corp.** **Booth 713**

350 Revolutionary Dr
E Taunton, MA 02718
USA
www.panconcorp.com

Paktron designs and manufactures in the USA, a Multi-layer Polymer (MLP) Film Capacitor that provides improved stability, both electrically and mechanically compared to multi-layer ceramic capacitors. Paktron capacitors feature non shorting operation and does not crack like large ceramic chip capacitors. Paktron also manufactures the Quencharc RC network.

Panasonic **Booth 201**

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.

Parker Overseas **Booth 638**

59/1/1, Industrial Area, Site – IV, Sahibabad
Distt. Ghaziabad, Utta Paredsh
Ghaziabad, 110092
India
www.parkeroverseas.com

Parker Overseas(an ISO 9001:2008 & ISO 14001:2004 certified company) a 100% Export Oriented Unit engaged in the Design, Manufacture & Supply of RoHS and REACH compliant in Thru-Hole (TH) & Surface Mount Type (SMT) Wound Magnetic Components like Transformers, Inductors, Chokes, Coils, Line Filters, Power Transformers, Current Transformers, Power Toroidal Transformers, Switching and SMPS Transformers, Modules for ISM/ISDN/ADSL/XDSL for Electronics and Telecommunication Applications. The products are UL.

Payton America Inc. **Booth 423**

1805 S Powerline Rd
Suite 109
Deerfield Beach, FL 33442
USA
www.paytongroup.com

Payton is the world leader in Planar magnetics technology and manufacturing. Designs in 24 hours and custom samples in few weeks. Few watts to over 100kWatts from 50kHz to few MHz. Design and manufacturing facilities around the world.

Pearson Electronics, Inc. **Booth 1515**

4009 Transport St
Palo Alto, CA 94303
USA
www.pearsonelectronics.com

Pearson Electronics is the original and leading manufacturer of the Wide Band Current Transformers used for accurate AC current measurements. Pearson Current Transformers can measure transients, harmonics, pulse, sine-wave and other complex current waveshapes. A typical model has 1% accuracy and a 3 dB bandwidth from 1 Hz to 20 MHz. We meet both OEM and custom requirements.

PELS (IEEE Power Electronics Society) .. **Booth 214**

445 Hoes Ln
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.

Pin Shine Industrial Co., Ltd **Booth 1433**

7 F-10 No 3 Wuquan 1st Rd
Xinzhuanq Dist.
New Taipei, 4892
Taiwan
www.pinshine.com

Pin Shine is a total solution manufacturer of electronic-mechanical components by using high-precision mold manufacturing, plastic injection insert molding, overmolding, metal stamping, plating, die-casting, and automatic production for applications for industries such as consumer electronics, industrial, automotive, and medical devices.

PINK GmbH Thermosysteme Booth 1538

704 Ginesi Dr
Suite 11A
Morganville, NJ 07751
USA
www.pink.de/en

PINK GmbH Thermosysteme is the leading manufacturer of Vacuum Soldering and Sintering systems. The VADU systems have the ability to process both preforms and solder paste within the same system. Whether performing R&D or high volume production, PINK's VADU systems can meet your requirements.

Plexim Booth 622

5 Upland Rd
Suite 4
Cambridge, MA 02140
USA
www.plexim.com

Plexim provides solutions for the design and test of power electronic systems and their associated controls. Our portfolio consists of the trusted simulation software PLECS, the RT Box for controller hardware-in-the-loop and rapid control prototyping, and processor-in-the-loop and web-based simulation tools.

PMBus Booth 1832

501 W President George Bush Hwy
Suite 130
Richardson, TX 75080 1141
USA
www.pmbus.org

The Power Management Bus (PMBus) is an open standard power-management protocol pioneered by leading power supply and semiconductor companies. Redefining power management, the communications protocol is maintained and promoted by the PMBus Implementers Forum (PMBus-IF) comprised of over 40 companies.

PMK Mess – und Kommunikationstechnik GmbH Booth 1723

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.

Power Electronic Measurements Ltd. ... Booth 925

Gloucester House, Wellington St
Long Eaton, Nottingham
U.K.
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.

Power Integrations Booth 1623

5245 Hellyer Ave
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 935

6555 Sugarloaf Pkwy
Suite 307-159
Duluth, GA 30097
USA
www.psl-powersolutions.com

PSL-Power Solutions Inc. are experts in Power Conversion Assemblies and Thermal Solutions. Producing in-house machined parts, water cooled chill-plates, heat-pipe solutions and bonded fin heat sinks. A subsidiary of PSL Assemblies located in the UK.

PowerAmerica Booth 737

930 Main Campus Dr
Suite 200
Raleigh, NC 27606
USA
<https://www.poweramericainstitute.org/>

PowerAmerica aims to save energy and create manufacturing jobs by accelerating the adoption of wide bandgap semiconductor devices in power electronic systems. Through participation in PowerAmerica, companies grow business by expedited product introduction, and universities engage in collaborative projects with industry.

PowerbyProxi Booth 1839

111 Franklin Rd
 Freemans Bay
 Auckland, NA 1011
 New Zealand
www.powerbyproxi.com

PowerbyProxi designs & develops safe, high efficiency & high density wireless power technology. We solve mission-critical problems in demanding, hostile industrial environments where the delivery of consistent power is imperative. Our wireless power designs & IP are used in numerous commercial applications around the world by some of the world's largest companies.

PowerELab Ltd. Booth 831

RM521-522, BLK 9, Enterprise Place
 5 Science Park West Ave, HK Science Park, Shatin
 Hong Kong
www.powerelab.com

PowerELab provides design services for many high efficiency, high power density and special application power electronics products, e.g.AC-DC power supply, 80+ server, 80+ ATX, LED driver, electronic ballast, 99+% Eff. Totem Pole PFC, EV charger, DC-AC inverter, battery charger, medical power supply, DC-DC converter, etc. patent licensing, consultancy and training. We also developed a LLC +SR digital controller and a free on-line power supply design tool PowerEsim.

Powerex, Inc. Booth 710

173 Pavilion Ln
 Youngwood, PA 15697
 USA
www.pwr.com

Powerex offers power semiconductor solutions including discrete diodes, SCRs, and power modules serving a broad range of applications including automotive, traction, industrial, medical, renewable energy, and white goods. A Industry standard and custom packages are available along with Silicon Carbide solutions.

Powersim, Inc Booth 615

2275 Research Blvd
 Suite 500
 Rockville, MD 20850
 USA
<https://powersimtech.com/>

Our main product PSIM is a power electronics simulation tool that empowers engineers to accelerate their pace of innovation with the fastest, most reliable and easy-to-use solution. PSIM is now available with an integrated SPICE engine.

Precision Inc. Booth 715

1700 Freeway Blvd
 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

PSMA (Power Sources Manufacturers Association) Booth 212

P.O. 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

Qualtek Booth 730

7610 Jenther Dr
 Mentor, OH 44060
 USA
www.qualtekusa.com

Qualtek Electronics has established itself as the global leader of high quality low cost products while providing the latest technology. Showcased are our full line of power supplies, AC and DC fans, and a full range of fan accessories.

Rectron Semiconductor Booth 733

13405 Yorba Ave
 Chino, CA 91710
 USA
rectron.com

A Taiwanese discrete semiconductor manufacturer since 1975, offers Diodes, Rectifiers, Transistors, SiC Schottky, TVS, ESD arrays, Zeners, and MOSFET products. All Rectron factories are wholly owned and have achieved TS16949 quality standards.

REMTEC, Inc. **Booth 938**

100 Morse St
 Norwood, MA 02062
 USA
www.remtec.com

REMTEC is your one-stop provider for Metallized Ceramic Packaging Solutions. We use Thick Film, Thin Film, Direct Bond Copper and Other Advanced Technologies to Design and Produce Cost-Effective Custom and Semi-Custom Packaging Solutions - Metallized Substrates, Hermetic and Non-Hermetic Packages and Components - Applications in Power Electronics, Renewable Energy, Optoelectronics and RF/MW, Commercial, Industrial, Automotive, Military and Aerospace Industries.

Renco Electronics, Inc. **Booth 610**

595 International Place
 Rockledge, FL 32955
 USA
www.rencousa.com

Leading Manufacture of Coils, Transformers and Inductors. Renco is an Engineering driven company based in Florida with worldwide manufacturing and distribution. Design, build to print or work in conjunction with your Engineering Team. Custom made prototypes as fast as 1 week.

Renesas Electronics **Booth 926**

2801 Scott Blvd
 Santa Clara, CA 95050
 USA
www.am.renesas.com

Renesas Electronics America, Inc., headquartered in Santa Clara, California, is a wholly owned subsidiary of Renesas Electronics Corporation, the world's number one supplier of microcontrollers and a premier supplier of advanced semiconductor solutions including microcontrollers, SoC solutions, and a broad range of analog and power devices. More information about the products offered by Renesas Electronics America can be found at renesas.com.

Richardson RFPD **Booth 930**

1950 S Batavia Ave
 Suite 100
 Geneva, IL 60134
 USA
www.richardsonrfpd.com

Richardson RFPD 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 whether it's designing components or engineering complete solutions.

Ridley Engineering, Inc. **Booth 303**

601 E Daily Dr
 Suite 112
 Camarillo, CA 93010
 USA
www.RIDLEYENGINEERING.com

Ridley Engineering is a global leader best known for its laboratory design workshops, POWER 4-5-6 design software and AP300 frequency response analyzer. A new Design Center facility opened in Camarillo, California in 2016 for training courses, research and consulting.

Rogers Corporation **Booth 1125**

One Technology Dr
 Rogers, CT 06263
 USA
www.rogerscorp.com

Rogers is a global technology leader in specialty materials & components that enable high performance and reliability of power electronics, mass transit, automotive & sustainable energy. RO-LINX[®] laminated busbars and curamik[®] Ceramic Substrates & Micro-Channel Coolers on display.

ROHM Semiconductor **Booth 1111**

2323 Owen St
 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 714

1301 N 17th Ave
 Greeley, CO 80631
 USA
www.rubadue.com

Manufacturing high quality insulated wire and triple insulated wire using ETFE, TEFLON, FEP, TCA, PFA. We also offer insulated and bare Litz Wire.

Starting as a local manufacturer in 1977, Rubadue Wire has evolved into a global supplier for a diverse range of applications and industries. We offer a full line of extruded wire and cable products in a wide variety of sizes and insulating materials. Currently our products are used all over the world in various applications.

Rubycon Booth 534

4293 Lee Ave
 Gurnee, IL 60031
 USA
www.rubycon.com

Capacitors for reliable power design. 65 years of pioneering spirit. Technology leading the world of electrolytics. Stop by for a FREE lifetime analysis. Expect efficient service from our engineering/sales experts. Film, Hybrid, EDLC technologies with immediate stock at Digi-Key.

Samwha USA Inc. Booth 1036

2555 Melksee St
 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 1325

50 Seaview Blvd
 Port Washington, NY 11050
 USA
www.sanrex.com

SanRex power module and discrete product lines: pioneer of diodes, thyristors, and triacs for electrical power switching, and conversion. We continue to achieve success developing power semiconductor technology. And, now we can include a range of SiC MOSFET products.

SBE, Inc. Booth 1434

81 Parker Rd
 Barre, VT 05641
 USA
www.sbelectronics.com

SBE Inc is a leading developer and manufacturer of integrated AC and DC film capacitor solutions for transportation, alternative energy, medical, HVDC and STATCOM systems and Data-center network power. The company has locations in Vermont, Colorado, and China.

Schaffner Trenco LLC Booth 1814

2550 Brookpark Rd
 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 EMC filters thru large power magnetic devices along with custom engineered solutions. Schaffner serves many North American and Global markets.

Schunk Hoffmann Carbon Technology . Booth 1727

Au 62
 Bad Goisern, 4822
 Austria
www.aluminium-graphite.com

Schunk Hoffmann Carbon Technology offers parts made of Aluminium Graphite, such as base plates or heat sinks for high reliability applications. Additionally, we will premier our self-encapsulating carbon phase change material as a novel approach for latent heat storage units.

Scientific Test, Inc. Booth 1725

1110 E Collins Blvd
 Suite 130
 Richardson, TX 75081
 USA
www.scitest.com

STI tests a wide array of devices including GaN, SiC, wafer level, and packaged devices. STI equipment can interface with any prober or handler and it can be utilized as a curve tracer or for simple go/no go testing.

Semikron, Inc. Booth 1203

11 Executive Dr
Hudson, NH 03051
USA
www.semikron.com

One of the world's leading manufacturers of power modules and systems primarily in the medium output range. Our products are at the heart of modern energy efficient motor drives and industrial automation systems. Application areas: power supplies, renewable energies & vehicles.

Semtech Corporation Booth 1525

200 Flynn Rd
Camarillo, CA 93012
USA
www.semtech.com

Semtech Corporation is a leading supplier of analog and mixed-signal semiconductors for high-end consumer, computing, communications and industrial equipment. Power management products include the LinkCharge wireless charging platform, Neo-Iso, switches for IoT applications, and more. For more information, visit www.semtech.com.

Shenzhen Zeasset Electronic Technology Co., Ltd. Booth 323

B1 Building Anle Industrial Park
Hangcheng Road, Banan District
Shenzhen
China
www.zeasset.com

Shenzhen Zeasset Electronic Technology Co., Ltd. specializes in R&D, production and marketing of aluminum electrolytic capacitors & EDLC, which products have characteristic of high voltage, high temperature, high reliability, long life, high ripple current, rapid charge and discharge, etc.

Silicon Frontline Technology, Inc. Booth 331

4030 Moorpark Ave
Suite 249
San Jose, CA 95117
USA
www.siliconfrontline.com

SFT provides electro-thermal analysis of power devices. R3D analyzes designs for Rdson, current density and sensitivity analysis. R3D Gate provides transient analysis of the distributed model of the device. Ethan delivers transient electro-thermal simulation of the design including packaging.

Simplis Technologies Booth 1223

P.O. Box 40084
Portland, OR 97240-0084
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.

Sonoscan, Inc Booth 1710

2149 E Pratt Blvd
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 1639

Calle Rios Rosas 47
Madrid, 28003
Spain
www.thespcard.com

SP Control Technologies is a startup company focused on developing state of the art electronics technology, like the SpCard, and innovative programs to help companies like Virtual Engineer.

Standex-Meder Electronics Booth 1137

4538 Camberwell Rd
Cincinnati, OH 45209
USA
www.standexelectronics.com

Standex-Meder Electronics is a worldwide market leader in the design, development, and manufacture of standard reed switch-based solutions & custom magnetics and power conversion components and assemblies.

Stapla Ultrasonics Booth 1536

250 Andover St
 Wilmington, MA 01887
 USA
www.staplaltrasonics.com

Stellar Industries Corp. Booth 211

50 Howe Ave
 Millbury, MA 01527
 USA
www.stellarind.com

Stellar Industries is an approved and preferred supplier to the Telecom, Biomedical, Microwave, and Defense Industries for custom metallized ceramic components and services.

STMicroelectronics Booth 803

30 Corporate Dr
 Suite 300
 Burlington, MA 01803
 USA
www.st.com

STMicroelectronics' products are found everywhere today, and together with our customers, we are enabling and powering smarter driving and smarter factories, cities and homes, and the next generation of mobile and Internet of Things devices. Visit us at www.st.com

Storm Power Components Booth 1435

240 Industrial Park Ln
 Decatur, TN 37322
 USA
www.stormpowercomponents.com

Storm's vertically integrated US facility is your one-stop source for simple to complex solutions for all power electronics & distribution needs. Laminated busbars, aluminum or copper, in-house electroplating & film or epoxy powder coat insulation systems, plus value added assemblies!

Sumida America Components Inc. Booth 1711

1251 N Plum Grove Rd
 Suite 150
 Schaumburg, IL 60173
 USA
www.sumida.com

Sumida is one of the largest manufacturers of coils and wire wound electronic products globally with over 75,000 active parts. Whether Consumer, Industrial or Automotive applications, Sumida has over 60 years of experience finding the best solution for its customers.

Synopsys, Inc. Booth 637

690 E Middlefield Rd
 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.

Taiwan Chinsan Ind. Co., LTD. Booth 1930

No. 1, Alley 11, Lane 68, Sec. 1 Kwang Fu Rd
 San Chung Dist.
 New Taipei City, 24158
 Taiwan
www.chinsan.com

Taiwan Chinsan Electronic was established in 1970 and is a publicly listed company on the Taiwan Stock Exchange (code : 8042). For 46 years Chinsan has manufactured the ELITE brand aluminum electrolytic capacitor ranging from radial, snap-in, lug, and screw type capacitors and more recently the conductive solid aluminium polymer capacitors.

Taiwan Semiconductor Inc. Booth 633

3040 Saturn St
 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 1237

TOC Bldg. 11F-58
 Nishi-gotanda
 Shinagawa-ku, Tokyo,
 Japan
www.taiyo-technology.jp/english.html

Taiyo Kogyo manufactures Heavy Copper/High Current PCB (HCPCB) used in low impedance power conversion, eliminating wires, dissipating heat efficiently. HCPCB combines signal with power on the same layer, and embeds busbars such as with IGBT or MOSFET signal.

Tamura Corporation of America Booth 436

1040 So. Andreasen Dr
Suite 100
Escondido, CA 92029
USA

www.tamuracorp.com; www.tamura-ss.co.jp

Tamura is a broad line magnetics manufacturer producing Standard and custom Transformers, Inductors, Reactors from 2VA to 1MVA. Also have Hall Effect Current Sensors, Power Modules and Gate Drivers. We will have rep's from US, Japan and China available.

TDK Corporation Booth 601

475 Half Day Rd
Suite 300
Lincolnshire, IL 60069
USA

www.global.tdk.com/worldwide/

TDK is a leader of innovative solutions for the power electronics industry. We offer a complete product range from TDK and EPCOS brand passive electronic components including MLCCs, aluminum and electrolytic capacitors, ferrites, inductors, wireless power products to the TDK-Lambda brand of stand-alone AC/DC power supplies and board mounted DC/DC power modules, and much more.

Tektronix Inc. Booth 934

14150 SW Karl Braun Dr
Beaverton, OR 97077
USA
www.tek.com

Headquartered in Beaverton, Oregon, Tektronix has been at the forefront of digital age for 70 years, delivering advance, precise, and most-capable test and measurement solutions that help to accelerate global innovation in power electronic designs. Visit us at www.tek.com.

Teledyne LeCroy Booth 1031

700 Chestnut Ridge Rd
Chestnut Ridge, NY 10977-6499
USA
www.teledynelecroy.com

Teledyne LeCroy is a leading provider of oscilloscopes, probes, and software analysis solutions for power electronics and three-phase testing. New products include digital power management and power integrity software and rail probes, and a high voltage fiber optically-isolated probe.

Texas Instruments Booth 701

12500 TI Blvd
Dallas, TX 75243
USA
www.ti.com

Texas Instruments Incorporated (TI) is a global semiconductor design and manufacturing company that develops analog ICs and embedded processors. By employing the world's brightest minds, TI creates innovations that shape the future of technology. Learn more at TI.com.

Thermik Corporation Booth 915

3304 US Hwy 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.

Torotel Products, Inc. Booth 1938

620 N Lindenwood Dr
Olathe, KS 66062
USA
www.torotelproducts.com

Torotel offers the highest quality solutions for magnetic components and assemblies. We engineer and manufacture more than 32,000 custom magnetic component designs and assemblies for every imaginable industry, using both client 'recipes' and black box design parameters.

TowerJazz Booth 1410

4321 Jamboree Rd
Newport Beach, CA 92660
USA
www.TowerJazz.com

TowerJazz (www.towerjazz.com) manufactures ICs, offering SiGe, BiCMOS, MS/CMOS, RF CMOS, CMOS Image Sensor, Power Management and MEMS capabilities as well as process transfer services. TowerJazz operates seven manufacturing facilities including three in Japan through TowerJazz Panasonic Semiconductor Company (TPSCo) providing 45nm CMOS, 65nm RF CMOS and 65nm 1.12um pixel technologies.

Transim Technology Booth 911

433 NW 4th Ave
Suite 200
Portland, OR 97209
USA
www.transim.com

Transim Technology is a global leader in delivering cloud based engineering solutions. Our design solutions utilize revolutionary technology platforms backed by notable engineering/software expertise. Come check out our cool new tools that facilitate the engineering design process.

Transphorm Booth 824

115 Castilian Dr
Goleta, CA 93117
USA
www.transphormusa.com

Transphorm is a global semiconductor company wholly-focused on delivering the highest quality, highest reliability gallium nitride (GaN) devices for high voltage power conversion applications and the leader in the design and manufacturing of JEDEC-qualified 650V GaN.

Triad Magnetics Booth 837

460 Harley Knox Blvd
Perris, CA 92571
USA
www.triadmagnetics.com

60+ years of excellence in designing and manufacturing popular standard, innovative custom and always reliable Transformers and Inductors for Medical, Industrial and commercial applications.

TSC Ferrite International Booth 1431

39105 North Magnetics Blvd
Wadsworth, IL 60083
USA

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.

TT Electronics Booth 825

4200 Bonita Place
Fullerton, CA 92835
USA
www.ttelectronics.com

TT Electronics is a global provider of engineered electronics. We provide customers with engineering support and expertise through an international network of specialists and world-class facilities. Our portfolio includes custom and standard magnetics, resistors, connectors, and power electronics.

Typhoon HIL, Inc. Booth 630

35 Medford St
Suite 305
Boston, MA 02143
USA
www.typhoon-hil.com

Typhoon HIL Inc. is the market and technology leader in the rapidly-growing field of ultra-high-fidelity controller Hardware in the Loop (HIL) simulation for power electronics, microgrids, and distribution networks. They provide industry-proven, vertically integrated test solutions along with highest-quality customer support.

United Chemi-Con Booth 1010

1701 Golf Rd 1-1200
Rolling Meadows, IL 60008
USA
www.chemi-con.com

United Chemi-Con, Inc. is the Global leader in the manufacture and development of Aluminum Electrolytic Capacitors. Founded in 1932 in Japan we also produce High CV MLCC's, Polymer and Hybrid Capacitors, Film Capacitors, Super Capacitors, Amorphous chokecoils and MOV's. Power, Automotive and Industrial Distribution are our key markets. We are also the largest Global producer of etched Aluminum Anode foil, which is the key raw material for rapidly advancing technology.

United Silicon Carbide Booth 1312

7 Deer Park Dr
Suite E
Monmouth Junction, NJ 08852
USA
unitedsic.com/

United Silicon Carbide (USCi) is a wide bandgap power discrete supplier. Products include diodes and switching devices available in industry standard packages and die. USCi supplies into a wide range of high volume markets providing cost effective energy efficient solutions.

VAC Magnetics, LLC Booth 922

2935 Dolphin Dr
Suite 102
Elizabethtown, KY 42701
USA
www.vacmagnetics.com

VACUUMSCHMELZE – a manufacturer of advanced magnetic materials – produces Rare Earth Permanent Magnets, Soft Magnetic Materials & Parts, and Cores & Inductive Components. A world leader in development, production and application know-how of magnetic materials, VAC supports customers selecting innovative materials and customizes unique materials for optimized solutions.

Venable Instrumentsx Booth 1310

8656 Hwy 71 W
Cuesta Centre, Bldg E
Austin, TX 78735
USA
www.venable.biz

Since 1979, Venable has been a leader with Frequency Response Analyzers for power supply design, stability and electronics testing and measurement. Over a dozen models, all with integrated isolation, are available for labs, digital, and our new low-cost portable unit for field applications.

Versatile Power Booth 734

743 Camden Ave
Campbell, CA 95136
USA
www.versatilepower.com

Versatile Power has a long history of designing robust power supplies for military, industrial, commercial, laboratory and medical applications. Founded in 2002, Versatile Power offers a line of standard power supplies as well as custom-design power solutions. All of our products are designed and manufactured in the US.

Viking Tech America Corporation Booth 1810

70, Kuanfu N Rd
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, and Power Resistors.

Vincotech GmbH Booth 1032

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 1101

63 Lancaster Ave
Malvern, PA 19355
USA
www.vishay.com

Vishay Intertechnology, Inc. 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. Vishay products can be found at www.vishay.com.

Voltage Multipliers, Inc. Booth 1714

8711 W Roosevelt Ave
Visalia, CA 93291
USA
www.VoltageMultipliers.com

Voltage Multipliers Inc. (VMI) manufactures high voltage components and assemblies including diodes, opto-couplers, multipliers, rectifiers, and power supplies. We offer extensive testing, design verification, production support, and custom design services. ISO9001:2008 certified.

Wakefield-Vette Thermal Solutions Booth 711

33 Bridge St
Pelham, NH 03076
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.

WEMS Electronics Booth 425

4650 West Rosecrans Ave
 Hawthorne, CA 90250
 USA
www.wems.com

Established in 1959, WEMS Electronics is a full service turn-key Small Business with an extensive AS9100C / ISO-9001 registered complex specializing in state-of-the-art EMI custom filters, engineering and manufacturing services. We are one of the few companies that offer a completely integrated approach to the design and fabrication of precision electronic components, assemblies and subsystems. In addition, our EMI/RFI filter division manufactures high reliability multi-circuit & discreet feed-through.

West Coast Magnetics Booth 1738

P.O. Box 31330
 Stockton, CA 95213
 USA
www.wcmagnetics.com

West Coast Magnetics designs best in class transformers and inductors and provides manufacturing services for electronic products with high engineering content. Our active R&D has resulted in new patented technology and innovative designs for power and RF magnetic components in many applications. We will continually redefine what is possible with magnetic technology. Headquartered in the San Francisco Bay Area.

Wolfspeed Booth 1110

3028 E Cornwallis Rd
 Research Triangle Park, NC 27709
 USA
www.wolfspeed.com

Wolfspeed is leading the innovation and commercialization of silicon carbide and gallium nitride, liberating designers to invent power and wireless systems for a responsible, energy-efficient future.

Wolfspeed's wide bandgap semiconductor products for power and radio-frequency (RF) applications deliver new levels of performance through increased efficiency, higher switching frequency and reduced system size and weight for the transportation, industrial, energy and communications markets.

Wolverine Tube Inc. – MicroCool Division Booth 1627

2100 Market St NE
 Decatur, AL 35601
 USA
www.microcooling.com

Wolverine Tube has been in business for 100 years providing innovative thermal solutions to the automotive and HVAC industries with enhanced copper tube. The MicroCool® Division has leveraged the company's proprietary MDT technology to produce novel cold plates and integrated base plates for optimal liquid cooling solutions for the Electronics Industry.

Würth Electronics Midcom Inc. Booth 811

121 Airport Dr
 Watertown, SD 57201
 USA
www.we-online.com

A leader in the design and manufacture of custom magnetics and transformers. A standard line of magnetics includes inductors, ferrites, chokes, LEDs, capacitors, wireless charging coils, and a wide array of connectors. Software tools include REDEXPERT and Smart Transformer Selector.

X-FAB Semiconductor Foundries Booth 639

275 Saratoga Ave
 Santa Clara, CA 95050
 USA
www.xfab.com

Leading analog/mixed-signal foundry offering technologies for sensors, actuators and SoCs based on modular CMOS, SOI, SiC and MEMS processes. X-FAB operates six wafer fab facilities in Germany, France, Malaysia and the US.

Xiame Faratronic Co., Ltd. Booth 2012

99, Xinyuan Rd
Haicang District
Xiame, 361022
China
www.faratronic.com

Xiame Faratronic Co.,Ltd., is a world leading professional manufacturer of film capacitors and metallized film.

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