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SAN ANTONIO, TEXAS
★ MARCH 4-8 ★

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PSMA Power Sources Manufacturers Association The Multinational Power Electronics Association

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APEC Mobile App & Internet

For the latest news and information, access to online conference and hotel information download the **APEC 2018 mobile app** on your mobile device. The app is accessible through Google Play (Android) and App Store (IOS devices) by searching keyword "**APEC IEEE Applied Power Electronics**".

Internet is available throughout the Henry B. Gonzalez Convention Center to APEC attendees and can be accessed by connecting to the "**APEC**" wireless network. After selecting the "APEC" wireless network, open your web browser and you will be prompted to input a password. The password is **APEC2018**.

Foreword

Foreword

It is my honor to personally welcome you to the 33nd annual IEEE Applied Power Electronics Conference and Exposition (APEC 2018), at the Henry B. Gonzalez Convention Center in historic downtown San Antonio, Texas. APEC brings together power electronic professionals from all sectors annually to participate in a rewarding exchange of technical knowledge, while gaining insight and 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 discover new problems to solve.

APEC is made possible each year through the tireless effort of its all-volunteer organizing committee and the three sponsoring organizations: Power Sources Manufacturers Association (PSMA), and two IEEE societies, the Power Electronics Society (PELS) and Industry Applications Society (IAS). It is their combined dedication, expertise, and support along with our professional conference management partner, SmithBucklin, which drives the success of this conference as a showcase of the latest advances in power electronics.

APEC 2018 provides an unmatched technical program and exposition experience, highlighting the best our industry has to offer. The conference begins with 18 Professional Education Seminars organized into 6 parallel tracks, followed by 6 Keynote speakers featured in the Plenary session on Monday afternoon. Then the exhibit hall, featuring cutting-edge technologies and products from 300 companies, opens with a reception for all attendees on Monday evening. Tuesday through Thursday feature the technical papers organized into 63 sessions with nearly 600 peer-reviewed paper presentations on the latest topics from worldwide academic, government and industry presenters, along with 25 industry sessions featuring an additional 130 presentations. Besides these technical sessions, there is also the Micro-Mouse contest on Monday night, 3 popular Rap sessions on Tuesday night, and the big social event/banquet on Wednesday night in the convention center ballroom. To help you navigate the conference, download the APEC Mobile App – it features an interactive directory and map of the floor as well as schedules and access to all the technical papers.

Besides all of these presentations, sessions and events to attend, I always find that is connecting with my peers, friends and colleagues face-to-face, catching-up with what new things they are working on, and discovering the latest trends in their realm that is the most rewarding aspect of attending APEC. I hope you are able to take advantage of the great restaurants and entertainment opportunities in San Antonio while enjoying all of the events at APEC with your friends and colleagues.

I want to thank the APEC attendees, exhibitors, sponsors, organizing & steering committee members, reviewers and volunteers - it is your passion and knowledge which makes APEC a memorable event year after year. I look forward to meeting you at APEC 2018 and sharing in this experience together.

Best Regards,

Eric Persson
General Chair
2018 IEEE Applied Power Electronics Conference and Exposition

Our Partners

APEC Partners provide financial support to enhance the experience while keeping registration fees low.

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Schedule-at-a-Glance

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

Schedule as of February 15

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

Sunday, March 4, 2018

Registration		8:00 a.m. – 5:00 p.m.	WEST REGISTRATION
Mobile App Help Desk		8:00 a.m. – 5:00 p.m.	MAIN LOBBY
Presenter Breakfast		8:00 a.m. – 9:00 a.m.	HEMISFAIR BALLROOM C3
S01:	Fundamentals of Switch Mode Power Conversion	9:30 a.m. – 1:00 p.m.	ROOM 217D
S02:	Modern Soft Switching Technologies	9:30 a.m. – 1:00 p.m.	ROOM 206
S03:	Thermal and Reliability Modelling of Power Electronics Systems	9:30 a.m. – 1:00 p.m.	ROOM 217A
S04:	WBG Switching Circuits: Design, Test, Devices and Applications	9:30 a.m. – 1:00 p.m.	ROOM 214AB
S05:	High-Efficiency Single-Phase Inverter Design – VT-FEEC Approach for Google Little Box Challenge	9:30 a.m. – 1:00 p.m.	ROOM 214CD
S06:	Power Quality Control in Hybrid AC/DC Microgrids	9:30 a.m. – 1:00 p.m.	ROOM 217BC
Break		11:00 a.m. – 11:30 a.m.	PARKVIEW REGISTRATION FOYER
Lunch		1:00 p.m. – 2:30 p.m.	On Own
S07:	Electromagnetic Interference and Compatibility for Power Electronics Engineers	2:30 p.m. – 6:00 p.m.	ROOM 217D
S08:	New High-Frequency Magnetics Circuit Models	2:30 p.m. – 6:00 p.m.	ROOM 214CD
S09:	Advanced Thermal Management Technologies	2:30 p.m. – 6:00 p.m.	ROOM 217A
S10:	Designing Reliable and High Density Power Supplies with GaN	2:30 p.m. – 6:00 p.m.	ROOM 214AB
S11:	Power Semiconductors for Traction Inverters in Vehicles: from Discretes to Power Modules, from Silicon to Wide Band Gap Devices	2:30 p.m. – 6:00 p.m.	ROOM 206
S12:	Power Converters for Energy Storage Applications – Analysis and Design from Theory to Practice	2:30 p.m. – 6:00 p.m.	ROOM 217BC
Break		4:00 p.m. – 4:30 p.m.	PARKVIEW REGISTRATION FOYER

Monday, March 5, 2018

Presenter Breakfast		7:00 a.m. – 8:00 a.m.	HEMISFAIR BALLROOM C3
Registration		7:00 a.m. – 6:00 p.m.	WEST REGISTRATION
Mobile App Help Desk		7:00 a.m. – 6:00 p.m.	MAIN LOBBY
Spouse and Guest Breakfast		8:00 a.m. – 10:00 a.m.	RIO VISTA ROOM at the MARRIOTT RIVERCENTER
S13:	Gate Driver Design for IGBT and SiC Based Power Devices and Modules	8:30 a.m. – 12:00 p.m.	ROOM 217BC
S14:	Closing the Feedback Loop Through Simulation and Analysis	8:30 a.m. – 12:00 p.m.	ROOM 214CD
S15:	International Product Compliance and Certifications – Safety and EMC Compliance 101	8:30 a.m. – 12:00 p.m.	ROOM 206
S16:	Maximizing GaN FET and IC Performance, Not Just a Drop in Replacement of MOSFETs	8:30 a.m. – 12:00 p.m.	ROOM 214AB

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

S17:	Optimizing Power Converter Topology and Module Selection in 1500V Solar Inverters	8:30 a.m. – 12:00 p.m.	ROOM 217A
S18:	Small-Signal Stability and Subsystem Interactions in Distributed Power Systems with Multiple Converters (II): 3-Phase AC Systems	8:30 a.m. – 12:00 p.m.	ROOM 217D
	Spouse and Guest Tour "Yanguana Mission Heritage Tour" departs *(Registration Required)*	9:00 a.m. – 12:00 p.m.	Departs from MARRIOTT RIVERCENTER LOBBY
	Break	10:10 a.m. – 10:40 a.m.	PARKVIEW REGISTRATION FOYER
	Lunch	12:00 p.m. – 1:15 p.m.	On Own
	Opening Plenary Session	1:15 p.m. – 5:00 p.m.	HEMISFAIR BALLROOM C1/C2
	Break	3:00 p.m. – 3:30 p.m.	HEMISFAIR BALLROOM FOYER
	Exhibit Hall Welcome Reception	5:00 p.m. – 8:00 p.m.	EXHIBIT HALL 3/4
	MicroMouse Contest	8:00 p.m. – 10:00 p.m.	EXHIBIT HALL 4B

Tuesday, March 6, 2018

	Presenter Breakfast	7:00 a.m. – 8:00 a.m.	HEMISFAIR BALLROOM C3
	Registration	7:00 a.m. – 5:00 p.m.	WEST REGISTRATION
	Mobile App Help Desk	7:00 a.m. – 5:00 p.m.	MAIN LOBBY
	Spouse and Guest Breakfast	8:00 a.m. – 10:00 a.m.	RIO VISTA ROOM at the MARRIOTT RIVERCENTER
IS01:	Latest Advancements in Device and Package Technology for High Power, High Frequency Switching Device	8:30 a.m. – 11:55 a.m.	ROOM 206
IS02:	High Frequency Magnetics – Winding Design	8:30 a.m. – 11:55 a.m.	ROOM 207
IS03:	Capacitors for Emerging Power Conversion Applications	8:30 a.m. – 11:55 a.m.	ROOM 205
IS04:	Comparisons and Tradeoffs of Integrated Gate Driver Isolation Technologies	8:30 a.m. – 11:55 a.m.	ROOM 212
IS05:	Energy Harvesting	8:30 a.m. – 11:55 a.m.	ROOM 213
T01:	Three-Phase AC-DC Converters	8:30 a.m. – 12:00 p.m.	ROOM 214A
T02:	Hybrid DC-DC Converters	8:30 a.m. – 12:00 p.m.	ROOM 214B
T03:	Power Electronics for Utility Interface – Structures & Topologies	8:30 a.m. – 12:00 p.m.	ROOM 214C
T04:	Faults in Electric Machines And Drives	8:30 a.m. – 12:00 p.m.	ROOM 214D
T05:	Power Devices Modeling	8:30 a.m. – 12:00 p.m.	ROOM 217A
T06:	Control of DC-DC Converters	8:30 a.m. – 12:00 p.m.	ROOM 217B
T07:	Inverters for PV Systems	8:30 a.m. – 12:00 p.m.	ROOM 217C
T08:	SMP Audio and Battery	8:30 a.m. – 12:00 p.m.	ROOM 217D
	Spouse and Guest Tour *San Antonio Botanical Gardens* departs *(Registration Required)*	8:30 a.m. – 12:00 p.m.	Departs from MARRIOTT RIVERCENTER LOBBY
	Break	10:10 a.m. – 10:40 a.m.	EXHIBIT HALL 3/4
	Lunch	12:00 p.m. – 1:30 p.m.	EXHIBIT HALL 3/4
	Exhibit Hall Open	12:00 p.m. – 5:00 p.m.	EXHIBIT HALL 3/4
	Exhibitor Seminars – Session #1 (Concurrent Sessions)	1:30 p.m. – 2:00 p.m.	See Page 59

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

Exhibitor Seminars – Session #2 (Concurrent Sessions)	2:15 p.m. – 2:45 p.m.	See Page 60
Break	2:45 p.m. – 3:15 p.m.	PARKVIEW REGISTRATION FOYER
Campfire Connections - Women in Engineering	2:45 p.m. – 3:15 p.m.	THE HUB, BOOTH 931
Exhibitor Seminars – Session #3 (Concurrent Sessions)	3:00 p.m. – 3:30 p.m.	See Page 61
Exhibitor Seminars – Session #4 (Concurrent Sessions)	3:45 p.m. – 4:15 p.m.	See Page 62
R01: Biggest Impact on Power Conversion- Devices or Magnetics	5:00 p.m. – 6:30 p.m.	HEMISFAIR C1
R02: Drive Isolation Technologies: Optical, Ganetic, or Capacitive Coupling	5:00 p.m. – 6:30 p.m.	HEMISFAIR C2
R03: GaN vs.SiC vs SI for next Generation Power Devices	5:00 p.m. – 6:30 p.m.	HEMISFAIR C3
IEEE PELS-IAS Young Professionals Reception	7:00 p.m. – 10:00 p.m.	RIO RIO CANTINA, ESTRELLA ROOM (3RD FLOOR)
IEEE PELS Mentorship Round Tables *(Registration Required)*	7:30 p.m. – 9:30 p.m.	ROOM 4

Wednesday, March 7, 2018

Presenter Breakfast	7:00 a.m. – 8:00 a.m.	HEMISFAIR BALLROOM C3
Registration	7:00 a.m. – 3:00 p.m.	WEST REGISTRATION
Spouse and Guest Breakfast	8:00 a.m. – 10:00 a.m.	RIO VISTA ROOM at the MARRIOTT RIVERCENTER
IS06: Wide Bandgap Device Topics	8:30 a.m. – 10:10 a.m.	ROOM 206
IS07: Power Solutions for Challenging Real-World Applications	8:30 a.m. – 10:10 a.m.	ROOM 207
IS08: Vehicle Electrification	8:30 a.m. – 10:10 a.m.	ROOM 205
IS09: Isolation Topics in Power Supplies	8:30 a.m. – 10:10 a.m.	ROOM 212
IS010: Modeling & Simulation	8:30 a.m. – 10:10 a.m.	ROOM 213
T09: Resonant Converters	8:30 a.m. – 10:10 a.m.	ROOM 214A
T10: Power Electronics for Utility Interface – Power Quality & Harmonics	8:30 a.m. – 10:10 a.m.	ROOM 214B
T11: Control of Inverters and Drives II	8:30 a.m. – 10:10 a.m.	ROOM 214C
T12: Magnetics	8:30 a.m. – 10:10 a.m.	ROOM 214D
T13: EMI Detection and Mitigation Methods	8:30 a.m. – 10:10 a.m.	ROOM 217A
T14: Battery Systems	8:30 a.m. – 10:10 a.m.	ROOM 217B
T15: Charging and Energy Storage Topics	8:30 a.m. – 10:10 a.m.	ROOM 217C
T16: New Technology	8:30 a.m. – 10:10 a.m.	ROOM 217D
Campfire Connections – Magnetics	10:10 a.m. – 10:40 a.m.	THE HUB, BOOTH 931
Exhibit Hall Open	10:00 a.m. – 2:00 p.m.	EXHIBIT HALL 3/4
Break	10:10 a.m. – 10:40 a.m.	EXHIBIT HALL 3/4
Exhibitor Seminars – Session #1 (Concurrent Sessions)	10:30 a.m. – 10:30 a.m.	See Pages 74-75
Exhibitor Seminars – Session #2 (Concurrent Sessions)	11:15 a.m. – 11:45 a.m.	See Pages 75-76
Exhibitor Seminars – Session #3 (Concurrent Sessions)	12:00 p.m. – 12:30 p.m.	See Page 76
Lunch	12:30 p.m. – 2:00 p.m.	EXHIBIT HALL 3/4
IS11: Enabling High-Volume Wide Bandgap Semiconductor Manufacturing and Applications	2:00 p.m. – 5:25 p.m.	ROOM 206

CONFERENCE AND EXPOSITION APEC 2★18

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

IS12:	Vehicle Batteries – It's More Than Just Stacking Cells Together and an EV1 Retrospective	2:00 p.m. – 5:25 p.m.	ROOM 207
IS13:	Alternative Energy	2:00 p.m. – 5:25 p.m.	ROOM 205
IS14:	Innovative Component, Reliability and Manufacturing 3D Power Packaging Solutions	2:00 p.m. – 5:25 p.m.	ROOM 212
IS15:	Motor Drives, Inverters and Modules	2:00 p.m. – 5:25 p.m.	ROOM 213
T17:	Single-Phase AC-DC Converters	2:00 p.m. – 5:30 p.m.	ROOM 214A
T18:	Soft Switching Converters	2:00 p.m. – 5:30 p.m.	ROOM 214B
T19:	Control of Inverters and Drives I	2:00 p.m. – 5:30 p.m.	ROOM 214C
T20:	GaN Device Opportunities and Challenges	2:00 p.m. – 5:30 p.m.	ROOM 214D
T21:	Power Converter Modeling & Control	2:00 p.m. – 5:30 p.m.	ROOM 217A
T22:	Control Strategies for Inverters & Motor Drives	2:00 p.m. – 5:30 p.m.	ROOM 217B
T23:	Wireless Power Transfer Applications	2:00 p.m. – 5:30 p.m.	ROOM 217C
T24:	Photovotlaic & Grid Tie Systems	2:00 p.m. – 5:30 p.m.	ROOM 217D
Break		3:40 p.m. – 4:10 p.m.	PARKVIEW REGISTRATION FOYER
"Western" Evening Social Event *(Ticket Required)*		6:00 p.m. – 9:00 p.m.	HEMISFAIR BALLROOM

Thursday, March 8, 2018

Presenter Breakfast		7:00 a.m. – 8:00 a.m.	HEMISFAIR BALLROOM C3
Registration		7:00 a.m. – 12:00 p.m.	WEST REGISTRATION
Spouse and Guest Breakfast		8:00 a.m. – 10:00 a.m.	RIO VISTA ROOM at the MARRIOTT RIVERCENTER
IS16:	Reliability and Ruggedness – How to Address These Challenges in Wide Bandgap Semiconductor Devices	8:30 a.m. – 11:30 a.m.	ROOM 206
IS17:	Powering Servers and Datacenters	8:30 a.m. – 11:30 a.m.	ROOM 207
IS18:	Topologies and Control	8:30 a.m. – 11:30 a.m.	ROOM 205
IS19:	Powering Mobile and Consumer Products	8:30 a.m. – 11:30 a.m.	ROOM 212
IS20:	PMBus Implementation and Applications	8:30 a.m. – 11:30 a.m.	ROOM 213
T25:	DC-DC Converter Applications	8:30 a.m. – 11:20 a.m.	ROOM 214A
T26:	Switched And Synchronous Reluctance Motor Drives	8:30 a.m. – 11:20 a.m.	ROOM 214B
T27:	Power Module Integration & Prognostics	8:30 a.m. – 11:20 a.m.	ROOM 214C
T28:	Power Quality Oriented Control	8:30 a.m. – 11:20 a.m.	ROOM 214D
T29:	Wireless Power Transfer for EV Applications	8:30 a.m. – 11:20 a.m.	ROOM 217A
T30:	Renewable Energy Topics	8:30 a.m. – 11:20 a.m.	ROOM 217B
T31:	Conversion Systems for Electric Vehicles	8:30 a.m. – 11:20 a.m.	ROOM 217C
T32:	Grid Applications	8:30 a.m. – 11:20 a.m.	ROOM 217D
Break		10:10 a.m. – 10:40 a.m.	PARKVIEW REGISTRATION FOYER
Lunch		11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D01:	AC-DC Converters II	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D02:	Miscellaneous Topics in DC-DC Converters I	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM

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

D03:	Miscellaneous Topics in DC-DC Converters II	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D04:	Power Electronics for Utility Interface I	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D05:	Power Electronics for Utility Interface II	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D06:	Controls & Diagnostics of Inverters & Drives	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D07:	Inverter Topologies	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D08:	Magnetics and Capacitors	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D09:	Power Devices	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D10:	Device Reliability	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D11:	Power Module Packaging, Thermal & Application	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D12:	Power Devices Modeling & Simulation	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D13:	Modeling and Simulation of Power Converters	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D14:	Control I	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D15:	Control II	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D16:	Wireless Power Transfer	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D17:	Wind And Solar Power	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D18:	Microgrids and Grid Connect	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D19:	Renewable Energy Systems	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D20:	Transportation Power Electronics	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D21:	LED Applications	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D22:	Industrial and Grid Applications	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
D23:	Switchmode Power Supply & Battery Applications	11:30 a.m. – 2:00 p.m.	HEMISFAIR BALLROOM
IS21:	Test & Measurement	2:00 p.m. – 3:40 p.m.	ROOM 206
IS22:	Passive Components	2:00 p.m. – 3:40 p.m.	ROOM 205
IS23:	Market Analysis and Semiconductor Fabrication Business	2:00 p.m. – 3:40 p.m.	ROOM 213
T33:	High Conversion Ratio Converters	2:00 p.m. – 5:30 p.m.	ROOM 214A
T34:	Power Electronics for Utility Interface – Control	2:00 p.m. – 5:30 p.m.	ROOM 214B
T35:	Multi-level Inverters and Converters	2:00 p.m. – 5:30 p.m.	ROOM 214C
T36:	Opportunities and Challenges of SiC & Si Devices	2:00 p.m. – 5:30 p.m.	ROOM 214D
T37:	Magnetics Modeling Design & Applications	2:00 p.m. – 5:30 p.m.	ROOM 217A
T38:	Control Application	2:00 p.m. – 5:30 p.m.	ROOM 217B
T39:	Renewable Energy Converter Topologies	2:00 p.m. – 5:30 p.m.	ROOM 217C
T40:	Industrial Applications	2:00 p.m. – 5:30 p.m.	ROOM 217D
Break		3:40 p.m. – 4:10 p.m.	PARKVIEW REGISTRATION FOYER

CONFERENCE AND EXPOSITION APEC 2★18

General Information

Conference Location

Henry B. Gonzalez Convention Center
900 E Market Street
San Antonio, TX 78205
Phone: 210-207-8500

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

- **Hilton Palacio del Rio**
  200 S Alamo Street
  San Antonio, TX 78205
- **The Marriott Rivercenter**
  101 Bowie Street
  San Antonio, TX 78205
- **The Marriott Riverwalk**
  889 E Market Street
  San Antonio, TX 78205
- **Menger Hotel**
  2204 Alamo Plaza
  San Antonio, TX 78205
- **Springhill Suites San Antonio Downtown/Riverwalk**
  524 S Saint Mary's Street
  San Antonio, TX 78205
- **The Westin Riverwalk**
  203 Alamo Plaza
  San Antonio, TX 78205

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Transportation

AREA AIRPORT

San Antonio International Airport – SAT
Distance: 9.5 miles from the Henry B. Gonzalez Convention Center and APEC hotels.

Estimated taxi fare: $25.00-$30.00 USD (one way)

Alternate transportation: Uber, Lyft

PARKING

- **Hilton Palacio del Rio**
  Self Parking Only (no valet offered)
- **Marriott Rivercenter/Riverwalk**
  Valet Parking: $42 (daily)
- **The Menger Hotel**
  Valet Parking: $20 per night excluding tax
- **Springhill Suites San Antonio Downtown/Riverwalk**
  Valet Parking: $24 (daily)
- **The Westin Riverwalk**
  Nightly Parking: $39 per day,
  one time (non-overnight) parking is $25

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.

Conference Registration

In order to participate in the APEC 2018 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 Henry B. Gonzalez Convention Center (West Registration).

Saturday, March 3. . . . . 4:00 p.m. – 7:00 p.m.
Sunday, March 4. . . . . 8:00 a.m. – 5:00 p.m.
Monday, March 5 . . . . . 7:00 a.m. – 6:00 p.m.
Tuesday, March 6 . . . . . 7:00 a.m. – 5:00 p.m.
Wednesday, March 7. . . . . 7:00 a.m. – 3:00 p.m.
Thursday, March 8 . . . . . 7:00 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: Hemisfair Ballroom C3
Henry B. Gonzalez Convention Center
DAY/TIME: Sunday at 8:00 a.m. and Monday at 7:00 a.m.

Industry Sessions and the Lecture 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 Lecture Technical Session Presenter Breakfast**
LOCATION: Hemisfair Ballroom C3
Henry B. Gonzalez 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: Hemisfair Ballroom C3
Henry B. Gonzalez Convention Center
DAY/TIME: Thursday at 7:00 a.m.

Speaker Ready Room:

The Speaker Ready room to available to all presenters should you need to review your presentation in advance of your session or make any edits.

LOCATION: Room 211, Henry B. Gonzalez Convention Center

HOURS:
Sunday, March 4. . . . . 8:00 a.m. – 5:00 p.m.
Monday, March 5 . . . . . 7:30 a.m. – 5:00 p.m.
Tuesday, March 6 . . . . . 7:30 a.m. – 5:00 p.m.
Wednesday, March 7. . . . . 7:30 a.m. – 5:00 p.m.
Thursday, March 8 . . . . . 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 in West Registration, starting at noon on Sunday, March 4.

	On-site
Conference Proceedings (USB Only)	$180.00 USD
Seminar Workbook (USB only)	$180.00 USD

Publications purchased can be picked up at the registration desk.

> **PURCHASING THROUGH THE IEEE**
Post conference APEC Proceedings may be purchased through the IEEE.

> **IEEE Single Copy Sales**
445 Hoes Lane
Piscataway, New Jersey 08854 USA
P: (800) 678-4333 (USA & Canada)
or (732) 981-0060
Web site: *http://shop.ieee.org/ieeestore/*

Important Rules, Notices & Conference Policies

Registration Cancellation & Refund Policy

All registrations 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. 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.

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 5, 2018. 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 2018 hotel space, meeting facilities or Exhibit Hall.

Distributing Commercial Material at APEC

Rules For Non-Exhibitors

Distribution of commercial material in the APEC 2018 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.

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 2018 Exposition. In addition APEC may use the information you provide to contact you with information about APEC 2018 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.

Conference Highlights

Plenary Session

APEC 2018 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 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 have 18 Professional Education Seminars which will take place on Sunday, March 4 and Monday, March 5. Seminars will be given with the following tracks: Fundamentals; Design; Reliability and Safety; Wide Bandgap; Inverters; Grid.

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 from 11:30 a.m. – 2:00 p.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 2018, 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.

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.

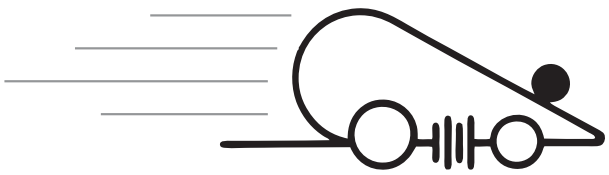
Entrance to the Exhibition is open to all conference attendees, including holders of the free Exhibits Only registration!

MicroMouse Contest

> **Monday, March 5, 2018**
> Starting at 8:00 p.m.
> (after Exhibit Hall closes at 8:00 p.m.)
> EXHIBIT HALL 4B

Enter the annual APEC Micromouse contest or join us as a spectator for this exciting event. Participants design, build, and program robotic mice and compete to see who can navigate their way through the maze in the shortest time.

The rules for the contest use a scoring system with a penalty for the time taken to map and run the maze, and a bonus for not touching the mouse. They are similar to those used at the IEE World Final held in London in 1987 except that the touch penalty has been reduced from 10 seconds to 2 seconds. The time for each contestant has also been reduced from 15 to 7 minutes. Within this time limit, the Micromouse may make up to 5 runs. Only one mouse per handler will be allowed this year.



Trophies and cash prizes will be awarded in the following categories based on score:

> $500 first place
> $250 second place
> $125 third place

Trophies and cash prizes will be awarded to students in the following categories:

> $500 best student (based on score)
> $150 fastest run (based on run time)

Conference Social Event

> **Wednesday, March 7**
> 6:00 p.m. – 9:00 p.m.
> HEMISFAIR BALLROOM
> HENRY B. GONZALEZ CONVENTION CENTER

APEC 2018 Full Conference and Technical Session registrants will receive a social event ticket with their registration. If you have a Seminar only registration, exhibits only registration or are registered as an exhibitor, you should purchase a social event ticket by visiting the registration desk. You can also purchase tickets for your guest to attend. Exhibiting Companies will receive a Social Event Ticket with their Conference Registration.

Young Professionals & Students Reception

(All Young Professionals and Students Welcome)

Sponsored by IEEE PELS and IEEE IAS

LOCATION: Rio Rio Cantina, Estrella Room,
421 E. Commerce Street

DAY/TIME: Tuesday, March 6, 7:00 p.m. – 10:00 p.m.

Power Electronics Society (PELS) and IEEE Industry Application Society (IAS) give you this opportunity to learn from the life journey of the biggest leaders at APEC along with an evening well spent talking to people from across the globe. Make sure you don't miss this wonderful chance to make new friends and meet new people. Please visit ***http://bit.ly/2rNjQFQ*** for more information.

Spouse & Guest Program

APEC welcomes the spouses and guests of the APEC conference to participate in conference activities. This year's options include:

SAN ANTONIO AMERICAN INDIAN MISSION TOURS

Monday, March 5, 2018 | 9:00 a.m. – 12:00 p.m.

- Yanguana Mission Heritage Tour with a cultural presentation and native food sampling included
- A traditional Native lunch will be prepared for all attendees
- COST: $100 per person

SAN ANTONIO BOTANICAL GARDENS

Tuesday, March 6, 2018 | 8:30 a.m. – 12:00 p.m.

- One hour guided tour of beautiful Botanical Gardens with tour guide
- Chef demonstration with gourmet food sampling included
- Self-Guided Scavenger Hunt for guests to explore more of the gardens on their own
- COST: $100 per person

Notes

Sponsor Meetings

IAS Meetings

Tuesday, March 6, 2018

IEEE PELS/IAS Young Professional Reception	7:00 p.m. – 10:00 p.m.	OFFSITE – RIO RIO CANTINA

IEEE PELS Meetings

Sunday, March 4, 2018

International Future Energy Challenge (IFEC) Workshop	8:00 a.m. – 6:00 p.m.	ROOM 7A
FEPPCON Steering Committee	9:00 a.m. – 10:00 a.m.	ROOM 5
Asian Power Electronics Coordination Committee	11:00 a.m. – 12:00 p.m.	ROOM 6A
EBL Leadership *(Members Only)*	11:00 a.m. – 2:55 p.m.	ROOM 5
New Administrative Committee Member Training	1:00 p.m. – 2:00 p.m.	ROOM 6A
PELS Exec Team Pre -Strategy *(Officers Only)*	3:00 p.m. – 5:00 p.m.	ROOM 5

Monday, March 5, 2018

Empower a Billion Lives Steering & Regional Committee	8:00 a.m. – 11:30 a.m.	ROOM 5
Electronics Transformers Technical Committee	8:30 a.m. – 12:00 p.m.	ROOM 4
ITRW Executive Committee	9:00 a.m. – 9:30 a.m.	ROOM 6B
PELS Bylaws and Constitution	9:00 a.m. – 10:00 a.m.	ROOM 7A
PELS Membership Committee	9:00 a.m. – 11:30 a.m.	ROOM 6A
PELS Conferences Committee Business *(Members Only)*	10:00 a.m. – 11:00 a.m.	ROOM 7A
ITRW Standards Groups	10:00 a.m. – 1:00 p.m.	ROOM 6B
PELS Fellows Committee	11:00 a.m. – 12:30 p.m.	ROOM 7A
PELS Chapter Chair Forum	11:30 a.m. – 1:00 p.m.	ROOM 6A
PELS TC & Academic Affairs Chairs Lunch	11:45 a.m. – 1:00 p.m.	ROOM 5
Magazine & Industry Advisory Board	6:00 p.m. – 7:00 p.m.	ROOM 7A
Mentorship Round Tables *(Paid Registration Required)*	7:30 p.m. – 9:30 p.m.	ROOM 4

Tuesday, March 6, 2018

PELS TC1 - Power and Control Core Technologies	8:30 a.m. – 10:30 a.m.	ROOM 6B
IEEE Journal of Emerging and Selected Topics on Power Electronics (JESTPE) Steering Committee	9:00 a.m. – 10:00 a.m.	ROOM 4
SPEC Steering	9:00 a.m. – 10:00 a.m.	ROOM 6A
PELS 30th Anniversary Committee	9:00 a.m. – 10:00 a.m.	ROOM 7A
ECCE Asia Coordination Committee	10:00 a.m. – 11:00 a.m.	ROOM 6A
PELS TC7- Intelec	10:00 a.m. – 11:30 a.m.	ROOM 7A
Mentorship Committee	10:30 a.m. – 11:30 a.m.	ROOM 6B

CONFERENCE AND EXPOSITION APEC 2★18

Tuesday, March 6, 2018 *(continued)*

IEEE Journal of Emerging and Selected Topics on Power Electronics (JESTPE) Editorial Board	10:00 a.m. – 12:00 p.m.	ROOM 4
PELS TC3 Motor Drives & Actuators	11:00 a.m. – 12:00 p.m.	ROOM 7A
Women in Engineering (WIE) Roundtable	12:00 p.m. – 1:30 p.m.	ROOM 7A
CPSS Transactions on Power Electronics and Applications New Journal	1:00 p.m. – 2:00 p.m.	ROOM 6B
ITRW IAB Meeting	1:00 p.m. – 2:00 p.m.	ROOM 6A
PELS TC4- / IAS Jt Vehicle and Transportation Systems	1:00 p.m. – 2:30 p.m.	ROOM 7A
Empower A Billion Lives (EBL)	2:30 p.m. – 3:30 p.m.	ROOM 6B
eGrid Steering Committee	2:30 p.m. – 3:30 p.m.	ROOM 7A
PELS TC6 - High Performance and Emerging Technologies	2:30 p.m. – 4:00 p.m.	ROOM 6A
PELS TC2 - Power Conversion Systems and Components	3:30 p.m. – 5:00 p.m.	ROOM 6B
PEDG Steering Committee	3:30 p.m. – 5:00 p.m.	ROOM 7A
PELS TC5 - Sustainable Energy Technical Committee	5:00 p.m. – 6:30 p.m.	ROOM 6A
Magazine & Industry Advisory Board	6:00 p.m. – 7:00 p.m.	ROOM 7A
IEEE IAS/PELS Young Professional Reception	7:00 p.m. – 9:00 p.m.	RIO RIO CANTINO, ESTRELLA ROOM

Wednesday, March 7, 2018

Women In Engineering (WIE) Breakfast	8:00 a.m. – 9:00 a.m.	ROOM 6A
Cyber Physical Security Meeting	9:00 a.m. – 10:30 a.m.	ROOM 4
PELS Products Committee	9:30 a.m. – 11:30 a.m.	ROOM 6A
IEEE Transactions on Power Electronics Editorial Board	11:30 a.m. – 2:00 p.m.	ROOM 6BC
PELS Standards Committee	2:00 p.m. – 2:30 p.m.	ROOM 7A
PELS Technical Operations Committee	2:30 p.m. – 4:30 p.m.	ROOM 6A
ITRW Steering Committee	2:30 p.m. – 4:30 p.m.	ROOM 7A

Thursday, March 8, 2018

PELS Conference Committee Breakfast	8:00 a.m. – 9:00 a.m.	ROOM 6A
PELS Conferences Committee	9:00 a.m. – 11:30 a.m.	ROOM 6BC
PELS Administrative Committee	2:00 p.m. – 5:30 p.m.	ROOM 6BC
PELS Administrative Committee Dinner	6:30 p.m. – 9:30 p.m.	OFFSITE

Friday, March 9, 2018

AdCom Breakfast *(Companions Welcome)*	7:00 a.m. – 8:00 a.m.	ROOM 6A
PELS Administrative Committee	8:00 a.m. – 11:30 a.m.	ROOM 6BC

Sponsor Meetings

Sponsor Meetings

PSMA Meetings

Saturday, March 3, 2018		
PSMA/PELS Workshop on High Frequency Magnetics	7:00 a.m. – 5:00 p.m.	CONVENTION CENTER
PSMA/PELS Workshop on Capacitors	7:00 a.m. – 5:00 p.m.	CONVENTION CENTER
Sunday, March 4, 2018		
PSMA/ CPSS Reception	12:00 p.m. – 2:30 p.m.	WATERFALL PATIO/LDR ROOM
Monday, March 5, 2018		
PSMA Annual Meeting - followed by March BoD Meeting	7:30 a.m. – 1:00 p.m.	ROOM 8AB
Tuesday, March 6, 2018		
PSMA Industry-Education / APEC Travel Support Committee Meeting	9:00 a.m. – 10:00 a.m.	ROOM 8A
PSMA Energy Management Committee Meeting	10:00 a.m. – 12:00 p.m.	ROOM 8B
PSMA Power Technology Roadmap Committee Meeting	12:00 p.m. – 2:00 p.m.	ROOM 8A
PSMA Marketing Committee Meeting	12:00 p.m. – 2:00 p.m.	ROOM 8B
PSMA Magnetics Committee Meeting	2:00 p.m. – 4:00 p.m.	ROOM 8A
PSMA Packaging Committee Meeting	2:00 p.m. – 4:00 p.m.	ROOM 8B
Wednesday, March 7, 2018		
PSMA Reliability Committee Meeting	8:00 a.m. – 10:00 a.m.	ROOM 8A
PSMA Transportation Committee Meeting	8:00 a.m. – 10:00 a.m.	ROOM 8B
PSMA Capacitor Committee Meeting	10:00 a.m. – 12:00 p.m.	ROOM 8A
PSMA Energy Harvesting Committee Meeting	10:00 a.m. – 12:00 p.m.	ROOM 8B
PSMA Semiconductor Committee Meeting	12:00 p.m. – 2:00 p.m.	ROOM 8A
PSMA Safety & Compliance Committee Meeting	1:00 p.m. – 3:00 p.m.	ROOM 8B

THE PREMIER GLOBAL EVENT IN APPLIED POWER ELECTRONICS™

APEC 2★18

Conference Program

Conference Program

Notes

Sunday
March 4, 2018

8:00 a.m. – 5:00 p.m.

Registration

WEST REGISTRATION

8:00 a.m. – 5:00 p.m.

Mobile App Help Desk

MAIN LOBBY

8:00 a.m. – 9:00 a.m.

Presenter Breakfast

HEMISFAIR BALLROOM C3

9:30 a.m. – 1:00 p.m.

Professional Education Seminars

(for detailed information see page 122)

S01: **Fundamentals of Switch Mode Power Conversion**
Bob White
Embedded Power Labs, United States
ROOM 217D

S02: **Modern Soft Switching Technologies**
Ionel Jitaru
Rompower Energy Systems Inc., United States
ROOM 206

S03: **Thermal and Reliability Modelling of Power Electronics Systems**
Amir Sajjad Bahman, Frede Blaabjerg, Francesco Iannuzzo
Aalborg University, Denmark
ROOM 217A

S04: **WBG Switching Circuits: Design, Test, Devices and Applications**
Edward Shelton[4], Patrick Palmer[4], Alan Mantooth[3], Brian Zahnstecher[2], Geoff Haynes[1]
[1]Inspirit Ventures, United Kingdom; [2]Power Rox Inc, United States; [3]University of Arkansas, United States; [4]University of Cambridge, United Kingdom
ROOM 214AB

S05: **High-Efficiency Single-Phase Inverter Design – VT-FEEC Approach for Google Little Box Challenge**
Jason Lai[1], Lanhua Zhang[2]
[1]Virginia Tech, United States, [2]Texas Instruments
ROOM 214CD

S06: **Power Quality Control in Hybrid AC/DC Microgrids**
Yunwei Li, Farzam Nejabatkhah
University of Alberta, Canada
ROOM 217BC

2:30 p.m. – 6:00 p.m.

Professional Education Seminars
(for detailed information see page 126)

S07: **Electromagnetic Interference and Compatibility for Power Electronics Engineers**
Graham Town
Macquarie University, Australia
ROOM 217D

S08: **New High-Frequency Magnetics Circuit Models**
Ray Ridley
Ridley Engineering US, United States
ROOM 214CD

S09: **Advanced Thermal Management Technologies**
Peter Ritt, Devin Pellicon
Advanced Cooling Technologies, United States
ROOM 217A

S10: **Designing Reliable and High Density Power Supplies with GaN**
Paul Brohlin, Masoud Beheshit, Sandeep Bahl, Serkan Dusmez, Ted Chen
Texas Instruments Inc., United States
ROOM 214AB

S11: **Power Semiconductors for Traction Inverters in Vehicles: from Discretes to Power Modules, from Silicon to Wide Band Gap Devices**
Andre Christmann, David Levett
Infineon Technologies Americas Corp., United States
ROOM 206

S12: **Power Converters for Energy Storage Applications – Analysis and Design from Theory to Practice**
Petar Grbovic
HUAWEI Technologies Dusseldorf GmbH, Germany
ROOM 217BC

Monday March 5, 2018

7:00 a.m. – 8:00 a.m.

Presenter Breakfast
HEMISFAIR BALLROOM C3

7:00 a.m. – 6:00 p.m.

Registration
WEST REGISTRATION

7:00 a.m. – 6:00 p.m.

Mobile App Help Desk
MAIN LOBBY

8:00 a.m. – 10:00 a.m.

Spouse Breakfast
RIO VISTA ROOM at MARRIOTT RIVERCENTER

8:30 a.m. – 12:00 p.m.

Professional Education Seminars
(for detailed information see page 130)

S13: **Gate Driver Design for IGBT and SiC Based Power Devices and Modules**
David Levett, Tim Frank, Dave Divins
Infineon, United States
ROOM 217BC

S14: **Closing the Feedback Loop Through Simulation and Analysis**
Christophe Basso
ON Semiconductor, France
ROOM 214CD

S15: **International Product Compliance and Certifications – Safety and EMC Compliance 101**
John Allen[1], Mark Montrose[2], Jeff Pasternak[3]
[1]IEEE Product Safety Engineering Society, United States; [2]Montrose Compliance Services, Inc., United States; [3]Intel Corporation, United States
ROOM 206

S16: **Maximizing GaN FET and IC Performance, Not Just a Drop in Replacement of MOSFETs**
Michael de Rooij, Alex Lidow, David Reusch, John Glaser
EPC, United States
ROOM 214AB

S17: **Optimizing Power Converter Topology and Module Selection in 1500V Solar Inverters**
Kevork Haddad[2], Bernhard Eichler[1], Paul Drexhage[2]
[1]SEMIKRON Elekronik GmbH&Co. KG, Germany; [2]SEMIKRON Inc., United States
ROOM 217A

S18: **Small-Signal Stability and Subsystem Interactions in Distributed Power Systems with Multiple Converters (II): 3-Phase AC Systems**
Jinjun Liu[3], Rolando Burgos[2], Paolo Mattavelli[1], Dushan Borojevich[2]
[1]University of Padova, Italy; [2]Virginia Tech, United States; [3]Xi'an Jiaotong University, China
ROOM 217D

9:00 a.m. – 12:00 p.m.

Spouse and Guest Tour
American Indians in Texas Mission Tour
(Registration Required)
departs from MARRIOT RIVERCENTER LOBBY

1:15 p.m. – 5:00 p.m.

Plenary Session
(for detailed information see page 136)
HEMISFAIR BALLROOM C1/C2

1:30 p.m. – 2:00 p.m.

Power: A Fundamental Ingredient of Advanced Science and Applied Technology
Adam L. Hamilton P.E., *President and Chief Executive Officer, Southwest Research Institute (SwRI®)*

2:00 p.m. – 2:30 p.m.

Vienna Rectifier and Beyond
Dr. Johann W. Kolar, *Director Power Electronic Systems Laboratory, ETH Zurich*

2:30 p.m. – 3:00 p.m.

Moving from Si to SiC from the End User's Perspective
Dr. Muhammad Nawaz, *Principal Scientist, ABB Corporate Research*

3:00 p.m. – 3:30 p.m.

Break

3:30 p.m. – 4:00 p.m.

WPT: from µW/cm2 Harvesting to kW Capacitive Vehicle Powering
Zoya Popovic, *Distinguished Professor and Lockheed Martin Endowed Chair, Electrical, Computer and Energy Engineering, University of Colorado, Boulder*

4:00 p.m. – 4:30 p.m.

3D Power Packaging made Real with Embedded Component and Substrate Technologies
Dr. Markondeya R. Pulugurtha, *Associate Research Director, Georgia Tech - PRC*

4:30 p.m. – 5:00 p.m.

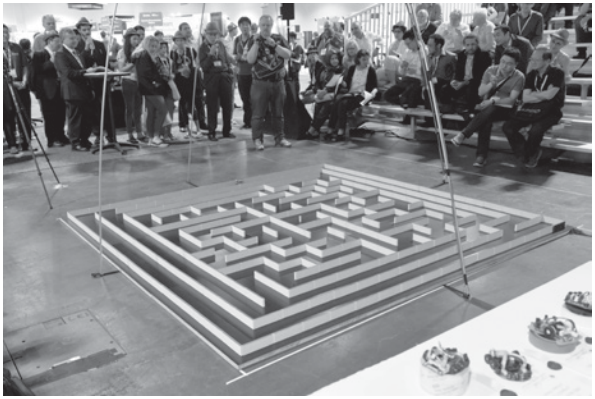
Does Power Efficiency Improve with Consolidation in the Semiconductor Industry?
Hans Stork, *Senior Vice President and Chief Technology Officer, ON Semiconductor*

5:00 p.m. – 8:00 p.m.

Exhibit Hall Welcome Reception
EXHIBIT HALL 3/4

8:00 p.m. – 10:00 p.m.

MicroMouse Contest
EXHIBIT HALL 4B



Monday

Tuesday
March 6, 2018

7:00 a.m. – 8:00 a.m.

Presenter Breakfast

HEMISFAIR BALLROOM C3

7:00 a.m. – 5:00 p.m.

Registration

WEST REGISTRATION

7:00 a.m. – 5:00 p.m.

Mobile App Help Desk

MAIN LOBBY

8:00 a.m. – 10:00 a.m.

Spouse and Guest Breakfast

RIO VISTA ROOM at MARRIOTT RIVERCENTER

8:30 a.m. – 12:00 p.m.

Spouse and Guest Tour
Tour of San Antonio Botanical Gardens
(Registration Required)
departs MARRIOTT RIVERCENTER LOBBY

8:30 a.m. – 11:55 a.m.

IS01: Latest Advancements in Device and Package Technology for High Power, High Frequency Switching Device

ROOM 206

Session Chairs:
Tim McDonald, *Infineon Technologies*
Ranbir Singh, *GeneSiC Semiconductor*

8:30 a.m. – 8:55 a.m.

IS01.1: **GaN Power ICs Enable Breakthroughs in Adapter Performance**
Dan Kinzer
Navitas Semiconductor United States

8:55 a.m. – 9:20 a.m.

IS01.2: **Industry's First 1200V Half Bridge Module based on GaN Technology**
Sharon Apter, David Shapiro, Valery Verpinsky. Lev Stessin, Gregory Bunin, Tamara Baksht
VisIC Technologies Israel

9:20 a.m. – 9:45 a.m.

IS01.3: **The Value of emode GaN HEMTs for High Density and High Efficiency Applications**
Gerald Deboy, Matthias Kasper, Alfredo Medina, Steffen Metzger, Manfred Schlenk
Infineon Technologies Austria AG Austria

9:45 a.m. – 10:10 a.m.

IS01.4: **Trench Based SiC Power MOSFETs – an Example How to Merge Performance, Robustness and Further Application Relevant Features**
Peter Friedrichs
Infineon Technologies Germany

10:40 a.m. – 11:05 a.m.

IS01.5: **Improving Totem-Pole PFC and on Board Charger Performance with Next Generation Components**
Anup Bhalla, *United Silicon Carbide United States*

11:05 a.m. – 11:30 a.m.

IS01.6: **SiC Power MOSFETs for Emerging High Voltage Applications**
Ranbir Singh
GeneSiC United States

11:30 a.m. – 11:55 a.m.

IS01.7: **Design of High Performance Power Conversion Systems for More Electric Aircrafts**
Shweta Sanjeev
Microsemi Corporation United States

8:30 a.m. – 11:55 a.m.

IS02: High Frequency Magnetics - Winding Design

ROOM 207

Session Chairs:
Ed Herbert, *PSMA*
Stephen Carlsen, *Raytheon*

8:30 a.m. – 8:55 a.m.

IS02.1: **Core Loss Initiative: Technical**
Charles R. Sullivan
Dartmouth, United States

Tuesday

8:55 a.m. – 9:20 a.m.

IS02.2: **GaN Technology as an Enabler for Higher Efficiency Magnetics**
Ionel Dan Jitaru
Rompower Energy Systems Inc., United States

9:20 a.m. – 9:45 a.m.

IS02.3: **Winding Capacitance**
Ray Ridley
Ridley Engineering, United States

9:45 a.m. – 10:10 a.m.

IS02.4: **Foil Windings for SMPS Inductors and Transformers**
Weyman Lundquist
West Coast Magnetics, United States

10:40 a.m. – 11:05 a.m.

IS02.5: **Litz Wire – When is it an Advantage?**
George Slama
Würth Electronics, United States

11:05 a.m. – 11:30 a.m.

IS02.6: **An Application-Oriented Determination of Losses within High Frequency Power Inductors**
Stefan Ehrlich, Christopher Joffe, Andreas Rosskopf
Fraunhofer IISB, Germany

11:30 a.m. – 11:55 a.m.

IS02.7: **A Spice Model for Windings**
Ray Ridley
Ridley Engineering, United States

8:30 a.m. – 11:55 a.m.

IS03: Capacitors for Emerging Power Conversion Applications

ROOM 205

Session Chairs:
Ralph Kerrigan, *NWL*
Fred Weber, *FTW*

8:30 a.m. – 8:55 a.m.

IS03.1: **PLZT (Lead-Lanthanum-Zirconium-Titanate) Capacitors for High Frequency Operation**
Suresh Chandran, Matt Reynolds
TDK-Epcos, United States

8:55 a.m. – 9:20 a.m.

IS03.2: **Switched Capacitor Invertors with Ceramics**
Wilmer Companioni
KEMET, United States

9:20 a.m. – 9:45 a.m.

IS03.3: **How Advances in Flat Aluminum Electrolytic Capacitors are Solving Today's Power Design Problems**
Scott Franco
Cornell Dubilier Electronics, United States

9:45 a.m. – 10:10 a.m.

IS03.4: **DC Link Film Capacitors with Ripple Current Frequencies at Least 50 Khz**
Ralph Kerrigan
NWL, United States

10:40 a.m. – 11:05 a.m.

IS03.5: **High Temperature Capacitor Applications in More Electric Aircraft**
Jeff Lawler
W.L. Gore & Associates, Inc., United States

11:05 a.m. – 11:30 a.m.

IS03.6: **Aluminum Polymer Capacitors**
Pierre Lohrber
Würth Electronik, Germany

11:30 a.m. – 11:55 a.m.

IS03.7: **Case Study: Small Size Stack Capacitors Replace Aluminum Electrolytic Capacitors in SMPS**
Ron Demcko, Eric DeRose
AVX Corporation, United States

8:30 a.m. – 11:55 a.m.

IS04: Comparisons and Tradeoffs of Integrated Gate Driver Isolation Technologies

ROOM 212

Session Chairs:
Kevin Parmenter, *Excelsys Technologies*
Jim Spangler, *Independent*

8:30 a.m. – 8:55 a.m.

IS04.1: **Turn-on Performance Comparison of Current-Source vs. Voltage-Source Gate Drivers**
Wolfgang Frank, Ziqing Zheng
Infineon Technologies AG ,Germany

8:55 a.m. – 9:20 a.m.

IS04.2: **Gate Drivers Market Evolution: Coreless Isolation and WBG Specific Solutions**
Mattin Grao Txapartegi, Pierric Gueguen
Yole Developpement, France

9:20 a.m. – 9:45 a.m.

IS04.3: **Unleash SiC MOSFETs – Extract the Best Performance**
Xuning Zhang, Gin Sheh, Levi Gant, Sujit Banerjee
Monolith Semiconductor Inc., United States

9:45 a.m. – 10:10 a.m.

IS04.4: **Isolation Strategies for High Power**
Michael Hornkamp
Power Integration, United States

10:40 a.m. – 11:05 a.m.

IS04.5: **Gate Driver Timing Specification Requirements for WBG Devices**
Ryan Schnell
Analog Devices, Inc., United States

11:05 a.m. – 11:30 a.m.

IS04.6: **A Deep Dive of Isolated Gate Driver Robustness – dv/dt (CMTI) and di/dt**
Wei Zhang
Texas Instruments, United States

11:30 a.m. – 11:55 a.m.

IS04.7: **Improvements of Partial Discharge Screening Results**
Wolfgang Frank, Matthias Stecher
Infineon Technologies AG, Germany,

8:30 a.m. – 11:55 a.m.

IS05: Energy Harvesting

ROOM 213

Session Chairs:
Michael Hayes, *Tyndall National Institute*
Brian Zahnstecher, *PowerRox*

8:30 a.m. – 8:55 a.m.

IS05.1: **IoT Sensors Powered by Solid State Batteries and Harvested Energy**
Gary Johnson, Denis Pasero
Iika Technologies, United Kingdom

8:55 a.m. – 9:20 a.m.

IS05.2: **Chip Scale Thermoelectric Generator for Smart Agriculture**
Marc Dunham, Jane Cornett, Baoxing Chen
ADI, United States

9:20 a.m. – 9:45 a.m.

IS05.3: **Techniques for Reducing ULP Device Power Consumption**
Ivan O'Connell
MCCI Ireland, Ireland

9:45 a.m. – 10:10 a.m.

IS05.4: **Challenges and Solutions for Implementing Energy Harvesting Powered Solutions**
Dusan Vuckovic
Delta Force, Denmark

10:40 a.m. – 11:05 a.m.

IS05.5: **Indoor Energy Harvesting with Photovoltaics**
Dan Stieler
Powerfilm Solar, United States

11:05 a.m. – 11:30 a.m.

IS05.6: **Vibrational Energy Harvester System Integration use Cases & Commercialization Considerations**
Roy Freeland
Perpetuum, United Kingdom

11:30a.m. – 11:55 a.m.

IS05.7: **Energy Harvesting Real-World Functional Demonstrations Session**
Brian Zahnstecher
PowerRox, United States

8:30 a.m. – 12:00 p.m.

T01: Three-Phase AC-DC Converters

ROOM 214A

AC-DC Converters

Haoyu Wang, *ShanghaiTech University*
Ruoyu Hou, *GaN Systems Inc.*

8:30 a.m. – 8:50 a.m.

T01.1: **High Power Three-Level Rectifier Comprising SiC MOSFET and Si Diode Hybrid Power Stage**
Xiaolong Yue[1], Xiongfei Wang[1], Frede Blaabjerg[1], Dushan Boroyevich[2], Rolando Burgos[2], Fred Lee[2]
[1]Aalborg University, Denmark; [2]Virginia Polytechnic Institute and State University, United States

Tuesday

8:50 a.m. – 9:10 a.m.

T01.2: **A Novel Soft Switching ZVS, Sinusoidal Input Boundary Current Mode Control of 6-Switch Three Phase 2-Level Boost Rectifier for Active and Active + Reactive Power Generation**

Nidhi Haryani, Bingyao Sun, Rolando Burgos

CPES, VT, United States

9:10 a.m. – 9:30 a.m.

T01.3: **Critical-Mode-Based Soft-Switching Modulation for Three-Phase Rectifiers**

Zhengrong Huang[2], Zhengyang Liu[2], Fred Lee[2], Qiang Li[2], Furong Xiao[1]

[1]Beijing Institute of Technology, China; [2]CPES, Virginia Tech, United States

9:30 a.m. – 9:50 a.m.

T01.4: **An Adaptive Selection of Intermediate Bus Voltage to Optimize Efficiency in a Universal Input Three-Phase Power Factor Correction Circuit**

Hamidreza Hafezinasab[2], Wilson Eberle[2], Deepak Gautam[1], Chris Botting[1]

[1]Delta-Q Technologies Corp, Canada; [2]University of British Columbia, Canada

9:50 a.m. – 10:10 a.m.

T01.5: **Analysis of One Phase Loss Operation of Three-Phase Isolated Buck Matrix-Type Rectifier with a Boost Switch**

Jahangir Afsharian[2], Dewei Xu[2], Bin Wu[2], Bing Gong[1], Zhihua Yang[1]

[1]Murata Power Solution, Canada; [2]Ryerson University, Canada

10:40 a.m. – 11:00 a.m.

T01.6: **A Four-Switch Three-Phase AC-DC Converter with Galvanic Isolation**

Javad Khodabakhsh, Gerry Moschopoulos

Western University, Canada

11:00 a.m. – 11:20 a.m.

T01.7: **A New Three-Phase Soft-Switched Bridgeless AC/DC Step-Up Converter with Current Fed Voltage Doubler Modules for DC Grid in Wind Systems**

Mehdi Abbasi, John Lam

York University, Canada

11:20 a.m. – 11:40 a.m.

T01.8: **Modular Three-Phase AC-DC LED Driver Based on Summing the Light Output of Each Phase**

Ignacio Castro, Manuel Arias, Diego G. Lamar, Marta M. Hernando, Javier Sebastian

University of Oviedo, Spain

11:40 a.m. – 12:00 p.m.

T01.9: **A New, Two-Switch, Isolated, Three-Phase AC-DC Converter**

Yungtaek Jang[2], Milan Jovanovic[2], Misha Kumar[2], Kurtis High[2], Yihua Chang[1], Yiwei Lin[1], Chun-Liang Liu[1]

[1]Delta Electronics, Inc., Taiwan; [2]Delta Products Corporation, United States

8:30 a.m. – 12:00 p.m.

T02: Hybrid DC-DC Converters

ROOM 214B

DC-DC Converters

Cahit Gezgin, *Infineon*

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

8:30 a.m. – 8:50 a.m.

T02.1: **A Multi-Level, Multi-Phase Buck Converter with Shared Flying Capacitor for VRM Applications**

Gianluca Roberts, Nenad Vukadinović, Aleksandar Prodić

University of Toronto, Canada

8:50 a.m. – 9:10 a.m.

T02.2: **An Ultra Efficient Composite Modular Power Delivery Architecture for Solar Farm and Data Center**

Dong Cao[2], Xiaofeng Lyu[2], Yanchao Li[2], Ze Ni[2], Jalen Johnson[2], Shuai Jiang[1], Chenhao Nan[1]

[1]Google Inc., United States; [2]North Dakota State University, United States

9:10 a.m. – 9:30 a.m.

T02.3: **Switched Tank Converters**

Shuai Jiang, Chenhao Nan, Xin Li, Chee Chung, Mobashar Yazdani

Google Inc., United States

9:30 a.m. – 9:50 a.m.

T02.4: **Switched Tank Converter Based Partial Power Architecture for Voltage Regulation Applications**

Yiou He[2], Shuai Jiang[1], Chenhao Nan[1]

[1]Google Inc., United States; [2]Massachusetts Institute of Technology, United States

9:50 a.m. – 10:10 a.m.

T02.5: **PCB Embedded Inductor for High-Frequency ZVS SEPIC Converter**

Yi Dou, Ziwei Ouyang, Prasanth Thummala, Michael Andersen

Technical University of Denmark (DTU), Denmark

10:40 a.m. – 11:00 a.m.

T02.6: **Design and Evaluation of Hybrid Switched Capacitor Converters for High Voltage, High Power Density Applications**
Joshua Stewart, James Richards, Jarod Delhotal, Jason Neely, Jack Flicker, Robert Brocato, Lee Rashkin
Sandia National Labs, United States

11:00 a.m. – 11:20 a.m.

T02.7: **Control Technique for Reliable Operation of the Synchronous Series Capacitor Tapped Inductor Converter**
Francesco Bez[2], Giovanni Bonanno[2], Luca Corradini[2], Cristian Garbossa[1]
[1]Infineon Technologies Italia Srl, Italy; [2]University of Padova, Italy

11:20 a.m. – 11:40 a.m.

T02.8: **A Resonant Switched Capacitor Based 4-to-1 Bus Converter Achieving 2180 W/In^3 Power Density and 98.9% Peak Efficiency**
Zichao Ye, Yutian Lei, Robert Pilawa-Podgurski
University of Illinois at Urbana-Champaign, United States

11:40 a.m. – 12:00 p.m.

T02.9: **Active Capacitor Voltage Balancing Control for Three-Level Flying Capacitor Boost Converter**
Hung-Chi Chen, Che-Yu Lu, Wei-Hsiang Lien
National Chiao Tung University, Taiwan

8:30 a.m. – 12:00 p.m.

T03: Power Electronics for Utility Interface – Structures & Topologies

ROOM 214C

Power Electronics for Utility Interface

Tiefu Zhao, *UNC Charlotte*

Praveen Jain, *Queen's University*

8:30 a.m. – 8:50 a.m.

T03.1: **50-Kw 1kV DC Bus Air-Cooled Inverter with 1.7 kV SiC MOSFETs and 3D-Printed Novel Power Module Packaging Structure for Grid Applications**
Madhu Chinthavali, Zhiqiang Jack Wang, Steven Campbell, Tong Wu, Burak Ozpineci
Oak Ridge National Laboratory, United States

8:50 a.m. – 9:10 a.m.

T03.2: **Design and Test of the Bidirectional Solid-State Switch for an 160kV/9kA Hybrid DC Circuit Breaker**
Tianyu Wei, Zhanqing Yu, Zhengyu Chen, Xiangyu Zhang, Weijie Wen, Yulong Huang, Rong Zeng
State Key Lab. of Power Systems, Department of Electrical Engineering, Tsinghua University, China

9:10 a.m. – 9:30 a.m.

T03.3: **A 10 kV DC Transformer (DCX) Based on Current Fed SRC and 15 kV SiC MOSFETs**
Qianlai Zhu[1], Li Wang[1], Liqi Zhang[2], Alex Q. Huang[2]
[1]North Carolina State University, United States; [2]University of Texas at Austin, United States

9:30 a.m. – 9:50 a.m.

T03.4: **Cascaded Quadruple Active Bridge Structures for Multilevel DC to Three-Phase AC Conversion**
Prasanta Achanta[2], Dragan Maksimovic[2], Brian Johnson[1]
[1]National Renewable Energy Laboratory, United States; [2]University of Colorado Boulder, United States

9:50 a.m. – 10:10 a.m.

T03.5: **Single-Phase Transformerless Dual Buck-Based Grid-Connected Inverter**
Lucas Munaretto, Marcelo Lobo Heldwein
Federal University of Santa Catarina, Brazil

10:40 a.m. – 11:00 a.m.

T03.6: **Common-Ground Transformerless Inverter for Solar Photovoltaic Module**
Saad Ul Hasan[1], Benjamin Shaffer[2], Hassan. A Hassan[2], Mark. J Scott[2], Yam Siwakoti[3], Graham. E Town[1]
[1]Macquarie University, Australia; [2]Miami University, United States; [3]University Technology Sydney, Australia

11:00 a.m. – 11:20 a.m.

T03.7: **Auxiliary Power Supply for Medium-Voltage Power Electronics Systems**
Jehyuk Won, Gholamreza Jalali, Xinyu Liang, Chi Zhang, Srdjan Srdic, Srdjan Lukic
North Carolina State University, United States

11:20 a.m. – 11:40 a.m.

T03.8: **Multi-Mode Operations for on-Line Uninterruptible Power Supply**
Jinghang Lu, Mehdi Savaghebi, Yajuan Guan, Mingshen Li, Josep Guerrero
Aalborg University, Denmark

11:40 a.m. – 12:00 p.m.

T03.9: **Controller and EMI Filter Design for Modular Front-End Solid-State Transformer**
Jung-Muk Choe[2], Chih-Shen Yeh[2], Oscar Yu[2], Moonhyun Lee[2], Hao Wen[2], Jih-Sheng Lai[2], Lanhua Zhang[1]
[1]Texas Instruments, United States; [2]Virginia Polytechnic Institute and State University, United States

8:30 a.m. – 12:00 p.m.

T04: Faults in Electric Machines And Drives

ROOM 214D

Motor Drives and Inverters

Joshua Hawke, *Naval Surface Warfare Center*

Siavash Pakdelian, *University of Massachusetts at Lowell*

8:30 a.m. – 8:50 a.m.

T04.1: Effect of Asymmetric Layout of IGBT Modules on Reliability of Power Inverters in Motor Drive System

Ui-Min Choi, Ionut Vernica, Frede Blaabjerg

Aalborg University, Denmark

8:50 a.m. – 9:10 a.m.

T04.2: Determining the Operating Region for Demagnetization-Free Fault Tolerant Control of Multiphase PMa-SynRM

Md. Zakirul Islam, Akm Arafat, Seungdeog Choi

The University of Akron, United States

9:10 a.m. – 9:30 a.m.

T043: Research on Short Circuit Operation Mechanism and Current Limiting Strategy of Single Phase Inverter

Zirui Fu, Fanghua Zhang, Shixian Li, Wuji Meng, Chunjuan Zhang

Nanjing University of Aeronautics and Austronautics, China

9:30 a.m. – 9:50 a.m.

T04.4: Study of Voltage Spikes and Temperature Rise in Power Module Based Integrated Converter for 48 V 20 kW Electrically Excited Synchronous Machines

Junfei Tang[1], Yujing Liu[1], Yashovardha Rastogi[3], Nimananda Sharma[1], Tanmay Shukla[2]

[1]Chalmers University of Technology, Sweden; [2]Segula Technologies AB, Sweden; [3]Volvo Cars Corporation, Sweden

9:50 a.m. – 10:10 a.m.

T04.5: Post-Fault Operation for Five-Phase Induction Machines Under Single-Phase Open Using Symmetrical Components

Shan He[1], Jin Huang[1], Min Kang[2]

[1]Department of Electrical Engineering, Zhejiang University, China; [2]Department of Electrical Engineering, Zhejiang University of Science and Technology & Hangzhou Fushe, China

10:40 a.m. – 11:00 a.m.

T04.6: Fault-Tolerant Control Scheme for Modular Multilevel Converter Based on Sorting Algorithm Without Reserved Submodules

Seok-Min Kim[1], Kyo-Beum Lee[1], June-Seok Lee[2]

[1]Ajou University, Korea; [2]KRRI, Korea

11:00 a.m. – 11:20 a.m.

T04.7: Lifetime Benchmarking of Two DC-Link Passive Filtering Configurations in Adjustable Speed Drives

Haoran Wang[1], Pooya Davari[1], Huai Wang[1], Dinesh Kumar[2], Firuz Zare[3], Frede Blaabjerg[1]

[1]Aalborg University, Denmark; [2]Danfoss Drives A/S, Denmark; [3]The University of Queensland, Australia

11:20 a.m. – 11:40 a.m.

T04.8: A Novel Current-Mode Actuator Driver for Enhanced Piezoelectric Reliability

Bernadette Kinzel, Frank Vanselow, Erkan Isa, Linus Maurer

Fraunhofer EMFT, Germany

8:30 a.m. – 12:00 p.m.

T05: Power Devices Modeling

ROOM 217A

Modeling and Simulation

Jin Wang , *Ohio State University*

Sara Ahmed, *University of Texas at San Antonio*

8:30 a.m. – 8:50 a.m.

T05.1: A Modified Behavior SPICE Model for SiC BJT

Shiwei Liang, Jun Wang, Zhigao Peng, Guanghui Chen, Xin Yin, Z.John Shen, Linfeng Deng

Hunan University, China

8:50 a.m. – 9:10 a.m.

T05.2: TCAD Modeling of a Lateral GaN HEMT Using Empirical Data

Michael Hontz[2], Rongming Chu[1], Raghav Khanna[2]

[1]HRL Laboratories, LLC, United States; [2]University of Toledo, United States

9:10 a.m. – 9:30 a.m.

T05.3: A Temperature Dependent Lumped-Charge Model for Trench FS-IGBT

Yaoqiang Duan[2], Yong Kang[2], Francesco Iannuzzo[1], Ionut Trintis[1], Frede Blaabjerg[1]

[1]Aalborg University, Denmark; [2]Huazhong University of Science and Technology, China

9:30 a.m. – 9:50 a.m.

T05.4: An Automated SPICE Modeling Procedure Utilizing Static and Dynamic Characterization of Power FETs

Andrew Sellers[2], Michael Hontz[2], Raghav Khanna[2], Andrew Lemmon[1], Ali Shahabi[1]
[1]University of Alabama, United States; [2]University of Toledo, United States

9:50 a.m. – 10:10 a.m.

T05.5: High-Accuracy Modelling of ZVS Energy Loss in Advanced Power Transistors

Jaume Roig[1], German Gomez[1], Filip Bauwens[1], Basil Vlachakis[1], Maria Rogina[2], Alberto Rodriguez[2], Diego Lamar[2]
[1]ON Semiconductor, Belgium; [2]University of Oviedo, Spain

10:40 a.m. – 11:00 a.m.

T05.6: A Behavioral Transient Model of IGBT for Switching Cell Power Loss Estimation in Electromagnetic Transient Simulation

Yanming Xu[2], Carl Ngai Man Ho[2], Avishek Ghosh[2], Dharshana Muthumuni[1]
[1]Manitoba HVDC Research Centre, Canada; [2]University of Manitoba, Canada

11:00 a.m. – 11:20 a.m.

T05.7: A Fast IGBT Model Considering the Dynamic Performance of Both IGBT and Antiparallel Diode

Feng Zhang, Xu Yang, Wei Xue, Ruiliang Xie, Yang Li, Yilin Sha
Xi'an Jiaotong University, China

11:20 a.m. – 11:40 a.m.

T05.8: Exploring the Behavior of Parallel Connected SiC Power MOSFETs Influenced by Performance Spread in Circuit Simulations

Johanna Müting, Nick Schneider, Thomas Ziemann, Roger Stark, Ulrike Grossner
ETH Zurich, Switzerland

11:40 a.m. – 12:00 p.m.

T05.9: Analytic Model for Power MOSFET Turn-Off Switching Loss Under the Effect of Significant Current Diversion at Fast Switching Events

Bai Nguyen[2], Xin Zhang[1], Andrew Ferencz[1], Todd Takken[1], Robert Senger[1], Paul Coteus[1]
[1]IBM T. J. Watson Research Center, United States; [2]IBM T. J. Watson Research Center & Washington State University, United States

8:30 a.m. – 12:00 p.m.

T06: Control of DC-DC Converters

ROOM 217B

Control

Jaber Abu Qahouq, *The University of Alabama*

Martin Ordonez, *The University of British Columbia*

8:30 a.m. – 8:50 a.m.

T06.1: Low-Frequency Ripple-Shaping Controller for Operation of Non-Inverting Buck-Boost Converters Near Step-Up Step-Down Boundary

Yuqing Zhang[2], Ivan Radović, Sheikh Ahsanuzzaman[2], Aleksandar Prodić, Giacomo Calabrese[1], Giovanni Frattini[1], Maurizio Granato[1]
[1]Texas Instruments, Germany; [1]Texas Instruments, Italy; [2]University of Toronto, Canada

8:50 a.m. – 9:10 a.m.

T06.2: A Single Mode Load Tracking Voltage Mode Controller with Near Minimum Deviation Transient Response

Tom Moiannou[2], Yanhui Liu[2], Aleksandar Prodic[2], Aleksandar Radic[1]
[1]Appulse Power, Canada; [2]University of Toronto, Canada

9:10 a.m. – 9:30 a.m.

T06.3: Near Time Optimal Recovery in a Digitally Current Mode Controlled Buck Converter Driving a CPL

Rabisankar Roy, Santanu Kapat
IIT Kharagpur, India

9:30 a.m. – 9:50 a.m.

T06.4: A Digital Robust Control Scheme for Dual Half-Bridge DC-DC Converters

Maxime Tissières[1], Iman Askarian[3], Majid Pahlevani[3], André Rotzetta[2], Andy Knight[3], Ioana Preda[2]
[1]HEIA-FR, University of Applied Science of Western Switzerland, Switzerland; [2]Institute ENERGY, University of Applied Science of Western Switzerland, Switzerland; [3]University of Calgary, Canada

9:50 a.m. – 10:10 a.m.

T06.5: ΔV/Δt-Intervention Control Concept for Improved Transient Response in Digitally Controlled Boost Converters

Samuel Quenzer-Hohmuth[2], Steffen Ritzmann[3], Thoralf Rosahl[3], Bernhard Wicht[1]
[1]Leibniz University Hannover, Germany; [2]Reutlingen University – Robert Bosch Center for Power Electronics, Germany; [3]Robert Bosch GmbH, Germany

10:40 a.m. – 11:00 a.m.

T06.6: Control of Active Component of Current in Dual Active Bridge Converter
Suyash Sushilkumar Shah, Subhashish Bhattacharya
North Carolina State University, United States

11:00 a.m. – 11:20 a.m.

T06.7: Nonlinear Characteristics of DAB Converter and Linearized Control Method
Anping Tong[2], Lijun Hang[1], Guojie Li[2], Jingjie Huang[2]
[1]Hangzhou Dianzi University, China; [2]Shanghai Jiaotong University, China

11:20 a.m. – 11:40 a.m.

T06.8: New Digital Control Method for Improving Dynamic Response of Synchronous Rectified Flyback Converter with CCM and DCM Mode
Shen Xu, Xinpeng Kou, Chong Wang, Qinsong Qian, Weifeng Sun
Southeast University, China

11:40 a.m. – 12:00 p.m.

T06.9: Distributed Battery System with Wireless Control and Power Transfer â€" A Concept Introduction
Jaber Abu Qahouq, Yuan Cao
The University of Alabama, United States

8:30 a.m. – 12:00 p.m.

T07: Inverters for PV Systems

ROOM 217C

Renewable Energy Systems

Afridi Khurram, *University of Colorado Boulder*

Hadi Marlek, *Utah State University*

8:30 a.m. – 8:50 a.m.

T07.1: Zero-Voltage-Switching Single-Phase Inverter with Active Power Decoupling
Zhengyu Ye, Yenan Chen, Dehong Xu
Zhejiang University, China

8:50 a.m. – 9:10 a.m.

T07.2: A Transformerless Single-Phase Symmetrical Z-Source HERIC Inverter with Reduced Leakage Currents for PV Systems
Kerui Li[3], Yanfeng Shen[1], Yongheng Yang[1], Zian Qin[2], Frede Blaabjerg[1]
[1]Aalborg University, Denmark; [2]Delft University of Technology, Netherlands; [3]The University of Hong Kong, China

9:10 a.m. – 9:30 a.m.

T07.3: Stability and Resonance Analysis and Improved Design of N-Paralleled Grid-Connected PV Inverters Coupled Due to Grid Impedance
Bao Xie, Lin Zhou, Chen Zheng, Qianjin Zhang
Chongqing University, China

9:30 a.m. – 9:50 a.m.

T07.4: A Common-Ground Single-Phase Five-Level Transformerless Boost Inverter for Photovoltaic Applications
Ben Shaffer[2], Hassan Hassan[2], Mark Scott[2], Saad Ul Hasan[1], Graham E. Town[1], Yam Siwakoti[3]
[1]Macquarie University, Australia; [2]Miami University, United States; [3]University of Technology Sydney, Australia

9:50 a.m. – 10:10 a.m.

T07.5: A Novel Control System for Solar Tile Micro-Inverters
Nicholas Falconar, Dawood Shekari Beyragh, Majid Pahlevani
University of Calgary, Canada

10:40 a.m. – 11:00 a.m.

T07.6: GaN Based Transformer-Less Microinverter with Coupled Inductor Interleaved Boost and Half Bridge Voltage Swing Inverter
Jinia Roy, Raja Ayyanar
Arizona State University, United States

11:00 a.m. – 11:20 a.m.

T07.7: A Low-Cost Single-Stage PV Inverter
Yuxiang Shi, Zhiguo Pan, Rostan Rodrigues, Chun Wei
ABB, United States

11:20 a.m. – 11:40 a.m.

T07.8: Design and Implementation of a 100 kW SiC Filterless PV Inverter with 5 kW/kg Power Density and 99.2% CEC Efficiency
Yanjun Shi, Lu Wang, Ren Xie, Hui Li
Florida State University, United States

11:40 a.m. – 12:00 p.m.

T07.9: Comparative Study of a 100kW PV WBG Inverter Using 1200V SiC MOSFET and JFET Cascode Devices
Sandro Martin, Thierry Kayiranga, Yanjun Shi, Hui Li
Center for Advanced Power Systems – Florida State University, United States

8:30 a.m. – 12:00 p.m.

T08: SMP Audio and Battery

ROOM 217D

Power Electronics Applications

Johan Strydom, *TI*

Ed Massey, *Methode Electronics*

8:30 a.m. – 8:50 a.m.

T08.1: Multilevel Tracking Power Supply for Switch-Mode Audio Power Amplifiers

Niels Iversen[1], Vladan Lazarevic[2], Miroslav Vasic[2], Arnold Knott[1], Michael Andersen[1], Jose Cobos[2]

[1]Technical University of Denmark, Germany; [1]Technical University of Denmark, Denmark; [2]Universidad Politécnica de Madrid, Spain

8:50 a.m. – 9:10 a.m.

T08.2: Improving the Efficiency of Class-D Audio Amplifier Systems Using Envelope Tracking DC-DC Power Supplies

Robert Bakker, Maeve Duffy

NUI Galway, Ireland

9:10 a.m. – 9:30 a.m.

T08.3: A High-Frequency Non-Isolated ZVS Synchronous Buck-Boost LED Driver with Fully-Integrated Dynamic Dead-Time Controlled Gate Drive

Qi Cheng, Hoi Lee

University of Texas at Dallas, United States

9:30 a.m. – 9:50 a.m.

T08.4: PWM Dimming Module Allowing Wide DC-Link Voltage Variation

Sui Pung Victor Cheung, Po Wa Jeff Chow, Wing To John Fan, Chung Pui Tung, Shu Hung Henry Chung

City University of Hong Kong, Hong Kong

9:50 a.m. – 10:10 a.m.

T08.5: Analysis and Experimentation on a New High Power Factor Off-Line LED Driver Based on Interleaved Integrated Buck Flyback Converter

Guirguis Zaki Abdelmessih[2], Jose Marcos Alonso[2], Wen-Tien Tsai[1]

[1]Industrial Technology Research Institute, Taiwan; [2]University of Oviedo, Spain

10:40 a.m. – 11:00 a.m.

T08.6: Evaluation of Paralleled Battery System with SoC Balancing and Battery Impedance Magnitude Measurement

Yuan Cao, Jaber Abu Qahouq

University of Alabama, United States

11:00 a.m. – 11:20 a.m.

T08.7: A Multifunction Series Inductive AC-Link Universal Power Converter with Reduced-Switch Count

Khalegh Mozaffari, Mahshid Amirabadi

Northeastern University, United States

11:20 a.m. – 11:40 a.m.

T08.8: Performance Assessment of the VSC Using Two Model Predictive Control Schemes

Mohamed Alhasheem[1], Ahmed Abdelhakim[3], Tomislav Dragicevic[1], Luca Dalessandro[2], Frede Blaabjerg[1]

[1]Aalborg university, Denmark; [2]Schaffner EMV AG, Switzerland; [3]University of Padova, Italy

11:40 a.m. – 12:00 p.m.

T08.9: State of Health (SOH) Estimation of Multiple Switching Devices Using a Single Intelligent Gate Driver Module

Sourov Roy, Faisal Khan

University of MIssouri-Kansas City, United States

12:00 p.m. –5:00 p.m.

Exhibit Hall Open

EXHIBIT HALL 3/4

1:30 p.m. – 2:00 p.m.

Exhibitor Seminars – Session #1

(for detailed information see pages 185-188)

SYNOPSYS
Latest Saber Modeling and Simulation Features for Power Electronics
ROOM 214A

LITTELFUSE
The Path to Predictable, High Volume, High-Yield Manufacturing of SiC Devices
ROOM 214B

MAGNETICS
Practical Considerations with Core Geometry in Inductor Design and New Products
ROOM 214C

POWER INTEGRATIONS
Digitally-Controlled Off-Line Flyback that Exceed DOE (6) Efficiency for Wide Range and USB PD Power Supplies
ROOM 214D

MOUSER ELECTRONICS
Robust Piezo Actuator Solution for Innovative HMI Haptic Feedback
ROOM 217A

COILCRAFT
Power Inductor Trends
ROOM 217B

PANASONIC
Designing & Optimizing Power Supplies in Several Gate Driving Method and New Application for Exceeding SI Limit with X-GaN
ROOM 217C

NAVITAS SEMICONDUCTOR
GaNFast to Higher Efficiency
ROOM 217D

2:15 p.m. – 2:45 p.m.

Exhibitor Seminars – Session #2

(for detailed information see pages 188-191)

LTEC CORPORATION
Predict Wide Bandgap Power Device Technology Trends Through Teardowns and Deep Analysis
ROOM 214A

SIMPLIS TECHNOLOGIES, INC.
Design Verification using Monte Carlo, Sensitivity and Worst-Case Analyses in SIMPLIS
ROOM 214B

TRANSPHORM
Reference Designs Kick Start Reliable High-Voltage GaN Application Development
ROOM 214C

UNITED CHEMI-CON INC.
Advanced DC Link Capacitor for 48V Inverter of MHV
ROOM 214D

STMICROELECTRONICS
Digital Combo Multi-Mode PFC and Time-Shift LLC Resonant Controller
ROOM 217A

RTDS TECHNOLOGIES INC.
Real Time Simulation: The Essential Tool for Both Low and High Power Applications
ROOM 217B

POWERSIM
Integrating PSIM and SPICE for Device Level and System Level Simulation
ROOM 217C

ADAPTIVE POWER SYSTEMS
Regulatory Power Compliance Testing Made Easy
ROOM 217D

3:00 p.m. – 3:30 p.m.

Exhibitor Seminars – Session #3

(for detailed information see pages 191-194)

ABSTRACT POWER ELECTRONICS
Primate Power Sources Use SiC Devices to Improve Efficiency & Response Time
ROOM 214A

OPAL-RT TECHNOLOGIES
How to Use Real-Time Simulation for a Better, Modern and Interactive Teaching Experience for Power Electronic and Electric Motors
ROOM 214B

HELIX SEMICONDUCTORS
Helix Semiconductors – A New Breed of Energy-Efficient Power Supply Solutions
ROOM 214C

FTCAP GMBH
Professional Capacitor Solutions for Severe Conditions: New Approach for Dealing with the Reduction of Parasetic Inductances, Improved Humidity Resistance and Dedicated Automotive Projects
ROOM 214D

ALPHA AND OMEGA SEMICONDUCTOR INC.
Latest Technology for High-Efficiency Power Conversion
ROOM 217A

NICHICON (AMERICA) CORP.
What Hybrid Capacitors Can Do For You
ROOM 217B

INFINEON TECHNOLOGIES
New Gate-Drive IC with Excellent Ground-Shift Robustness
ROOM 217C

MERSEN
Safety and Reliability for Power Electronics
ROOM 217D

Tuesday

3:45 p.m. – 4:15 p.m.

Exhibitor Seminars – Session #4

(for detailed information see pages 195-198)

PIN SHINE INDUSTRIAL CO., LTD.
Transformer Applications: Reserch on Overmolding Technics of Composite Materials
ROOM 214A

RIDLEY ENGINEERING
Prototype in 1 Day with SwitchBit
ROOM 214B

COGNIPOWER, LLC
Pushing Flyback Converters Above 65 Watts and the PFC Question
ROOM 214C

HOI LUEN ELECTRICAL MANUFACTURER CO., LTD.
Mighty Solutions of Fully Insulated Wire (FIW) and the Insulation System
ROOM 214D

NH RESEARCH, INC. (NHR)
NHR's New AC & DC Regenerative Source/Loads
ROOM 217B

SBE, INC.
Advanced Developments for High Temperature, High Efficiency and Greater Working Voltages of Capacitors
ROOM 217C

INNOCIT LLC
Advanced WBG-Based Converters
ROOM 217D

5:00 p.m. – 6:30 p.m.

Rap Sessions

(for detailed information see page 140)

R01: **Biggest Impact on Power Conversion – Devices or Magnetics?**
HEMISFAIR BALLROOM C1

R02: **Gate Drive Isolation Technologies: Optical, Magnetic, or Capacitive Coupling?**
HEMISFAIR BALLROOM C2

R03: **GaN vs. SIC ss SI for Next Generation Power Devices**
HEMISFAIR BALLROOM C3

7:00 p.m. –10:00 p.m.

IEEE-PELS-IAS Young Professionals Reception

RIO RIO CANTINA, ESTRELLA ROOM (3RD FLOOR)

Wednesday
March 7, 2018

7:00 a.m. – 8:00 a.m.

Presenter Breakfast

HEMISFAIR BALLROOM C3

7:00 a.m. – 3:00 p.m.

Registration

WEST REGISTRATION

8:00 a.m. – 10:00 a.m.

Spouse and Guest Breakfast

RIO VISTA ROOM at MARRIOTT RIVERCENTER

8:30 a.m. – 10:10 a.m.

IS06: Wide Bandgap Device Topics

ROOM 206

Session Chairs:

Peter Di Maso, *GaN Systems*

Laszlo Balogh, *ON Semiconductor*

8:30 a.m. – 8:55 a.m.

IS06.1: **GaN/Si a New Era of Energy Conversion: Road Map and Demonstrators**
Thierry Bouchet
CEA LETI, France

8:55 a.m. – 9:20 a.m.

IS06.2: **System Level Considerations with GaN Power Switching**
Peter Di Maso, Di Chen
GaN Systems, Canada

9:20 a.m. – 9:45 a.m.

IS06.3: **Potential Impacts of WBG and UWBG Devices on Realizing Radiation-Hard Power Electronics**
Jason Neely, Robert Kaplar, Michael King, Elizabeth Auden, Jack Flicker, Jon Salton
Sandia National Labs, United States

9:45 a.m. – 10:10 a.m.

IS06.4: **State of the Art of GaN on Si HEMT: Technology & Cost Overview**
Elena Barbarini
System Plus Consulting, France

8:30 a.m. – 9:45 a.m.

IS07: Power Solutions for Challenging Real-World Applications

ROOM 207

Session Chairs:

Pietro Scalia

Texas Instruments

8:30 a.m. – 8:55 a.m.

IS07.1: **Are Antiparallel Diodes Needed for SiC MOSFETs?**
Xuning Zhang, Gin Sheh, Levi Gant.
Sujit Banerjee, *Monolith Semiconductor Inc. United States,*

8:55 a.m. – 9:20 a.m.

IS07.2: **Optimum Powering of Signal Chain in 5G AAS m-MIMO Architectures**
Pietro Scalia, Mark Ng, Ryan Manack
Texas Instruments, Germany

9:20 a.m. – 9:45 a.m.

IS07.3: **PFC Choke Ringing and Near Field Radiation**
Dave R. Pacholok[1], Jim Spangler[2]
CEC Induction LLC United States[1], Spangler Prototype Inc., United States[2],

8:30 a.m. – 10:10 a.m.

IS08: Vehicle Electrification

ROOM 205

Session Chair:

Dennis Stephens, *Continental Automotive*

8:30 a.m. – 8:55 a.m.

IS08.1: **Is EV/HEV a Driver for Innovation?**
Pierric Gueguen
Yole Développement, France

8:55 a.m. – 9:20 a.m.

IS08.2: **Efficient, Compact and Scalable DC Fast Charging Concept**
Timo Gassaue
SEMIKRON Elektronik GmbH & Co. KG, Germany

9:20 a.m. – 9:45 a.m.

IS08.3: **A High-Power-Density, SiC-Based, 150 kW Inverter**
Austin Curbow, Daniel Martin, Brice McPherson, Stephen Minden, Jonathan Hayes, Ty McNutt
Wolfspeed. United States

9:45 a.m. – 10:10 a.m.

IS08.4: **Delivering Customer Value through Vehicle Electrification**
Kent Wanner
John Deere Electronic Solutions, United States

8:30 a.m. – 10:10 a.m.

IS09: Isolation Topics in Power Supplies

ROOM 212

Session Chairs:
Kevin Parmenter, *Excelsys Technologies*
Jim Spangler, *Independent*

8:30 a.m. – 8:55 a.m.

IS09.1: **Isolation in Power Supply**
Jason Duan
Analog Devices, United States

8:55 a.m. – 9:20 a.m.

IS09.2: **Powering Devices Across the Isolation Barrier**
Long Nguyen, *Silicon Laboratories, United States*

9:20 a.m. – 9:45 a.m.

IS09.3: **Increased Power Density Through Capacitive Conversion – Revolution Enabled**
Harold Blomquist, Neaz Farooqi, Ken Harada, Randy Sandusky
Helix Semiconductors, United States

9:45 a.m. – 10:10 a.m.

IS09.4: **Isolation Techniques without an Isolator**
Anthony T. Huynh
Maxim Integrated, United States

8:30 a.m. – 10:10 a.m.

IS10: Modeling & Simulation

ROOM 213

Session Chair:
Wisam Moussa, *Infineon Technologies*

8:30 a.m. – 8:55 a.m.

IS10.1: **High Power Switching Device, SiC MOSFET LTspice Model**
Teik Siang Ong
Wolfspeed, Cree, United States

8:55 a.m. – 9:20 a.m.

IS10.2: **Modeling Thermal Impedance of GaN and SiC Power Transistors Under Short-Circuit Conditions – How to Estimate Your Transistor Temperature During a Short-Circuit Event**
Alberto O. Adan, Louis Burgyan, Daisuke Tanaka, Yuji Kakizaki
LTEC Corporation, Japan

9:20 a.m. – 9:45 a.m.

IS10.3: **Application Example for Lifetime Estimation of Power Semiconductor Devices Combining Active Power Cycling and Thermal Simulation**
Attila Szel
Mentor Graphics, Hungary

9:45 a.m. – 10:10 a.m.

IS10.4: **When and Why to use Electromagnetic (EM) Simulation when Analyzing Printed Circuit Boards**
John Rice[1], Patick DeRoy[2],
Texas Instruments, United States[1], CST of America, United States[2]

8:30 a.m. – 10:10 a.m.

T09: Resonant Converters

ROOM 214A

DC-DC Converters

Jason Neely, *Sandia National Laboratories*
Veda Galigekere, *Oak Ridge National Laboratory*

8:30 a.m. – 8:50 a.m.

T09.1: **LLC Converters: Beyond Datasheets for MOSFET Power Loss Estimation**
Ettore Scabeni Glitz, Matthieu Amyotte, Maria Celeste Garcia Perez, Martin Ordonez
The University of British Columbia, Canada

8:50 a.m. – 9:10 a.m.

T09.2: **A WBG Based Three Phase 12.5 kW 500 kHz CLLC Resonant Converter with Integrated PCB Winding Transformer**
Bin Li, Qiang Li, Fred Lee
Virginia Polytechnic Institute and State University, United States

9:10 a.m. – 9:30 a.m.

T09.3: **Design and Analysis of a Dual-Input Single-Resonant Tank LLC Converter for PV Applications**
Seyed Milad Tayebi, Haibing Hu, Osama Abdel-Rahman, Issa Batarseh
University of Central Florida, United States

Wednesday

9:30 a.m. – 9:50 a.m.

T09.4: A Magnetic Integration Half-Turn Planar Transformer for LLC Resonant DC-DC Converters
Enguo Rong, Siqi Li, Rui Zhang, Xiao Du, Qingyun Min, Sizhao Lu
Kunming University of Science and Technology, China

9:50 a.m. – 10:10 a.m.

T09.5: A Novel LLC Resonant Controller with Best-in-Class Transient Performance and Low Standby Power Consumption
Yalong Li, Brent McDonald
Texas Instruments, United States

8:30 a.m. – 10:10 a.m.

T10: Power Electronics for Utility Interface – Power Quality & Harmonics

ROOM 214B

Power Electronics for Utility Interface

Davide Giacomini, *Infineon Technologies*
Alireza Bakhshai, *Queen's University*

8:30 a.m. – 8:50 a.m.

T10.1: An Improved Current-Limiting Strategy for Shunt Active Power Filter (SAPF) Using Particle Swarm Optimization (PSO)
Wu Cao[2], Mumu Wu[2], Jianfeng Zhao[2], Weiqun Liu[1], Yu Lu[1]
[1]NARI-Relays Electric Co.Ltd, China; [2]Southeast University, China

8:50 a.m. – 9:10 a.m.

T10.2: Harmonic Current Analysis of the Active Front End System in the Presence of Grid Voltage Disturbance
Bo Wen[1], Paolo Mattavelli[2]
[1]The University of Manchester, United Kingdom; [2]University of Padova, Italy

9:10 a.m. – 9:30 a.m.

T10.3: An Adaptive Framework for Mitigating the Current Harmonics Produced by Distributed Energy Resources Using an AC-Stacked Architecture
John Troxler, Robert Cox
UNC Charlotte, United States

9:30 a.m. – 9:50 a.m.

T10.4: Distributed Power Quality Enhancement Using Residential Power Routers
Shuang Zhao, Zhongjing Wang, Janviere Umuhoza, Alan Mantooth, Yue Zhao, Chris Farnell
University of Arkansas, United States

9:50 a.m. – 10:10 a.m.

T10.5: Power Quality Assessment in Real Shipboard Microgrid Systems Under Unbalanced and Harmonic AC Bus Voltage
Wenzhao Liu[1], Tomasz Tarasiuk[2], Mariusz Gorniak[2], Josep.M Guerrero[1], Mehdi Savaghebi[1], Juan.C Vasquez[1], Chun-Lien Su[3]
[1]Aalborg university, Denmark; [2]Gdynia Maritime University, Poland; [3]National Kaohsiung Marine University, Taiwan

8:30 a.m. – 10:10 a.m.

T11: Control of Inverters and Drives II

ROOM 214C

Motor Drives and Inverters

Bulent Sarlioglu, *University of Wisconsin at Madison*
Omer Onar, *Oak Ridge National Laboratory*

8:30 a.m. – 8:50 a.m.

T11.1: Design and Performance Improvement for Single-Voltage-Loop Controlled Voltage-Source-Converters with a Low LC-Resonant-Frequency
Xiaoqiang Li[2], Pengfeng Lin[2], Yi Tang[2], Kai Wang[1]
[1]China University of Mining and Technology, China; [2]Nanyang Technological University, Singapore

8:50 a.m. – 9:10 a.m.

T11.2: Identification of Load Current Influences on Position Estimation Errors for Sensorless SPMSM Drives
Hechao Wang, Kaiyuan Lu, Dong Wang, Frede Blaabjerg
Aalborg University, Denmark

9:10 a.m. – 9:30 a.m.

T11.3: Initial Rotor Position Estimation for Wound-Rotor Synchronous Starter/Generators Based on Multi-Stage-Structure Characteristics
Tao Meng, Weiguo Liu, Ningfei Jiao, Jichang Peng, Yujie Zhu
Department of Electrical Engineering, Northwestern Polytechnical University, China

9:30 a.m. – 9:50 a.m.

T11.4: A Torque Ripple Reduction Method for the Aircraft Wound-Rotor Synchronous Starter/Generator in the Starting Mode
Shuai Mao, Weiguo Liu, Zan Zhang, Ningfei Jiao, Dongdong Zhao
Northwestern Polytechnical University, China

9:50 a.m. – 10:10 a.m.

T11.5: Active Front End Motor-Drive System Operation Under Power and Phase Loss
Ahmed Sayed-Ahmed, Brian Seibel, Russel Kerkman
Rockwell Automation, United States

8:30 a.m. – 10:10 a.m.

T12: Magnetics

ROOM 214D

Devices and Components

Matt Wilkowski, *Intel*

Jason Pries, *Oak Ridge National Laboratory*

8:30 a.m. – 8:50 a.m.

T12.1: High Inductance Thin-Film Transformer for High Switching Frequency

Dragan Dinulovic[2], Mahmoud Shousha[2], Martin Haug[2], Santosh Kulkarni[1], Paul McCloskey[1], Cian O'Mathuna[1], Joe A'Brien[1]

[1]Tyndall National Institute, Ireland; [2]Würth Elektronik eiSos GmbH & Co. KG

8:50 a.m. – 9:10 a.m.

T12.2: Winding Design of Series AC Inductor for Dual Active Bridge Converters

Zhan Shen[1], Huai Wang[1], Yanfeng Shen[1], Zian Qin[2], Frede Blaabjerg[1]

[1]Aalborg University, Denmark; [2]Technische Universiteit Delft, Netherlands

9:10 a.m. – 9:30 a.m.

T12.3: An Improved Rogowski Coil Configuration for a High Speed, Compact Current Sensor with High Immunity to Voltage Transients

Christopher Hewson, Joanne Aberdeen

Power Electronic Measurements Ltd, United Kingdom

9:30 a.m. – 9:50 a.m.

T12.4: A Low-Loss Inductor Structure and Design Guidelines for High-Frequency Applications

Rachel Yang[2], Alex Hanson[2], David Perreault[2], Charles Sullivan[1]

[1]Dartmouth, United States; [2]Massachusetts Institute of Technology, United States

9:50 a.m. – 10:10 a.m.

T12.5: Investigation of Magnetic Field Immunity and Near Magnetic Field Reduction for the Inductors in High Power Density Design

Yanwen Lai, Shuo Wang

University of Florida, United States

8:30 a.m. – 10:10 a.m.

T13: EMI Detection and Mitigation Methods

ROOM 217A

Power Electronics Integration and Manufacturing

Lei Wang, *Dell EMC*

Jim Marinos, *Payton*

8:30 a.m. – 8:50 a.m.

T13.1: Common Mode Filter for EMI Mitigation in Active Phase Converter

Anil Adapa, Vinod John

Indian Institute of science, India

8:50 a.m. – 9:10 a.m.

T13.2: Investigation of a DC Bus Differential Mode EMI Filter for AC/DC Power Adapters

Yiming Li[2], Le Yang[2], Shuo Wang[2], Honggang Sheng[1], Srikanth Lakshmikanthan[1], Liang Jia[1]

[1]Google Inc., United States; [2]University of Florida, United States

9:10 a.m. – 9:30 a.m.

T13.3: Research of Active EMI Suppression Strategy for High Power Density Power Supply

Yilin Sha[3], Wenjie Chen[3], Zifeng Zhao[3], Feng Zhang[3], Changsheng Pei[2], Zhensheng Chen[1]

[1]Huawei Technologies Co. Ltd, China; [2]Huawei Technologies Co. LtdXi'an Jiaotong University, China; [3]Xi'an Jiaotong University, China

9:30 a.m. – 9:50 a.m.

T13.4: Magnetic Paste As Feedstock for Additive Manufacturing of Power Magnetics

Chao Ding[2], Lanbing Liu[2], Yunhui Mei[1], Khai D.T. Ngo[2], Guo-Quan Lu[2]

[1]Tianjin University, China; [2]Virginia Tech, United States

9:50 a.m. – 10:10 a.m.

T13.5: Analysis of Gate Signal Interference in an Integrated SiC MOSFET Module

Zezheng Dong, Xinke Wu, Kuang Sheng

Zhejiang University, China

8:30 a.m. – 10:10 a.m.

T14: Battery Systems

ROOM 217B

Renewable Energy Systems

Robert Balog, *Texas A&M University at Qatar*

Reza Sharifi, *TI*

8:30 a.m. – 8:50 a.m.

T14.1: Frequency Support Comparison for Vanadium and Lithium-Ion BESSs Using a Converter-Based Grid Emulator

Jessica Boles[1], Yiwei Ma[2], Leon Tolbert[2], Fred Wang[2]

[1]Massachusetts Institute of Technology, United States; [2]University of Tennessee, Knoxville, United States

8:50 a.m. – 9:10 a.m.

T14.2: Isolated Single Stage Bidirectional AC-DC Converter with Power Decoupling and Reactive Power Control to Interface Battery with the Single Phase Grid

Damian Sal Y Rosas[2], David Frey[1], Jean-Luc Schanen[1], Jean-Paul Ferrieux[1]

[1]G2Elab, France; [2]UNI, Peru

9:10 a.m. – 9:30 a.m.

T14.3: The State of Charge Balancing Techniques for Electrical Vehicle Charging Stations with Cascaded H-Bridge Multilevel Converters

Amirhossein Moeini, Shuo Wang

University of Florida, United States

9:30 a.m. – 9:50 a.m.

T14.4: A Grid-Tied Reconfigurable Battery Storage System

Fa Chen, Hongmei Wang, Wei Qiao, Liyan Qu

University of Nebraska-Lincoln, United States

9:50 a.m. – 10:10 a.m.

T14.5: Rippleless Resonant Boost Converter for Fuel-Cell Power Conditioning Systems

Hwasoo Seok[2], Byeongcheol Han[2], Soo-Hong Kim[1], Jae-Geun Lee[1], Minsung Kim[2]

[1]LG Innotek, Korea; [2]Pohang University of Science and Technology, Korea

8:30 a.m. – 10:10 a.m.

T15: Charging and Energy Storage Topics

ROOM 217C

Transportation Power Electronics

Omer Onar, *Oak Ridge National Laboratory*

Yingying Kuai, *Caterpillar Inc.*

8:30 a.m. – 8:50 a.m.

T15.1: Extreme Fast Charging Station Architecture for Electric Vehicles with Partial Power Processing

Vishnu Mahadeva Iyer, Srinivas Gulur, Ghanshyamsinh Gohil, Subhashish Bhattacharya

North Carolina State University, United States

8:50 a.m. – 9:10 a.m.

T15.2: Kilowatt-Scale Large Air-Gap Multi-Modular Capacitive Wireless Power Transfer System for Electric Vehicle Charging

Brandon Regensburger, Sreyam Sinha, Ashish Kumar, Jason Vance, Zoya PopoviÄ‡, Khurram Afridi

University of Colorado Boulder, United States

9:10 a.m. – 9:30 a.m.

T15.3: Hybrid Commutation Method with Current Direction Estimation for Three-Phase-to-Single-Phase Matrix Converter

Shunsuke Takuma, Jun-Ichi Itoh

Nagaoka University of Technology, Japan

9:30 a.m. – 9:50 a.m.

T15.4: A Direct Multi-Cells-to-Multi-Cells Equalizer Based on LC Matrix Converter for Series-Connected Battery Strings

Naxin Cui, Yunlong Shang, Qi Zhang, Chenghui Zhang

Shandong University, China

9:50 a.m. – 10:10 a.m.

T15.5: A Novel Hybrid Energy Storage System Using the Multi-Source Inverter

Lea Dorn-Gomba, Ephrem Chemali, Ali Emadi

Electrical and Computer Engineering Department, McMaster University, Canada

8:30 a.m. – 10:10 a.m.

T16: New Technology

ROOM 217D

Power Electronics Applications

Indumini Ranmuthu, *TI*

Jeff Nilles, *TI*

8:30 a.m. – 8:50 a.m.

T16.1: Hybrid Active Power Filter with GaN Power Stage for 5kW Single Phase Inverter

Ruben Otero-De-Leon[1], Liming Liu[1], Sandeep Bala[1], Giovanni Manchia[2]

[1]ABB Corporate Research Center, United States; [2]ABB S.p.A., Italy

8:50 a.m. – 9:10 a.m.

T16.2: High Frequency Electroporation for Biomedical Applications Using GaN Gate Injection Transistors

Hector Sarnago, Oscar Lucia, Jose M. BurdÃo

Universidad de Zaragoza, Spain

9:10 a.m. – 9:30 a.m.

T16.3: A Miniaturized Cost Effective Shared Inductor Based Energy Management System for Ultra-Low-Voltage Electromagnetic Energy Harvesters in Battery Powered Applications

Mahmoud Shousha, Dragan Dinulovic, Michael Brooks, Martin Haug

Magi3C R&D, WÃ¼rth Elektronik eiSos, Germany

9:30 a.m. – 9:50 a.m.

T16.4: Low Voltage Sub-Nanosecond Pulsed Current Driver IC for High-Resolution LIDAR Applications

Eli Abramov, Michael Evzelman, Or Kirshenboim, Tom Urkin, Mor Peretz

Ben-Gurion University of the Negev, Israel

10:00 a.m. – 2:00 p.m.

Exhibit Hall Open

EXHIBIT HALL 3/4

10:30 a.m. – 11:00 a.m.

Exhibitor Seminars – Session #1

(for detailed information see pages 198-201)

RICHARDSON RFPD
Biasing Your Gates-How to Simplify Your Power Switching Applications with RECOM DC/DC Converters
ROOM 214A

TEKTRONIX, INC.
Half Bridge and Gate Driver Measurements
ROOM 214B

NAMICS TECHNOLOGIES, INC.
NAMICS New Technology and Products
ROOM 214C

TELEDYNE LECROY
Debug and Validate Control, Drive and Motor Performance with a Motor Drive Analyzer
ROOM 214D

TT ELECTRONICS
Resistor Selection for Proper Circuit Operation and Reliability
ROOM 217A

WURTH ELECTRONICS
How to Use This Stuff Called Ferrite
ROOM 217B

POWEELAB LTD.
Optimize Power Supply Design in Minutes for Free-PowerEsim
ROOM 217C

HBM TEST AND MEASUREMENT
Rapid Efficiency Motor Mapping and Analysis
ROOM 217D

11:15 a.m. – 11:45 a.m.

Exhibitor Seminars – Session #2

(for detailed information see pages 202-204)

PACIFIC SOWA CORP C/O EPSON ATMIX CORP
High U Super Low Core Loss Nanocystalline Powder "KUAMET NC1"
ROOM 214A

PSEMI (Formerly PEREGRINE SEMICONDUCTOR)
Vertical Integration to Support Next-Generation Power Conversion Solutions
ROOM 214B

SCHUNK CARBON TECHNOLOGY GMBH
Graphite-Based Solutions for (Power) Electronics Cooling
ROOM 214C

ZES ZIMMER INC.
Advancements in PWM Efficiency Power Testing
ROOM 214D

PLEXIM
Rapid Control Prototyping for Power Electronic Systems Using the PLECS Tool-Chain
ROOM 217C

Wednesday

EATON
Applications and Benefits of Supercapacitor Technology
ROOM 217A

SIDELINESOFT LLC
NL5-Circuit Simulator with Ideal Components
ROOM 217B

EFFICIENT POWER CONVERSION CORPORATION
GaN Transistors for Efficient Power Conversion
ROOM 217D

12:00 p.m. – 12:30 p.m.

Exhibitor Seminars – Session #3

(for detailed information see pages 205-208)

IWATSU ELECTRIC COMPANY LIMITED
Comparison between Digitizer, Power Analyzer and CROSS POWER Method on Magnetic Material Analysis
ROOM 214A

STAR TECHNOLOGIES, INC.
Taurus-PDAT-Power Device Analytical Tester
ROOM 214B

WEST COAST MAGNETICS
What does the future hold for Transformers and Inductors in Medium and High-Power Applications
ROOM 214C

DANFOSS SILICON POWER GMBH
Automotive Traction Module Platform
ROOM 214D

ITG ELECTRONICS INC.
COTS Filters for MIL-STD-461 Applications
ROOM 217A

UNITED SILICON CARBIDE INC.
USCi Gen 3 Cascode and Diode Products
ROOM 217B

SABIC
ULTEM UTF120 High Temperature Dielectric Film for Capacitor Applications
ROOM 217C

MITSUBISHI ELECTRIC US, INC.
Latest Power Semiconductor Packaging and Chip Technology
ROOM 217D

2:00 p.m. – 5:25 p.m.

IS11: Enabling High-Volume Wide Bandgap Semiconductor Manufacturing and Applications
ROOM 206

Session Chair:
Jim LeMunyon, *PowerAmerica*

2:00 p.m. – 2:25 p.m.

IS11.1: **Advantages of Wide Bandgap Technology in Industrial Applications**
Luis Arnedo
United Technologies Research Center, United States

2:25 p.m. – 2:50 p.m.

IS11.2: **Challenges in Vehicle System Integration of Wide Bandgap Semiconductors**
Marko Jaksik
General Motors, United States

2:50 p.m. – 3:15 p.m.

IS11.3: **High Frequency GaN Power Converter Applications**
Tom Byrd
Lockheed-Martin, United States

3:15 p.m. – 3:40 p.m.

IS11.4: **High Performance of SiC Power Devices for Vehicle Electrification**
Avi Kashyap
Microsemi, United States

4:10 p.m. – 4:35 p.m.

IS11.5: **Requirements for Cost-Effective Manufacturing of SiC MOSFETS**
Sung Joon Kim
Global Power Technologies, United States

4:35 p.m. – 5:00 p.m.

IS11.6: **Reliability of SiC Power Devices in Industrial Applications**
Stephen Bayne
Texas Tech, United States

5:00 p.m. – 5:25 p.m.

IS11.7: **Accelerating the Adoption of SiC and GaN Technology**
James LeMunyon
PowerAmerica, United States

Wednesday

2:00 p.m. – 5:25 p.m.

IS12: Vehicle Batteries - It's More Than Just Stacking Cells Together and an EV1 Retrospective

ROOM 207

Session Chairs:

Ralph Taylor, *Delphi*

Fred Weber, *FTW*

2:00 p.m. – 2:25 p.m.

IS12.1: **EV1 Retrospective and the Electric Vehicle Revolution**
Robert Dawsey
Flex Power Control, Inc., United States

2:25 p.m. – 2:50 p.m.

IS12.2: **Battery Power for All-Electric Road Vehicles**
John B. Goodenough, M. Helena Braga
University of Texas at Austin, United States

2:50 p.m. – 3:15 p.m.

IS12.3: **Lithium Ion Batteries: Current Status and Future Needs for Electric Vehicles and Fast Charging**
Claus Daniel
Oak Ridge National Laboratory United States

3:15 p.m. – 3:40 p.m.

IS12.4: **An Overview of the Part Acceptance Process for Regulated Lithium Ion Batteries in Transportation**
Eric Schneider
Independent, United States

4:10 p.m. – 4:35 p.m.

IS12.5: **Thermal Management of Lithium-Ion Batteries**
Greg Albright
AllCell Technologies, United States

4:35 p.m. – 5:00 p.m.

IS12.6: **Supercapacitors for Transportation Applications**
Nihal Kularatna
University of Waikato ,New Zealand

5:00 p.m. – 5:25 p.m.

IS12.7: **An Overview and Comparison of on Board Chargers Topologies, Semiconductors Choices and Synchronous Rectification Advantages in Automotive Applications**
Davide Giacomini
Infineon, Italy

2:00 p.m. – 5:00 p.m.

IS13: Alternative Energy

ROOM 205

Session Chair:

Jason Katcha, *Present Power Systems*

2:00 p.m. – 2:25 p.m.

IS13.1: **Worth of a Watt – Its Capital Equivalent**
Mark Jacobs
Boisbrun Hofman, United States

2:25 p.m. – 2:50 p.m.

IS13.2: **Lifetime Evaluation of Power Module with SiC MOSFET designed for Solar Applications**
Andrea Bianchi
ABB, Italy

2:50 p.m. – 3:15 p.m.

IS13.3: **Microgrid PV with DC Coupled Battery**
Aleksandar Vukojevic
Duke Energy, United States

3:15 p.m. – 3:40 p.m.

IS13.4: **Deterministic Communications in Distributed Data Acquisition and Control Systems for Smart Energy Applications**
Igor Alvarado
National Instruments, United States

4:10 p.m. – 4:35 p.m.

IS13.5: **Energy Network for Residential Storage Applications**
Yabiao Gao
sonnen Inc., United States

4:35 p.m. – 5:00 p.m.

IS13.6: **SiC Based Flyback Converter for Solar PV**
Jason Katcha
Present Power Systems, United States,

Wednesday

2:00 p.m. – 5:25 p.m.

IS14: Innovative Component, Reliability and Manufacturing 3D Power Packaging Solutions

ROOM 212

Session Chairs:

Brian Narveson, *Narveson Innovative Consulting*

Ernie Parker, *Crane Aerospace*

2:00 p.m. – 2:25 p.m.

IS14.1: **Conductive Fusion Technology: Advanced Die Attach Materials for High Power Applications**
Nicholas Krasco[1], Maciej Patelka[1], Steve Anagnostopoulos[1].
Sho Ikeda[1], Frank Letizia[1], Toshiyuki Sato[1], Satomi Kawamoto[1], Miguel Goni[2], Elbara Ziade[2], Aaron J. Schmidt[2]
NAMICS, United States[1], Boston University, United States[2]

2:25 p.m. – 2:50 p.m.

IS14.2: **Joining Materials Reliability for Evolving Power Applications**
Andy C. Mackie, Hongwen Zhang, Sihai Chen, Seth Homer, Karthik Vijayamadhavan
Indium Corporation, United States

2:50 p.m. – 3:15 p.m.

IS14.3: **Transient Liquid Phase Sintering Pastes as Solder Alternatives in System in Package Applications**
Catherine Shearer
Ormet Circuits Inc., United States

3:15 p.m. – 3:40 p.m.

IS14.4: **Embedded Passives – Recent Advances and Opportunities: From PSMA Phase III Report**
P.M. Raj, Himani Sharma, Teng Sun, Robert Grant Spurney, Rao Tummala
Georgia Institute of Technology, United States

4:10 p.m. – 4:35 p.m.

IS14.5: **New Wave SiP Solution for Power**
Vincent Lin
ASE Group, Taiwan

4:35 p.m. – 5:00 p.m.

IS14.6: **Power Modules – A New Packaging Approach**
David Cooper
Sumida Inc., Canada

5:00 p.m.. – 5:25 p.m.

IS14.7: **Chip Embedding in Laminate based on Cu Leadframe for Thin Die Packaging**
Klaus Pressel
Infineon Technologies AG, Germany

2:00 p.m. – 5:25 p.m.

IS15: Motor Drives, Inverters and Modules

ROOM 213

Session Chair:

David Levett, *Infineon*

2:00 p.m. – 2:25 p.m.

IS15.1: **Optimized Thermal Layout for Nano Half-Bridge Intelligent Power Modules**
Pengwei Sun, Pei Jin, Vazgen Avakian, Danish Khatri, Katsumi Okawa
Infineon Technologies Americas Corp., United States

2:25 p.m. – 2:50 p.m.

IS15.2: **A Novel Hybrid Compensation Control Method for Electrolytic Capacitorless Inverter Fed IPMSM Drive**
Ling Luo[1], Zheng Wang[2]
[1]LG Electronics China R&D Center, China, [2]Southeast University

2:50 p.m. – 3:15 p.m.

IS15.3: **Performance Improvement in SiC Based Inverters by Dead-Time Optimization**
Martin Röblitz, Christopher Schmidt, Kevork Haddad.
SEMIKRON Elektronik GmbH & Co. KG, Germany

3:15 p.m. – 3:40 p.m.

IS15.4: **Motor Drives and SiC MOSFETs, a Good Match?**
Peter Friedrichs, David Levett
Infineon, Germany

4:10 p.m. – 4:35 p.m.

IS15.5: **Silicon Carbide MOSFETs – Handle with Care**
Nitesh Satheesh,*AgileSwitch, LLC United States*

4:35 p.m. – 5:00 p.m.

IS15.6: **Dual High Voltage IGBT Modules with Metal Casting Direct Bonding (MCB) Baseplate**
Michael Rogers[1], Junya Sakai[1], Eric Motto[2]
[1]Mitsubishi Electric Corporation, United States, [2]Powerex

5:00 p.m. – 5:25 p.m.

IS15.7: **A High Voltage Motor Emulator using SiC MOSFET Modules**
Bill Peterson
E&M Power, United States

2:00 p.m. – 5:30 p.m.

T17: Single-Phase AC-DC Converters

ROOM 214A

AC-DC Converters

Gerry Moschopoulos, *Western University*

Leila Parsa, *Rensselaer Polytechnic Institute*

2:00 p.m. – 2:20 p.m.

T17.1: A Novel AC-DC Interleaved ZCS-PWM Boost Converter
Ramtin Rasoulinezhad, Adel Abosnina, Gerry Moschopoulos
Western University, Canada

2:20 p.m. – 2:40 p.m.

T17.2: A Single-Stage Bidirectional Dual-Active-Bridge AC-DC Converter Based on Enhancement Mode GaN Power Transistor
Tianxiang Chen, Ruiyang Yu, Qingyun Huang, Alex Q. Huang
University of Texas at Austin, United States

2:40 p.m. – 3:00 p.m.

T17.3: A 99.1% Efficient, 490 W/InÂ³ Power Density Power Factor Correction Front End Based on a 7-Level Flying Capacitor Multilevel Converter
Shibin Qin, Zitao Liao, Zichao Ye, Derek Chou, Nathan Brooks, Robert Pilawa-Podgurski
University of Illinois, Urbana Champaign, United States

3:00 p.m. – 3:20 p.m.

T17.4: Multitrack Power Factor Correction Architecture
Minjie Chen[2], Sombuddha Chakraborty[3], David Perreault[1]
[1]Massachusetts Institute of Technology, United States; [2]Princeton University, United States; [3]Texas Instruments, United States

3:20 p.m. – 3:40 p.m.

T17.5: Improving SRC with Capacitor Bypassing Method for Universal AC-DC Adapter
Yang Chen[2], Hongliang Wang[2], Yan-Fei Liu[2], P. C. Sen[2], Xiaodong Liu[1]
[1]Anhui University of Technology, China; [2]Queen's University, Canada

4:10 p.m. – 4:30 p.m.

T17.6: Minimum Inrush Start-Up Control of a Single-Phase Interleaved Totem-Pole PFC Rectifier
Ayan Mallik, Jiangheng Lu, Shenli Zou, Peiwen He, Alireza Khaligh
University of Maryland, College Park, United States

4:30 p.m. – 4:50 p.m.

T17.7: Novel Adaptive Pulse Width Modulator Provides Quasi-Fixed Switching Frequency in Constant On/Off-Time Controlled Regulators
Giovanni Gritti
STMicroelectronics, United States

4:50 p.m. – 5:10 p.m.

T17.8: Quasi-Resonant Flyback Converter with New Valley Voltage Detection Mechanism
Wei-Chia Wu[2], Tsorng-Juu Liang[2], Kai-Hui Chen[1], Cheng-Yuan Li[1]
[1]National Cheng Kung Univeristy, Taiwan; [2]National Cheng Kung University, Taiwan

5:10 p.m. – 5:30 p.m.

T17.9: Improving Light Load Power Factor for GaN Based Totem Pole Bridgeless PFC Using Digital Phase Locked Loop Based Vector Cancellation & Tracking Error Compensation
Manish Bhardwaj, Sheng-Yang Yu, Zhong Ye, Shamim Choudhury
Texas Instruments, United States

2:00 p.m. – 5:30 p.m.

T18: Soft Switching Converters

ROOM 214B

DC-DC Converters

Luke Jenkins, *IBM*

Aleksandar Prodic, *University of Toronto*

2:00 p.m. – 2:20 p.m.

T18.1: Design Considerations of Highly-Efficient Active Clamp Flyback Converter Using GaN Power ICs
Lingxiao Xue, Jason Zhang
Navitas Semiconductors, United States

2:20 p.m. – 2:40 p.m.

T18.2: Design Consideration of Active Clamp Flyback Converter with Highly Nonlinear Junction Capacitance
Pei-Hsin Liu
Texas Instruments, United States

2:40p.m. – 3:00 p.m.

T18.3: A High-Efficiency High-Power-Density 1MHz LLC Converter with GaN Devices and Integrated Transformer
Runruo Chen, Sheng-Yang Yu
Texas Instruments, United States

Wednesday

3:00 p.m. – 3:20 p.m.

T18.4: **High-Frequency LC³L Resonant DC-DC Converter for Automotive LED Driver Applications**
Satyaki Mukherjee[1], Alihossein Sepahvand[2], Dragan Maksimović[3]
[1]Indian Institute of Technology, Kharagpur, India; [2]Texas Instruments, United States; [3]University of Colorado, Boulder, United States

3:20 p.m. – 3:40 p.m.

T18.5: **A Topology Morphing Multi-Element Resonant Converter with Wide Voltage Gain Range**
Liang Yang, Yifeng Wang, Chengshan Wang, Wei Li, Mengying Chen
Tianjin University, China

4:10 p.m. – 4:30 p.m.

T18.6: **Study on Reducing Switching Current in Dual Bridge Series Resonant DC/DC Converter**
Bo Yang, Qiongxuan Ge, Lu Zhao, Zhida Zhou, Dongdong Cui, Yaohua Li
Institute of Electrical Engineering, Chinese Academy of Sciences, China

4:30 p.m. – 4:50 p.m.

T18.7: **The Improved Dual Active Bridge Converter with a Modified Phase Shift and Variable Frequency Control**
Feilong Liu, Xiaofeng Sun, Jia Feng, Junjuan Wu, Xin Li
College of Electrical Engineering of Yanshan University, China

4:50 p.m. – 5:10 p.m.

T18.8: **Merged PWM-Resonant Converter for Direct Panel to Grid-Level Conversion in Localized PV Energy Harvesting**
Or Kirshenboim, Guy Sovik, Dor Yairi, Mor Mordechai Peretz
Ben Gurion University, Israel

5:10 p.m. – 5:30 p.m.

T18.9: **An Improved Active Zero Voltage Switching Assisting Circuit with Lower dv/dt for DC-DC Series Resonant Converter with Constant Input Current**
Tarak Saha, Hongjie Wang, Baljit Riar, Regan Zane
Utah State University, United States

2:00 p.m. – 5:10 p.m.

T19: Control of Inverters and Drives I

ROOM 214C

Motor Drives and Inverters

Thomas Gietzold, *United Technologies Aerospace Systems*
Ali Bazzi, *UCONN*

2:00 p.m. – 2:20 p.m.

T19.1: **Sensorless Control Using a Full-Order Observer Based on a Novel Flux Model of High Power Interior Permanent Magnet Synchronous Motor**
Young Seol Lim[1], June-Seok Lee[2], Joon Hyoung Ryu[2], Kyo-Beum Lee[1]
[1]Ajou University, Korea; [2]KRRI, Korea

2:20 p.m. – 2:40 p.m.

T19.2: **Automatic Advance Angle Control Algorithm Using Anti-Windup Feedback Voltage of Pi Current Controller for Wide Range Speed Operation of BLDCM**
Min-Hyo Lee[2], Ho-Jin Kim[1], Hyeong-Jin Kim[3], Jang-Mok Kim[3]
[1]Busan Techno-Park, Korea; [2]LG Electronics, Korea; [3]Pusan National University, Korea

2:40 p.m. – 3:00 p.m.

T19.3: **Line Voltage Difference Integral Method of Commutation Error Adjustment for Sensorless Brushless DC Motor**
Xuliang Yao, Hao Lin, Jicheng Zhao
Harbin Engineering University College of automation, China

3:00 p.m. – 3:20 p.m.

T19.4: **Two-Segment Three-Phase PMSM Drive with Carrier Phase-Shift PWM**
Xun Han, Dong Jiang, Tianjie Zou, Ronghai Qu, Kai Yang
Huazhong University of Science&Technology, China

3:20 p.m. – 3:40 p.m.

T19.5: **A Full-Order Sliding Mode Flux Observer with Stator and Rotor Resistance Adaptation for Induction Motor**
Yuanbo Guo, Ze Li, Bijun Dai, Xiaohua Zhang
Dalian University of Technology, China

4:10 p.m. – 4:30 p.m.

T19.6: **Stability Analysis and Improvement of V/Hz Controlled Adjustable Speed Drives Equipped with Small DC-Link Thin Film Capacitors**
Zhentian Qian[2], Wenxi Yao[2], Kevin Lee[1]
[1]Eaton Corporation, United States; [2]Zhejiang University, China

Wednesday

4:30 p.m. – 4:50 p.m.

T19.7: **Suppressing Dead-Time Effect in Current-Controlled Three-Phase PWM Inverters by Using Virtual Inductor**
Adinda Ihsani Putri, Arwindra Rizqiawan, Tridesmana Rachmilda, Yanuarsyah Haroen, Pekik Argo Dahono
Institut Teknologi Bandung, Indonesia

4:50 p.m. – 5:10 p.m.

T19.8: **Hybrid Space Vector Pulse Width Modulation Synthesis to Minimize the Common-Mode Voltage**
Ameer Janabi, Bingsen Wang
Michigan State University, United States

2:00 p.m. – 5:30 p.m.

T20: GaN Device Opportunities and Challenges

ROOM 214D

Devices and Components

Tim McDonald, *Infineon Technologies*

Xin Zhang, *IBM*

2:00 p.m. – 2:20 p.m.

T20.1: **Opportunities and Design Considerations of GaN HEMTs in ZVS Applications**
Juncheng Lucas Lu, Ruoyu Hou, Di Chen
GaN Systems Inc., Canada

2:20 p.m. – 2:40 p.m.

T20.2: **Design Considerations for GaN Transistor Based Synchronous Rectification**
David Reusch, John Glaser
Efficient Power Conversion (EPC), United States

2:40 p.m. – 3:00 p.m.

T20.3: **High Power 3-Phase to 3-Phase Matrix Converter Using Dual-Gate GaN Bidirectional Switches**
Hidekazu Umeda, Yasuhiro Yamada, Kenichi Asanuma, Fumito Kusama, Yusuke Kinoshita, Hiroaki Ueno, Hidetoshi Ishida, Tsuguyasu Hatsuda, Tetsuzo Ueda
Panasonic Corporation, Japan

3:00 p.m. – 3:20 p.m.

T20.4: **Dynamic on-State Resistance Evaluation of GaN Devices Under Hard and Soft Switching Conditions**
Rui Li, Xinke Wu, Gang Xie, Kuang Sheng
Zhejiang University, China

3:20 p.m. – 3:40 p.m.

T20.5: **Wideband Contactless Current Sensing Using Hybrid Magnetoresistor-Rogowski Sensor in High Frequency Power Electronic Converters**
Shahriar Jalal Nibir, Sven Hauer, Mehrdad Biglarbegian, Babak Parkhideh
University of North Carolina at Charlotte, United States

4:10 p.m. – 4:30 p.m.

T20.6: **The Mitigating Effects of the Threshold Voltage Shifting on the False Turn-on of GaN E-HEMTs**
Guangzhao Xu, Xu Yang, Ruiliang Xie, Feng Zhang, Naizeng Wang, Mofan Tian, Haiyang Jia, Laili Wang
Xi'an Jiaotong University, China

4:30 p.m. – 4:50 p.m.

T20.7: **An Analytical Turn-on Power Loss Model for 650-V GaN eHEMTs**
Yanfeng Shen[1], Huai Wang[1], Zhan Shen[1], Frede Blaabjerg[1], Zian Qin[2]
[1]Aalborg University, Denmark; [2]Delft University of Technology, Netherlands

4:50 p.m. – 5:10 p.m.

T20.8: **Parasitic Capacitance Eqoss Loss Mechanism, Calculation, and Measurement in Hard-Switching for GaN HEMTs**
Ruoyu Hou, Juncheng Lu, Di Chen
GaN Systems Inc., Canada

5:10 p.m. – 5:30 p.m.

T20.9: **High Precision Gate Signal Timing Control Based Active Voltage Balancing Scheme for Series-Connected Fast Switching Field-Effect Transistors**
Zheyu Zhang, Handong Gui, Jiahao Niu, Ruirui Chen, Fred Wang, Leon Tolbert, Daniel Costinett, Benjamin Blalock
the University of Tennessee, United States

2:00 p.m. – 5:30 p.m.

T21: Power Converter Modeling & Control

ROOM 217A

Modeling and Simulation

Sara Ahmed, *University of Texas at San Antonio*

Liming Liu, *ABB Inc.*

2:00 p.m. – 2:20 p.m.

T21.1: Impedance-Based Analysis of DC Link Control in Voltage Source Rectifiers

Dapeng Lu, Xiongfei Wang, Frede Blaabjerg

Aalborg University, Denmark

2:20 p.m. – 2:40 p.m.

T21.2: Modeling Resonant Converters in a Rotating, Polar Coordinate

Yi-Hsun Hsieh, Fred C. Lee

Virginia Polytechnic Institute and State University, United States

2:40 p.m. – 3:00 p.m.

T21.3: First Order Design by Optimization Method: Application to an Interleaved Buck Converter and Validation –

Mylène Delhommais[2], Jean-Luc Schanen[2], Frédéric Wirtz[2], Cécile Rigaud[1], Sylvain Chardon[1]

[1]TRONICO-ALCEN, France; [2]Institut Polytechnique de Grenoble, France

3:00 p.m. – 3:20 p.m.

T21.4: Approaches for Continuous-Time Dynamic Modeling of the Asymmetric Dual-Active Half-Bridge Converter

Shiladri Chakraborty, Manas Palmal, Souvik Chattopadhyay

Indian Institute of Technology Kharagpur, India

3:20 p.m. – 3:40 p.m.

T21.5: Analysis and Evaluation of Input Power Splitting Method Between Multiple Transmitters for Maximum Wireless Power Transfer

Yuan Cao, Jaber Abu Qahouq

The University of Alabama, United States

4:10 p.m. – 4:30 p.m.

T21.6: Virtual Impedance Based Stability Analysis for Direct Digital Controlled Single-Phase Grid-Connected Inverter with LCL Filter Having Wide Inductance Variation

Tsai-Fu Wu, Mitradatta Misra, Ying-Yi Jhang, Chun-Yi Lin

National Tsing Hua University, Taiwan

4:30 p.m. – 4:50 p.m.

T21.7: Multi-Objective Optimization Based Real-Time Control for PEV Hybrid Energy Management Systems

Xiaoying Lu, Yaojiang Chen, Haoyu Wang

ShanghaiTech University, China

4:50 p.m. – 5:10 p.m.

T21.8: Utilizing Method of Moments Electromagnetic Technology to Model High Speed Power Converter Parasitics

Chris Mueth

Keysight Technologies, United States

5:10 p.m. – 5:30 p.m.

T21.9: EMI Noise Source Modeling Based on Network Theory for Power Converters with Mixed-Mode Characterization

Huan Zhang, Shuo Wang

University of Florida, United States

2:00 p.m. – 5:30 p.m.

T22: Control Strategies for Inverters & Motor Drives

ROOM 217B

Control

Jaber Abu Qahouq, *The University of Alabama*

Xiong Li, *Texas Instrument*

2:00 p.m. – 2:20 p.m.

T22.1: Common-Mode Voltage Elimination of Three-Level T-Type Inverters with a Finite Control Set Model Predictive Control Method

Xiaodong Wang, Jiaoxiao Zou, Jiancheng Zhao, Zhenhua Dong, Min Wei, Chuan Xie, Kai Li

University of Electronic Science and Technology of China,School of Automation Engineering, China

2:20 p.m. – 2:40 p.m.

T22.2: Using One FPGA to Control Two High-Switching-Frequency PMSM Drive Systems Through a Novel Time-Division Multiplexing Method

Wei Qian[2], Fanning Jin[2], Kevin Bai[2], Dingguo Lu[1], Bing Cheng[1]

[1]Mercedes-Benz Research, United States; [2]University of Michigan-Dearborn, United States

Wednesday

2:40 p.m. – 3:00 p.m.

T22.3: **Improved Virtual Synchronous Generator Control Strategy for Seamless Switching**
Zishun Peng[1], Jun Wang[1], Yuxing Dai[1], Yeting Wen[1], Z. John Shen[1], Zongjian Li[1], Daqiang Bi[2]
[1]Hunan University, China; [2]Tsinghua University, China

3:00 p.m. – 3:20 p.m.

T22.4: **Decentralized Control of Series Stacked Bidirectional DC-AC Modules**
Prasanta Achanta[2], Milan Ilic[1], Dragan Maksimovic[2]
[1]Empower Micro Systems, United States; [2]University of Colorado Boulder, United States

3:20 p.m. – 3:40 p.m.

T22.5: **A Novel Adaptive Control for Three-Phase Inverter**
Xiangjun Quan[2], Alex Q. Huang[2], Xiaobo Dou[1], Zaijun Wu[1], Minqiang Hu[1]
[1]Southeast University, China; [2]The University of Texas at Austin, United States

4:10 p.m. – 4:30 p.m.

T22.6: **Reference Current Regulation for Inverter with Virtual Resistor Damping Control**
Cheng Nie, Wanjun Lei, Yue Wang, Tian Li, Yan Zhang
Xi'an Jiaotong University, China

4:30 p.m. – 4:50 p.m.

T22.7: **Expanding the CCM Boundary of a Current-Fed Switched Inverter**
Anil Gambhir, Santanu Mishra
IIT Kanpur, India

4:50 p.m. – 5:10 p.m.

T22.8: **Stationary Reference Frame Based Current Control Structure with Improved Disturbance Rejection for Grid Connected Converters**
Srinivas Gulur, Vishnu Mahadeva Iyer, Subhashish Bhattacharya
North Carolina State University, United States

5:10 p.m. – 5:30 p.m.

T22.9: **Sliding Mode Control of the Modular Multilevel Converter**
Qichen Yang, Maryam Saeedifard
Georgia Institute of Technology, United States

2:00 p.m. – 5:30 p.m.

T23: Wireless Power Transfer Applications

ROOM 217C

Wireless Power Transfer

Afridi Khurram, *University of Colorado Boulder*

Michael de Rooij, *Efficient Power Conversion Corporation*

2:00 p.m. – 2:20 p.m.

T23.1: **Thin Self-Resonant Structures with a High-Q for Wireless Power Transfer**
Aaron Stein, Phyo Aung Kyaw, Jesse Feldman-Stein, Charles Sullivan
Dartmouth College, United States

2:20 p.m. – 2:40 p.m.

T23.2: **Analysis and Design of a Series Self-Resonant Coil for Wireless Power Transfer**
Jie Li, Daniel Costinett
University of Tennessee, Knoxville, United States

2:40p.m. – 3:00 p.m.

T23.3: **A Hybrid RF and Vibration Energy Harvester for Wearable Devices**
Son Nguyen, Rajeevan Amirtharajah
University of California, Davis, United States

3:00 p.m. – 3:20 p.m.

T23.4: **A 10 nW, 10 mV Signal Detector Using a 2 pA Standby Voltage Reference, for Always-on Sensors and Receivers**
Salah-Eddine Adami, Guang Yang, Chunhong Zhang, Plamen Proynov, Bernard Stark
University of Bristol, United Kingdom

3:20 p.m. – 3:40 p.m.

T23.5: **A Burst Mode Pulse Density Modulation Scheme for Inductive Power Transfer Systems Without Communication Modules**
Shuxin Chen, Hongchang Li, Yi Tang
Nanyang Technological University, Singapore

4:10 p.m. – 4:30 p.m.

T23.6: **A Dynamic Tuning Method Utilizing Inductor Paralleled with Load for Inductive Power Transfer**
Yeran Liu, Ruikun Mai, Pengfei Yue, Zhengyou He
Southwest Jiaotong University, China

4:30 p.m. – 4:50 p.m.

T23.7: **Design and Analysis of the S/P Compensated Contactless Converter for High Voltage Ignition**
Jingwen Gao[2], Qianhong Chen[2], Xiaoyong Ren[2], Zhiliang Zhang[2], Hui Shi[1], Hanzheng Ran[1]
[1]China Academy of Engineering Physics, China; [2]Nanjing University of Aeronautics and Astronautics, China

4:50 p.m. – 5:10 p.m.

T23.8: **Transmission Characteristics Analysis of a Doublecheeked MCR WPT System with Two Receivers Under Varying Spatial Scales**
Weiwei Ye[1], Fuxin Liu[2], Tianming Mei[2], Xuling Chen[2], Ralph M. Kennel[3]
[1]Nanjing University of Aeronautics & Astronautics, China; [2]Nanjing University of Aeronautics and Astronautics, China; [3]Technical University of Munich, Germany

5:10 p.m. – 5:30 p.m.

T23.9: **Magnetic-Field-Model based Analysis of Two-Phase Magnetically Coupled Resonant Wireless Power Transfer Systems.**
Tlanming Mei[1], Fuxin Liu[2], Chong Jiang[2], Xuling Chen[2], Ralph Technische[3]
[1]Nanjing University of Aeronautics and Astronautics China., [2]Nanjing University of Aeronautics and Astronautics ,[3] Universitat Munchen, Germany

2:00 p.m. – 5:30 p.m.

T24: Photovotlaic & Grid Tie Systems

ROOM 217D

Renewable Energy Systems

Martin Ordonez, *The University of British Columbia*

Veda Galigekere, *Oak Ridge National Laboratory*

2:00 p.m. – 2:20 p.m.

T24.1: **Distributed MPPT for Modular Differential Power Processing in Scalable Photovoltaic System**
Chang Liu, Yue Zheng, Deyu Li, Brad Lehman
Northeastern University, United States

2:20 p.m. – 2:40 p.m.

T24.2: **Reliability Evaluation of an Impedance-Source PV Microconverter**
Yanfeng Shen[1], Elizaveta Liivik[2], Frede Blaabjerg[1], Dmitri Vinnikov[2], Huai Wang[1], Andrii Chub[2]
[1]Aalborg University, Denmark; [2]Tallinn University of Technology, Estonia

2:40 p.m. – 3:00 p.m.

T24.3: **On-Line Global Maximum Power Point (GMPP) Identification of Solar PV Plants**
Matam Manjunath[2], Barry Venugopal Reddy[1], Ye Zhao[3], Brad Lehman[3]
[1]National Institue of Technology Goa, India; [2]National Institute of Technology Goa, India; [3]Northeastern University, United States

3:00 p.m. – 3:20 p.m.

T24.4: **A General Algorithm for Flexible Active Power Control of Photovoltaic Systems**
Hossein Dehghani Tafti[2], Ariya Sangwongwanich[1], Yongheng Yang[1], Georgios Konstantinou[3], Josep Pou[2], Frede Blaabjerg[1]
[1]Aalborg University, Denmark; [2]Nanyang Technological University, Singapore; [3]University of New South Wales, Australia

3:20 p.m. – 3:40 p.m.

T24.5: **Soft-Switching Technique for a Three-Phase Bidirectional Grid-Tie DC-AC-AC Converter**
Mahmoud Abdallah Sayed, Kazuma Suzuki, Takaharu Takeshita, Wataru Kitagawa
Nagoya Institute of Technology, Japan

4:10 p.m. – 4:30 p.m.

T24.6: **Adaptive Synchronization of Grid-Connected Three-Phase Inverters by Using Virtual Oscillator Control**
Mingshen Li, Yonghao Gui, Juan C. Vasquez, Josep M. Guerrero
Aalborg Universtiy, Denmark

4:30 p.m. – 4:50 p.m.

T24.7: **Distributed Autonomous Voltage Balancing Control for a Modular IPOS DC Grid-Connected Renewable Power System**
Xiaofeng Dong[1], Hongfei Wu[1], Yangjun Lu[1], Haibing Hu[1], Kai Sun[2]
[1]Nanjing University of Aeronautics and Astronautics, China; [2]Tsinghua University, China

4:50 p.m. – 5:10 p.m.

T24.8: **Adaptive Control Method for Enhancing the Stability of Grid-Connected Inverters Under Very Weak Grid Condition**
Jinming Xu, Qiang Qian, Shaojun Xie
Nanjing University of Aeronautics and Astronautics, China

5:10 p.m. – 5:30 p.m.

T24.9: **Multi-Purpose Generic Board for Hands-On Power Electronics Education of Different Power Converter Topologies in PV Applications**
Mehrdad Biglarbegian[1], Iman Mazhari[1], Hamidreza Jafarian[1], Namwon Kim[1], Babak Parkhideh[1], ohan Enslin[2]
[1]University of North Carolina at Charlotte, [2]Clemson University

6:00 p.m. – 9:00 p.m.

Social Event

(Ticket Required)

HEMISFAIR BALLROOM

APEC 2018 Full Conference and Technical Session registrants will receive a social event ticket with their registration. If you have a Seminar only registration, exhibits only registration or are registered as an exhibitor, you should purchase a social event ticket by visiting the registration desk if you wish to attend the social event. You can also purchase tickets for your guest to attend. Exhibiting Companies will receive a Social Event Ticket with their Conference Registration.

Thursday
March 8, 2018

7:00 a.m. – 8:00 a.m.

Presenter Breakfast

HEMISFAIR BALLROOM C3

7:00 a.m. – 12:00 p.m.

Registration

WEST REGISTRATION

8:00 a.m. – 10:00 a.m.

Spouse and Guest Breakfast

RIO VISTA ROOM at MARRIOTT RIVERCENTER

8:30 a.m. – 11:30 a.m.

IS16: Reliability and Ruggedness - How to Address These Challenges in Wide Bandgap Semiconductor Devices

ROOM 206

Session Chairs:

Tim McDonald, *Infineon Technologies*

Jaume Roig, *ON Semiconductor*

8:30 a.m. – 8:55 a.m.

IS16.1: **GaN Reliability through Integration and Application Relevant Stress Testing**
Nick Fichtenbaum
Navitas Semiconductor, Inc., United States

8:55 a.m. – 9:20 a.m.

IS16.2: **Dynamic High Temperature Operating Life Tests for GaN Hybrid-Drain-Embedded GITs – Demonstration of Highly Reliable Operations**
Ayanori Ikoshi, Kenichiro Tanaka, Masahiro Toki, Hiroto Yamagiwa, Kazuki Suzuki, Daijiro Arisawa, Masahiro Hikita, Manabu Yanagihara, Yasuhiro Yasuhiro, Tetsuzo Ueda
Panasonic Corporation, Japan

9:20 a.m. – 9:45 a.m.

IS16.3: **Status of Wide Bandgap Device Qualification Standards Effort by New JEDEC Committee JC70**
Stephanie Watts Butler, Tim McDonald
Texas Instruments, United States

9:45 a.m. – 10:10 a.m.

IS16.4: **Gate Oxide and Threshold-Voltage Reliability Considerations for SiC MOSFETs**
Peter Friedrichs, Thomas Aichinger
Infineon Technologies, Germany

10:40 a.m. – 11:05 a.m.

IS16.5: **H3TRB-HVDC on SiC: A Relevant Test for Industrial Applications**
Jonny Ingman, Joni Jormanainen, Elena Mengotti
ABB, Finland

11:05 a.m. – 11:30 a.m.

IS16.6: **SiC Current Limiting Device (CLD) SOA Determination by Accurate Electro Thermal Spice Model**
Jean-Baptiste Fonder, Sophie Rollet, Dominique Tournier
CALY Technologies, France

8:30 a.m. – 11:30 a.m.

IS17: Powering Servers and Datacenters

ROOM 207

Session Chairs:

Harry Soin, *Artesyn Embedded Technologies*

Rick Fishbune, *IBM*

8:30 a.m. – 8:55 a.m.

IS17.1: **2-Stage Solution for Data Centers**
Amin Bemat[1], Qian Ouyang[1], Rohan Samsi[2], Jinghai Zhou[2],
HP Enterprise United States[1], Monolithic Power Systems[2]

8:55 a.m. – 9:20 a.m.

IS17.2: **Distributed System Stability in a 48V DC Datacenter**
Mehran Mirjafari, Lei Wang, Guangyong Zhu
Padmanabh Gharpure, John Breen, *Dell EMC United States*

9:20 a.m. – 9:45 a.m.

IS17.3: **Switched Tank Converter Technology for Next-Gen 48V Data Center Power Delivery**
Shuai Jiang, Chenhao Nan, Xin Li, Chee Chung,
Mobashar Yazdani
Google, United States

9:45 a.m. – 10:10 a.m.

IS17.4: **A Smart Implementation of Switched-Tank Converter System for Next-Gen 48V Data Center Power Delivery**
Paolo Sandri, Francesco Ghilardi, Roberto Peritore
STMicroelectronics, United States

10:40 a.m. – 11:05 a.m.

IS17.5: **Heterogeneously Integrated Power Stages Enable Low Profile 12-48V Voltage Regulators**
Robert Conner, Greg Miller
Sarda Technologies, United States

11:05 a.m. – 11:30 a.m.

IS17.6: **Smooth Transition between Battery and Power Supply in a Datacenter**
Lei Wang, Mehran Mirjafari, Kunrong Wang.
Guangyong Zhu,
Dell EMC United States,

8:30 a.m. – 11:30 a.m.

IS18: Topologies and Control

ROOM 205

Session Chairs:

Bill Peterson, *E and M Power*

Laszlo Balogh, *ON Semiconductor*

8:30 a.m. – 8:55 a.m.

IS18:1: **Zero Voltage Switched Interleaved Critical Conduction Mode Totem Pole Bridgeless PFC with GaN Power Stage**
Hrishikesh Nene, Ted Chen, Salil Chellappan, Igor An
Texas Instruments, United States

8:55 a.m. – 9:20 a.m.

IS18.2: **E-Mode GaN, 600V, 0.07Ohm, Utilized in 3600W_ LLC 380V to 52V Converter**
Moshe Domb
Infineon Technolgies, United States

9:20 a.m. – 9:45 a.m.

IS18.3: **A New Buck-Boost Converter that eliminates the Right-Half-Plane-Zero**
Shingo Hashiguchi, Tetsuo Tateishi
ROHM Semiconductor, Japan

9:45 a.m. – 10:10 a.m.

IS18.4: **Moving Up in Voltage with GaN FETs**
John Glaser
Efficient Power Conversion, United States

10:40 a.m. – 11:05 a.m.

IS18.5: **Ultra-Narrow Pulse Buck Converter**
Yuhei Yamaguchi, Tetsuo Tateishi
ROHM Semiconductor, Japan

11:05 a.m. – 11:30 a.m.

IS18.6: **Practical Comparison of Three Control Schemes used in Point-of-Load DC-DC Converters**
Anthony Fagnani, Carl Wu, Pradeep Shenoy
Texas Instruments, United States,

8:30 a.m. – 11:05 a.m.

IS19: Powering Mobile and Consumer Products

ROOM 212

Session Chair:
Thomas Hopkins, *ST Microlectronics*

8:30 a.m. – 8:55 a.m.

IS19.1: **Solutions for Fast Charging**
Lasse Harju
Dialog Semiconductor. Germany

8:55 a.m. – 9:20 a.m.

IS19.2: **Emerging Application of USB PD for Rapid Charging in Mobile Devices**
Yong Li
Dialog Semiconductor, United States

9:20 a.m. – 9:45 a.m.

IS19.3: **A Digital Controlled High Density Power Converter for Low Power Applications**
Alfredo Medina Garcia, Manfred Schlenk, Matthias Joachim Kasper, Gerald Deboy
Infineon Technologies AG, Germany

9:45 a.m. – 10:10 a.m.

IS19.4: **How a Switched-Capacitor Architecture Halves Losses in LED Boosts**
Greg Szczeszynsk
pSemi Corporation, United States

10:40 a.m. – 11:05 a.m.

IS19.5: **Amplifier Design Challenges for Large Area Highly Resonant Wireless Power Systems**
Michael de Rooij, Yuanzhe Zhang
Efficient Power Conversion, United States

8:30 a.m. – 11:30 a.m.

IS20: PMBus Implementation and Applications

ROOM 213

Session Chairs:
Ramesh Balasubramaniam, *Infineon Technologies*
Travis Summerlin, *Texas Instruments*

8:30 a.m. – 8:55 a.m.

IS20.1: **PMBus in System**
Kevin Parmenter
Excelsys Technologies, United States

8:55 a.m. – 9:20 a.m.

IS20.2: **Attaining PMBus Adoption in Spaceborne Power Systems**
Tim Meade
Cobham Semiconductor Solutions, United States

9:20 a.m. – 9:45 a.m.

IS20.3: **Server Telemetry: Insight Into Platform & Performance with Node Manager and PMBus Standard**
Mariusz Oriol
Intel Technology, Poland

9:45 a.m. – 10:10 a.m.

IS20.4: **PMBus Adaption Over Various Transport Protocols**
Chris Jones
Artesyn Embedded Technologies, United States

10:40 a.m. – 11:05 a.m.

IS20.5: **Application Profiles for Isolated and Non-Isolated DC-DC Power Modules**
Oleg Volfson
Flex Power, United States

11:05 a.m. – 11:30 a.m.

IS20.6: **Leveraging App Profiles Firmware Standardization**
Michael Jones
Linear Technology, United States

Thursday

8:30 a.m. – 11:20 a.m.

T25: DC-DC Converter Applications

ROOM 214A

DC-DC Converters

Olivier Trescases, *University of Toronto*

David Reusch, *Efficient Power Conversion Corporation*

8:30 a.m. – 8:50 a.m.

T25.1: Design of a 1 kV Bidirectional DC-DC Converter with 650 V GaN Transistors
Andrew Stillwell, Margaret Blackwell, Robert Pilawa-Podgurski
University of Illinois at Urbana-Champaign, United States

8:50 a.m. – 9:10 a.m.

T25.2: Efficiency/Cost Trade-Off Design of a Multiple-Active-Bridge Converter for Smart Transformer
Levy Costa, Giampaolo Buticchi, Marco Liserre
Christian-Albrechts-University of Kiel, Germany

9:10 a.m. – 9:30 a.m.

T25.3: A 6.6kW SiC Bidirectional on-Board Charger
Haoran Li[1], Lei Bai[1], Zhiliang Zhang[1], Shengdong Wang[1], Jiacheng Tang[1], Xiaoyong Ren[1], Jianfei Li[2]
[1]Nanjing University of Aeronautics and Astronautics, China; [2]Sineng Electric Corporation, China

9:30 a.m. – 9:50 a.m.

T25.4: Performance Evaluation of a VLC Transmitter Based on the Split of the Power
Juan RodrÃguez, Daniel G. Aller, Diego G. Lamar, Javier SebastiÃ¡n
University of Oviedo, Spain

9:50 a.m. – 10:10 a.m.

T25.5: High Current Switching Capacitor Converter for on-Package VR
Stefano Saggini[2], Shuai Jiang[1], Mario Ursino[2], Chenhao Nan[1], Roberto Rizzolatti[2]
[1]Google, United States; [2]University of Udine, Italy

10:40 a.m. – 11:00 a.m.

T25.6: Single-Inductor Multiple-Output Converter for High-Power LED Applictions with Independent Current Control Based on SiC SBD
Jinjin Liu, Hongliang Lv, Yimeng Zhang, Qingwen Song, Yuming Zhang, Xiaoyan Tang
Xidian University, China

11:00 a.m. – 11:20 a.m.

T25.7: Modeling and Control of Sigma Converter for 48V Voltage Regulator Application
Virginia Li, Mohamed Ahmed, Qiang Li, Fred Lee
Virginia Polytechnic Institute and State University, United States

8:30 a.m. – 11:20 a.m.

T26: Switched And Synchronous Reluctance Motor Drives

ROOM 214B

Motor Drives and Inverters

Prerit Pramod, *Nexteer Automotive*

Rakib Islam, *Nexteer Automotive*

8:30 a.m. – 8:50 a.m.

T26.1: Acoustic Noise Mitigation of Switched Reluctance Machines with Windows in Both Stator and Rotor Poles
Mohammed Elamin[2], Yusuf Yasa[2], Omer Gundogmus[2], Yilmaz Sozer[2], John Kutz[1], Joshua Tylenda[3], Ronnie Wright[1]
[1]DCS, United States; [2]University of Akron, United States; [3]US ARMY, United States

8:50 a.m. – 9:10 a.m.

T26.2: Design of an Axial-Flux Switch Reluctance Motor for a Novel Integrated Motor-Compressor System
Abdul Bandarkar, Iftekhar Hasan, Yilmaz Sozer, Alex De Abreu-Garcia
University of Akron, United States

9:10 a.m. – 9:30 a.m.

T26.3: Torque Ripple Minimization in SRMs at Medium and High Speeds Using a Multi-Stator Windings with a Novel Power Converter
Oguzhan Kilic[2], Ali Elrayyah[1], Yilmaz Sozer[2]
[1]Qatar Research Foundation, Qatar; [2]University of Akron, United States

9:30 a.m. – 9:50 a.m.

T26.4: A Novel Boost Converter for Segmented-Stator Hybrid-Excitation Switched Reluctance Motor Drive with High Performance
Wen Ding, Shuai Yang, Yanfang Hu
Xi'an Jiaotong University, China

9:50 a.m. – 10:10 a.m.

T26.5: State Space Modeling and Feedback Control of Five-Phase Permanent Magnet Assisted Synchronous Reluctance Motor Under Open Phase Faults
Akm Arafat, Seungdeog Choi
University of Akron, United States

10:40 a.m. – 11:00 a.m.

T26.6: Three-Phase Four-Leg Drive for DC-Biased Sinusoidal Current Vernier Reluctance Machine
An Li[1], Zihan Gao[1], Dong Jiang[1], Wubin Kong[1], Shaofeng Jia[2], Ronghai Qu[1]
[1]Huazhong University of Science and Technology, China; [2]Xi'an Jiaotong University, China

11:00 a.m. – 11:20 a.m.

T26.7: **Low-Cost Sub-Fractional Horsepower Brushless Direct Current Claw-Pole Machine Topology for Fan Applications**
Stefan Leitner, Hannes Gruebler, Annette Muetze
CD-Lab for Brushless Drives for Pump and Fan Applications, Electric Drives and Machines Institute, Austria

8:30 a.m. – 11:20 a.m.

T27: Power Module Integration & Prognostics

ROOM 214C

Power Electronics Integration and Manufacturing

Liming Liu, *ABB Inc.*
Zach Pan, *ABB USCRC*

8:30 a.m. – 8:50 a.m.

T27.1: **A Power Converter Integration Approach with a Multi-Functional Heat Sink Shaped Inductor**
Wenbo Liu[1], Yan-Fei Liu[1], Laili Wang[2]
[1]Queen's University, Canada; [2]Xi'an Jiaotong University, China

8:50 a.m. – 9:10 a.m.

T27.2: **Three-Phase Inverter Employing PCB Embedded GaN FETs**
Stephen Savulak, Ben Guo, Shashank Krishnamurthy
United Technologies Research Center, United States

9:10 a.m. – 9:30 a.m.

T27.3: **Gate Driver Design and Continuous Operation of an Improved 1200V/200A FREEDM-Pair Half-Bridge Power Module**
Liqi Zhang[3], Xin Zhao[3], Xiaoqing Song[1], Qianlai Zhu[2], Soumik Sen[3], Pengkun Liu[3], Junhong Tong[3], Alex Q. Huang[3]
[1]ABB, United States; [2]North Carolina State University, United States; [3]University of Texas at Austin, United States

9:30 a.m. – 9:50 a.m.

T27.4: **Performance Optimization of a 1.2kV SiC High Density Half Bridge Power Module in 3D Package**
Xin Zhao[2], Bo Gao[1], Liqi Zhang[2], Douglas Hopkins[1], Alex Q. Huang[2]
[1]North Carolina State University, United States; [2]University of Texas at Austin, United States

9:50 a.m. – 10:10 a.m.

T27.5: **On Condition Monitoring of High Frequency Power GaN Converters with Adaptive Prognostics**
Mehrdad Biglarbegian, Saman Mostafavi, Sven Hauer, Shahriar Nibir, Namwon Kim, Robert Cox, Babak Parkhideh
University of North Carolina at Charlotte, United States

10:40 a.m. – 11:00 a.m.

T27.6: **Miller Plateau As an Indicator of SiC MOSFET Gate Oxide Degradation**
Ze Ni, Yanchao Li, Xiaofeng Lyu, Om Prakash Yadav, Dong Cao
North Dakota State University, United States

11:00 a.m. – 11:20 a.m.

T27.7: **6.0kV, 100A, 175kHz Super Cascode Power Module for Medium Voltage, High Power Applications**
Bo Gao, Adam Morgan, Yang Xu, Xin Zhao, Douglas Hopkins
North Carolina State University, United States

8:30 a.m. – 11:20 a.m.

T28: Power Quality Oriented Control

ROOM 214D

Control

Martin Ordonez, *The University of British Columbia*
Manish Bhardwaj, *Texas Intrument*

8:30 a.m. – 8:50 a.m.

T28.1: **An Improved Burst-Mode Control for VIENNA Rectifiers to Mitigate DC Voltage Ripples at Light Load**
Xinxi Tang[2], Yang Cao[2], Yan Xing[2], Haibin Hu[2], Lidong Xu[1]
[1]JiangSu JinFan Power Technology Co., Ltd, China; [2]Nanjing University of Aeronautics and Astronautics, China

8:50 a.m. – 9:10 a.m.

T28.2: **Control Strategy for Reduction of Current Distortion in Reverse Matrix Converter Under Unbalanced Input Conditions**
Dongho Choi[1], Yeongsu Bak[1], Jong-Pil Lee[2], Tae-Jin Kim[2], Kyo-Beum Lee[1]
[1]Ajou University, Korea; [2]KERI, Korea

9:10 a.m. – 9:30 a.m.

T28.3: **Analysis and Design of Enhanced DFT-Based Controller for Selective Harmonic Compensation in Active Power Filters**
Hao Chen[1], Huawu Liu[1], Yan Xing[1], Haibing Hu[1], Kai Sun[2]
[1]Nanjing University of Aeronautics and Astronautics, China; [2]Tsinghua University, China

9:30 a.m. – 9:50 a.m.

T28.4: **Analysis of Dead-Time Harmonics in Single-Phase Transformerless Full-Bridge PV Inverters**
Yongheng Yang[1], Keliang Zhou[2], Frede Blaabjerg[1]
[1]Aalborg University, Denmark; [2]University of Glasgow, United Kingdom

9:50 a.m. – 10:10 a.m.

T28.5: **Application of Generalized Peak Current Controllers for Active Power Filters and Rectifiers with Power Factor Correction**
Mohammad Ebrahimi, S. Ali Khajehoddin
University of Alberta, Canada

10:40 a.m. – 11:00 a.m.

T28.6: **Minimum Conduction Loss ZVS Control for Buck-Type Active Filter Operating As Decoupling Circuit**
Behnam Koushki, Praveen Jain, Alirzea Bakhshai
Queen's University, Canada

11:00 a.m. – 11:20 a.m.

T28.8: **Improved Selective Harmonic Compensation for Single-Phase Inverters**
Jiao Jiao, John Hung, Robert Nelms
Auburn University, United States

8:30 a.m. – 11:20 a.m.

T29: Wireless Power Transfer for EV Applications

ROOM 217A

Wireless Power Transfer

Raghav Khanna, *University of Toledo*

Sheldon Williamson, *University of Ontario Institute of Technology*

8:30 a.m. – 8:50 a.m.

T29.1: **A Study on the Shielding for Wireless Charging Systems of Electric Vehicles**
Hongzhi Cui, Wenxing Zhong, Hao Li, Fengchun He, Min Chen, Dehong Xu
Zhejiang University, China

8:50 a.m. – 9:10 a.m.

T29.2: **An Optimal ZVS Angle Selection for Constant Current Charging of EV's Battery in Series-Series Compensated Wireless Power Transmission System**
Yongbin Jiang, Junwen Liu, Xiufang Hu, Laili Wang, Yue Wang, Gaidi Ning
Xi'an Jiaotong University, China

9:10 a.m. – 9:30 a.m.

T29.3: **Optimization of Ferrite Core to Reduce the Core Loss in Double-D Pad of Wireless Charging System for Electric Vehicles**
Mostak Mohammad, Seungdeog Choi
University of Akron, United States

9:30 a.m. – 9:50 a.m.

T29.4: **Integrated Control of Bridge Type Inductive Power Transfer Systems for Light Load Efficiency Improvement**
Sangjoon Ann, Jongeun Byun, Dongmyoung Joo, Byoung Kuk Lee
Sungkyunkwan University, Korea

9:50 a.m. – 10:10 a.m.

T29.5: **A Reverse-Coupled Bipolar Coil Structure for an Integrated LCC-Compensated Inductive Power Transfer System**
Fei Lu[2], Hua Zhang[2], Chong Zhu[2], Ying Mei[1], Jie Zhang[1], Chris Mi[2]
[1]LG Electronics, China; [2]San Diego State University, United States

10:40 a.m. – 11:00 a.m.

T29.6: **Analysis and Designed of Three-Phase Capacitive Coupled Wireless Power Transfer for High Power Charging System**
Bo Luo, Ruikun Mai, Rui Shi, Zhengyou He
Southwest Jiaotong University, China

11:00 a.m. – 11:20 a.m.

T29.7: **Non-Linear Capacitor based Variable Capacitor for Self-Tuning Resonant Converter in Wireless Power Transfer**
Hulong Zeng, Fang Zheng Peng
Michigan State University, United States

8:30 a.m. – 11:20 a.m.

T30: Renewable Energy Topics

ROOM 217B

Renewable Energy Systems

Katherine Kim, *Ulsan National Institute of Science and Technology*

Haoyu Wang, *ShanghaiTech University*

8:30 a.m. – 8:50 a.m.

T30.1: **Power Management of a Self-Powered Multi-Parameter Wireless Sensor for IoT Application**
Dingyi He, Babak Fahimi
The University of Texas at Dallas, United States

8:50 a.m. – 9:10 a.m.

T30.2: **Multi-Port Bidirectional Three-Phase AC-DC Converter with High Frequency Isolation**
Allan Uchoa Barbosa[1], Bruno Ricardo de Almeida[2], Demercil de Souza Oliveira Jr.[1], Paulo Peixoto Praça[1], Luiz Henrique S. C. Barreto[1]
[1]Federal University of Ceará, Brazil, [2]University of Fortaleza

9:10 a.m. – 9:30 a.m.

T30.3: **A New Vector Control of Brushless Doubly-Fed Induction Generator with Transient Current Compensation for Stand-Alone Power Generation Applications**

Yi Liu[2], Wei Xu[2], Kailiang Yu[2], Frede Blaabjerg[1]
[1]Aalborg University, Denmark; [2]Huazhong University of Science and Technology, China

9:30 a.m. – 9:50 a.m.

T30.4: **A Passivity-Based Decentralized Control Strategy for Current-Controlled Inverters in AC Microgrids**

Hui Yu, Hao Tu, Srdjan Lukic
North Carolina State University, United States

9:50 a.m. – 10:10 a.m.

T30.5: **Power Management of Virtual Synchronous Generators Through Using Hybrid Energy Storage Systems**

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

10:40 a.m. – 11:00 a.m.

T30.6: **Design of Virtual Synchronous Generators with Enhanced Frequency Regulation and Reduced Voltage Distortions**

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

11:00 a.m. – 11:20 a.m.

T30.7: **A New Power Flow Control Approach for Power Converters in Single-Phase Microgrids**

Sajjad Makhdoomi Kaviri[1], Hadis Hajebrahimi[1], Majid Pahlevani[2], Praveen Jain[1], Alireza Bakhshai[1]
[1]Queen's University, Canada; [2]University of Calgary, Canada

8:30 a.m. – 11:20 a.m.

T31: Conversion Systems for Electric Vehicles

ROOM 217C

Transportation Power Electronics

Serkan Dusmez, *Texas Instruments*

Yongheng Yang, *Aalborg University*

8:30 a.m. – 8:50 a.m.

T31.1: **High Efficiency SiC Traction Inverter for Electric Vehicle Applications**

Jianglin Zhu, Hyeokjin Kim, Hua Chen, Robert Erickson, Dragan Maksimović
University of Colorado Boulder, United States

8:50 a.m. – 9:10 a.m.

T31.2: **A Quadruple Active Bridge Converter As the Storage Interface in the More Electric Aircraft**

Giampaolo Buticchi[2], Levy Costa[3], Davide Barater[4], Marco Liserre[3], Eugenio Dominguez[1]
[1]SerTec S.L., Germany; [2]The University of Nottingham Ningbo China, China; [3]University of Kiel, Germany; [4]University of Parma, Italy

9:10 a.m. – 9:30 a.m.

T31.3: **Resonant Switched Capacitor Converter Based DC Auto-Transformer for Urban Rail Transit**

Miao Wang, Xiaofeng Yang, Lulu Wang, Trillion Zheng
Beijing Jiaotong University, China

9:30 a.m. – 9:50 a.m.

T31.4: **A Single-Stage Bi-Directional AC-DC Converter with No Electrolytic Capacitor for EV**

Behnam Koushki, Praveen Jain, Alireza Bakhshai
Queen's University, Canada

9:50 a.m. – 10:10 a.m.

T31.5: **A Unity Power Factor Active Rectifier with Optimum Space-Vector Predictive DC Voltage Control for Variable Frequency Supply Suitable for More Electric Aircraft Applications**

Joseph Benzaquen[1], Mohammad Shadmand[1], Arlie Stonestreet II[2], Behrooz Mirafzal[1]
[1]Kansas State University, United States; [2]Ultra-ICE, United States

10:40 a.m. – 11:00 a.m.

T31.6: **A Hybrid Negative Current Compensation System for High-Speed Railway Power System**

Jiaxin Yuan, Feiran Xiao, Chenmeng Zhang, Zhou Ni, Yongheng Zhong
Wuhan University, China

11:00 a.m. – 11:20 a.m.

T31.7: **Discontinuous Conduction Mode Three Phase Buck-Boost Derived PFC Converter for More Electric Aircraft with Reduced Switching, Sensing and Control Requirements**

Sivanagaraju Gangavarapu[1], Akshay Rathore[1], Deepak Fulwani[2]
[1]Concordia University, Canada; [2]Indian Institute of Technology, Jodhpur, India

8:30 a.m. – 11:20 a.m.

T32: Grid Applications

ROOM 217D

Power Electronics Applications

Mike Seeman, *ETA power*

Zhong Nie, *SF Motors*

8:30 a.m. – 8:50 a.m.

T32.1: Reactive Power Compensation and Resonance Damping for Three-Phase Buck-Type Dynamic Capacitor

Liangli Xiong[2], Ke Dai[2], Xinwen Chen[2], Xiaosheng Wang[2], Ziwei Dai[1]

[1]Department of Electrical, Computer and System, Engineering Rensselaer Polytechnic Institute, United States; [2]School of Electrical and Electronic Engineering, Huazhong University of Science and Technology, China

8:50 a.m. – 9:10 a.m.

T32.2: Duty-Cycle Plus Phase-Shift Control for a Dual Active Half Bridge Based Bipolar DC Microgrid

Fei Gao, Dan Rogers

University of Oxford, United Kingdom

9:10 a.m. – 9:30 a.m.

T32.3: Investigation of Control and Applications of Modular Multilevel Converter with Sub-Modular Series IGBTs

Lu Yue, Xiu Yao

SUNY at Buffalo, United States

9:30 a.m. – 9:50 a.m.

T32.4: Three-Phase Buck-Boost Y-Inverter with Wide DC Input Voltage Range

Michael Antivachis, Dominik Bortis, Lukas Schrittwieser, Johann Kolar

EidgenÃ¶ssische Technische Hochschule Zürich, Switzerland

9:50 a.m. – 10:10 a.m.

T32.5: Energy Storage System Control Strategy to Minimize the Voltage and Frequency Fluctuation in the Microgird

Qin Lei, Yunpeng Si, Yifu Liu

Arizona State University, United States

10:40 a.m. – 11:00 a.m.

T32.6: A Novel Three-Phase Bidirectional DC-DC Converter For UPS Applications

Adel Abosnina, Gerry Moschopoulos

Western University, Canada

11:00 a.m. – 11:20 a.m.

T32.7: Model Predictive Direct Current Control Strategy for Three-Level T-Type Rectifier under Unbalanced Grid Voltage Conditions

Xiaoyan Li, Chenghui Zhang, Alian Chen, Xiangyang Xing, Guangxian Zhang

Shandong University

11:30 a.m. – 2:00 p.m.

Dialogue Session

(for detailed information see page 144)

HEMISFAIR BALLROOM

2:00 p.m. – 3:40 p.m.

IS21: Test & Measurement

ROOM 206

Session Chair:

Tom Neville, *Tektronix*

2:00 p.m. – 2:25 p.m.

IS21.1: Evaluation of Measurement Techniques for High-Speed GaN Transistors

Suvankar Biswas[1], Tom Neville[2].

Efficient Power Conversion Corporation United States[1], Tektronix Inc., United States[2],

2:25 p.m. – 2:50 p.m.

IS21.2: WBG Power Circuit Simulation with Extensive Device Characterization and Modeling

Noriyoshi Hashimoto[1], Ryo Takeda[1], Tatsuya Yanagi[2]. Hiroyuki Sakairi[2], Naotaka Kuroda[2], Ken Nakahara[2],

Keysight Technologies Japan[1], ROHM Semiconductor, Japan[2]

2:50 p.m. – 3:15 p.m.

IS21.3: Fundamentals of 4-Quadrant Power: New Approaches in Bi-Directional AC Loading

Martin Weiss, Ben Jackson

NH Research, Inc. (NHR) United States

3:15 p.m. – 3:40 p.m.

IS21.4: Scalable Platform for In-Circuit Reliability Testing of SiC MOSFETs and Diodes Emulating Real-Life Voltage and Current Stresses

Gin Sheh, Xuning Zhang, Sujit Banerjee, Levi Gant,

Monolith Semiconductor Inc., United States

2:00 p.m. – 3:40 p.m.

IS22: Passive Components

ROOM 205

Session Chair:

George Slama, *Würth Electronics*

2:00 p.m. – 2:25 p.m.

IS22.1: **High Ripple Magnetics**
Stephen Schlarman
Würth Elektronik, United States

2:25 p.m. – 2:50 p.m.

IS22.2: **High Performance Pulse Load Surface Mount Resistors**
Breno Albuquerque
Vishay Intertechnology, Inc., United States

2:50 p.m. – 3:15 p.m.

IS22.3: **Design Selection of Ferrite and Powder Inductors using New SPICE Models**
Zhuomin Liu, Clarita Knoll, Ramdev Kanapady, Tissaphern Mirfakhrai,
Eaton, United States

3:15 p.m. – 3:40 p.m.

IS22.4: **Near Field Radiation of Storage Inductors in Power Electronics – Causes, Prevention & Suppression**
George Slama, Ranjith Bramanpalli
Würth Elektronik eiSos GmbH, United States

2:00 p.m. – 3:40 p.m.

IS23: Market Analysis and Semiconductor Fabrication Business

ROOM 213

Pierric Gueguen, *Yole Developpement*

Indumini Ranmuthu, *Texas Instruments*

2:00 p.m. – 2:25 p.m.

IS23.1: **Status of Power Electronic Industry: Market and Technology Trends**
Mattin Grao Txapartegi
Yole Développement, France

2:25 p.m. – 2:50 p.m.

IS23.2: **Market Forecasts for SiC and GaN Power Semiconductors**
Kevin Anderson, Richard Eden.
Michael Markides
IHS Markit, United States

2:50 p.m. – 3:15 p.m.

IS23.3: **Which Business Model (Foundry or IDM) for GaN and SiC Market?**
Ana Villamor
Yole Développement, France

3:15 p.m. – 3:40 p.m.

IS23.4: **Foundry Solutions for Integrated Power Management Trends**
Erez Sarig
TowerJazz, Israel

2:00 p.m. – 5:30 p.m.

T33: High Conversion Ratio Converters

ROOM 214A

DC-DC Converters

Xin Zhang, *IBM*

Robert Pilawa, *UC Berkeley*

2:00 p.m. – 2:20 p.m.

T33.1: **A Novel and Simple Hybrid DC-DC Converter of Resonant Forward and PWM Flyback**
Han Peng[1], Mengtian Yu[2], Jin Ke[2], Ming Xu[1]
[1]FSP-Powerland Technology, China; [2]Nanjing University of Aeronautics and Astronautics, China

2:20 p.m. – 2:40 p.m.

T33.2: **Boost Half-Bridge DC-DC Converter with Reconfigurable Rectifier for Ultra-Wide Input Voltage Range Applications**
Dmitri Vinnikov[2], Andrii Chub[2], Elizaveta Liivik[1], Frede Blaabjerg[1], Yam Siwakoti[3]
[1]Aalborg University, Denmark; [2]Tallinn University of Technology, Estonia; [3]University of Technology Sydney, Australia

2:40 p.m. – 3:00 p.m.

T33.3: **A Novel High-Gain Three-Phase DC-DC PWM Boost Converter**
Adel Abosnina, Gerry Moschopoulos
Western University, Canada

3:00 p.m. – 3:20 p.m.

T33.4: **A Switched-Boost DC/DC Converter with High Voltage Gain and Continuous Input Current**
Ali Mostaan[2], Ahmed Abdelhakim[3], Mohsen Soltani[1], Frede Blaabjerg[1]
[1]Aalborg University, Denmark; [2]Iranian Central Oil Field Company, Iran; [3]University of Padova, Italy

Thursday

3:20 p.m. – 3:40 p.m.

T33.5: **Closed-Loop Voltage Control of a GaN-Based Modular Multilevel Clamped Capacitor Converter**
Liyao Wu, Maryam Saeedifard
Georgia Institute of Technology, United States

4:10 p.m. – 4:30 p.m.

T33.6: **Direct 400 VDC to 1 VDC Power Conversion with Input Series Output Parallel Connection for Data Center Power Supplies**
Yutian Cui, Leon Tolbert, Daniel Costinett, Fred Wang, Benjamin Blalock
university of Tennessee, United States

4:30 p.m. – 4:50 p.m.

T33.7: **A High-Voltage-Gain DC-DC Converter for Powering a Multi-Mode Monopropellant-Electrospray Propulsion System in Satellites**
Bhanu Prashant Baddipadiga, Scott Strathman, Mehdi Ferdowsi, Jonathan Kimball
Missouri S&T, United States

4:50 p.m. – 5:10 p.m.

T33.8: **A Nonisolated Three-Level Bidirectional DC-DC Converter**
Jianfei Chen[1], Caisheng Wang[2], Jian Li[1], Chenguang Jiang[2], Chen Duan[2]
[1]Chongqing University, China; [2]Wayne State University, United States

5:10 p.m. – 5:30 p.m.

T33.9: **A Phase-Shift-Based Synchronous Rectification Scheme for Bi-Directional High-Step-Down CLLC Resonant Converters**
Yucheng Gao, Kai Sun, Xiang Lin, Zhiqiang Guo
Tsinghua University, China

2:00 p.m. – 5:30 p.m.

T34: Power Electronics for Utility Interface – Control

ROOM 214B

Power Electronics for Utility Interface

Yongheng Yang, *Aalborg University*
Majid Pahlevani, *University of Calgary*

2:00 p.m. – 2:20 p.m.

T34.1: **Single-Loop Control of Buck Power-Pulsation Buffer for AC-DC Converter System**
Yuri Panov, Milan Jovanović, Brian Irving
Delta Products Corp, United States

2:20 p.m. – 2:40 p.m.

T34.2: **A Hardware Decoupling Method for Series-Resonance-Based Isolated Three-Port DC/DC Converters**
Panbao Wang[2], Wei Wang[2], Dianguo Xu[2], Xiaonan Lu[1]
[1]Argonne National Laboratory, United States; [2]Harbin Institute of Technology, China

2:40 p.m. – 3:00 p.m.

T34.3: **A Partially Rated DC-DC Converter for Power Flow Control in Meshed LVDC Distribution Grids**
Pavel Purgat, Ryan Adilardi Prakoso, Laurens Mackay, Zian Qin, Laura Ramirez-Elizondo, Pavol Bauer
TU Delft, Netherlands

3:00 p.m. – 3:20 p.m.

T34.4: **A Carrier Magnitude Varying Modulation for Distributed Static Series Compensator to Achieve a Maximum Reactive Power Generating Capability**
Yunting Liu, Fang Zheng Peng
Michigan State University, United States

3:20 p.m. – 3:40 p.m.

T34.5: **Asymmetric Low-Voltage Ride-Through Scheme and Dynamic Voltage Regulation in Distributed Generation Units**
Masoud M. Shabestary, Shahed Mortazavian, Yasser A-R. I. Mohamed
University of Alberta, Canada

4:10 p.m. – 4:30 p.m.

T34.6: **Smart Transformer Universal Operation**
Youngjong Ko, Andrii Chub, Levy Costa, Markus Andresen, Marco Liserre
Kiel University, Germany

4:30 p.m. – 4:50 p.m.

T34.7: **Proportional Integral – Resonant and Dual Loop Current Control Structure Comparison for Grid Connected Converters in the Rotating Frame**
Srinivas Gulur, Vishnu Mahadeva Iyer, Subhashish Bhattacharya
North Carolina State University, United States

4:50 p.m. – 5:10 p.m.

T34.8: **A Single-Phase Self-Synchronized Synchronverter with Bounded Droop Characteristics** –
Tarek Younis[1], Mohamed Ismeil[1], Mohamed Orabi[1], Essam Hussain[2]
[1]APEARC, Aswan University, Egypt; [2]University of Sheffield, United Kingdom

5:10 p.m. – 5:30 p.m.

T34.9: **Optimal Design of Hybrid Battery Energy Storage System for Minimizing the Number of Batteries with High Efficiency Control Algorithm Based on Fuzzy Logic**
Tae-Won Noh, Jung-Hoon Ahn, Hyo Min Ahn, Byoung Kuk Lee
Sungkyunkwan University, Korea

2:00 p.m. – 5:10 p.m.

T35: Multi-level Inverters and Converters

ROOM 214C

Motor Drives and Inverters

Scott Ramsay, *DRS Consolidated Controls*
Jeff Czapor, *DRS Consolidated Controls*

2:00 p.m. – 2:20 p.m.

T35.1: **A Novel Switched-Capacitor Multilevel Inverter Offering Modularity in Design**
Yat Chi Fong, Raghu Raman Sekhar, Moonson Manxin Chen, Ka Wai Eric Cheng
The Hong Kong Polytechnic University, Hong Kong

2:20 p.m. – 2:40 p.m.

T35.2: **Quasi Two-Level PWM Operation of a Nine-Arm Modular Multilevel Converter for Six-Phase Medium-Voltage Motor Drives**
Mohamed Diab[2], Grain Adam[2], Barry Williams[2], Ahmed Massoud[1], Shehab Ahmed[3]
[1]Qatar University, Qatar; [2]Strathclyde University, United Kingdom; [3]Texas A&M University at Qatar, Qatar

2:40 p.m. – 3:00 p.m.

T35.3: **Hardware Design of a 1.7 kV SiC MOSFET Based MMC for Medium Voltage Motor Drives**
He Li[2], Karun Potty[2], Ziwei Ke[2], Jianyu Pan[2], Yingzhuo Chen[1], Fan Zhang[1], Muneer Al Sabbagh[1], Will Perdikakis[1], Gengyao Li[1], Xi Ye[1], Risha Na[1], Julia Zhang[2], Longya Xu[2], Jin Wang[2]
[1]Ohio State University, United States; [2]The Ohio State University, United States

3:00 p.m. – 3:20 p.m.

T35.4: **Power-Dense Multilevel Inverter Module Using Interleaved GaN-Based Phases for Electric Aircraft Propulsion**
Nathan Pallo, Thomas Foulkes, Tomas Modeer, Samantha Coday, Robert Pilawa-Podgurski
University of Illinois, United States

3:20 p.m. – 3:40 p.m.

T35.5: **Transient Analysis of a Modular Multilevel Converter with Coupled Arm Inductors**
Bogdan Džonlaga, Davi Rabelo Joca, Loïc Quéval, Jean-Claude Vannier
CentraleSupélec Paris, France

4:10 p.m. – 4:30 p.m.

T35.6: **Capacitor Voltage Balancing of a Nested T-Type Four-Level Inverter Using Space Vector Modulation**
Ahoora Bahrami, Mehdi Narimani
McMaster University, Canada

4:30 p.m. – 4:50 p.m.

T35.7: **Spatial Repetitive Controller for Improved Steady State Performance of Droop Regulated Modular Multilevel Converter in Wind Farm Application**
Sandeep Kolluri, Naga Brahmendra Gorla, Rajesh Sapkota, Sanjib Kumar Panda
National University of Singapore, Singapore

4:50 p.m. – 5:10 p.m.

T35.8: **A Novel Zero-Sequence Current Elimination PWM Scheme for an Open-End Winding Motor Drive with Dual Two-Level Inverter**
Zewei Shen, Dong Jiang, Jianan Chen, Ronghai Qu
Huazhong University of Science & Technology, China

2:00 p.m. – 5:30 p.m.

T36: Opportunities and Challenges of SiC & Si Devices

ROOM 214D

Devices and Components

Douglas Hopkins, *North Carolina State University*
Jean-Luc Schanen, *Grenoble Institute of Technology*

2:00 p.m. – 2:20 p.m.

T36.1: **Junction Temperature Estimation of SiC MOSFETs Based on Extended Kalman Filtering**
Xiangyu Han, Maryam Saeedifard
Georgia Institute of Technology, United States

2:20 p.m. – 2:40 p.m.

T36.2: **An Accurate Calorimetric Method for Measurement of Switching Losses in Silicon Carbide (SiC) MOSFETs**
Anup Anurag[1], Sayan Acharya[1], Yos Prabowo[1], Ghanshyamsinh Gohil[2], Hulgize Kassa[1], Subhashish Bhattacharya[1]
[1]North Carolina State University, United States; [2]University of Texas at Dallas, United States

2:40 p.m. – 3:00 p.m.

T36.3: High Voltage SiC Super-Cascode Power Switch Parameter Optimization for Loss Reduction
Xintong Lyu, He Li, Boxue Hu, Zhuxuan Ma, Jin Wang
The Ohio State University, United States

3:00 p.m. – 3:20 p.m.

T36.4: High Current Medium Voltage Solid State Circuit Breaker Using Paralleled 15kV SiC ETO
Liqi Zhang[3], Richard Woodley[2], Xiaoqing Song[1], Soumik Sen[3], Xin Zhao[3], Alex Q. Huang[3]
[1]ABB USCRC, United States; [2]North Carolina State University, United States; [3]University of Texas at Austin, United States

3:20 p.m. – 3:40 p.m.

T36.5: Experimental Evaluation of IGCT Converters with Reduced di/dt Limiting Inductance
Tianyu Wei, Qiang Song, Jianguo Li, Biao Zhao, Zhengyu Chen, Rong Zeng
State Key Lab. of Power Systems, Department of Electrical Engineering, Tsinghua University, China

4:10 p.m. – 4:30 p.m.

T36.6: Optimal Control Strategies for SiC MOSFET and Si IGBT Based Hybrid Switch
Zongjian Li, Jun Wang, Xi Jiang, Z.John Shen, Xin Yin, Cheng Zeng, Linfeng Deng
Hunan University, China

4:30 p.m. – 4:50 p.m.

T36.7: Increasing Emitter Efficiency in 3.3-kV Enhanced Trench IGBTs for Higher Short-Circuit Capability
Paula Diaz Reigosa[1], Francesco Iannuzzo[1], Munaf Rahimo[2], Chiara Corvasce[2], Frede Blaabjerg[1]
[1]Aalborg University, Denmark; [2]ABB Switzerland Ltd. Semiconductors, Switzerland

4:50 p.m. – 5:10 p.m.

T36.8: Thermal Resistor and Capacitor Parameter Identification Using Cooling Curve of IGBT Module
Jun Zhang[1], Xiong Du[1], Shuai Zheng[1], Heng-Ming Tai[2]
[1]Chongqing University, China; [2]University of Tulsa, United States

5:10 p.m. – 5:30 p.m.

T36.9: Improved Dynamic Voltage Sharing in Multilevel Converters Through Diode Characterization
Juan Ramirez[1], Luke Solomon[2], Daniel Opila[3]
[1]GE Healthcare, United States; [2]GE Power, United States; [3]United States Naval Academy, United States

2:00 p.m. – 5:30 p.m.

T37: Magnetics Modeling Design & Applications

ROOM 217A

Modeling and Simulation

Rolando Burgos, *Virginia Tech*

Sandeep Bala, *ABB Inc. USCRC*

2:00 p.m. – 2:20 p.m.

T37.1: Understanding Middle-Point Inductance's Effect on Switching Transients for Multi-Chip SiC Package Design with P-Cell/N-Cell Concept
Fei Yang[2], Zhiqiang Wang[1], Zheyu Zhang[2], Steven Campbell[1], Fred Wang[2], Madhu Chinthavali[1]
[1]Oak Ridge Nationa Lab, United States; [2]The University of Tennessee, Knoxville, United States

2:20 p.m. – 2:40 p.m.

T37.2: Modeling of Variable Magnetic Elements Including Hysteresis and Eddy Current Losses
Sarah Saeed, Jorge Garcia, Ramy Georgious
Universidad de Oviedo, Spain

2:40 p.m. – 3:00 p.m.

T37.3: Minimum Loss Operation of High-Frequency Inductors
Panteleimon Papamanolis, Florian Krismer, Johann Walter Kolar
ETH Zurich, Switzerland

3:00 p.m. – 3:20 p.m.

T37.4: Permeance Based Modeling of Magnetic Hysteresis with Inclusion of Eddy Current Effect
Min Luo[1], Drazen Dujic[1], Jost Allmeling[2]
[1]EPFL, Power Electronics Laboratory, Switzerland; [2]Plexim GmbH, Switzerland

3:20 p.m. – 3:40 p.m.

T37.5: Estimation and Minimization of Power Loop Inductance in 135 kW SiC Traction Inverter
Bryce Aberg, Radha Sree Krishna Moorthy, Li Yang, Wensong Yu, Iqbal Husain
North Carolina State University, United States

4:10 p.m. – 4:30 p.m.

T37.6: Modeling and Reduction of Radiated EMI for Isolated Power Converters
Yingjie Zhang[2], Shuo Wang[2], Yongbin Chu[1]
[1]Texas Instruments Inc., United States; [2]University of Florida, United States

4:30 p.m. – 4:50 p.m.

T37.7: Multi-Variable Optimization Methodology for Medium-Frequency High-Power Transformer Design Employing Steepest Descent Method

Annoy Kumar Das[2], Zhongbao Wei[1], Baylon G. Fernandes[2], Haonan Tian[1], Madasamy P. Thevar[1], Shuyu Cao[1], Vaisambhayana B. Sriram[1], Anshuman Tripathi[1], Philip C. Kjær[3]
[1]Energy Research Institute, NTU, Singapore; [2]Indian Institute of Technology, Bombay, India; [3]Vestas Wind System, Denmark

4:50 p.m. – 5:10 p.m.

T37.8: AC Winding Loss in Closed Core Thin Film Transformers Accounting for Two Dimensional Magnetic Fields

Ciaran Feeney, Ningning Wang
Sengled, China

5:10 p.m. – 5:30 p.m.

T37.9: Design for Reliability and Robustness Tool Platform for Power Electronic Systems – Study Case on Motor Drive Applications

Ionut Vernica, Huai Wang, Frede Blaabjerg
Aalborg University, Denmark

2:00 p.m. – 5:30 p.m.

T38: Control Application

ROOM 217B

Control

Seungdeog Choi, *The University of Akron*

Shamim Choudhury, *Texas Instruments*

2:00 p.m. – 2:20 p.m.

T38.1: Efficiency Improvement of Three Port High Frequency Transformer Isolated Triple Active Bridge Converter

Ritwik Chattopadhyay[1], Ghanshyam Gohil[2], Sayan Acharya[1], Viju Nair[1], Subhashish Bhattacharya[1]
[1]NCSU, United States; [2]UT Dallas, United States

2:20 p.m. – 2:40 p.m.

T38.2: Coordinated Control Strategy Between Large-Scale Photovoltaic Power Stations and VSC-HVDC Without Communication

Yan Wang, Tianqu Hao, Feng Gao
Shandong University, China

2:40 p.m. – 3:00 p.m.

T38.3: Research on Different Balance Control Strategies for a Power Electronic Traction Transformer

Jingxi Yang, Jianqiang Liu, Jiepin Zhang, Nan Zhao, Trillion Zheng
Beijing Jiaotong University, China

3:00 p.m. – 3:20 p.m.

T38.4: State-of-Health Indication Method for Li-Ion Batteries

Zhiyong Xia, Jaber Abu Qahouq
The University of Alabama, United States

3:20 p.m. – 3:40 p.m.

T38.5: Virtual Resistor Based Active Damping of LC Filter in Standalone Voltage Source Inverter

Anil Adapa, Vinod John
Indian Institute of science, India

4:10 p.m. – 4:30 p.m.

T38.6: Analysis and Control of a Transformerless Series Injector Based on Paralleled H-Bridge Converters for Measuring Impedance of Three-Phase AC Power Systems

Zeng Liu[3], Igor Cvetkovic[2], Zhiyu Shen[1], Dushan Boroyevich[2], Rolando Burgos[2], Jinjun Liu[3]
[1]General Electric Global Research Center, United States; [2]Virginia Tech, United States; [3]Xi'an Jiaotong University, China

4:30 p.m. – 4:50 p.m.

T38.7: Improved Zero-Crossing Distortion of a Boundary-Conduction-Mode Boost Converter with Digital Average-Current-Mode Control

Robert Ryan[2], John Hayes[2], Richard Morrison[1], Diarmuid Hogan[1]
[1]Excelsys Technologies, Ireland; [2]University College Cork, Ireland

4:50 p.m. – 5:10 p.m.

T38.8: Online Condition Monitoring Based Dead-Time Compensation for High Frequency SiC Voltage Source Inverter

Jacob Dyer, Zheyu Zhang, Fred Wang, Daniel Costinett, Leon Tolbert, Benjamin Blalock
University of Tennessee, United States

5:10 p.m. – 5:30 p.m.

T38.9: A 150V Monolithic Synchronous Gate Driver with Built-in ZVS Detection for Half-Bridge Converters

Lin Cong, Hoi Lee
The University of Texas at Dallas, United States

2:00 p.m. – 5:30 p.m.

T39: Renewable Energy Converter Topologies

ROOM 217C

Renewable Energy Systems

Jin Wang , *Ohio State University*

Akshay Rathore, *Concordia University*

2:00 p.m. – 2:20 p.m.

T39.1: **High Voltage Gain Dual Active Bridge Converter with an Extended Operation Range for Renewable Energy Systems**

Zhe Zhang, Kevin Tomas-Manez, Yudi Xiao, Michael A. E. Andersen

Technical University of Denmark, Denmark

2:20 p.m. – 2:40 p.m.

T39.2: **Power Plateau and Anti-Power Phenomenon of Dual Active Bridge Converter with Phase-Shift Modulation**

Yudi Xiao[1], Zhe Zhang[2], Xingkui Mao[1], Kevin Tomas Manez[2], Michael A. E. Andersen[2]

[1]Fuzhou University, China; [2]Technical University of Denmark, Denmark

2:40 p.m. – 3:00 p.m.

T39.3: **Hybrid Resonant Half-Bridge DC/DC Converter with Wide Input Voltage Range**

Bumyun Kim[2], Sooa Kim[2], Dong-Young Huh[1], Jung-Hwan Choi[1], Minsung Kim[2]

[1]LG Innotek, Korea; [2]Pohang University of Science and Technology, Korea

3:00 p.m. – 3:20 p.m.

T39.4: **Sensorless Phase Shift Control for Phase Shifted DC-DC Converters for Eliminating DC Transients from Transformer Winding Currents**

Ritwik Chattopadhyay, Utkarsh Raheja, Ghanshyam Gohil, Viju Nair, Subhashish Bhattacharya

North Carolina State University, United States

3:20 p.m. – 3:40 p.m.

T39.5: **System-Level Lifetime-Oriented Power Sharing Control of Paralleled DC/DC Converters**

Saeed Peyghami, Pooya Davari, Frede Blaabjerg

Aalborg University, Denmark

4:10 p.m. – 4:30 p.m.

T39.6: **Capacitor Current Compensation Scheme for Flyback Based Photovoltaic AC Module**

Oscar Montes[1], Sungho Son[1], Jong-Woo Kim[2], Minsung Kim[1]

[1]Pohang University of Science and Technology, Korea; [1]Pohang University of Science and Technology, El Salvador; [2]Virginia Polytechnic Institute and State University, Korea

4:30 p.m. – 4:50 p.m.

T39.7: **Analysis of Switched Supercapacitor Circuit for Varying Energy Harvesting Source Conditions**

David Newell, Maeve Duffy

NUIG, Ireland

4:50 p.m. – 5:10 p.m.

T39.8: **Bumpless Transfer of Non-Inverting Buck Boost Converter Among Multiple Working Modes**

Jianjun Ma, Miao Zhu, Xiuyi Li, Xu Cai

Shanghai Jiao Tong University, China

5:10 p.m. – 5:30 p.m.

T39.9: **Current-Fed Isolated LCC-T Resonant Converter with ZVS and Improved Transformer Utilization**

Venkata Ratnam Vakacharla[1], Akshay Kumar Rathore[1], Rajesh Kumar[2]

[1]Concordia University, Canada; [2]Malviya National Institute of Technology, India

2:00 p.m. – 5:30 p.m.

T40: Industrial Applications

ROOM 217D

Power Electronics Applications

Jim Moss, *TI*

Lanhua Zhang, *Texas Instruments*

2:00 p.m. – 2:20 p.m.

T40.1: **IC for Online EIS in Automotive Batteries and Hybrid Architecture for High-Current Perturbation in Low-Impedance Cells**

Zhe Gong[4], Zhi Liu[4], Yi Wang[4], Kshitij Gupta[4], Carlos Da Silva[4], Todd Liu[1], Z.H. Zheng[2], W.P. Zhang[2], Joop van Lammeren[3], Henk Jan Bergveld[3], C. H. Amon[4], Olivier Trescases[4]

[1]Datang NXP Semiconductor, China; [2]Datang NXP Semiconductors, China; [3]NXP Semiconductors, Netherlands; [4]University of Toronto, Canada

2:20 p.m. – 2:40 p.m.

T40.2: **An Online Battery Impedance Spectrum Measurement Method with Increased Frequency Resolution**

Zhiyong Xia[1], Jaber Abu Qahouq[2]

[1]The University of Alabama, United States; [2]The University of Alabama / ECE, United States

2:40 p.m. – 3:00 p.m.

T40.3: **Design and Implementation of a Distributed Control Structure for Modular Multilevel Matrix Converter**

Jian Liu[2], Wenxi Yao[2], Zhengyu Lu[2], Jiankai Ma[1]

[1]Newcastle University, United Kingdom; [2]Zhejiang University, China

3:00 p.m. – 3:20 p.m.

T40.4: A Non-Isolated Asynchronous Low Power High Voltage Boost Converter for Discontinuous Conduction Mode and Portable Applications

Frank Vanselow[1], Bernadette Kinzel[1], Linus Maurer[2], Erkan Isa[1]
[1]Fraunhofer EMFT, Germany; [2]UniversitÃ¤t der Bundeswehr, Germany

3:20p.m. – 3:40 p.m.

T40.5: A Novel Bidirectional Three-Phase AC-DC/DC-AC Converter for PMSM Virtual Machine System with Common DC Bus

Arvind H. Kadam, Rishi Menon, Sheldon S. Williamson
University of Ontario Institute of Technology, Canada

4:10 p.m. – 4:30 p.m.

T40.6: A Series-AC-Link ISOP AC-AC Converter with Two Power Cells

Ehsan Afshari, Mahshid Amirabadi
Northeastern University, United States

4:30 p.m. – 4:50 p.m.

T40.7: Analysis and Design Method for Parallel Quasi Resonant Inverter in Induction Heating Applications

Isaac Nam
GE Appliances, a Haier Company, United States

4:50 p.m. – 5:10 p.m.

T40.8: SiC Solid State Circuit Breaker with an Adjustable Current-Time Tripping Profile

Yanjun Feng, Yuanfeng Zhou, Z. John Shen
Illinois Institute of Technology, United States

5:10 p.m. – 5:30 p.m.

T40.9: Design of a High Power MEMS Relay with Zero Voltage Switching and Isolatedpower and Signal Transfer

Yan Zhang[2], Wenbo Liu[2], Lei Kou[2], Yan-Fei Liu[2], Chris Keimel[1]
[1]Menlo Microsystems, Canada; [2]Queen's University, Canada

Professional Education Seminars

as of 2.15.18

APEC strives to offer seminars with a practical mix of theory and application for the professional working in power electronics. APEC 2018 features 18 professional education seminars with a broad range of topics.

Sunday, March 4

9:30 a.m. – 6:00 p.m.

Session One, Track 1 (S01)

Fundamentals of Switch Mode Power Conversion

Robert V. White

ROOM 217D

9:30 a.m.– 1:00 p.m.

Today's switch-mode power converters are extraordinary devices converting power with efficiencies approaching 100% and power conversion densities into the 100's of watts per cubic inch. Just how do they do that? This seminar is a look "under the hood" of switch mode power converter. Imagine looking under the hood of a car at the engine with a mechanic. The mechanic would describe all of the various parts, like pistons and fuel injectors, and how they work together to create the power to drive the car. This seminar is a "look under the hood" of switch mode power converters. The goal is to present the principles and concepts needed to understand how switch mode converters work without a deep technical dive into the details.

The first half of the seminar will focus on the circuits ("topologies") used to convert power. The various building blocks, such a switching devices and inductors will be described. Then the key principle of switch mode power will be presented to show how an ideal switch mode converter can convert at 100% efficiency. This introduces the buck converter which is explored in some detail. The workings of other key topologies such as the boost, buck-boost, flyback, and SEPIC converter are also shown to expand the understanding.

In the second half, the basics of controlling a switch mode power converter are explained. A quick review of systems and feedback starts the discussion. Then roles and function of the error amplifier, compensator, and modulator described. The concepts of how one designs a stable control are also discussed. The seminar concludes with an overview of current mode control.

This seminar is suited for those wishing to know how a switch mode power converter works without being drenched in technical details, such as those new to switch mode power conversion or those working in sales, marketing, or application support of switch power converters or components used in switch mode power converters.

Session One, Track 2 (S02)

Modern Soft Switching Technologies

Ionel Dan Jitaru

ROOM 206

9:30 a.m.– 1:00 p.m.

This seminar will present modern soft switching technologies as an avenue to increase the efficiency and power density in power conversion.

The modern soft switching technologies which will be presented in the seminar do provide true soft switching. In true soft switching technology, the primary switching devices turn on at zero voltage and the secondary switching devices turn off at zero current. There is no ringing or spikes across any of the switching devices during operation. These technologies are a derivation of the classical topologies, such as flyback, boost, two transistors forward, half bridge and full bridge.

Though the seminar will be focused on the modern soft switching technologies, a section is dedicated to magnetics. In the quest for efficiency above 99%, the magnetic technology plays a very important role. In spite of the significant progress in the semiconductor industry, the technology in magnetics lags behind.

The developments in semiconductor technology such as GaN and SiC did help us to further improve the efficiency exceeding the 99% in some applications.

The presentation will be highlighted with design examples and experimental results such as 99%+ efficiency PFC with power densities above 1000W/in3, and 99% efficiency isolated DC-DC Converters.

Session One, Track 3 (S03)

Thermal and Reliability Modeling of Power Electronics Systems

Frede Blaabjerg, Francesco Iannuzzo, Amir Sajjad

ROOM 217A

9:30 a.m.– 1:00 p.m.

Thermal management and reliability are – besides the costs – the most challenging issues in power electronics. Besides, simulation of power electronic systems and devices is a key to achieve design for reliability. In this education seminar, after a review of the basic theory of heat transfer, and loss calculation in a voltage source inverter, different thermal approaches will be discussed including equivalent thermal network calculation, finite element modelling (FEM) and computational fluid dynamics (CFD) simulations. Depending on the application, certain types of cooling are permitted which reach from natural convection to pool boiling as the most efficient cooling technique. The education seminar will address the sources of heat generation in a power electronic system as well as the basics and possibilities of heat exchange. Case studies will show typical applications for several industrial applications. The results are compared to thermal measurements using the IR camera. Lifetime modelling and simulation is also an important stage in a robust and reliable design that is based on the physics-of-failure approach i.e. appropriate models is prerequisite for lifetime simulation. Moreover, the different operational and environmental stresses which are applied during operation have to be considered (mission profiles). Details on failure mechanisms and mission profiles will highlight the correlation between thermal characteristic and reliability. The education seminar will present and discuss the state-of-the-art of thermal and reliability simulation in the field of power electronics. Application of simulation tools to analyze the correlation between thermal impedance and reliability and the impact of cooling technologies will conclude the education seminar.

Session One, Track 4 (S04)

WBG Switching Circuits: Design, Test, Devices and Applications

Edward Shelton, Dr Patrick R. Palmer, Alan Mantooth, Brian Zahnstecher, Geoff Haynes

ROOM 214AB

9:30 a.m.– 1:00 p.m.

The presentation will start with an overview of GaN and SiC transistor structures, the advantages they offer, and the applications and markets they are well suited to. We will then explore the technical benefits offered by WBG switching devices, and the challenges that are faced by engineers using them. It will be explained how these benefits can be achieved with a power circuit, gate-drive and PCB layout that are all optimised for fast switching. Switching test results will be examined and straightforward numerical analysis applied to quantify the issues and arrive at appropriate solutions. The implementations of these circuits will be described in detail and further test results shown to demonstrate their effectiveness. It will be explained that the performance of such an optimised circuit can only be successfully tested and verified using high performance non-intrusive instrumentation systems, such as the embedded measurement circuits that will be presented. The circuit design for a currentsource gate-drive will be presented and compared to a conventional resistive gate-drive. Consideration will be given to reliable operation, improving efficiency and reducing EMI. Finally, experimental test results for GaN, SiC, CoolMOS and IGBT switching devices will be presented, with the merits of each compared.

Session One, Track 5 (S05)

High-Efficiency Single-Phase Inverter Design-VT-FEEC Approach for Google Little Box Challenge

Jason Lai, Lanhua Zhang

ROOM 214CD

9:30 a.m.– 1:00 p.m.

With fast development of wide bandgap (WBG) semiconductor devices and their promise on superior conducting and switching characteristics, the inverter can be designed with ultrahigh efficiency and power density. In the Google Little Box Challenge, the winning award was given to the one with highest power density. Virginia Tech Future Energy Electronics (VT-FEEC) Center, however, being the advocate for ultrahigh efficiency inverter design for the global environment and energy concern is the only university team that went through all the tests successfully and was placed as the Top-Three Finalist in 2016. Major challenges of the design include how to deal with the low-frequency second harmonic ripples, output filter size minimization, electromagnetic interference, and thermal management. This presentation will discuss how the VT-FEEC team went through device and circuit selection for high-efficiency consideration, the low-frequency suppression for capacitor size reduction, cooling system design approach, and filter design for harmonic and EMI compliance. The resulting design achieved 98.0% CEC weighted efficiency and 69.3 W/in3 power density. The presentation materials involve both technology survey and design aspects and are intended for audience with intermediate knowledge level in power electronics.

Session One, Track 6 (S06)

Power Quality Control in Hybrid AC/DC Microgrids

Yunwei (Ryan) Li, Farzam Nejabatkhah

ROOM 217BC

9:30 a.m.– 1:00 p.m.

Today, conventional power systems are evolving into modern smart grids, where interconnected microgrids may dominate the distribution system with high penetration of renewable energies and storage elements. The hybrid AC/DC systems with DC and AC sources/loads are considered to be the most likely future distribution or even transmission structures. In such hybrid AC/DC microgrids, power quality control is one of the most critical operation aspects, and the high penetration level of power electronics interfacing converters creates great potential to control the power quality.

This tutorial focuses on the power quality control in hybrid AC/DC microgrids. It includes both converter level control design and system level management and coordination. It will cover four main topics: i) overview of hybrid AC/DC microgrids and their power quality issues; ii) power management strategies and grid support control in hybrid microgrids; iii) control strategies for single-phase and three-phase interfacing converters to compensate for the unbalanced voltage in hybrid AC/DC microgrids; and iv) harmonic compensation in hybrid microgrids.

The tutorial will be suitable for university researchers who are working on microgrids and grid interfacing converters, as well as industry people who wants to learn more about smart converters controls and hybrid AC/DC microgrids operations.

Prof. Education Seminars

Session Two, Track 7 (S07)

Electromagnetic Interference and Compatibility for Power Electronics Engineers

Graham Town

ROOM 217D

2:30 p.m.– 6:00 p.m.

The increasing use of high speed power electronics in electrical power conversion and control is also increasing the potential for electromagnetic interference (EMI) with the operation of other electronic equipment. EMI is often difficult to diagnose yet can have potentially serious consequences, especially for wireless systems used for sensing, communication and control (e.g. as in "smart grids"). Consequently it is important for power electronics engineers to understand how and why EMI occurs and methods for minimizing its impact.

This seminar will explain the various sources and characteristics of electromagnetic interference (EMI) generated by power electronic circuits, the physical mechanisms by which those sources may interfere with the operation of electronic equipment, and practical techniques for limiting the interference and/or its impact on other electronic circuits, i.e. to improve electromagnetic compatibility (EMC).

Topics covered will include: sources of EMI (electronic switching, electrical transients, etc.) characteristics of EMI (temporal and spectral properties, etc.), fundamental coupling mechanisms (conducted, inducted, radiated), EMI standards and measurements, testing for electromagnetic compatibility (EMC), and practical strategies and methods to minimize EMI and/or its impact.

Intended audience: Design engineers and researchers with experience in circuit design linking electromagnetic theory with practice in the context of power electronics.

Session Two, Track 8 (S08)

New High-Frequency Magnetics Circuit Models

Ray Ridley

ROOM 214CD

2:30 p.m.– 6:00 p.m.

This seminar will present latest research results for high-frequency magnetics modeling and analysis. It will cover both fundamentals and advanced concepts of rugged transformer and inductor design. Topics will include core loss, winding loss, saturation, frequency response measurements, circuit modeling, leakage inductance, winding layout arrangements, and materials. The usually-difficult topics of proximity loss and core loss will be greatly simplified with new circuit models that make results accessible to all designers or users of standard magnetics parts. Equations for the derivation of circuit elements and design examples will be given.

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.

Session Two, Track 9 (S09)

Advanced Thermal Management Technologies

Peter Ritt, Devin Pellicone

ROOM 217A

2:30 p.m.– 6:00 p.m.

The course will provide an in-depth explanation of the principles of several advanced thermal technologies. Essential heat transfer equations and correlations will be presented and explained for each of these thermal management technologies. Additionally real world applications where these technologies are implemented will be discussed in detail. The participant will come away with an understanding and appreciation of thermal management technologies, how they work, when they should be applied and how they can improve component and system level design performance.

Session Two, Track 10 (S10)

Designing Reliable and High Density Power Supplies with GaN

Paul L. Brohlin, Masoud Beheshti, Sandeep Bahl, Serkan Dusmez, Ted Chen

ROOM 214AB

2:30 p.m.– 6:00 p.m.

Gallium Nitride (GaN) is enabling a new generation of power conversion designs not possible before. These designs allow systems to reach unprecedented levels of power density and efficiency while delivering the reliability and the ruggedness that the power supply engineers expect. This presentation provide a technical overview of GaN technology, how it is qualified for reliable operation in power applications, and an in depth discussion of designing for high density in various topologies such high frequency LLC converters, power factor correction, and active clamp Flyback. The overview is intended to help both novice and seasoned power designers to gain deeper insight into GaN reliability, high frequency design techniques, component selections, and how to optimize the density, efficiency, and reliability of a power supply design.

Prof. Education Seminars

Power Semiconductors for Traction Inverters in Vehicles: from Discretes to Power Modules, from Silicon to Wide Band Gap Devices

Andre Christmann, David Levett,

ROOM 206

2:30 p.m.– 6:00 p.m.

This seminar will provide an overview of the use of power semiconductors in vehicle traction inverter applications. It will cover four major aspects of three-phase inverters for DC-AC power conversion in HEVs, PHEVs, and EVs: Semiconductor packaging; Performance assessment of different families of semiconductors: IGBTs, MOSFETs and SiC; Inverter design principles for high efficiency; Integration of different package types into an Inverter. IGBTs (Insulated Gate Bipolar Transistors) are at the heart of most modern traction inverters and perform the electronic switching functions. They are assembled in different kinds of packages, mounted onto cooling structures and connected via bus bars to a capacitor bank. A fully functional inverter stack compromises of these components integrated together with other subassemblies, such as control boards, filters and current sensors. Although the market for electrical and hybrid cars cannot be described as an emerging market, the typical standardization of automotive components has not yet occurred for high power inverters. Nevertheless the physics for driving an electrical motor are the same for all the different vehicles. The seminar will connect various aspects of inverter design from the view point of power semiconductors: Packaging, thermal and electrical performance and the integration into an inverter.

Power Converters for Energy Storage Applications- Analysis and design from Theory to Practice

Petar Grbovic

ROOM 217BC

2:30 p.m.– 6:00 p.m.

Power electronics and static power converters play significant role in industrial applications, power generation and transmission, home appliance, transportation, etc., etc. In most of the applications above mentioned, we are facing higher and higher demand for an energy storage device. Several different energy storage technologies are available today: flywheel, electrochemical double layer capacitors (EDLC), fuel-cells (FC) and electrochemical batteries. An energy storage cannot be directly connected to the power conversion system. An interface ac/dc or dc/dc power converter between the energy storage and the system is also required.

In the first part of the seminar we will discuss state of the art energy storage devices, their applications, design and sizing. In the second part of the seminar, we will discuss in deep details interface power converters such as dc/dc and ac/dc converters. The discussion will cover different topologies such as voltage and current source converters, multi-cell and multi-level converters, isolated and non-isolated converters, full and partial power rated converters, etc., etc. Control strategy of different concepts will be covered too. Several case studies and design examples will be given as concluding part of the seminar.

This seminar is aimed at power electronics engineers, professionals and graduate students who want to improve their knowledge and understanding of advanced energy storage devices, interface converters and their application in power conversion, nowadays as well as in the near future.

Monday, March 5

8:30 a.m. – 12:00 p.m.

Session Three, Track 13 (S13)

Gate Driver Design for IGBT and SiC Based Power Devices and Modules

David Levett, Tim Frank, David Divins

ROOM 217BC

8:30 a.m.– 12:00 p.m.

The goal of this seminar is to provide a very practical course on how to design gate drivers for both IGBT and SiC MOSFET power semiconductors. The seminar will be given by design engineers, with more than 50 years of combined real world design experience, for design engineers with the aim of benefiting anyone involved in power converter design from entry level to veteran.

Subjects to be covered include: comparison of gate driver requirements and measured waveforms from an equal rated IGBT and SiC MOSFET. Explanation of different gate driver isolation types from junction isolated, through opto couplers to fiber optics and the application benefits of each. How to design floating isolated power supplies from bootstrap to full galvanic isolation and the important design parameters for high dv/dt switching. Key elements required to protect IGBT's and SiC MOSFETs under over-current, short circuit and over-voltage conditions. Finally some examples and tips on how to do pcb layout especially for fast switching and paralleled devices.

The seminar will be most relevant to engineers designing converters in the 1kW to 10MW power range and will emphasize designs utilizing power modules using IGBT's and SiC MOSFET semiconductors in the 650V, 1200V and 1700V voltage classes.

Session Three, Track 14 (S14)

Closing the Feedback Loop Through Simulation and Analysis

Christophe Basso

ROOM 214CD

8:30 a.m.– 12:00 p.m.

Loop control represents an important part of power converters design. However, among the long list of things to consider when developing a new product, it is often ignored until the very end of the design process. Attempting to stabilize a converter in emergency without a thorough understanding of its operating mechanisms can be a perilous exercise when trial and error is involved. Despite the power of nowadays simulation engines, nothing replaces the thorough analytical analysis of a control loop to identify where the offenders are and how to neutralize them via an adequate compensation policy.

Capitalizing on the author experience in this field, the seminar describes several paths to let you efficiently stabilize a converter through the combination of analytical analysis, simulation and bench experiments. The seminar starts by introducing the tools we need –small-signal models, fast analytical circuits techniques (FACTs) and simulation models – and quickly dive into the subject through application examples. At the end of this seminar, you will know the basic steps for stabilizing a typical switching converter.

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.

Session Three, Track 15 (S15)

International Product Compliance and Certifications-Safety and EMC Compliance 101

John Allen, Mark Montrose, Jeff Pasternak

ROOM 206

8:30 a.m.– 12:00 p.m.

This tutorial is for those new to EMC and Safety compliance which allows one to implement both safety and EMC requirements at an introductory level.

For the safety portion, we start with a brief history and the international approval process. We examine how to obtain the CE mark for Europe along with creating Technical Files, use of Notified Bodies plus related international regulations and Directives including how to create a Declaration of Conformity. In addition, we present briefly major areas of concern with regard to risk hazard analysis with a focus on power electronics that includes construction requirements, tests required, warnings labels plus appropriate standards.

For the EMC section, this introductory tutorial presents in unique manner the field of electromagnetic compatibility made simple with a focus on the design of printed circuit boards and systems to meets any emissions and immunity requirement. The target audience is everyone regardless of expertise wishing to [re-]learn electromagnetic theory in a non-academic manner "without the math". A visualization approach is taken that allows attendees to understand what Maxwell's equations tells us, converting his four equations conceptually into five simple algebraic equations to solve almost any EMC problem in minutes using only a calculator.

Session Three, Track 16 (S16)

Maximizing GaN FET and IC Performance, Not Just a Drop in Replacement of MOSFETs

Michael de Rooij, Alex Lidow, David Reusch, John Glaser

ROOM 214AB

8:30 a.m.– 12:00 p.m.

Gallium Nitride (GaN) power semiconductors have seen increased adoption in many power electronic applications. The performance of GaN FETs continues to evolve and improve but the challenges of maximizing the GaN Benefit increases too. The goal of this tutorial is to provide engineers the tools and understanding needed to fully utilize the potential of GaN FETs and emerging GaN integrated circuits, and to teach them that GaN devices are not merely a drop in replacement for MOSFETs. The seminar comprises three main sections; 1) An introduction to the important distinguishing characteristics of GaN FETs, 2) The fundamentals of designing with GaN FETs and ICs, and 3) GaN based application examples demonstrating the techniques presented in section II.

Session Three, Track 17 (S17)

Optimizing Power Converter Topology and Module Selection in 1500V Solar Inverters

Kevork Haddad, Bernhard Eichler, Paul Drexhage

ROOM 217A

8:30 a.m.– 12:00 p.m.

1500VDC is set to be the mainstream in PV based power plants. Increasing the maximum DC voltage poses significant challenges to the Engineer who is tasked to design the solar inverter having DC link voltages higher than 1000V. The following aspects during the design phase need to be answered concretely: what topology to be used two level or three level converter? Which topology is the optimum topology? What kind of design margin gives one particular solution vs another? What is the robustness of the design in terms of cosmic ray failure?.

The objective of the tutorial is to give the practicing Engineer step by step approach how to reach to the optimum solution by using industry standard topologies and modules. The course will demonstrate and explain how to include mission profile to account for cosmic ray failures which impacts the final solution. Module technologies suitable for 1500V PV string and central inverters are presented. Semiconductor losses calculations for various solutions are described with concrete examples. An in-depth discussion of the role of cosmic radiation on semiconductors in regards to failure rates is planned with practical examples. The course takes into consideration large central inverters for high power solar installations. Hence, parallelization of standard and three level modules are treated with practical examples. Importance and the 2/5 design aspects of such as sizing of filter components and DC link capacitors will be discussed as well.

Session Three, Track 18 (S18)

Small-Signal Stability and Subsystem Interactions in Distributed Power Systems with Multiple Converters (II): 3-Phase AC Systems

Jinjun Liu, Rolando Burgos, Paolo Mattavelli, Dushan Borojevich

ROOM 217D

8:30 a.m.– 12:00 p.m.

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. 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 3-phase AC systems is delivered. Topics that will be covered include a brief review of small-signal stability and sub system interactions in dc systems, DQ impedances of three-phase AC system, small-signal stability analysis using Generalized Nyquist Criterion, dynamics caused by Phase-Locked-Loop (PLL), stability criterion of droop-controlled parallel inverters considering dynamics of fundamental frequency, stability analysis for 3-phase systems based on single impedance model, and impedance measurement and practical implementations. The targeting audience of the seminar/tutorial would be engineers, graduate students and academia faculties who are interested in the topic. The level of the intended audience will be intermediate.

Plenary Session

as of 2.15.18

Monday, March 5

1:15 p.m. – 5:00 p.m.

HEMISFAIR BALLROOM C1/C2

The APEC 2018 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 several presentations from respected industry leaders. Each presentation is 30 minutes in length and allows for interactive Q&A at the end of each presentation.

Power: A Fundamental Ingredient of Advanced Science and Applied Technology

1:30 p.m. – 2:00 p.m.

SPEAKER:

Adam L. Hamilton P.E.

President and Chief Executive Officer, Southwest Research Institute (SwRI®)

T3 days ago

Imagine a sophisticated and expensive scientific instrument package that must function flawlessly and never be serviced during its one-way mission. Years of research, development, and planning depend on embedded power components to conduct the furthest exploration in the history of humankind. The New Horizons spacecraft left Earth in 2006, sped perilously close to Pluto in 2015, and promises another scientific bounty in 2019 with the flyby of 2014-MU69, an object outside of our solar system. Next, imagine the interconnected infrastructure of a smart transportation system dependent on a trickle of power to predict and prevent catastrophic accidents. Humankind's insatiable scientific and engineering curiosity, and its continuing advancement, will always require power. Join us during this plenary session as we consider the enabling power of power for the future of science and technology.

VIENNA Rectifier and Beyond

2:00 p.m. – 2:30 p.m.

SPEAKER:

Dr. Johann Kolar

Director Power Electronic Systems Laboratory, ETH Zurich

Twenty years ago at the Plenary Session of APEC 1998 in Anaheim, CA, a single-stage isolated three-phase PWM rectifier system was introduced. Since then the Vienna Rectifier has been proven to fit well for today's applications. With newer and wider range of power semiconductor devices and updated system requirements, topological variations in today's uses and what's in store in research for the future trends will be discussed.

Moving from Si to SiC from the End User's Perspective

2:30 p.m. – 3:00 p.m.

SPEAKER:

Dr. Muhammad Nawaz

Principal Scientist, ABB Corporate Research

Ever increasing demand of energy supply as a result of continuous population growth, human mobility leading to more urbanization and widening industrialization scope with lower environmental impact is the basic challenge that power electronics community is facing nowadays for sustainable societal growth. While electricity consumption is continuously growing at a fast rate over the coming decade, combating the energy demand and climatic problem therefore requires a more complex interdisciplinary approach involving new technological solutions such as sustainable energy sources and more efficient energy usage. With these considerations in mind, an enabling technology that provides an efficient energy conversion and distribution, reliable control and conditioning of electric energy from the source to the load end will be the main objective of futuristic research and development. High power Semiconductor devices such as MOSFETs, IGBTs and IGCTs provide basic building blocks for variety of high power conversion applications. As witnessed by recent device technological trend, wide bandgap electronic devices using silicon carbide (SiC) material system promise potential replacement to leading horse silicon based devices; thanks to larger bandgap of SiC (3 times than that of Si), higher critical field strength (10 time than that of Si) along with higher thermal conductivity of SiC (3 times than that of Si) besides superior transport of carriers (2 times higher saturation velocity than that of Si).

Break

3:00 p.m. – 3:30 p.m.

WPT: from μW/cm2 Harvesting to kW Capacitive Vehicle Powering

3:30 p.m. – 4:00 p.m.

Speakers:

Zoya Popovic

Distinguished Professor and Lockheed Martin Endowed Chair, Electrical, Computer and Energy Engineering, University of Colorado, Boulder

This talk will overview wireless power transfer for power levels from W to kW. The ultra-low power density application is in far-field harvesting at GHz frequencies for unattended wireless sensors. In this case, efficiency and power management are challenging, as well as miniaturization and energy storage. Several examples will be shown, including harvesting sidelobes from a 4.3GHz altimeter radar antenna on a Boeing 737 aircraft for powering health-monitoring aircraft sensors. At the high power levels, near-field capacitive power transfer is chosen in the 6 MHz range for powering stationary vehicles and vehicles in motion. In this case, over 85% efficiency is achieved for 1kW of capacitive power transfer while meeting safety standards in the vicinity of the vehicle through a near-field phased array approach. Other approaches, such as power beaming and multi-mode shielded wireless powering will also be discussed.

3D Power Packaging made Real with Embedded Component and Substrate Technologies

4:00 p.m. – 4:30 p.m.

Speaker:

Dr. P. Markondeya Raj

Associate Research Director, Georgia Tech – PRC

Future electronic systems require new strategies for power module integration, much beyond discrete and two-dimensional packaging that has been prevalent for decades. Packaging will add dramatic value in supplying power to high-performance devices and systems by addressing the barriers to better and cheaper components and their heterogeneous integration as 3D power packages. Power Sources Manufacturers Association (PSMA) is releasing its extensive industry report this year, compiling these latest industry advances with improved passive component designs, nanostructured materials and innovative process integration that benefits from such materials.

Does Power Efficiency Improve with Consolidation in the Semiconductor Industry?

4:30 p.m. – 5:00 p.m.

Speaker:

Hans Stork

Senior Vice President and Chief Technology Officer, ON Semiconductor

Recently, the semiconductor industry has been rapidly consolidating for financial, operational, pricing and market-share reasons. Having fewer and larger businesses may actually accelerate the broad acceptance and commercialization of innovative technologies like wide bandgap power devices. Although many concepts for smaller and more efficient power management have been demonstrated by research and startup companies, the realization of full-scale adoption, ranging from household adaptors to automobiles and to data center management, requires significant resources to meet demands for global supply and quality. Large enterprises have the manufacturing and supply chain infrastructure, as well as the depth in R&D knowledge. This talk will provide an overview of the progress, in cost andperformance, of both silicon and wide bandgap materials, devices, circuits and applications, highlighting both technical and commercial challenges.

Rap Sessions

as of 2.15.18

Tuesday, March 6

5:00 p.m. – 6:30 p.m.

R01: Biggest Impact on Power Conversion-Devices or Magnetics?

HEMISFAIR BALLROOM C1

MODERATOR:

Kevin Parmenter, *Excelsys: Ray Ridley, Ridley Engineering*

SPEAKERS:

- Ray Ridley, *Ridley Engineering*
- Jim Marinos, *Payton America*
- Dan Kinzer, *Navitas*
- Manfred Schlenk, *Infineon*
- Ira Pitel, *Magna-Power Electronics*
- Dan Jitaru, *RomPower*

New power electronics architectures and converter designs are usually proposed in order to reduce the cost, weight, and volume of the power electronic converters while adding more functionalities and improving efficiency. With the recent advancements in wide bandgap power electronic semiconductor device technologies, it is possible to operate at higher switching frequencies, lower switching losses, higher voltages, and at higher temperatures than the conventional silicon semiconductor devices. However, it is obvious that wide bandgap semiconductor technology has more room for improvement in terms of cost, reliability and robustness, and the current rating for better power converters. On the other hand, magnetics technologies experienced some improvements with the advancements in materials technology, new geometric designs with the high performance computing, and even 3-D printing technologies for the magnetic composites for more effective shapes and geometries. This rap session will discuss the impact of magnetics and devices in power electronics inventions and future opportunities, possibilities, challenges, and limitations that our industry may experience. This session will provide an insight if we need to advance device technologies or if we need to invest more on the magnetic structures in order to achieve the ideal power converter. Come and participate in the debate with industry experts as to which makes the most difference in power converter efficiency; the semiconductor devices or the magnetics materials and design.

R02: Gate Drive Isolation Technologies: Optical, Ganetic, or Capacitive Coupling?

HEMISFAIR BALLROOM C2

MODERATOR:

Aung Tu, *Industrial Gate Drivers, Infineon*

SPEAKERS:

- Baoxing Chen, *Analog Devices*
- Laszlo Balogh, *ON Semiconductor*
- Tom Bonifield, *Texas Instruments*
- Wolfgan Frean, *Infineon Technology*
- Keith Coffey, *Silicon Labs*

Today's isolated gate drive ICs switches discrete IGBTs, power MOSFETs and high-voltage power modules for many applications such as industrial drives, solar inverters, UPS, and EV chargers. Performance expectations from include delay matching, high reliability, strong robustness, and design flexibility. An isolated gate drive should isolate the gate signals with high robustness regardless of the common-mode noise, it should provide stable operation under high dV/dt noises, and it should have tight propagation delay matching that does not vary with the age, temperature, and operating conditions. An ideal gate driver should also provide some design flexibility with the ability of operating at wide range of gate voltages for different devices including the negative gate voltage while being capable of operating at relatively higher switching frequencies for new SiC and GaN power devices. It should also include protection features such as desaturation detection or short-circuit protection. It should utilize precise integrated filters for reduced propagation delay with minimal variation over a broad range of operating points for minimal dead time. This rap session will discuss the advantages, drawbacks, performance, integration flexibility, cost, and design complexity of different gate drive isolation technologies. Which is the best approach: magnetic, capacitive or optical isolation? Come debate it with the industry experts in the field.

R03: GaN vs. SiC vs SI for Next Generation Power Devices

HEMISFAIR BALLROOM C3

MODERATOR:

Indumini Ranmuthu, *Texas Instruments*

SPEAKERS:

- John Palmour, *Wolfspeed (CREE)*
- Paul Bohlin, *Texas Instruments*
- Gerald DeoBoy, *Infineon*
- Chingchi Chen, *Ford Research Labs*
- Alex Huang, *University of Texas at Austin*

Consumer, industrial, and automotive applications require lighter weight, smaller size, and more efficient power electronic converters with higher temperature operation capability and reduced requirements for thermal management systems. After staying at research level applications for many years, wide bandgap power electronic devices such as silicon carbide (SiC) and gallium nitride (GaN) are taking more roles in the commercial power electronic converters thanks to their fast turn-on and turn-off times, ultra-fast recovery times, higher efficiency, and higher temperature operation capabilities. Also there are efforts made by the by the manufacturers and early industry users to address reliability, cost, and maturity issues. On the other hand, conventional silicon-based devices never stay where they are and their performances, operating limits, and high temperature capabilities continuously improve while they are still dominating the larger portion of the market. Given this is GaN and SiC better than silicon or will silicon continue to dominate? Where, when and under what conditions GaN and SiC will dominate? What issues need to be resolved for them to dominate? What is the state of the art, requirements, and issues of next generation power devices? Come discuss debate and get your questions answered from a panel of experts on GaN, SiC and Silicon power devices.

Notes

Dialogue Session

as of 2.15.18

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 8

11:30 a.m. – 2:00 p.m.

HEMISFAIR BALLROOM

D01: AC-DC Converters

AC-DC Converters

CHAIRS:

Davide Giacomini, *Infineon Technologies*

John Lam, *York University*

D01.1 : Wideband Small-Signal Input dq Admittance Modeling of Six-Pulse Diode Rectifiers
Chushan Li[3], Jintao Lei[3], Qingxin Guan[1], Yu Zhang[1], Shuai Wang[2], David Xu[2]
[1]Huazhong University of Science and Technology, China; [2]Ryerson University, Canada; [3]Zhejiang University, China

D01.2: Implementation and Performance Evaluation of 100- kHz, Soft-Switched Bidirectional PFC/Inverter with Silicon MOSFETs
Brian Irving, Yungtaek Jang, Milan Jovanović
Delta Products Corp, United States

D01.3: Duty Compensated Reduced Harmonic Control for a Single-Phase H-Bridge PFC Converter
Arun Sankar, Ayan Mallik, Alireza Khaligh
UNIVERSITY OF MARYLAND, United States

D01.4: A Mathematical Guideline for Designing an AC-DC LLC Converter with PFC
Yajie Qiu[1], Wenbo Liu[2], Peng Fang[2], Yan-Fei Liu[2], Paresh C. Sen[2]
[1]GaN Systems, Canada; [2]Queen's University at Kingston, Canada

D01.5: Optimum Harmonics Injection to Minimize Bus Capacitance of CRM Boost PFC Conveters Meeting EN61000-3-2 Class D Limits
Zhehui Guo, Xiaoyong Ren, Yu Wu, Lei Bai, Zhiliang Zhang, Qianhong Chen
Nanjing University of Aeronautics and Astronautics, China

D01.6: Three-Phase Single-Stage Three-Level AC/DC Converter with a Wide Output Voltage Control Range
Eunsoo Kim, Yechang Heo, Takongmo Marius, Jicheol Lee
Jeonju University, Korea

D01.7: Performance Evaluation of a Single-Phase Three-Port Boost-Rectifier-Based PFC Converter with Stacked/Sigma Configuration for Higher Voltage Step-Up Application
Hongfei Wu, Meng Han, Yihang Jia, Yan Xing
Nanjing University of Aeronautics and Astronautics, China

D01.8: A High Frequency Power Factor Correction Converter with Soft Switching
Alex Hanson, David Perreault
Massachusetts Institute of Technology (MIT), United States

D01.9: A Single-Phase Single-Stage AC-DC Stacked Flyback Converter with Active Clamp ZVS
Yuntong Li, Gerry Moschopoulos
University of Western Ontario, Canada

D01.10: A Simple ZVT Auxiliary Circuit for Full-Bridge Based Bridgeless Single-Phase PFC with Hybrid PWM Modulation Scheme
Ziwei Yu, Yinglai Xia, Raja Ayyanar
Arizona State University, United States

D01.11: Optimized Hybrid PWM Scheme for Mitigating Zero-Crossing Distortion in Totem-Pole Bridgeless PFC
Wing To Fan, Shun Cheung Yeung, Shu Hung Chung
City University of Hong Kong, Hong Kong

D01.12: Primary-Side Feedback Control IC Design for Flyback Converter with Energy Saving Burst Mode
Chun-Yu Huang[1], Tsorng-Juu Liang[2], Kai-Hui Chen[1], Cheng-Yuan Li[1]
[1]National Cheng Kung Univeristy, Taiwan; [2]National Cheng Kung University, Taiwan

D01.13: Single Phase Universal Input PFC Converter Operating at HF
Juan Santiago-Gonzalez[2], David Otten[2], Seungbum Lim[2], Khurram Afridi[1], David Perreault[2]
[1]CU Boulder, United States; [2]MIT, United States

D01.14: Line Power Extension Method for Capacitor Reduction for AC-DC Application
Yang Chen[2], Hongliang Wang[2], Yan-Fei Liu[2], Sucheng Liu[1]
[1]Anhui University of Technology, China; [2]Queen's University, Canada

D01.15: Improved Analysis, Design and Control for Interleaved Dual-Phase ZVS GaN-Based Totem-Pole PFC Rectifier with Coupled Inductor
Qingyun Huang[2], Qingxuan Ma[2], Ruiyang Yu[2], Tianxiang Chen[2], Alex Huang[2], Zhuoran Liu[1]
[1]University of Chinese Academy of Sciences, China; [2]University of Texas at Austin, United States

D01.16: **Third Harmonic Compensation in Bridgeless Current Sensorless PFC**
Felipe Lopez[1], Francisco Javier Azcondo[1], Luca Corradini[2], Paula Lamo[1], Alberto Pigazo[1]
[1]University of Cantabria, Spain; [2]University of Padova, Italy

D02: Miscellaneous Topics in DC-DC Converters I

DC-DC Converters

Chenhao Nan, *Google*

Robert Pilawa, *UC Berkeley*

D02.1: **A Digital Detecting Method for Synchronous Rectification Based on Dual-Verification for LLC Resonant Converter**
Qinsong Qian[1], Shen Xu[1], Juzheng Yu[1], Weifeng Sun[1], Haisong Li[2]
[1]National ASIC System Engineering Research Center, Southeast University, China; [2]Wuxi Chipown Micro-electronics limited, China

D02.2: **Flyback Converter with Hybrid Clamp**
Laszlo Huber[3], Milan JovanoviÄ‡[3], Haibin Song[2], Daofei Xu[2], Alpha Zhang[2], Chien-Chung Chang[1]
[1]Delta Electronics Inc., Taiwan; [2]Delta Electronics Shanghai, China; [3]Delta Products Corp., United States

D02.3: **Integrated Switched-Capacitor-Based Cold-Start Circuit for DC-DC Energy Harvesters with Wide Input/Output Voltage Range and Low Inductance in 40-nm CMOS**
David King Li[2], Mojtaba Ashourloo[2], Matthias Rose[1], Henkjan Bergveld[1], Olivier Trescases[2]
[1]NXP semiconductors, Netherlands; [2]University of Toronto, Canada

D02.4: **Integrated Magnetics Design for a Full-Bridge Phase-Shifted Converter**
Yu-Chen Liu[1], Chen Chen[2], Shu-Yi Lin[2], Cheng-You Xiao[2], Katherine Kim[3], Yao-Ching Hsieh[2], Huang-Jen Chiu[2]
[1]National Ilan University, Taiwan; [2]National Taiwan University of Science and Technology, Taiwan; [3]Ulsan National Institute of Science and Technology, Korea

D02.5: **LLC Resonant Converter with Wide Output Voltage Control Characteristics According to Operating Mode Transition**
Eunsoo Kim[2], Jicheol Lee[2], Yechang Heo[1], Takongmo Marius[2], Jongseong Ju[2], Yoonsang Kook[3]
[1]Jeonju Uinversity, Korea; [2]Jeonju University, Korea; [3]PACTECH Co., LTD, Korea

D02.6: **LLC Resonant Converter with Wide Output Voltage Control Ranges Operating at a Constant Switching Frequency**
Eunsoo Kim[2], Jicheol Lee[2], Yechang Heo[1], Takongmo Marius[2]
[1]Jeonju Uinversity, Korea; [2]Jeonju University, Korea

D02.7: **An Improved Analysis Method of Loss for the LCLC Multi-Resonant Three-Port Bidirectional DC-DC Converter**
Bo Chen, Yifeng Wang, Ping Wang, Wei Li, Fuqiang Han, Liang Yang
TianJin University, China

D02.8: **A Study of Multilevel Resonant DC-DC Converters for Conventional DC Voltage Bus Applications**
Javad Khodabakhsh, Gerry Moschopoulos
Western University, Canada

D02.9: **Light-Load Efficiency Improvement for LLC Converter with Synchronous Rectification in Solid-State Transformer Application**
Chih-Shen Yeh[2], Lanhua Zhang[1], Jung-Muk Choe[2], Cheng-Wei Chen[2], Oscar Yu[2], Jih-Sheng Lai[2]
[1]Texas Instruments, United States; [2]Virginia Tech, United States

D02.10: **Hybrid Buck Converter Optimization and Comparison for Smart Phone Integrated Battery Chargers**
Gabriel Gabian, Jordan Gamble, Benjamin Blalock, Daniel Costinett
University of Tennessee, United States

D02.11: **Design of an All-GaN Bidirectional DC-DC Converter for Medium Voltage DC Ship Power Systems Using Series-Stacked GaN Modules**
Mehdi Shojaie, Nour Elsayad, Osama Mohammed
Florida International University, United States

D02.12: **Ceramic Capacitor Controlled Resonant LLC Converters**
Ido Kolberg[2], Doron Shmilovitz[2], Shmuel Ben-Yaakov[1]
[1]Ben Gurion University, Israel; [2]Tel-Aviv University, Israel

D02.13: **Comparative Analysis of Two Compact and Highly Efficient Resonant Switched Capacitor Converters**
Miroslav Vasić[2], Diego Serrano[2], Jesús A. Angel Oliver[2], Pedro Alou[2], Petar Grbović[1], José A. Antonio Cobos[2]
[1]Huawei Smart Energy Innovation Center, Spain; [2]Universidad Politecnica de Madrid, Spain

D02.14: **Zero Inductor Voltage Multilevel Bus Converter**
Samuel Webb, Tianshu Liu, Yan-Fei Liu
Queen's University, Canada

D02.15: **A General Multi-Phase Coupled-Resonant-Tank Resonant Converter**
Hongliang Wang, Yang Chen, Yan-Fei Liu, P.C Sen
Queen's University, Canada

D02.16: **System Optimization of a High Power Density Non-Isolated Intermediate Bus Converter for 48 V Server Applications**
David Reusch, Suvankar Biswas, Yuanzhe Zhang
Efficient Power Conversion (EPC), United States

D02.17: **A Current-Fed DC-DC Converter Using Two Transformers with Reducing Current Ripple and Wide Input Range**
Deshang Sha, Ke Liu, Xiao Wang
Beijing Institute of Technology, China

Dialogue Sessions

D03: Miscellaneous Topics in DC-DC Converters II

DC-DC Converters

Abhijit Pathak, *Infineon*

D03.1: Duty Phase Shift Technique for Extended-Duty-Ratio Boost Converter for Reducing Device Voltage Stress Over Wider Operating Range
Jinia Roy, Raja Ayyanar
Arizona State University, United States

D03.2: Modeling and Dynamics Investigation of an Active-Clamp Buck Converter
Ziwei Yu[1], Chenhao Nan[2], Raja Ayyanar[1]
[1]Arizona State University, United States; [2]Google, United States

D03.3: Real-Time Adaptive Timing Control of Synchronous Rectifiers in High Frequency GaN LLC Converter
Zhuoran Liu[1], Ruiyang Yu[2], Tianxiang Chen[2], Qingyun Huang[2], Alex Q. Huang[2]
[1]Institute of Electrical Engineering, Chinese Academy of Sciences, China; [2]The University of Texas at Austin, United States

D03.4: A Multi-Channel LED Driver with Selective Dimming
Ye Cikai[2], Pritam Das[1], Sahoo Sanjib Kumar[2], Majid Pahlevaninezhad[3]
[1]ECE, Binghamton University, United States; [2]National University of Singapore, Singapore; [3]University of Calgary, Canada

D03.5: An Improved Analysis of dv/dt-Induced Low-Side MOSFET False Turn on in Synchronous Buck Converters
Ruqi Li[1], Joyce Zhu[1], Manjing Xie[2]
[1]Cisco, Inc., United States; [2]Texas Instruments, Inc., United States

D03.6: 60 V-to-35 kV Input-Parallel Output-Series DC-DC Converter Using Multi-Level Class-DE Rectifiers
Sanghyeon Park, Lei Gu, Juan Rivas-Davila
Stanford University, United States

D03.7: Modelling the Performance of a SiC-Based Synchronous Boost Converter Using Different Conduction Modes
Maria Rodriguez Rogina, Alberto Rodriguez, Aitor Vazquez, Diego G. Lamar, Marta M. Hernando
University of Oviedo, Spain

D03.8: A Helical Air-Core Transformer with Even Current Distribution for VHF Converters
Jiahua Xu[2], Zhiliang Zhang[2], Xinlu Chen[1], Ke Xu[2], Zhou Dong[2], Xiaoyong Ren[2]
[1]Beijing Century Goldray Semiconductor Co., Ltd., China; [2]Nanjing University of Aeronautics and Astronautics, China

D03.9: Air-Core Transformer Integration for GaN VHF Converters
Ke Xu[2], Zhiliang Zhang[2], Zhi-Wei Xu[2], Jiahua Xu[2], Xiaoyong Ren[2], Qianhong Chen[2], Fengbing Yu[1]
[1]Mornsun Company, China; [2]Nanjing University of Aeronautics and Astronautics, China

D03.10: Discrete-Time Framework for Digital Control Design in a High-Frequency Dual Active Bridge Converter
Avishek Pal[2], Santanu Kapat[2], Kapil Jha[1], Arvind Tiwari[1]
[1]GE Global Research, India; [2]IIT Kharagpur, India

D03.11: A Self-Bias Supply Scheme for the Control Circuit in Power Converter
Lijuan Shen[2], Junjun Zhang[1], Junming Zhang[2], Shuai Shao[2]
[1]Fudan University,State Key Laboratory of Operation and Control of Renewable Energy & Storage, China; [2]Zhejiang University, China

D03.12: Analysis, Design and Control of a Resonant Forward-Flyback Converter
Chao Quan[1], Yuchuan Geng[2], Qianhong Chen[2], Ming Xu[1], Julu Sun[1]
[1]FSP-Powerland, China; [2]Nanjing University of Aeronautics & Astronautics, China

D03.13: A Sliding Mode Duty-Ratio Control with Current Balancing Algorithm for Interleaved Buck Converters
Mohammad Hazzaz Mahmud[2], Yue Zhao[2], Yuzhi Zhang[1]
[1]ABB US Corporate Research Center, United States; [2]University of Arkansas, United States

D03.14: Optimal Design of Multi-Winding Planar Transformers in 1 MHz GaN Multiple-Output Forward Converters
Dongdong Hu[2], Dongdong Ye[1], Zhiliang Zhang[2], Binghui He[2], Xiaoyong Ren[2]
[1]Beijing Institute of Control Engineering, China; [2]Nanjing University of Aeronautics and Astronautics, China

D03.15: A SiC-Based Isolated DC/DC Converter for High Density Data Center Applications
Ali Shahabi[3], Andrew N Lemmon[3], Ryan C Graves[3], Sujit Banerjee[2], Levi Gant[2], Luke L. Jenkins[1]
[1]IBM, United States; [2]Monolith Semiconductor, Inc., United States; [3]The University of Alabama, United States

D03.16: Novel High-Gain Hybrid Current-Driven DC-DC Converter Topology
Snehal Bagawade[1], Majid Pahlevani[3], Ryan Fernandes[2], Praveen Jain[1]
[1]Queens University, Canada; [2]Sparq Systems Inc., Canada; [3]University of Calgary, Canada

D03.17: Half-Bridge Controller with Optimized Pre-Biased Start-Up
Wangxin Huang[2], Tobin Hagan[2], Maxim Franke[2], Brent McDonald[2], Oscar Persson[1]
[1]Flex Power, Sweden; [2]Texas Instruments, United States

Dialogue Sessions

D04: Power Electronics for Utility Interface I

Power Electronics for Utility Interface

Majid Pahlevani, *University of Calgary*

Ali Khajehoddin, *University of Alberta*

D04.1: Harmonic Filter Topologies for Low DC Bus Capacitance of 6-Pulse Rectifier Front End Adjustable Speed Drives
Tin Luu, Todd Shudarek
MTE Corporation, United States

D04.2: A Study of Power Electronic Based Stall and Electromechanical Yaw Power Control Strategies in Small-Scale Grid-Connected Wind Turbines
Ebrahim Mohammadi[1], Roohollah Fadaeinedjad[1], Gerry Moschopoulos[2]
[1]Graduate University of Advanced Technology, Iran; [2]University of Western Ontario, Canada

D04.3: Finite States Model Predictive Direct Power Control for Phase Leg Faults Tolerant Operation of Bidirectional AC/DC Converter
Nan Jin, Leilei Guo, Chongyan Zhao, Zhifeng Dou, Guangzhao Cui
Zhengzhou University of Light Industry, China

D04.4: A PS-SWM Strategy for Isolated Modular Multilevel DC/DC Converter with Reduced Passive Component Size and Low Total Device Rating
Ran Mo, Ren Xie, Yanjun Shi, Hui Li
Florida State University, United States

D04.5: Atypical PWM for Maximizing 2L-VSI DC-Bus Utilization in Inverter-Based Microgrids with Ancillary Services
Aswad Adib[1], Jacob Lamb[2], Behrooz Mirafzal[1]
[1]Kansas State University, United States; [2]Rockwell Automation, United States

D04.6: Reachability Analysis for a Grid-Connected Voltage-Sourced Converter (VSC)
Parisa M. Shabestari, Saleh Ziaeinejad, Ali Mehrizi-Sani
Washington State University, United States

D04.7: Provision of Ancillary Service in a Grid-Connected Photovoltaic Power System
Jéssica P.M. Rocha, Fabiano Salvadori, Camila Seibel Gehrke
Federal University of Paraíba – UFPB, Brazil

D04.8: Solid State Auto-Transformer Concept for Multi-Pulse Rectifiers
Harish Krishnamoorthy, Srikanth Yerra
University of Houston, United States

D04.9: Use of Series Negative Impedance to Cancel the Effect of Equivalent Grid Impedance on the Grid-Connected Inverter Stability in the DPGS
Yuanbin He[2], Chun-Tak Lai[1], Henry Shu-Hung Chung[1], Xin Zhang[3], Weimin Wu[4]
[1]City University of Hong Kong, Hong Kong; [2]Hangzhou Dianzi University, China; [3]Nanyang Technological University, Singapore; [4]Shanghai Maritime University, China

D04.10: An Accurate Power Control Scheme for Droop-Controlled Grid-Connected Inverters
Baojin Liu, Jinjun Liu, Zeng Liu, Teng Wu, Ronghui An
Xi'an Jiaotong University, China

D05: Power Electronics for Utility Interface II

Power Electronics for Utility Interface

Alireza Bakhshai, *Queen's University*

Xiong Li, *Texas Instrument*

D05.1: Scale-Up Methodology of a Modular Multilevel Converter for HVDC Applications
Mohammed Alharbi, Subhashish Bhattacharya
North Carolina State University, United States

D05.2: A SiC-Based Power Electronics Interface for Integrating a Battery Energy Storage Into the Medium (13.8 kV) Distribution System
Janviere Umuhoza, Haider Mhiesan, Kenneth Mordi, Chris Farnell, Alan Mantooth
University of Arkansas, United States

D05.3: A New Active EMI Filter with Virtual Impedance Enhancement
Zhe Zhang[2], Weiqiang Chen[2], Ali Bazzi[2], Scott Ramsay[1], Jeffrey Czapor[1], John Aslanidis[1]
[1]DRS Consolidated Controls, Inc., United States; [2]University of Connecticut, United States

D05.4: Energy Management of Microgrid in Smart Building Considering Air Temperature Impact
Mohamad Abou Houran, Xu Yang, Wenjie Chen
XI'AN JIAOTONG UNIVERSITY, China

D05.5: Single-Phase Bidirectional Three-Level T-Type Inverter
Min-Kwon Yang, Woo-Young Choi
Chonbuk National University, Korea

D05.6: A Design Investigation of a 1 MVA SiC Medium Voltage Three Phase Rectifier Based on Isolated Dual Active Bridge
Hanning Tang, Alex Huang
The University of Texas at Austin, United States

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D05.7: **A Novel Single-Stage High-Frequency Boost Inverter for PV Grid-Tie Applications**
Hamdy Radwan[3], Mahmoud A. Sayed[3], Takaharu Takeshita[3], Adel A. Elbaset[2], Gaber Shabib[1]
[1]Aswan university, Egypt; [2]Minia University, Egypt; [3]Nagoya Institute of Technolog, Japan

D05.8: **A New Six-Switch Five-Level Boost-Active Neutral Point Clamped (5L-Boost-ANPC) Inverter**
Yam Siwakoti
University of Technology Sydney, Australia

D05.9: **Modeling and Stability Analysis for Multiple Parallel Grid-Connected Inverters System**
Xiaoming Zou, Xiong Du, Guoning Wang
Chongqing University, China

D06: Controls & Diagnostics of Inverters & Drives

Motor Drives and Inverters

Ali Bazzi, *University of Connecticut*

Rakib Islam, *Nexteer Automotive*

D06.1: **Starting Current Reduction of Single-Phase Induction Motor for Ultra-Low Temperature Freezer**
Seon-Hwan Hwang[1], Jang-Mok Kim[2]
[1]Kyungnam University, Korea; [2]Pusan National University, Korea

D06.2: **A Novel Initial Rotor Position Estimation Method for Wound-Rotor Synchronous Starter/Generator**
Rui Wang, Weiguo Liu, Yujie Zhu, Jichang Peng, Tao Meng
Northwestern Polytechnical University, China

D06.3: **Two-Phase X-Type Current Source Rectifier with Reduced Active Switch Count for Open-End Permanent-Magnet Synchronous Generator**
Louelson Costa[2], Montiê A. Vitorino[2], Maurício B.R. Corrêa[2], Filipe A. C. Bahia[2], Frede Blaabjerg[1]
[1]Aalborg University, Denmark; [2]Federal University of Campina Grande, Brazil

D06.4: **Online Stator End Winding Thermography Using Infrared Sensor Array**
Padmanabhan Sampath Kumar[1], Lihua Xie[1], Mohamed Sathik Mohamed Halick[1], Viswanathan Vaiyapuri[2]
[1]Nanyang Technological University, Singapore; [2]Rolls-Royce Singapore Pte., Ltd, Singapore

D06.5: **Direct Torque Model Predictive Control of a Poly-Phase Permanent Magnet Synchronous Motor with Current Harmonic Suppression and Loss Reduction**
Benjamin Cao[3], Brandon Grainger[3], Xin Wang[2], Yu Zou[1], Zhi-Hong Mao[3]
[1]Saginaw Valley State University, United States; [2]Southern Illinois University Edwardsville, United States; [3]University of Pittsburgh, United States

D06.6: **Generalized Tri-State PWM Method Based High Frequency SiC Three-Phase Inverter**
Junzhong Xu, Yong Wang, Erlong Zhu, Khurram Hashmi, Xiaoyu Zha, Jingwen Han, Houjun Tang
Shanghai Jiao Tong University, China

D06.7: **A Simple Zero-Sequence Voltage Injection Method to Balance the Neutral-Point Potential for Three-Level NPC Inverters**
Xingda Zhou, Shuai Lu
Chongqing University, China

D06.8: **An Improved Drive Signal Exchange Strategy for Cascaded H-Bridge Topology**
Hanyang Yu[1], Jian Liu[1], Wenxi Yao[1], Zhengyu Lu[1], Yu Ji[2]
[1]College of Electrical Engineering, Zhejiang University, China; [2]State Grid Nantong Power Supply Company, China

D06.9: **Online Fault Detection of Stator Winding Faults in IM Driven by DTC Using the Off-Diagonal Term of the Symmetrical Component Impedance Matrix**
Alberto Berzoy, Hassan Eldeeb, Osama Mohammed
Florida International University, United States

D06.10: **Pulse-Width Modulation Scheme for a ZVS Single-Phase Inverter in Rectifier Operation**
Yenan Chen, Dehong Xu
Zhejiang University, China

D06.11: **An Improved High-Frequency Common-Mode Voltage Injection Method in Modular Multilevel Converter in Motor Drive Application**
Shuguang Song, Jinjun Liu, Shaodi Ouyang, Xingxing Chen
Xi'an Jiaotong University, China

D06.12: **A Power Decoupling Control Method for the Regenerative Cascaded-H-Bridge-Based Motor Drive**
Zezhou Yang[3], Jinwu Gong[3], Jianjun Sun[3], Yi Tang[2], Cheng Cheng[3], Xiaoming Zha[3], Jinmao Gu[1]
[1]Beijing Xinhang Electrical and Mechanical Equipment Co.,ltd, China; [2]Nanyang technological University, Singapore; [3]Wuhan University, China

D06.13: **Voltage Based 2/3/4-Step Commutation for Direct Three-Level Matrix Converter**
Martin Leubner, Nico Remus, Stephan Schwarz, Wilfried Hofmann
Technical University of Dresden, Germany

D06.14: **Common-Mode Noise Reduction with Impedance Balancing in DC-Fed Motor Drives**
Ruirui Chen, Zheyu Zhang, Ren Ren, Jiahao Niu, Handong Gui, Fred Wang, Leon Tolbert, Daniel Costinett, Benjamin Blalock
The University of Tennessee, United States

D06.15: **Constant Duty Cycle Sinusoidal Output Inverter with Sine Amplitude Modulated High Frequency Link**
Gustavo Carlos Knabben, Dominik Neumayr, Johann Walter Kolar
PES / ETH Zurich, Switzerland

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D06.16: **An Enhanced PWM Method for Loss Balancing of Five Level T-Type Inverter in PV Systems**
Mokhtar Aly[1], Emad M. Ahmed[1], Mohamed Orabi[1], Masahito Shoyama[2]
[1]Aswan University, Egypt; [2]Kyushu University, Japan

D06.17: **Optimized Short-Through Time Distribution for Inductor Current Ripple Reduction in Z-Source Inverter**
Ryuji Iijima, Takanori Isobe, Hiroshi Tadano
University of Tsukuba, Japan

D06.18: **Carrier-Based PWM Design of Multilevel ANPC-Based Converter Through Hierarchical Decomposition**
Yuzhuo Li, Yunwei Li, Hao Tian
University of Alberta, Canada

D07: Inverter Topologies

Motor Drives and Inverters

Ali Khajehoddin, *University of Alberta*

Mahshid Amirabadi, *Northeastern University*

D07.1: **New Topology for a Single-Phase Buck-Boost Inverter**
Andreas Mattos Pratto Correa, Telles Brunelli Lazzarin, Ivo Barbi
Federal University of Santa Catarina (UFSC), Brazil

D07.2: **Analysis and Design of an Energy Regenerative Snubber for Magnetically Coupled Impedance Source Converters**
Mojtaba Forouzesh[1], Ahmed Abdelhakim[2], Yam Siwakoti[3], Frede Blaabjerg[1]
[1]Aalborg University, Denmark; [2]University of Padova, Italy; [3]University of Technology Sydney, Australia

D07.3: **A Novel Forward-Mode Five-Level Inverter with High Frequency Link**
Kunshan Gong, Lei Li
Nanjing University of Science and Technology, China

D07.4: **An EMI-Less Full-Bridge Inverter for High Speed SiC Switching Devices**
Jun Sakata[1], Masao Taguchi[1], Shoichi Sasaki[1], Tadahiro Kuroda[1], Keiji Toda[2]
[1]Keio University, Japan; [2]Toyota Motor Corporation, Japan

D07.5: **Research on a Multi-Port Converter with Nine-Switch Cells**
Pan Wang[2], Xiaoming Zha[1], Fei Liu[1], Chao Chen[1], Tianyi Yu[1], Yizhan Zhuang[1], Jinwu Gong[1]
[1]Wuhan University, China; [2]Wuhan University / Wuhan Electric Power Technical College, China

D07.6: **Common-Mode Inductor Saturation Analysis and Design Optimization Based on Spectrum Concept**
Ruirui Chen, Zheyu Zhang, Ren Ren, Jiahao Niu, Handong Gui, Fred Wang, Leon Tolbert, Daniel Costinett, Benjamin Blalock
The University of Tennessee, United States

D07.7: **Investigation and Evaluation of High Power SiC MOSFETs Switching Performance and Overshoot Voltage**
Peizhong Yi, Yujia Cui, Anthony Vang, Lixiang Wei
Rockwell Automation, United States

D07.8: **Open-End Multilevel Six-Phase Machine Drive System with Three Three-Leg NPC Converters**
Ivan Da Silva[1], Cursino Jacobina[1], Ayslan Maia[1], Isaac Freitas[2], Reuben Sousa[1]
[1]Federal University of Campina Grande, Brazil; [2]Federal University of Paraiba, Brazil

D07.9: **Comparative Investigation of PWM Current-Source Inverters for Future Machine Drives Using High-Frequency Wide-Bandgap Power Switches**
Hang Dai, Thomas Jahns
WEMPEC, University of Wisconsin-Madison, United States

D07.10: **A Three-Level, T-Type, Power Electronics Building Lock Using Si-SiC Hybrid Switch for High-Speed Drives**
Amol Deshpande[2], Yingzhuo Chen[1], Balaji Narayanasamy[2], Arvind S Sathyanarayanan[1], Fang Luo[2]
[1]The Ohio State University, United States; [2]University of Arkansas, United States

D07.11: **One-Inductor Single-Stage Differential Boost Inverter Operated in Discontinuous Current Mode for Single-Phase Grid-Tied Photovoltaic System**
Ayato Sagehashi, Le Hoai Nam, Jun-Ichi Itoh
Nagaoka University of Technorogy, Japan

D07.12: **Comparative Performance Evaluation of Common Mode Voltage Reduction Three-Phase Inverter Topologies**
Di Han, Woongkul Lee, Silong Li, Bulent Sarlioglu
University of Wisconsin-Madison, United States

D07.13: **Dynamic Control Set-Model Predictive Control for Field-Oriented Control of VSI-PMSM**
Shuai Wang[1], Dewei Xu[1], Chushan Li[2]
[1]Ryerson University, Canada; [2]Zhejiang University, Canada

D07.14: **Fault-Tolerant Operation with 1-Phase Open in Parallel-Connected Motor**
Sunku Kwon, Jung-Ik Ha
Seoul National University, Korea

D07.15: **Duo-Active-Neutral-Point-Clamped Multilevel Converter: an Exploration of the Fundamental Topology and Experimental Verification**
Vahid Dargahi[2], Keith Corzine[5], Johan Enslin[2], Mostafa Abarzadeh[3], Arash Khoshkbar Sadigh[4], Jose Rodriguez[6], Frede Blaabjerg[1]
[1]Aalborg University, Denmark; [2]Clemson University, United States; [3]École de Technologie Supérieure, University of Quebec, Canada; [4]Extron Electronics, United States; [5]UC Santa Cruz, United States; [6]Universidad Andres Bello, Chile

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D08: Magnetics and Capacitors

Devices and Components

Edward Herbert, *PSMA*

Stephan Carlsen, *Raytheon Co*

D08.1: **Integrated Inductors, Capacitors, and Damping in Bus Bars for dv/dt Filter Applications**
Andy Schroedermeier, Daniel Ludois
University of Wisconsin-Madison, United States

D08.2: **Thermal Model of Litz Wire Toroidal Inductor Based on Experimental Measurements**
Mylene Delhommais[1], Jean-Luc Schanen[1], Frédéric Wurtz[1], Cécile Rigaud[3], Sylvain Chardon[3], Stephane Vighetti[2]
[1]Grenoble Institute of Technology, France; [2] SIREPE, France; [3]TRONICO-ALCEN, France

D08.3: **Comparison Between Desaturation Sensing and Rogowski Coil Current Sensing for Shortcircuit Protection of 1.2 kV, 300 a SiC MOSFET Module**
Slavko Mocevic[2], Jun Wang[2], Rolando Burgos[2], Dushan Boroyevich[2], Constantin Stancu[1], Marko Jaksic[1], Brian Peaslee[1]
[1]General Motors, United States; [2]Virginia Tech/CPES, United States

D08.4: **High Power Density PCB Coil Array Applied to Domestic Induction Heating Appliances**
Javier Serrano[2], Jesus Acero[2], Ignacio Lope[1], Claudio Carretero[2], JosÃ© Miguel BurdÃo[2]
[1]BSH Home Appliances Group, Spain; [2]University of Zaragoza, Spain

D08.5: **High Frequency LLC Resonant Converter with Magnetic Shunt Integrated Planar Transformer**
Mingxiao Li, Ziwei Ouyang, Michael Andersen
Technical University of Denmark (DTU), Denmark

D08.6: **Impact of Charge Redistribution on Delivered Energy of Supercapacitors with Constant Power Loads**
Hengzhao Yang
California State University, Long Beach, United States

D08.7: **Test Fixture to Apply DC Bias and AC Ripple Current for Reliability Testing of Electrolytic Capacitors**
Xuechao Wang, Marzieh Karami, Rangarajan Tallam
Rockwell Automation, United States

D08.8: **Thermal Management of Compact Nanocrystalline Inductors for Power Dense Converters**
Yiren Wang, Gerardo Calderon-Lopez, Andrew Forsyth
The University of Manchester, United Kingdom

D09: Power Devices

Devices and Components

Hui Li, *Florida State University*

Rostan Rodrigues, *ABB*

D09.1: **Comparative Evaluation of Static and Dynamic Performance of 1.2-kV SiC Power Switches**
Yang Jiao, Milan Jovanović
Delta Products Corporation, United States

D09.2: **Dynamic Performance of 4H-SiC Power MOSFETs and Si IGBTs Over Wide Temperature Range**
Jinwei Qi, Kai Tian, Zhangsong Mao, Song Yang, Wenjie Song, Mingchao Yang, Xuhui Wang, Anping Zhang
Xi'an Jiaotong University, China

D09.3: **Developing a Standardized Method for Measuring and Quantifying Dynamic on-State Resistance via a Survey of Low Voltage GaN HEMTs**
Thomas Foulkes, Tomas Modeer, Robert Pilawa-Podgurski
University of Illinois at Urbana-Champaign, United States

D09.4: **Development of Isolated SenseGaN Current Monitoring for Boundary Conduction Mode Control of Power Converters**
Mehrdad Biglarbegian, Namwon Kim, Tiefu Zhao, Babak Parkhideh
University of North Carolina at Charlotte, United States

D09.5: **Voltage Rating and Performances Enhancement Technology for Market Available Diodes**
Han Peng[1], Kunqi Li[2], Xiaoyong Ren[2], Ming Xu[1]
[1]FSP-Powerland Technology Inc., China; [2]Nanjing University of Aeronautics and Astronautics, China

D09.6: **Single Shot Avalanche Energy Characterization of 10kV, 10A 4H-SiC MOSFETs**
Ashish Kumar, Sanket Parashar, Jayant Baliga, Subhashish Bhattacharya
North Carolina State University, United States

D09.7: **Investigations on Circuits and Layout for Non-Intrusive Switch Current Measurements in High Frequency Converters Using Parallel GaN HEMTs**
Shahriar Jalal Nibir, Daniel Fregosi, Babak Parkhideh
University of North Carolina at Charlotte, United States

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D10: Device Reliability

Devices and Components

Dong Cao, *North Dakota State University*
Christina Dimarino, *Virginia Tech*

D10.1: **High Reliable and High Bonding Strength of Silver Sintered Joints on Copper Surfaces by Pressure Sintering Under Air Atmosphere**
Ly May Chew, Wolfgang Schmitt
Heraeus Deutschland GmbH & Co. KG, Germany

D10.2: **Power Semiconductor Ageing Test Bench Dedicated to Photovoltaic Applications**
Mouhannad Dbeiss, Yvan Avenas
Grenoble Institute of Technology, France

D10.3: **A New Gate Drive Technique for Superjunction MOSFETs to Compensate the Effects of Common Source Inductance**
Bernhard Zojer
Infineon Technologies Austria AG, Austria

D10.4: **Online Junction Temperature for Off-the-Shelf Power Converters**
Mohamed Halick Mohamed Sathik[1], Sundararajan Prasanth[1], Firman Sasongko[1], Sampath Kumar Padmanabhan[1], Josep Pou[1], Rejeki Simanjorang[2]
[1]ROLLS ROYCE-NTU CORPORATE LAB, Singapore; [2]Rolls-Royce Rolls-Royce Singapore Pte Ltd, Singapore

D10.5: **Short Circuit Characterization of 3rd Generation 10 kV SiC MOSFET**
Shiqi Ji[2], Marko Laitinen[1], Xingxuan Huang[2], Jingjing Sun[2], William Giewont[1], Leon Tolbert[2], Fred Wang[2]
[1]Danfoss Drives, United States; [2]University of Tennessee, United States

D11: Power Module Packaging, Thermal & Application

Power Electronics Integration and Manufacturing

John Vigars, *Allegro Microsystems*
Yuxiang Shi, *ABB USCRC*

D11.1: **Top Die Surface Reprocessing for Planar Package with Double Sided Cooling**
Puqi Ning[1], Lei Li[1], Xuhui Wen[1], Qiongxuan Ge[1], Yaohua Li[1], Yunhui Mei[2]
[1]Institute of Electrical Engineering Chinese Academy of Sciences, China; [2]Tianjin University, China

D11.2: **Temperature Dependency of the on-State Voltage of IGBT and its Application in Thermal Resistance Test**
Lei Li, Puqi Ning, Ye Li, Xuhui Wen, Dong Zhang, Qiongxuan Ge, Yaohua Li
Institute of Electrical Engineering, Chinese Academy of Sciences, China

D11.3: **A Dynamic Thermal Controller for Power Semiconductor Devices**
Mohamed Halick Mohamed Sathik[1], Sundararajan Prasanth[1], Firman Sasongko[1], Sampath Kumar Padmanabhan[1], Josep Pou[1], Rejeki Simanjorang[2]
[1]Nanyang Technological University, Singapore; [2]Rolls-Royce Rolls-Royce Singapore Pte Ltd, Singapore

D11.4: **Modular Heat Sink for Chip-Scale GaN Transistors in Multilevel Converters**
Nathan Pallo[2], Chirag Kharangate[1], Tomas Modeer[2], Joseph Schaadt[1], Mehdi Asheghi[1], Kenneth Goodson[1], Robert Pilawa-Podgurski[2]
[1]Stanford University, United States; [2]University of Illinois, United States

D11.5: **Analysis and Design of an Overcurrent Protection Scheme Based on Parasitic Inductance of SiC MOSFET Power Module**
Keyao Sun[1], Jun Wang[1], Rolando Burgos[1], Dushan Boroyevich[1], Yonghan Kang[2], Edward Choi[2]
[1]CPES, Virginia Tech, United States; [2]LG Electronics, United States

D11.6: **Online Junction Temperature Extraction and Aging Detection of IGBT via Miller Plateau Width**
Jingcun Liu, Guogang Zhang, Qian Chen, Lu Qi, Zheng Qin, Jianhua Wang, Yingsan Geng
Xi'an Jiaotong University, China

D11.7: **Bus Bar Embedded Rogowski Coil**
Yoshikazu Kuwabara[1], Keiji Wada[1], Jean-Michel Guichon[2], Jean-Luc Schanen[2], James Roudet[2]
[1]TokyoMetropolitanUniversity, Japan; [2]Univ. Grenoble Alpes, Grenoble Institute of Technology, France

D11.8: **Active Power Cycling and Condition Monitoring of IGBT Power Modules Using Reflectometry**
Abu Hanif, Swagat Das, Faisal Khan
University of Missouri Kansas City, United States

D11.9: **Development of a Low-Inductance SiC Trench MOSFET Power Module for High-Frequency Application**
Zhiqiang Jack Wang[1], Fei Yang[2], Steven Campbell[1], Madhu Chinthavali[1]
[1]Oak Ridge National Laboratory, United States; [2]University of Tennessee, United States

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D12: Power Devices Modeling & Simulation

Modeling and Simulation

Marco Meola, *Integrated Device Technology*

Yu Du, *ABB*

D12.1: A Scalable Drain Current Model of AlN/GaN Mis-Hemts with Embedded Source Field-Plate Structures
Hitoshi Aoki[2], Hiroyuki Sakairi[1], Naotaka Kuroda[1], Yohei Nakamura[1], K. Chikamatsu[1], Ken Nakahara[1]
[1]ROHM Co., Ltd., Japan; [2]Teikyo Heisei University, Japan

D12.2: Inverter Power Module Parasitics Modeling with Cross-Coupling Simplification for Fast Model Extraction and Switching Characteristics Simulation
Thomas Bayer
General Electric, United States

D12.3: Electro-Thermal Co-Simulation of Two Parallel-Connected SiC-MOSFETs Under Thermally-Imbalanced Conditions
Yasushige Mukunoki[1], Takeshi Horiguchi[1], Akinori Nishizawa[1], Kentaro Konno[2], Tsubasa Matsuo[2], Masaki Kuzumoto[2], Makoto Hagiwara[2], Hirofumi Akagi[2]
[1]Mitsubishi Electric Corp., Japan; [2]Tokyo Institute of Technology, Japan

D12.4: A Full Power Emulation Platform for Evaluating Power Semiconductors
Juncheng Lucas Lu[1], Yajie Qiu[2], Di Chen[2]
[1]GaN Systems Inc, Canada; [2]GaN Systems Inc., Canada

D12.5: Normalization-Based Approach to Electric Motor BVR Related Capacitances Computation
Jero Ahola[2], Annette Muetze[1], Markku Niemelä[2], Aleksei Romanenko[2]
[1]Graz University of Technology, Austria; [2]Lappeenranta University of Technology, Finland

D12.6: Circuit Simulation of a Silicon-Carbide MOSFET Considering the Effect of the Parasitic Elements on Circuit Boards by Using S-Parameters
Tatsuya Yanagi[3], Hiroyuki Sakairi[3], Hirotaka Otake[3], Naotaka Kuroda[3], Seiya Kitagawa[3], Noriyoshi Hashimoto[2], Ryo Takeda[1], Ken Nakahara[3]
[1]Keysight Technologies International Japan GK, Japan; [2]Keysight Technologies Japan GK, Japan; [3]Rohm Co., Ltd, Japan

D12.7: Ceramic Capacitors: Turning a Deficiency Into an Advantage
Sam Ben-Yaakov[1], Ilya Zeltser[2]
[1]Ben-Gurion University of the Negev, Israel; [2]Rafael Advanced Defense Systems Ltd., Israel

D12.8: Fatigue Life Prediction Model for Surface Mountable Power Electronics Fuses
Ramdev Kanapady, Tissaphern Mirfakhrai, Clarita Knoll, Zhuo Min Liu
Eaton Corporation, United States

D12.9: Finite Element Model Optimization and Thermal Network Parameter Extraction of Press-Pack IGBT
Hai Ren[1], Wei Lai[1], Zeshen Jiang[1], Shengyang Kang[1], Ran Yao[1], Li Ran[1], Hui Li[1], Rui Jin[2], Jialiang Wen[2]
[1]Chongqing University, China; [2]Global Energy Interconnection Research Institute, China

D12.10: Modeling the Gate Driver IC for GaN Transistor: a Black-Box Approach
Ruiliang Xie[2], Guangzhao Xu[2], Xu Yang[2], Gaofei Tang[1], Jin Wei[1], Mofan Tian[2], Feng Zhang[2], Wenjie Chen[2], Laili Wang[2], Kevin J Chen[1]
[1]The Hong Kong University of Science and Technology, Hong Kong; [2]Xi'an Jiaotong University, China

D13: Modeling and Simulation of Power Converters

Modeling and Simulation

Babak Parkhideh, *University of North Carolina Charlotte*

Hui Li, *Florida State University*

D13.1: A New Electronic Design Automation Tool for the Optimization of PwrSoC/PwrSiP DC-DC Converters
Ciaran Feeney, Ningning Wang
Sengled, China

D13.2: Modeling and Analysis of Coexisting Slow- and Fast-Scale Instabilities in Current-Mode PI-Controlled Hbridge Inverter
Xuanlyu Wu[1], Weilin Li[1], Ruihong Zhang[1], Xiaohua Wu[1], Xiaobin Zhang[1], Bei Wang[3], Guochun Xiao[2], Shuai Zhang[2]
[1]Northwestern Polytechnical University, China; [2]Xi'an Jiaotong University, China; [3]Xi'an XD Electric Research Institute Co., Ltd, China

D13.3: Simplified Discrete-Time Modeling and Dynamic Characteristics Analysis of Pi-Controlled Voltage Source Inverter
Xuanlyu Wu[1], Ruihong Zhang[1], Weilin Li[1], Xiaohua Wu[1], Xiaobin Zhang[1], Bei Wang[3], Guochun Xiao[2], Daoshu Yang[2]
[1]Northwestern Polytechnical University, China; [2]Xi'an Jiaotong University, China; [3]Xi'an XD Electric Research Institute Co., Ltd, China

D13.4: Sate-Space Modelling and Design of a 10MHz 180W Class E DC/DC Converter Using WBG Devices
Samer Aldhaher, Paul Mitcheson
Imperial College London, United Kingdom

D13.5: An Improved Robust Adaptive Parameter Identifier for DC-DC Converters Using H-Infinity Design
Palak Jain[1], Jason Poon[3], Li Jian[2], Costas Spanos[3], Seth R. Sanders[3], Jian-Xin Xu[1], Sanjib Kumar Panda[1]
[1]National University of Singapore, Singapore; [2]Northeast Electric Power University, China; [3]University of California, Berkeley, United States

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D13.6: Harmonics and Voltage Quality in Post-Fault Reconfigured Multi-Level Inverters
Weiqiang Chen, Ethan Hotchkiss, Ali Bazzi
UCONN, United States

D13.7: Fault-Tolerant Performance Comparisons Between External and Internal Rotor PMa-SynRMs
Sai Sudheer Reddy Bonthu, Tawhid Bin Tarek Md, Arafat Akm, Zakirul Islam Md, Seungdeog Choi
The University of Akron, United States

D13.8: Performance Analysis of Rare-Earth and Rare-Earth Free External Rotor Motors Under Eccentricity Faults
Sai Sudheer Reddy Bonthu, Tawhid Bin Tarek Md, Zakirul Islam Md, Seungdeog Choi
The University of Akron, United States

D13.9: Novel Hardware-in-the-Loop Simulation (HILS) Technology for Virtual Testing of a Power Supply
Yu Yonezawa, Hiroshi Nakao, Yoshiyasu Nakashima
Fujitsu Laboratories LTD., Japan

D13.10: Performance Analysis of Synchronization Algorithms for Grid-Connected Power Converters Under Sub and Inter-Harmonics Distortion
Jean Marcos Lobo Da Fonseca, Samuel Soares Queiroz, Siomara Lima, Welton Da Silva Lima, Rosana Guimaraes Almeida, Francisco Kleber Lima, Carlos Gustavo Branco
Federal University of Ceara, Brazil

D13.11: Design and Analysis of a New GaN-Based AC/DC Topology for Battery Charging Application
Akrem Elrajoubi, Kenny George, Simon Ang
University of Arkansas, United States

D14: Control I

Control

Martin Ordonez, *The University of British Columbia*

Fang Luo, *University of Arkansas*

D14.1: A Concurrent Design Methodology for Grid-Current Feedback Active Damping for LCL-Based Grid-Tied Voltage-Source Converter
Jiazhi Liang[1], Jiuchun Jiang[1], Olorunfemi Ojo[2], Josiah Haruna[2]
[1]Beijing Jiaotong University, China; [2]Tennessee technological University, United States

D14.2: Iterative Learning Controller for Flyback Inverter: a Hybrid Learning Scheme
Minsung Kim, Byeongcheol Han, Sungho Son, Sooa Kim, Jun-Seok Kim, Kwang-Seop Kim, Hyosin Kim
Pohang University of Science and Technology, Korea

D14.3: A Gate Drive with Active Voltage Divider Based Auxiliary Power Supply for Medium Voltage SiC Device in High Voltage Applications
Boxue Hu, Zhuo Wei, He Li, Diang Xing, Risha Na, John Brothers, Jin Wang
The Ohio State Univeristy, United States

D14.4: New Communication and Isolation Technology for Integrated Gate Driver IC Solutions Suitable for IGBT and Si/SiC MOSFETs: Gate Drive Units, Intelligent Integrated Drivers
Andrew Smith, Kevin Lenz
Power Integrations, Inc., Germany; Power Integrations, Inc., United States

D14.5: Sensorless Control of Switched Reluctance Motor Drive Using an Improved Simplified Flux Linkage Model Method
Tao Wang, Wen Ding, Yanfang Hu, Shuai Yang, Shuai Li
Xi'an Jiaotong University, China

D14.6: A Fast Selection Algorithm Based on Binary Numbers for Capacitor Voltage Balance in Modular Multilevel Converter *3*
Tao Wang, Hua Lin, Zhe Wang, Yajun Ma, Xingwei Wang
Huazhong University of Science and Technology, China

D14.7: The Improved Model Predictive Control Based on Novel Error Correction Between Reference and Predicted Current
Guiping Du, Jiajian Li, Zhifei Liu
South China University of Technology, China

D14.8: Transient Angle Stability Analysis of Grid-Connected Converters with the First-Order Active Power Loop
Heng Wu, Xiongfei Wang
Aalborg University, Denmark

D14.9: Closed Loop Analog Active Gate Driver for Fast Switching and Active Damping of SiC MOSFET
Vamshi Krishna Miryala, Kamalesh Hatua
IIT Madras, India

D14.10: Methods for Monitoring 3-D Temperature Distributions in Power Electronic Modules
Christoph van der Broeck[1], Robert Lorenz[2], Rik De Doncker[1]
[1]ISEA RWTH Aachen, Germany; [2]WEMPEC UW Madison, United States

D14.11: A Sampling Scheme for Three-Phase High Switching Frequency and Speed Converter
Bo Liu, Ren Ren, Zheyu Zhang, Fred Wang, Daniel Costinett
the University of Tennessee, United States

D14.12: Super-High Bandwidth Secondary Control of AC Microgrids
Tomislav DragiÄ eviÄ‡, Rasool Heydari, Frede Blaabjerg
Aalborg University, Denmark

Dialogue Sessions

D15: Control II

Control

Martin Ordonez, *The University of British Columbia*

D15.1: Real-Time Calculation Method for Single-Phase Multilevel Converters Based on Phase-Shifted Carrier Pulsewidth Modulation
Junpeng Ma[2], Xiongfei Wang[1], Frede Blaabjerg[1], Wensheng Song[2]
[1]Aalborg University, Denmark; [2]Southwest Jiaotong University, China

D15.2: A Hybrid Communication Topology for Modular Multilevel Converter
Hao Tu, Srdjan Lukic
North Carolina State University, United States

D15.3: Coil Misalignment Compensation Algorithm for Single-Stage Inductive Wireless Power Transfer System Using Model-Based Approach
Mina Kim, Hwa-Pyeong Park, Jee-Hoon Jung
UNIST, Korea

D15.4: Output Voltage Regulation of IPOS Modular Dual Active Bridge DC/DC Converters Using Sliding Mode Control
Sangmin Lee, Yoon-Cheul Jeung, Dong-Choon Lee
Yeungnam University, Korea

D15.5: A Novel Bidirectional Current Estimator for Digital Controlled DC-DC Converters
Rajat Channappanavar, Santanu Mishra
Indian Institute of Technology Kanpur, India

D15.6: Active Thermal Cycle Reduction of Power Modules via Gate Resistance Manipulation
Christoph van der Broeck[1], Lukas Ruppert[1], Robert Lorenz[2], Rik De Doncker[1]
[1]ISEA RWTH Aachen, Germany; [2]WEMPEC UW Madison, United States

D15.7: Single-Inductor Multi-Capacitor Buck Converter for High Peak-to-Average Power Envelope Tracking
Inder Kumar, Arnab Dey, Santanu Kapat
IIT Kharagpur, India

D15.8: Active Power Decoupling Method Based on Dual Buck Circuit with Model Predictive Control
Shunlong Xiao, Xiao Li, Haiyu Zhang, Robert Balog
Texas A&M University, United States

D15.9: Noise Mitigation and Delay Compensation in High Frequency Dual Current Programmed Mode Control
Kamal Sabi, Daniel Costinett
University of Tennessee, United States

D15.10: Peak Offsetting Based CPM Controller for Multi-Level Flying Capacitor Converters
Liangji Lu[2], Sheikh Ahsanuzzaman[2], Aleksandar Prodić[2], Giacomo Calabrese[1], Giovanni Frattini[1], Maurizio Granato[1]
[1]Texas Instruments, Germany; [1]Texas Instruments, Italy; [2]University of Toronto, Canada

D15.11: Active Gate Control for Switching Waveform Shaping Irrespective of the Circuit Stray Inductance in a Practical Full-Bridge IGBT Inverter
Tomoyuki Mannen[1], Keiji Wada[1], Hidemine Obara[3], Koutaro Miyazaki[2], Makoto Takamiya[2], Takayasu Sakurai[2]
[1]Tokyo Metropolitan University, Japan; [2]University of Tokyo, Japan; [3]Yokohama National University, Japan

D15.12: An Improved Modulation Strategy for Quasi-Z-source Rectifier with Minimum Switching Frequency and High Efficiency
Xinying Li, Yan Zhang, Jinjun Liu, Yanfei Huang, Kaicheng Ding
Xi'an Jiaotong University, China

D15.13: AC- and DC-Side Start-Up Strategies for Half-/Full-Bridge Hybrid Modular Multilevel Converter
Ang Li, Lei Lin, Chen Xu, Jiabing Hu
Huazhong University of Science and Technology, China

D16: Wireless Power Transfer

Wireless Power Transfer

Brian Zahnstecher, *PowerRox*

Sheldon Williamson, *University of Ontario Institute of Technology*

D16.1: Modeling the Dynamics of Wireless Power Transfer Using a Generalized Average Model of High-Q Resonators
Hongchang Li, Jingyang Fang, Xiaoqiang Li, Shuxin Chen, Yi Tang
Nanyang Technological University, Singapore

D16.2: Resonant Full-Bridge Synchronous Rectifier Utilizing 15V GaN Transistors for Wireless Power Transfer Applications Following Airfuel Standard Operating at 6.78MHz
Christopher Have Kiaerskou Jensen, Frederik Monrad Spliid, Jens Christian Hertel, Yasser Nour, Tiberiu-Gabriel Zsurzsan, Arnold Knott
Technical University of Denmark, Denmark

D16.3: Analysis and Design of Load Independent ZPA Operation for P/S and PS/S Tank Networks in IPT Applications
Suvendu Samanta, Akshay Rathore
Concordia University, Canada

D16.4: A Pulse Density Modulation Method for ZVS Full-Bridge Converters in Wireless Power Transfer Systems
Hongchang Li[1], Jingyang Fang[1], Shuxin Chen[1], Yi Tang[1], Kangping Wang[2]
[1]Nanyang Technological University, Singapore; [2]Xi'an Jiaotong University, China

D16.5: High Efficiency Capacitive Power Transfer Converter
Jaime Lopez-Lopez, Carlos Salto, Pablo Zumel, Cristina Fernandez, Alba Rodriguez-Lorente, Emilio OlÃas
Universidad Carlos III de Madrid, Spain

D16.6: **A High-Frequency Inverter Architecture for Providing Variable Compensation in Wireless Power Transfer Systems**
Ashish Kumar, Sreyam Sinha, Khurram Afridi
University of Colorado Boulder, United States

D16.7: **A Single-Stage 6.78 MHz Transmitter with the Improved Light Load Efficiency for Wireless Power Transfer Applications**
Ling Jiang, Daniel Costinett
University of Tenessee, United States

D16.8: **Improved Design Optimization of Efficient Matching Networks for Capacitive Wireless Power Transfer Systems**
Sreyam Sinha, Ashish Kumar, Khurram Afridi
University of Colorado Boulder, United States

D16.9: **A Novel Target Detection Algorithm for Capacitive Power Transfer Systems**
Chae-Ho Jeong, Phuong-Ha La, Sung-Jin Choi, Hee-Su Choi
University of Ulsan, Vietnam; University of Ulsan, Korea

D16.10: **Analysis and Design of an Integrated LCL-S Contactless Resonant Converter**
Wei Gao[2], Lixin Jiang[3], Qianhong Chen[2], Xiaoyong Ren[2], Zhiliang Zhang[2], Siu-Chung Wong[1]
[1]Hong Kong Polytechnic University, China; [2]Nanjing University of Aeronautics and Astronautics, China; [3]Nari Technology Co., Ltd., China

D16.11: **Saturable Inductors for Superior Reflexive Field Containment in Inductive Power Transfer Systems**
Alireza Dayerizadeh, Srdjan Lukic
North Carolina State University, United States

D16.12: **Magnetic-Field-Model Based Analysis of Two-Phase Magnetically Coupled Resonant Wireless Power Transfer System**
Tianming Mei[1], Fuxin Liu[1], Chong Jiang[1], Xuling Chen[1], Ralph M. Kennel[2]
[1]Nanjing University of Aeronautics and Astronautics, China; [2]Technical University of Munich, Germany

D17: Wind And Solar Power

Renewable Energy Systems

Jason Pries, *Oak Ridge National Laboratory*

Sara Ahmed, *University of Texas at San Antonio*

D17.1: **A 5-Level High Efficiency Low Cost Hybrid Neutral Point Clamped Transformerless Inverter for Grid Connected Photovoltaic Application**
Abhijit Kadam, Anshuman Shukla
Indian Institute of Technology Bombay, India

D17.2: **A Hybrid CHB Multilevel Inverter with Supercapacitor Energy Storage for Grid-Connected Photovoltaic Systems**
Lan Xiong[1], Yuan Gui[1], Huimei Liu[1], Wen Yang[1], Jinwu Gong[2]
[1]Hubei University of Technology, China; [2]Wuhan University, China

D17.3: **A New Dynamic PV Firming Control Algorithm Using Grid-Tied Three-Port Micro-Converter**
Mahmood Alharbi, Anirudh Pise, Hu Haibing, Issa Batarseh
University of Central Florida, United States

D17.4: **A Method for FRT Capacity Enhancement of DFIG Based Wind Farm Using Saturated Core Fault Current Limiter**
Jiaxin Yuan, Zehua Huang, Pengcheng Gan, Feiran Xiao, Xin Yan
Wuhan University, China

D17.5: **Single-Phase Dual-Mode Four-Switch Buck-Boost Transformerless PV Inverter with Inherent Leakage Current Elimination**
Qingyun Huang, Qingxuan Ma, Alex Huang
University of Texas at Austin, United States

D17.6: **Sensitivity Analysis of the Wind Farm High Frequency Resonance Under Transmission Cable Resistance Variation**
Yipeng Song, Esmaeil Ebrahimzadeh, Frede Blaabjerg
Aalborg University, Denmark

D17.7: **A Synergistic Modulation Method for Hybrid Cascaded Photovoltaic Inverter with Supercapacitor**
Lan Xiong[1], Huimei Liu[1], Jinwu Gong[2], Wen Yang[1], Yuan Gui[1]
[1]Hubei University of Technology, China; [2]Wuhan University, China

D17.8: **Active Gate Driver for SiC MOSFET Based PV Inverter with Enhanced Operating Range**
Sayan Acharya[2], Xu She[1], Fengfeng Tao[1], Tony Frangieh[1], Maja Harfman Todorovic[1], Rajib Datta[1]
[1]GE Global Research, United States; [2]North Carolina State University, United States

D17.9: **Comparative Evaluation of Modulation Strategies for a Single-Phase PV Micro-Inverter with High-Frequency Transformer**
Jonatas Rodrigo Kinas, Diego Alberto Acevedo-Bueno, Gabriel Sales Lins Rodrigues, Montie Alves Vitorino, Alexandre Cunha Oliveira, Antonio Marcus Nogueira Lima
Federal University of Campina Grande (UFCG), Brazil

D17.10: **Flexible High Efficiency Battery-Ready PV Inverter for Rooftop Systems**
Namwon Kim, Mehrdad Biglarbegian, Babak Parkhideh
University of North Carolina at Charlotte, United States

D17.11: Performance Evaluation of Single-Phase Transfomer-Less PV Inverter Topologies
Jinia Roy, Yinglai Xia, Raja Ayyanar
Arizona State University, United States

D17.12: A Dual-Active-Bridge-Based High-Frequency Isolated Inverter for Interfacing Multiple PV Modules with Distributed MPPT
Shiladri Chakraborty, Souvik Chattopadhyay
Indian Institute of Technology Kharagpur, India

D17.13: Reliability Evaluation of Power Capacitors in a Wind Turbine System
Dao Zhou, Frede Blaabjerg
Aalborg University, Denmark

D18: Microgrids and Grid Connect

Renewable Energy Systems

Yingying Kuai, *Caterpillar Inc.*

D18.1: A Series-Resonance-Based Three-Port Converter with Unified Autonomous Control Method in DC Microgrids
Panbao Wang[2], Shuxin Zhang[2], Dianguo Xu[2], Xiaonan Lu[1]
[1]Argonne National Laboratory, United States; [2]Harbin Institute of Technology, China

D18.2: Decoupled Modeling and Control of the Modular Multilevel Converter
Binbin Li, Zigao Xu, Jian Ding, Dianguo Xu
Harbin Institute of Technology, China

D18.3: Control System Design and Stability Analysis for a Three Phase SiC-Based Filter-Less Grid-Connected PV Inverter
Yanjun Shi, Lu Wang, Hui Li
Florida State University, United States

D18.4: A Phase-Lead Compensation Strategy on Enhancing Robustness Against Grid Impedance for LCL-Type Grid-Tied Inverters
Chun Huang, Tianzhi Fang, Li Zhang
Nanjing University of Aeronautics and Astronautics, China

D18.5: Stability Improvement of Microgrids Using a Novel Reduced UPFC Structure via Nonlinear Optimal Control
Hossein Saberi, Shahab Mehraeen, Boyu Wang
Louisiana State University, United States

D18.6: Stability and Improvement of LCL-Filtered Inverters Using Only Grid Current Feedback Active Damping for Weak Grid Applications
Jinming Xu, Binfeng Zhang, Shaojun Xie
Nanjing University of Aeronautics and Astronautics, China

D18.7: An Improved Discontinuous Space Vector Modulation Scheme for the Three-Phase Impedance Source Inverters
Ahmed Abdelhakim[2], Frede Blaabjerg[1], Paolo Mattavelli[2]
[1]Aalborg University, Denmark; [2]University of Padova, Italy

D18.8: A Phase Feedforward Based Virtual Synchronous Generator Control Scheme
Mingxuan Li[2], Yue Wang[2], Hui Zhou[2], Weihao Hu[1]
[1]Aalborg University, Denmark; [2]Xi'an Jiaotong University, China

D18.9 : An Improved Hierarchy and Autonomous Control for DC Microgrid Based on Both Model Predictive and Distributed Droop Control
Shunlong Xiao, Robert Balog
Texas A&M University, United States

D18.10: Two-Degree-of-Freedom Admittance-Type Droop Control for Plug-and-Play DC Microgrid
Zheming Jin, Josep Guerreros
Aalborg University, Denmark

D18.11: A Complete Small Signal Modeling and Adaptive Stability Analysis of an Islanded Mode Operation of a Nonlinear Droop-Controlled MICROGRID
Hassan Abdelgabir[2], Ali Boynuegri[2], Ali Elrayyah[1], Yilmaz Sozer[2]
[1]Qatar Research Foundation, Qatar; [2]University of Akron, United States

D19: Renewable Energy Systems

Renewable Energy Systems

Seungdeog Choi, *The University of Akron*

Ruoyu Hou, *GaN Systems Inc.*

D19.1: Modeling and Control of a Dual Cell Link for Battery-Balancing Auxiliary Power Modules
Weizhong Wang, Matthias Preindl
Columbia University, United States

D19.2: Diagnosis of Inter-Turn Short Circuit and Rotor Eccentricity for PMSG Used in Wave Energy Conversion
Hongwei Fang[2], Yuzhu Feng[2], Runan Song[2], Ru Jiang[1]
[1]China North Vehicle Research Institute, China; [2]Tianjin University, China

D19.3: Circuit Parameters Extraction Algorithm for a Lithium-Ion Battery Charging System Incorporated with Electrochemical Impedance Spectroscopy
S M Rakiul Islam[1], Sung-Yeul Park[1], Balakumar Balasingam[2]
[1]University of Connecticut, United States; [2]University of Windsor, Canada

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D19.4: **An Efficient Voltage Equalization Algorithm for Low-Power Supercapacitor Applications**
Yu Song, Weirong Liu, Hongtao Liao, Heng Li, Yun Jiao, Jun Peng, Zhiwu Huang
Central South University, China

D19.5: **Outlier Mining-Based Fault Diagnosis for Multicell Lithium-Ion Batteries Using a Low-Priced Microcontroller**
Taesic Kim[2], Amit Adhikaree[2], Rajendra Pandey[2], Daewook Kang[1], Myoungho Kim[1], Chang-Yeol Oh[1], Juwon Back[1]
[1]Korea Electrotechnology Research Institute, Korea; [2]Texas A&M University-Kingsville, United States

D19.6: **Low-Frequency Input Ripple Current Compensation in Single-Phase Fuel Cell Power Systems**
Soumya Sinha, Wajiha Shiren, Sumit Pramanick
University of Houston, United States

D19.7: **A Hybrid Flyback Led Driver with Utility Grid and Renewable Energy Interface**
Awab Ali[3], Jonathan Lange[3], Ali Elrayyah[2], Yilmaz Sozer[3], Alex De Abreu-Garcia[3], Augustin Mpanda[1]
[1]ESIEE-Amiens, France; [2]Qatar Research Foundation, Qatar; [3]University of Akron, United States

D20: Transportation Power Electronics

Transportation Power Electronics

Somasundaram Essakiappan, *The University of North Carolina at Charlotte*

Ralph Taylor, *Delphi Automotive*

D20.1: **Frozen Leg Operation of a Three-Phase Dual Active Bridge DC/DC Converter at Light Loads**
Saeid Haghbin[3], Frede Blaabjerg[1], Farzad Yazdani[2], Amir Sajjad Bahman[1]
[1]Aalborg University, Denmark; [2]Chalmers University, Sweden; [3]Elbind Elektronik AB, Sweden

D20.2: **Adaptive Detection of DC Arc Faults Based on Hurst Exponents and Current Envelope**
Yousef Abdullah[2], Boxue Hu[2], Zhuo Wei[2], Jin Wang[2], Amin Emrani[1]
[1]Ford Motor Company, United States; [2]The Ohio State University, United States

D20.3: **SiC Based on-Board EV Power-Hub with High-Efficiency DC Transfer Mode Through AC Port for Vehicle-to-Vehicle Charging**
Miad Nasr, Kshitij Gupta, Carlos Da Silva, Cristina Amon, Olivier Trescases
University of Toronto, Canada

D20.4: **Three-Phase on-Board Charger with Three Modules of Single-Stage Interleaved Soft-Switching AC-DC Converter**
Byeongwoo Kim, Hyojun Kim, Sewan Choi
Seoul National University of Science and Technology, Korea

D20.5: **An Improved Minimum-Cost Charging Schedule for Large-Scale Penetration of Electric Vehicles**
Wenping Zhang, Caleb Dreise, Riming Shao, Liuchen Chang
University of New Brunswick, Canada

D20.6: **Accurate Voltage Equalization of Supercapacitors with Online Identification Model**
Xiaoyong Zhang, Yun Jiao, Hongtao Liao, Heng Li, Yanhui Zhou, Zhiwu Huang
Central South University, China

D20.7: **Design and Optimization of a Dielectric-Gas-Based Single-Phase Electrostatic Motor**
Nannan Zhao[2], Fei Lu[1], Hua Zhang[1], Chris Mi[1]
[1]San Diego State University, United States; [2]Xi'an University of Architecture and Technology, China

D20.8: **A Finite-Set Model-Based Predictive Battery Thermal Management in Connected and Automated Hybrid Electric Vehicles**
Chong Zhu, Fei Lu, Hua Zhang, Kangxi Zhu, Chris Mi
San Diego State University, United States

D20.9: **Single-Phase Multifunctional Onboard Battery Chargers with Active Power Decoupling Capability**
Hoang Vu Nguyen, Dong-Choon Lee
Yeungnam University, Korea

D20.10: **A Fast-Speed Heater with Internal and External Heating for Lithium-Ion Batteries at Low Temperatures**
Yunlong Shang[1], Chenghui Zhang[2], Naxin Cui[2], Chris Mi[1]
[1]San Diego State University, United States; [2]Shandong University, China

D21: LED Applications

Power Electronics Applications

Jim Spangler, *Spangler Protype Inc*

D21.1: **Cascode Switching Modeling and Improvement in Flyback Converter for LED Lighting Applications**
Liang Jia[1], Srikanth Lakshmikanthan[1], Yan-Fei Liu[2]
[1]Google Inc, United States; [2]Queens University, Canada

D21.2: **Controlling the Input Impedance of Constant Power Loads**
Manuel Gutierrez[1], Peter Lindahl[1], Arijit Banerjee[2], Steven Leeb[1]
[1]Massachusetts Institute of Technology, United States; [2]University of Illinois Urbana-Champaign, United States

D21.3: **380V Digital Isolated Quasi-Resonant Multiphase Converter for High Power LED Application**
Stefano Saggini[2], Roberto Rizzolatti[2], Mario Ursino[2], Osvaldo Zambetti[1]
[1]STMicroelectronics, Italy; [2]University of Udine, Italy

Dialogue Sessions

D21.4: **Developing Highly Reliable LED Luminaires for High Temperature Applications Using AC-Direct Driving LED Technology**
Hui Zhang
State University of New York at Oswego, United States

D21.5: **Active Pulse Shaping Circuit for Bandwidth Enhancement of High-Brightness LEDs Using GaN Devices**
Kumar Modepalli[1], Leila Parsa[2]
[1]Rensselaer Polytechnic Institute, United States; [2]University of California, Santa Cruz, United States

D21.6: **A High Power Factor Two-Channel PSR Flyback LED Driver with Controllable Output Current Sharing Based on Open-Looped SSPR Control**
Chunqiao Wu, Hanjing Dong, Xiaogao Xie
Hangzhou Dianzi University, China

D22: Industrial and Grid Applications

Power Electronics Applications

Yogesh Ramadass, *Texas Instruments*

Geng Niu, *Karma Automotive*

D22.1: **DC Distributed Systems Stabilization and Performance Improvement Using Small-Signal Voltage Injection**
Ahmed Aldhaheri, Amir Etemadi
The George Washington University, United States

D22.2: **Load Adaptive Modulation Method for All-Metal Induction Heating Application**
Hwa-Pyeong Park[2], Mina Kim[2], Jee-Hoon Jung[2], Ho-Sung Kim[1]
[1]Korea Electrotechnology Research Institute, Korea; [2]Ulsan National Institute of Science and Technology, Korea

D22.3: **Research on Common Mode Voltage Suppression of Three-Phase Four-Bridge Matrix Converter Considering Unbalance Inductance**
Songtao Huang[3], Yougui Guo[3], Lie Xu[1], Yu Guo[2], Yongdong Li[1], Wenlang Deng[3]
[1]Tsinghua University, China; [2]University of Illinois at Chicago, China; [3]Xiangtan University, China

D22.4: **Modified Bi-Directional Z-Source Breaker with Reclosing and Rebreaking Capabilities**
Swati Savaliya, Baylon Fernandes
Indian Institute of Technology Bombay, India

D22.5: **High-Performance and Cost-Effective Single-Ended Induction Heating Appliance Using New MOS-Controlled Thyristors**
Hector Sarnago, Oscar Lucia, Jose M. BurdÃo
Universidad de Zaragoza, Spain

D22.6: **A Novel Platform for Power Train Model of Electric Cars with Experimental Validation Using Real-Time Hardware in-the-Loop (HIL):,a Case Study of GM Chevrolet Volt 2nd Generation**
Khalil Algarny[2], Ahmed Abdelrahman[2], Mohamed Youssef[1]
[1]Univeristy of Ontario Institute of Techology, Canada; [2]University of Ontario Institute of Technology, Canada

D22.7: **A New Control Method for Series Resonant Inverter with Inherently Phase-Locked Coil Current with Induction Cookware Applications**
Jong-Woo Kim, Moonhyun Lee, Jih-Sheng Lai
Virginia Tech, United States

D22.8: **Lifetime-Based Power Routing of Smart Transformer with CHB and DAB Converters**
Vivek Raveendran[1], Markus Andresen[1], Marco Liserre[1], Giampaolo Buticchi[2]
[1]University of Kiel, Germany; [2]University of Nottingham Ningbo China, China

D22.9: **Soft-Transient Modulation Strategy for Improved Efficiency and EMC Performance of PFC Converters Applied to Flexible Induction Heating Appliances**
Mario Pérez-Tarragona, Héctor Sarnago, Oscar Lucia, Jose M. BurdÃo
Universidad de Zaragoza, Spain

D22.10: **Single-Phase to Two-Phase Power Converter**
Bruna Seibel Gehrke, Cursino Brandao Jacobina, Nayara Brandao de Freitas, Antonio de Paula D. Queiroz
Federal University of Campina Grande, Brazil

D22.11: **Power Rectifier Based on Open-End Converter with Floating Capacitor Under Non-Sinusoidal and Unbalanced Input**
Alan S. Felinto, Cursino B. Jacobina, João P.R.A Mello, Gregory A. A. Carlos, Ivan da Silva
Federal University of Campina Grande, Brazil

D22.12: **Doubly-Fed Machine with Wireless Power Transfer Ability**
Jun Lee, Jung-Ik Ha
Seoul National University

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D23: Switchmode Power Supply & Battery Applications

Power Electronics Applications

Sombuddha Chakraboty, *Texas Instruments*

D23.1: **A Battery Management System Adapted for an Energy Harvester with a Low-Power State of Charge Monitoring Method and a 24 Microwatt Intermittently Enabled Coulomb Counter**
Jun-Ichi Nagata, Kenichi Kawasaki, Hiroyuki Nakamoto
Fujitsu Laboratories Ltd., Japan

D23.2: **Control Method of Input-Parallel and Output-Series Connected Inverters for Plasma Generator**
Hyo Min Ahn[2], Won-Yong Sung[2], Minkook Kim[2], Byoung Kuk Lee[2], Seung-Hee Ryu[1], Chang-Seop Lim[1]
[1]New Power Plasma Corporation, Korea; [2]Sungkyunkwan University, Korea

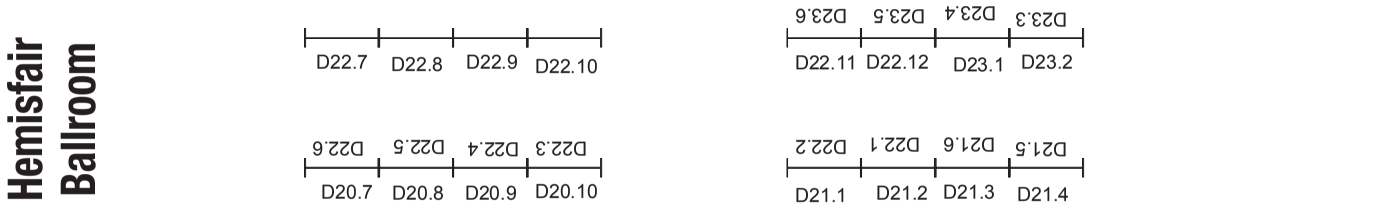
D23.3: **Optimized Modulation Scheme for Dual Active Bridge DC-DC Converter**
Chaochao Song, Alian Chen, Jie Chen, Chunshui Du, Chenghui Zhang
Shandong University, China

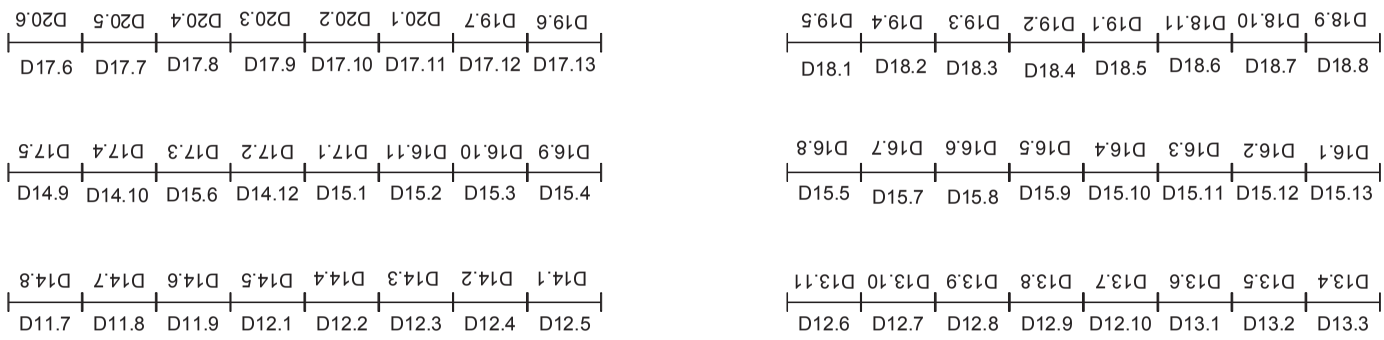
D23.4: **Two-Phase Three-Dimension Common Inductor LLC Resonant Converter with Automatic Current Sharing**
Hongliang Wang, Yang Chen, Bo Sheng, Yan-Fei Liu, P.C Sen
Queen's University, Canada

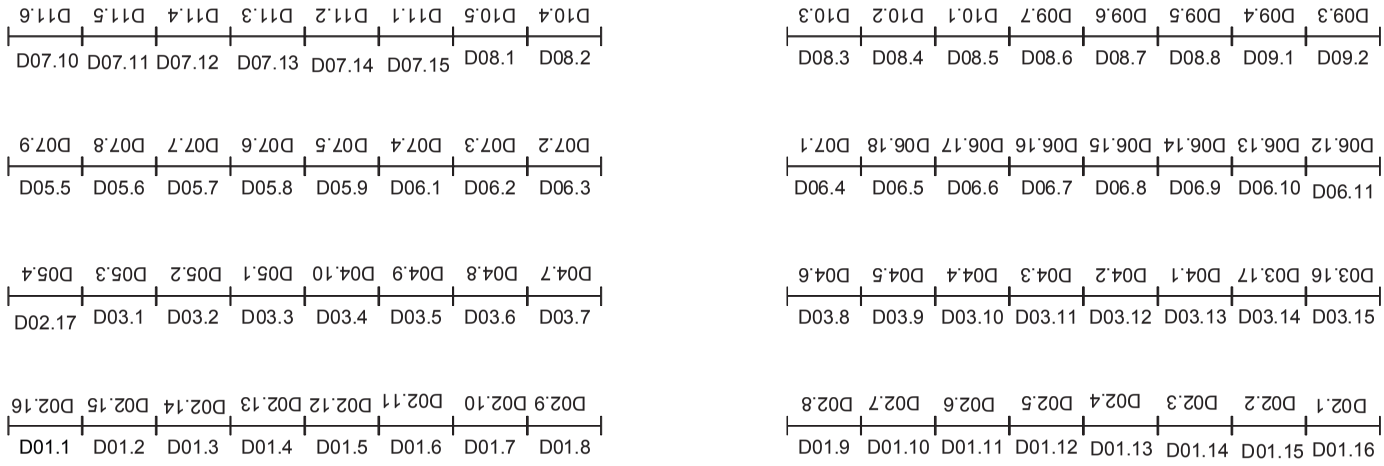
D23.5: **Design of Fast Charging Technique for Electrical Vehicle Charging Stations with Grid-Tied Cascaded H-Bridge Multilevel Converters**
Amirhossein Moeini, Shuo Wang
University of Florida, United States

D23.6: **Enhanced SOH Balancing Method of MMC Battery Energy Storage System with Cell Equalization Capability**
Zhan Ma, Tianqu Hao, Feng Gao, Nan Li, Xin Gu
Shandong University, China

Notes







Dialogue Sessions
Floor Plan

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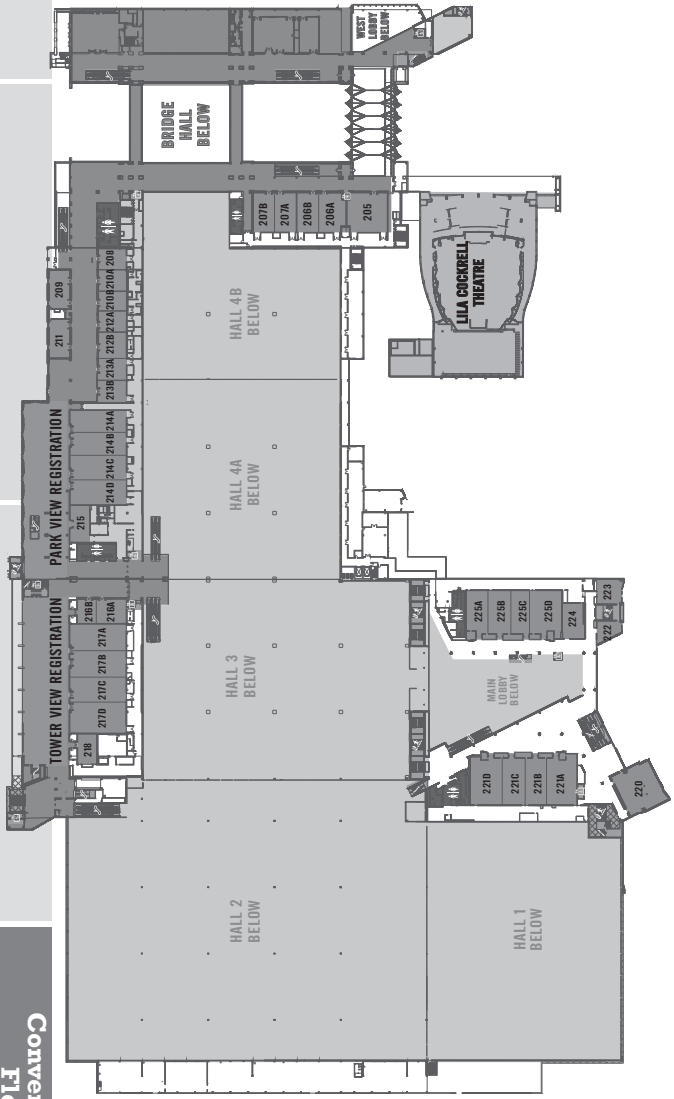
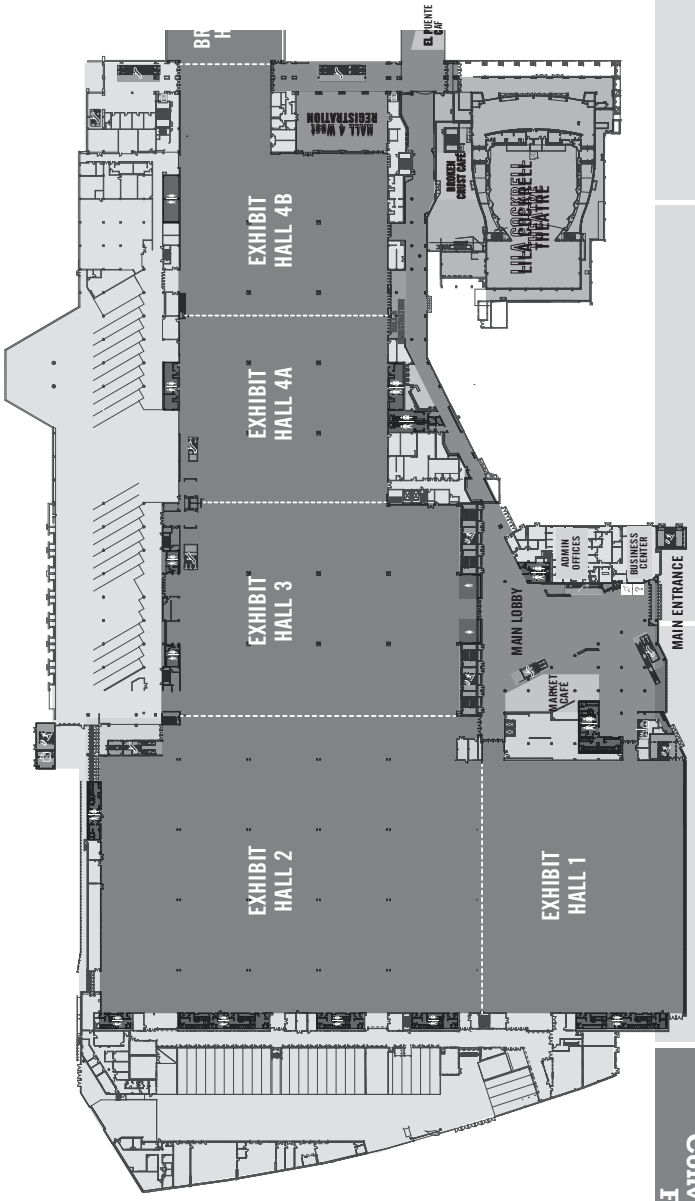
Meeting Room Level



Street Level



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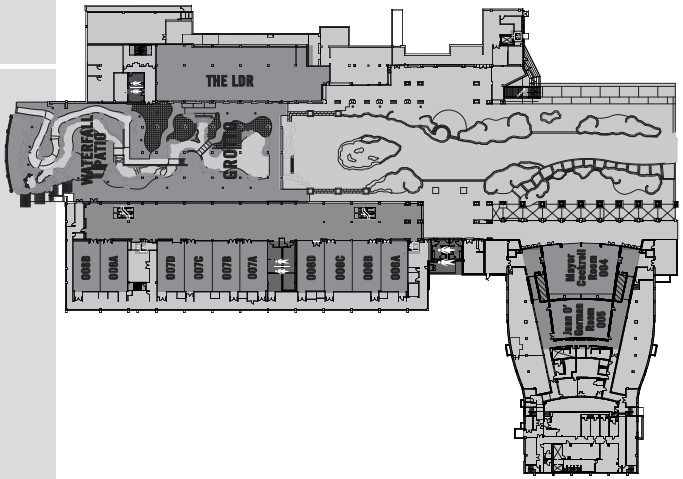
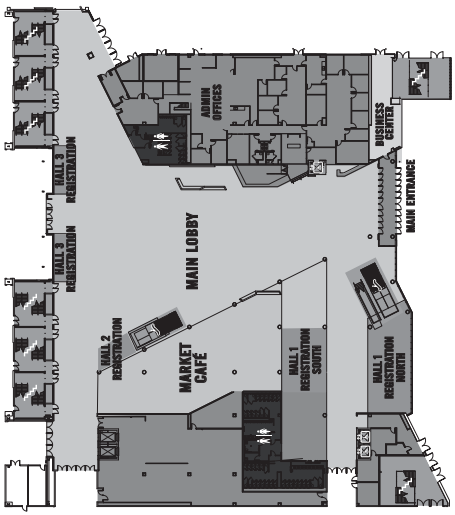
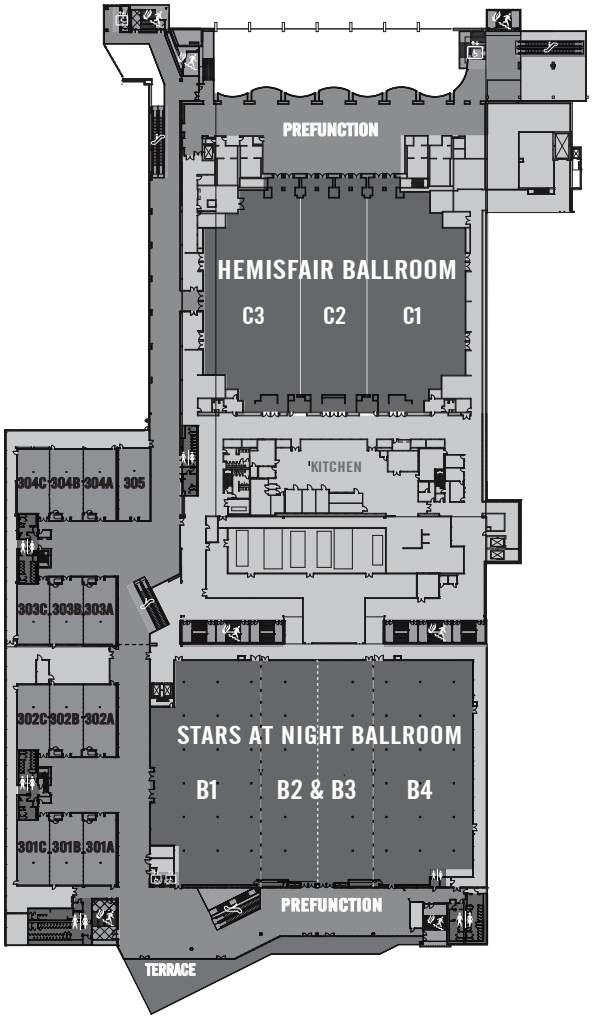
River Level





Ballroom Level



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NOTES

APEC 2018 Exposition

The APEC 2018 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 8:00 p.m. by the 32nd Annual MicroMouse Contest, then on Tuesday at 5:00 p.m. the Rap Sessions covering topics of interest in power electronics.

NEW this Year in the Exhibit Hall – Campfire Connections Access

Relax around the campfire and engage in roundtable discussions with peers in The HUB, booth #931.

> **Tuesday, March 6**
2:45 p.m. – 3:15 p.m.
Women in Engineering

> **Wednesday, March 7**
10:00 a.m. – 10:30 a.m.
Magnetics

In The HUB this year, join us for a Virtual Reality Experience Sponsored by Wurth, our Prize Give-a-way and join us for a custom coffee drink from our Barista.

A thank you goes to our long-term APEC sponsors the Industrial Applications & Power Electronics Societies (IAS & PELS), and the Power Sources Manufacturers Association (PSMA) for their commitment and support of APEC 2018. In addition, a special thanks goes to our conference partners who have provided additional financial support to make your conference experience even better. ***Please enjoy!***

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Exposition Information

The Exposition will open on Monday, March 5 when the Plenary Session concludes.

Exposition Hours

Monday, March 5 . . . . . 5:00 p.m. – 8:00 p.m.

Tuesday, March 6. . . . . 12:00 p.m. – 5:00 p.m.

Wednesday, March 7 . . . . . 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

The Welcome Reception will be held in the Exhibit Hall on Monday, March 5, from 5:00 p.m. until 8:00 p.m. Come join us for a Taste of San Antonio! Registered spouses and guests are welcome.

EXPOSITION LUNCH AND BREAKS

Lunch will be served in the Exhibit Hall on Tuesday from 12:00 p.m. – 1:30 p.m. and on Wednesday from 12:30 p.m. – 2:00 p.m. free of charge to all who have access to the exhibit hall. Lunch will be on your own on Sunday and Monday.

The Wednesday morning coffee break will be served in the Exhibit Hall from 10:10 a.m. to 10:40 a.m. The Tuesday afternoon coffee break will be in Exhibit Hall from 2:45 p.m. to 3:15 p.m.

Exposition & Giveaway

During all three days of the Exposition we will be giving out prizes. At registration everyone (exhibits only registrants and exhibitors included) will be issued a raffle ticket that you will put in a drop box located in Booth 931. This will be good for all three days of raffles during the exposition.

Exhibitor Seminars

as of 2.15.18

Exhibitor Seminars – Session #1

Tuesday, March 6 – 1:30 p.m. – 2:00 p.m.

Synopsys

ROOM 214A

Latest Saber Modeling and Simulation Features for Power Electronics

PRESENTED BY: Alan Courtay

The Synopsys Saber simulator continues to address the need for accurate and efficient models in power electronics. The library of Saber power MOSFET tools has recently been extended to cover a wide range of manufacturers and technologies including Silicon Carbide and Gallium Nitride. Lessons learned from characterizing devices based on datasheets and an assessment of the quality of SPICE models from various manufacturers will be shared. In addition, the latest Saber release introduces a new battery modeling tool focused on Lithium-Ion chemistries and a faster periodic AC analysis (PAC) to characterize switch mode power converters in the frequency domain. A peek at the upcoming Saber BJT modeling tool will also be given.

Littelfuse

ROOM 214B

The Path to Predictable, High-Volume, High-Yield Manufacturing of SiC Devices

PRESENTED BY: By: Corey Deyalsingh *(Littelfuse),* Andy Wilson *(X-Fab),* Sujit Banerjee *(Monolith Semiconductor)*

Making the next generation of silicon carbide (SiC) devices like MOSFETs and Schottky diodes more affordable depends on the ability to produce them in high volumes with high yields predictably. The first steps on the path toward this goal have been making the transition from 3 inch and 4-inch SiC wafers to 6-inch SiC wafers and developing design and process techniques that are compatible with processes in a silicon CMOS fab. More than 90 percent of SiC device processes are compatible with processes already available in a silicon CMOS fab. Integrating the process flows for silicon and SiC wafers and running them in parallel offers chip producers enormous economies of scale. This approach has already proven successful in the production of 1200 V SiC MOSFETs and Schottky diodes in an automotive-qualified 150 mm CMOS fab owned by X-FAB Silicon Foundries. The devices produced are not only highly manufacturable but display superior device performance, gate oxide reliability, and robustness.

Magnetics
ROOM 214C

Practical Considerations with Core Geometry in Inductor Design and New Products

Presented by: Sam Davis

Magnetics will be presenting on both our latest materials and products as well as up and coming products to be released in the near future. We will also be continuing our study of core geometry and how that impacts core performance. Last time, cores of various geometry, size and permeability were tested using a standardized testing method used by Magnetics in order to find offsets in core performance. This time, inductors using a variety of core geometries will be designed to a specific inductance under load to further distinguish offsets in performance and to compare with last year's findings. The cores chosen for the study all have a similar inductance factor which will act as a constant for the study since that parameter is only dependent on geometrical properties given the same material and permeability.

Power Integrations
ROOM 214D

Digitally-Controlled Off-Line Flyback that Exceeds DOE (6) Efficiency for Wide Range and USB PD Power Supplies

Presented by: Amruta Patra

Synchronous rectification and quasi-resonant operations are well known techniques for increasing power supply efficiency. Achieving high efficiency with a highly variable output voltage is substantially more difficult due to transformer optimization, reflected voltage limitations and SR FET timing constraints. This presentation describes a 40 W off-line flyback power supply design that maintains flat efficiency across the load range, meeting all international standards for power supply efficiency. The presentation will cover power stage and magnetics design, implementation of the control interface and EMI optimization for open frame applications, field configurable power, and adapters requiring USB PD with PPS compliance.

Mouser Electronics
ROOM 217A

Robust Piezo Actuator Solution for Innovative HMI Haptic Feedback

Presented by: Matt Reynolds *(EPCOS),*
Kelly Griffin *(Texas Instruments)*

The new PowerHap™ piezo actuator with haptic feedback and integrated sensor functionality from TDK Corporation is a compact and innovative actuator that significantly enhances the sensory experience of the human machine interface. The PowerHap Piezo actuator is robust and powerful enough to operate in hostile, low-visibility and noise-filled environments. With integrated sensors, the actuator features unrivalled performance in terms of acceleration, force and response time, and thus offers an unprecedented quality of haptic feedback. The presentation will also discuss haptic feedback trends and how multilayer piezo plate technology can increase the user experience while remaining cost-effective.

Coilcraft
ROOM 217B

Power Inductor Trends

Presented by: Len Crane

Coilcraft introduces power inductors optimized for high frequency switching, high ripple current, and high power density. This presentation discusses the new high-performance materials and features of these inductors. New Coilcraft inductor families include XEL for high frequency, XTL for high inductance, SRT for high current and power density, and XAR designed for integrated packaging. This presentation will demonstrate how these inductors meet the challenges of today's changing technologies and applications.

Panasonic
ROOM 217C

Gate Driving Method and New Application for Exceeding the Si limit with X-GaN

Presented by: Tom Higuchi

Let's start discussion of GaN implementation since X-GaN qualified proper reliability. You can see that the X-GaN's gate drive method is not difficult, after this seminar. You will discern how to drive X-GaN using generic Gate Driver IC. The importance of schematic and routing are defined in order to be maximized the benefit of X-GaN high performance. The suitable topology and application for X-GaN are illustrated. Expansion to Power Supply, AC-Adapter and Inverter is expected in the future. Don't miss next industry standards coming within reach of your hands.

Navitas Semiconductor
ROOM 217D

GaNFast to Higher Efficiency

Presented by: Dan Kinzer

GaN's device-level performance is 5-10x better than that of Si for key switching and loss figures of merit. This offers a benefit in hard-switching topologies but the real value is to use mono-

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lithic integration of FET, drive and logic to operate 5x, 10x or 20x faster in soft-switching circuits. GaN Power ICs exploit not only GaN's advances like RDS(ON) QG, QOSS, QRR, but also cut losses by enhancing switching speed and improving gate control. A study of PFC reference designs ranging in power from 100 W to 3.2 kW, with CrCM boost, Totem-Pole and interleaved topologies, and switching frequencies from 100 kHz to 1MHz is presented.

Exhibitor Seminars – Session #2

Tuesday, March 6 – 2:15 p.m. – 2:45 p.m.

Ltec Corporation

ROOM 214A

Predict Wide Bandgap Power Device Technology Trends Through Teardowns, and Deep Analysis

PRESENTED BY: Louis Burgyan

Analyze the past to predict future trends and gain competitive edge! Having examined hundreds of devices, LTEC engineers identify essential construction details of SiC and GaN semiconductor technologies and link specific findings obtained from physical device de-construction, materials, and electrical analysis to key performance parameters and potential reliability concerns. Attributes essential to achieving high temperature operation and improved short-circuit survival are revealed. Various technologies and associated scaling trends are discussed, including their impact on performance and cost. This presentation offers "hard to access" knowledge base essential to the development of power electronic systems.

SIMPLIS Technologies, Inc.

ROOM 214B

Design Verification using Monte Carlo, Sensitivity, and Worst-Case Analyses in SIMPLIS

PRESENTED BY: Matthew Fortin and John Wilson

As the pressure to reduce design cycle time builds, the use of simulation to highlight and expose design flaws before building the first prototype becomes essential. In this seminar, we begin a process of design verification first employing the time-tested Monte Carlo analysis. Next, we perform sensitivity and worst-case analyses using standard built-in Design Verification Module (DVM) functions. Finally, we show how to automatically change schematic component values to use statistical distribution functions from the sensitivity tolerance definitions, including those of circuit elements that employ SIMPLIS' new ability to describe the digital behavior of a SIMPLIS subcircuit with user-defined C/C++ code.

Transphorm

ROOM 214C

Reference Designs Kick Start Reliable High-voltage GaN Application Development

PRESENTED BY: Philip Zuk, *Vice President of Technical Marketing, Transphorm*

The power electronics industry's adoption of high-efficiency, high-reliability Gallium Nitride (GaN) is increasing. Yet, to many engineers developing power systems, GaN remains a new technology presenting new design challenges. Transphorm stands as one of the only high-voltage GaN manufacturers with customer products in production. Based on those projects as well as its own R&D, Transphorm holds a unique understanding of effective design methods that properly leverage GaN for optimal performance and system lifespan. Transphorm now extends that knowledge to engineers via various reference designs. Learn how to kick start your high-voltage application designs with Transphorm, and join the GaN Revolution!

United Chemi-Con Inc.

ROOM 214D

Advanced DC Link Capacitor for 48V inverter of MHV

Presented By: Tony Olita and Toshihiko Furukawa

The life requirement of DC Link capacitors mounted on the invertor is one of key parameter to maintain the inverter efficiency. Less efficiency of the inverter because of the degradation of the capacitors will impact on reducing of MPG and increasing of CO2. In this seminar, the life requirement for DC-Link Capacitor and the life prediction with multiple types current profiles under the typical temperature profile will be presented. Also, advanced DC-Link capacitor products line up will be presented.

STMicroelectronics

ROOM 217A

Digital Combo Multi-mode PFC and Time-shift LLC Resonant Controller

PRESENTED BY: Rosario Attanasio

STNRG011 is a new digital controller in an O20 package that includes a multi-mode (transition-mode and DCM) PFC controller, a high voltage double-ended controller for the LLC resonant half-bridge, an 800 V-rated startup generator and a sophisticated digital engine, that manages the optimal operation of the three blocks. The digital algorithms are stored into an internal ROM memory while a programmable NVM (non volatile memory) allows a wide configurability and calibration of the key parameters for applications.

RTDS Technologies Inc.

ROOM 217B

Real Time Simulation: The Essential Tool for Both Low and High Power Applications

Presented by: Dr. Ehsan Tara

Power electronics-based high power conversion systems are an integral part of our power system. A typical step in the development of these high power conversion systems is the testing of the controller. If the rating of the system is reasonable (in the kW range), it is common to use a real system for testing both the power stack and the control system. However, the trend from industry is larger and riskier each day, with HVDC ratings in the hundreds of MW or even GW range. These systems are impractical to test with physical replicas. Additionally, these systems are meant to be interfaced with an existing utility grid, containing many elements with their own characteristics. Closed-loop testing with the RTDS Simulator has been established as the de facto method for testing the controls of these high power systems for more than 20 years, with the RTDS Simulator used for the Factory Acceptance Testing for most major HVDC and FACTS projects. Real time simulation offers a highly flexible and accurate solution for simulating not only the power stack and power electronics in question, but also the interconnected AC system. This presentation explores the importance of real time simulation in these areas and gives some real world examples of the benefits.

PowerSim

ROOM 217C

Integrating PSIM & SPICE for Device Level and System Level Simulation

Presented by: Albert Dunford

The new PSIM release includes a built-in SPICE engine and support for LTspice simulation, with support to SiC/GaN models. While PSIM excels in system level and control simulation, SPICE is great in device level simulation. The combined platform makes the best use of both engines in a complementary way. In addition, PSIM provides the dual-model definition functionality, making the transition seamless between PSIM and SPICE simulation. With SPICE integration, PSIM is now a one-stop solution for all your simulation and design needs, including power supplies, motor drives, analog & digital control, loss calculation, and DSP code generation.

Adaptive Power Systems

ROOM 217D

Regulatory Power Compliance Testing Made Easy

Presented by: Herman Van Eijkelenburg

AC power products that operate on utility power must be designed to withstand power grid fluctuations and anomalies that can occur on most grids. This is especially true for CE marked products destined for the European market at CE marking implies meeting a variety of AC power related IEC 61000-4 immunity test standards as part of the EMC requirements. This session will illustrate the built-in IEC 61000-4 test capabilities of modern day programmable AC power source that allow design engineers to perform pre-compliance testing during product development, greatly increasing the chances of the product passing these requirements and avoiding costly late-in-life design changes.

Exhibitor Seminars – Session #3

Tuesday, March 6 – 3:00 p.m. – 3:30 p.m.

Abstract Power Electronics

ROOM 214A

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.

OPAL-RT Technologies

ROOM 214B

How to Use Real-Time Simulation for a Better, Modern, and Interactive Teaching Experience for Power Electronic and Electric Motors

Presented by: Christophe Brayet

This topic demonstrates how to use Real-Time Simulation for a Better, Modern, and Interactive Teaching Experience for Power Electronics and Electric Motors. Real-time simulation laborato-

ries are introduced here to enhance the teaching experience and add the "User-In-The-Loop" concept. Students interact with real equipment and the simulated systems in real-time via a panel and the "user-interaction-bandwidth" is taken into account. This allows for a better understanding of phenomena, and a visualization of critical system behaviors without the worry of damaging physical material. Universities around the world are rapidly adopting HIL technology in their programs in order to leverage their engineering education. Based on years of research and experience in power electronics and power system, and listening to the users' needs, OPAL-RT offers Hardware-in-the-Loop (HIL) and Rapid Control Prototyping (RCP) Teaching Laboratories to universities in an efficient, reliable and affordable way.

Helix Semiconductors

ROOM 214C

Helix Semiconductors – A New Breed of Energy-Efficient Power Supply Solutions

PRESENTED BY: Harold A. Blomquist

With electricity grids around the globe burdened to the brink of failure, massive energy shortages being predicted (due to all of the connected devices on the internet of things), multiple government entities enacting strict energy efficiency standards, and vampire loads wasting more than $80 billion per year, the time is now to address the way power conversions are being made. Helix Semiconductors is focused on addressing the global initiatives for more efficient power supplies through its core energy-efficiency technology (MuxCapacitorTM), which takes a different approach to power conversion than traditional methods. Over the entire load range, from low-load to full-load conditions, Helix's MuxCapacitor converts mains power worldwide to virtually any lower voltage with over 95% efficiency. Helix's technology enables the highest power density through capacitive power conversion and capacitive isolation. This capacitive conversion voltage-reduction technology makes possible best-in-class energy conversion efficiencies across the full load range, and especially while the system is in power down (standby and vampire power) and lightly loaded operation. Applications that will benefit from Helix's MuxCapacitor technology include everything from IoT sensors and gateways – and all of the things they connect – to external power adapters and chargers, white goods user interfaces, wireless access points, VoIP phones, telecom and data center line cards, electric vehicles, solar converters, and more.

FTCAP GmbH

ROOM 214D

Professional Capacitor Solutions for severe conditions: New approaches for dealing with the reduction of parasetic inductances, improved humidity resistance and dedicated automotive projects.

PRESENTED BY: Dr. Thomas Ebel

FTCAP capacitors are used in many products where a layperson would not expect them at all. For example, they are an integral part of autonomous defibrillators, hybrid race cars, solar ships and computer tomographs. Uninterrupted power supplies are another example. An important area is medical technology. Currently there is large potential in renewable energies – capacitors are installed for example in wind turbines and photovoltaic systems and are increasingly in demand in view of the energy transition. The same applies to the large growth market for electromobility. The presentation provides information on the potential applications of FTCAP capacitors in different industries.

Alpha and Omega Semiconductor Inc.

ROOM 217A

Latest Technology for High-Efficiency Power Conversion

PRESENTED BY: Peter H. Wilson

Power conversion is an essential element in today's society from cloud computing to mobile devices. Higher efficiency demands are pushing power technology. AOS offers a full line of power technology from discrete devices (MOSFET, IGBT, and GaN), integrated solutions such as Power IC, and digital power to enable innovative solutions.

Nichicon (America) Corp

ROOM 217B

What Hybrid Capacitors Can Do For You

PRESENTED BY: Mark Gebbia

Nichicon Corporation has introduced a new line of Conductive Polymer Hybrid Electrolytic Capacitors that will allow designers to develop smaller more compact products. Hybrid Capacitors are ideal for applications where standard polymers or aluminum electrolytics are not the ideal choices. Polymer Electrolytics are great for increased current capabilities and longer life in smaller case sizes, but have limitations that prevent them from being widely accepted. Hybrid capacitors address these issues making them ideal for applications where polymer or aluminum electrolytics are not acceptable. This seminar will highlight

the advantages hybrid aluminum electrolytic capacitors have compared to standard aluminum electrolytic and aluminum polymer capacitors. We will demonstrate how hybrid capacitors have characteristics of both aluminum electrolytic and polymer capacitors.

Infineon Technologies

ROOM 217C

New Gate-Driver IC with Excellent Ground-Shift Robustness

PRESENTED BY: Hubert Baierl

In conventional low-side gate-driver ICs, high current transients may cause ground shift potential between the driver IC and controller IC, causing false triggering or failure of the gate-driver IC. Infineon Technologies is announcing a robust and small size solution to this common problem. This new driver IC features a true differential input, to isolate the input stage from common mode ground shifts and enhance switching speed as well as reliability in hard-switching applications, especially when using MOSFETS with kelvin source packages or in low-cost PCBs with long distance between the gate-driver IC and the control IC.

Mersen

ROOM 217D

Safety and Reliability for Power Electronics

PRESENTED BY: Kian Sanjari

Session presents Mersen's commitment to develop industry-leading technologies to improve efficiency and reliability of power electronics equipment. Key topics include an Overview of Fast Acting Power Semiconductor Protection Fuses, plus an introduction to innovative hybrid DC overcurrent protection devices for EV applications. We will explain how Air and Liquid Cooling solutions provide thermal protection for semiconductor components and that efficient cooling is key to long term reliability and performance of fast switching semiconductor components. We will also present how Laminated bus bars provide the most efficient connection between various components, thus limiting parasitic inductance, improving ease of assembly and integration while minimizing wiring errors and costs.

Exhibitor Seminars – Session #4

Tuesday, March 6 – 3:45 p.m. – 4:15 p.m.

Pin Shine Industrial Co., Ltd.

ROOM 214A

Transformer Applications: Research on Vermolding Technics of Composite Materials

PRESENTED BY: Leo Liou

The main design concept of overmolding is to integrate insert-molding technology to combine the substrate and composite materials through second molding or multiple molding process. The advantages are as following: overmolding process can be used to different materials; including copper wire, silicone steel, core, metal shell and other composite items. Overmolding process increases the distance of the creepage and enhances product performance requirement within a limited space. Overmolding parts have waterproof and dustproof properties; while engineering plastic has high temperature, chemical (oil) and hydrolysis resistance properties. By combining these properties, it allows overmolding products to work in harsh environments.

Ridley Engineering, Inc.

ROOM 214B

Prototype In 1 Day With SwitchBit®

PRESENTED BY: Dr. Ray Ridley

Generating the first working prototype with full power and custom magnetics takes months of trial and error. What if you could reduce this process to just one day? In this seminar, we will demonstrate our combined approach. Learn how we use advanced software, specialized high-frequency prototyping boards, and unique measurement tools to achieve the fastest working prototype results in the industry.

CogniPower, LLC

ROOM 214C

Pushing Flyback Converters Above 65 Watts and the PFC Question

PRESENTED BY: Tom Lawson

Modern flyback converters are efficient and cost-effective to well over 100 Watts. Power Factor Correction is required in many higher power applications. Alternative techniques are considered for Power Factor correction with a focus on the CogniPower Compound Converter for low cost, high efficiency and near-ideal Power Factor Correction.

Hoi Luen Electrical Manufacturer Co., Ltd.

ROOM 214D

Mighty solutions of Fully Insulated Wire (FIW) and the Insulation System

PRESENTED BY: Calvin Ku

Fully Insulated Wire (FIW) with high thermal class, extremely thick high voltage layer and zero-defect insulation compliance with IEC 60317 and 60950, is the next generation wire for miniaturized transformers at lower cost and higher insulation resistance. Embracing high thermal class, very small overall diameters, tight bending radii and high level flexibility, it's the best alternative to substitute traditional triple insulated wire.

NH Research, Inc. (NHR)

ROOM 217B

NHR's New AC & DC Regenerative Source/Loads

PRESENTED BY: Martin Weiss

NH Research is an industry-leading test equipment manufacturer exhibiting a number of our regenerative test solutions including grid-simulators, AC Sources, 4-Quadrant AC Loads, and Battery Emulators. Regenerative systems save money as they reduce the daily operating costs associated with product testing. This session covers key selection factors, common applications, built-in measurement features, and performance characteristics of these types of testing instruments giving engineers and laboratory managers the information required and confidence that the right testing solution is selected for their application testing needs.

SBE, Inc.

ROOM 217C

Advanced Developments for High Temperature, High Efficiency, and Greater Working Voltages of Capacitors

PRESENTED BY: Michael Brubaker

Next generation power converters require high performance capacitors and bus structures in the enabling "ecosystem" for both advanced silicon and silicon carbide devices. High power applications demand increased efficiency, which requires a very low inductance DC link to enable fast switching at maximum DC voltage. Note that paralleling of switch modules is often necessary to achieve the desired current rating and inductance, which requires a fully integrated capacitor/bus. DC link capacitors must also shift to higher operating temperatures to reduce the cost and volume of cooling infrastructure. Finally, increasing device voltages to further improve efficiency requires higher voltage DC link capacitors. SBE has developed answers to all of the capacitor needs outlined above. SBE pioneered the fully integrated capacitor/bus approach with proprietary technology for surface mounting of optimal form factor capacitors directly to bus structures with demonstrated commutation inductances of less than 5nH. SBE has partnered with DuPont Teijin films to address the high temperature film capacitor gap with a solution that can operate at 150C hotspot using their PEN HVTM material. Finally, the unique SBE Power Ring form factor supports higher voltage applications where very light metallization strategies can be utilized without creating excessive equivalent series resistance.

InnoCit LLC

ROOM 217D

Advanced WBG-based Converters

PRESENTED BY: Mehdi Ferdowsi

This seminar covers some of the challenges that power electronic engineers face once they start working with wide bandgap devices. Some of the advantages of GaN switches are lower specific RDS(on), faster switching, lower gate drive voltage, reduced gate charge, lower parasitic capacitances and inductances, and zero reverse recovery. Therefore, they offer higher switching frequency, higher efficiency, and smaller footprint. Despite their many advantages, several challenges lie in the deployment of such devices.

Exhibitor Seminars – Session #1

Wednesday, March 7 – 10:30 a.m. – 11:00 a.m.

Richardson RFPD

ROOM 214A

Biasing Your Gates – How to Simplify Your Power Switching Applications with RECOM DC/DC Converters

PRESENTED BY: Matthew Dauterive, Justin Hill, Peter Victoria

Controlling power switching transistors requires specific voltages to be applied to the gate of the transistor. The required voltage will depend on the chemistry of the transistor – IGBTs for example, typically require +15V across the gate to "turn on" the transistor. In many applications, unwanted turn-on of the gate because of the Miller capacitance can occur, and often the most practical method to prevent this is to apply a negative voltage to the gate. For many IGBTs, the ideal value is -9V. This means that for a half-bridge configuration where there is a high-side and low-side transistor, four separate power supplies would be necessary. With RECOM's asymmetric output DC/DC converters, this reduces the need to only two power supplies. RECOM has high-isolation, asymmetric DC/DC converters for IGBT (+15V/-9V) and SiC (+20V/-5V & +15V/-3V). RECOM also has high-isolation converters for the latest GaN transistors which typically only require a single 6V supply for the gate. RECOM has also introduced a new reference design (R-REF01-HB) that will allow designers to evaluate different types of transistors to find the best fit for their application. The designer can solder either TO247-3L or TO247-4L transistors of their choice to the board and the corresponding RECOM DC/DC converters which are included with the board. In addition to being able to quickly evaluate the performance of the application, the complete design files are open-sourced for ease of implementation into the final design. The design can be used with voltages up to 1kV and up to 10A of current and because the signal ground is galvanically isolated from the power ground, any potential up to 2.5kV may be referenced. The board can be configured to several different topologies which can be found in the datasheet.

Tektronix, Inc.

ROOM 214B

Half Bridge and Gate Driver Measurements

PRESENTED BY: Wilson Lee

The faster switching transitions on modern power devices has made measuring and characterizing a considerable challenge, and in some cases, impossible. IsoVu technology from Tektronix allows designers to accurately measure half bridge and gate driver waveforms that were previously hidden. During our presentation, we will we discuss the following topics: measurement challenges on gate drivers and half bridges, common sources of measurement error, why a probe's poor common mode rejection can cause misleading and useless measurements and how IsoVu technology has created opportunities in CMTI, ESD testing, and the double pulse test.

NAMICS Technologies, Inc.

ROOM 214C

NAMICS New Technology and Products

PRESENTED BY: Ken Araujo

NAMICS is developing the latest cutting edge materials for power modules packages for Die Attach, Insulating Adhesive Film and Liquid Type Encapsulation. In this presentation, we will introduce our development approach for each material. Our Die Attach materials are characterized by a pressureless, low temperature sintering structure providing high thermal and electrical conductivity. They offer outstanding reliability by controlling the modules to handle a variety of power module packages. Future development is focused on a copper sintering type. ,The Insulating Adhesive Film is designed to offer low thermal resistance with thin thickness for high thermal conductivity and voltage breakdown for wide band gap applications. Our current material offers 3 W/mK of thermal conductivity and over 4 kV/mm of breakdown voltage at 50 um thickness. Future development is focused higher thermal conductivity over 10 W/mK. Latest demands for Power Module Packaging require materials to withstand operating temperatures over 200 degree C. To meet these requirements, we are developing a Liquid Encapsulation Compound with a stable resin system at elevated temperature. Our focus is on a new resin system offering high thermal stability while controlling modulus and C.T.E. to meet the rigorous reliability requirements.

Teledyne LeCroy

ROOM 214D

Debug and Validate Control, Drive and Motor Performance with a Motor Drive Analyzer

Presented by: Ken Johnson

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).

TT Electronics

ROOM 217A

Resistor Selection for Proper Circuit Operation and Reliability

Presented by: Tom Morris

This presentation has a goal of educating and informing about the myriad of various resistor types such as wirewound, metal film, carbon film, carbon composition, thick film, networks, etc., their characteristics, and how to properly select them for best performance and optimum cost. Resistors have a myriad of functions in an electronic circuit and the proper resistor selection can be critical not only for normal operating parameters, but also to perform satisfactorily in certain abnormal conditions which could occur.

Wurth Electronics

ROOM 217B

How to Use This Stuff Called Ferrite

Presented by: George Slama

Ferrite cores are used extensively in switching power supplies. With so many manufacturers and a multitude of materials, shapes and sizes to choose from how does the new or practicing engineer select the right core material for a given application? What does the data sheet reveal? How does one compare one core materials to another? This session will be a quick overview of what all those tables and charts in core catalogs mean from a user's perspective.

PowerELab Ltd.

ROOM 217C

Optimize Power Supply Design in Minutes for Free – PowerEsim

Presented by: Dr. Franki Poon

PowerEsim, www.powerEsim.com, is a free tool that seamlessly integrated circuit simulator, transformer/inductor building & simulation tool, thermal simulation, DVT, MTBF, Monte Carlo, Input harmonic and EMI, loop analysis in s and z domain, etc. As a whole it give engineer an virtual environment to build a power supply but do thousands times faster than in real life. Engineer can now wind a real transformer in that virtual environment and immediately see result when they change number of turn of winding method. All result immediately updated when a component changed. No even need to click a "run" button.

HBM Test and Measurement

ROOM 217D

Rapid Efficiency Motor Mapping and Analysis

Presented by: Mike Hoyer

Characterizing electric motors has become an important topic in many engineering labs throughout the world. To test and characterize electric motors, many labs have put together systems with multiple pieces of measurement equipment from different suppliers. While these systems may work, they often have high levels of complexity, synchronization issues, limited capability and operate much slower than an optimized system. This presentation will introduce a revolutionary advanced power analyzer specifically designed for dynamic electric motor testing that generates efficiency motor maps in minutes not hours, calculates any desired analysis in real-time including dq0 and Space Vector Transformation and records over 50 phases of power measurements plus multiple torque, speed, temperature, strain and vibration signals all in a single mainframe. Producing rapid results significantly boosts productivity and R&D, saving significant time and money enabling one to design, test and produce the most efficient electric motors, better and faster than anyone else.

Exhibitor Seminars – Session #2

Wednesday, March 7 – 11:15 a.m. – 11:45 a.m

Pacific Sowa Corp C/O Epson Atmix Corp

ROOM 214A

High U Super Low Core Loss Nanocystalline Powder "KUAMET NC1"

PRESENTED BY: Yoshizawa Masahito

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.

pSemi (formerly Peregrine Semiconductor)

ROOM 214B

Vertical Integration to Support Next-Generation Power Conversion Solutions

PRESENTED BY: Stephen Allen

pSemi, a Murata company, is bringing together a wide range of technologies which collectively will enable significant improvements in performance, size and cost for next-generation DC-DC converters. This presentation will describe the benefits of vertical integration – combining architectural and process innovations, together with advanced packaging and passive components to enable solutions that drive higher switching frequencies, higher conversion efficiencies, and much smaller form factors – often mutually exclusive goals. Examples will be given from existing and soon to be released products from pSemi, solving real-life problems in power conversion for mobile, computing, datacoms and telecoms applications.

Schunk Carbon Technology GmbH

ROOM 214C

Graphite-Based Solutions for (Power) Electronics Cooling

PRESENTED BY: Dr. Sandra Reisinger

Schunk Carbon Technology provides two graphite-based solutions for the electronics cooling industry. The composite, Aluminium Graphite, combines a high thermal conductivity with a low coefficient of thermal expansion and density, to create the ideal thermal management material for high-reliability RF, power and microelectronics applications. Schunk produces a wide range of customized parts with different plating options in various quantities. Our innovative phase change composite, Latent Heat Carbon, allows for effective buffering of temperature peaks as well as energy storage. Its unique production process allows for custom designs at attractive cost with optimal thermal properties tailored to each customer's specific needs.

Zes Zimmer Inc.

ROOM 214D

Advancements in PWM Efficiency Power Testing

PRESENTED BY: Robert Emerson

In applications where power conversion takes place and high-speed switching is involved, such as drives and inverters, great care must be taken when measuring power efficiency. A proper measuring system for efficiency must include high frequency response for the switching consumption and also accurately measure the usable power at the fundamental frequency, and do this without error from alias. Come join us and see this solution and the other advances ZES ZIMMER is making in single and multi-phase power analysis.

Plexim

ROOM 217C

Rapid Control Prototyping for Power Electronic Systems Using the PLECS Toolchain

PRESENTED BY: Vitalik Ablaev

Plexim creates design tools for the development and testing of power electronic systems. The company's electrical engineering software, PLECS, is widely adopted in industry and academia worldwide. PLECS is a complete power conversion system simulation package that yields robust and fast results. Plexim recently added a real-time simulation platform offering to its portfolio. The RT Box is the most versatile and easy-to-use real-time power electronics simulator on the market. With its combination of low round-trip latency, numerical accuracy, scalability, and seamless integration with PLECS, the RT Box is a versatile processing unit for both real-time hardware-in-the-loop (HIL) testing and rapid control prototyping (RCP). In this presentation, Plexim's engineers will demonstrate RCP with an RT Box used as a controller exchanging signals with a TI Boosterpack board to spin a small DC motor. See our effortless, transparent workflow of generating real-time code from a PLECS model, deploying it onto the RT Box with one click, and viewing the real-time waveforms with the PLECS scope.

Eaton

ROOM 217A

Applications and Benefits of Supercapacitor Technology

Presented by: Jason Lee

Imagine the possibilities of a long life, maintenance-free energy storage! Join Jason Lee, product manager at Eaton, for a presentation on the benefits and features of supercapacitors, and how they can be utilized in transportation, industrial, energy, medical and computing markets. Learn about key supercapacitor products and differentiators, and hear how supercapacitors can replace or extend the life of batteries in transportation, renewables, grid storage and UPSs.

Sidelinesoft LLC

ROOM 217B

NL5 – Circuit Simulator With Ideal Components

Presented by: Alexei Smirnov

Most electronic circuit simulation tools on the market are based on the SPICE algorithm. It provides high accuracy and fast simulation, with many models of real components available from manufacturers. However, there are many tasks and applications, especially in power electronics, where SPICE does not perform well, and sometimes does not work at all. NL5 Circuit Simulator is proven to be a perfect alternative to SPICE for such tasks. Instead of very complex models of semiconductor devices, it deals with very simple "ideal" components. As a result, simulation is extremely fast and reliable, with practically no convergence problem. Great performance, ease of use, and many unique features developed in more than 25 years, made NL5 a tool of preference for many users all over the world.

Efficient Power Conversion Corporation

ROOM 217D

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.

Exhibitor Seminars – Session #3

Wednesday, March 7 – 12:00 p.m. – 12:30 p.m

Iwatsu Electric Company Limited

ROOM 214A

Comparison Between Digitizer, Power Analyzer and CROSS POWER Method on Magnetic Material Analysis

Presented by: Ryu Nagahama

Iwatsu introduces two types of solutions for low power loss devices test measuring core losses following the CROSS-POWER method, power analyzer, and digitizer method. The CROSS-POWER method enable precise and highly accurate measurement embedded minimizing phase error integration in current detector (current probe) and compensating in detection circuit on amplitude and phase.

STAr Technologies, Inc.

ROOM 214B

Taurus PDAT – Power Device Analytical Tester

Presented by: Dan Hicks

Today's GaN and SiC power devices and their ever-increasing slew rates present challenges for manufacturers and end users who want to accurately measure and characterize these devices' AC dynamic performance. STAr Technologies offers a new, innovative test solution to solve this problem with the Power Device Analytical Tester (PDAT). AC performance parameters such as diode recovery, switching energy loss, and rise/fall time can now be accurately and easily measured on GaN, SiC, IGBT, and MOSFET transistors and diodes. Join us for a discussion to see how PDAT makes this possible and how it can benefit you.

APEC 2018 Exposition

West Coast Magnetics
ROOM 214C

What Does the Future Hold for Transformers and Inductors In Medium And High Power Applications

PRESENTED BY: Weyman Lundquist

Passive magnetic components that store and transfer energy are typically amongst the largest items in an electronic assembly. There is substantial room for size and cost reduction over the next 5 to 10 years. This talk will examine how far these improvements can be taken. Improvements in magnetic components can be achieved from a number of areas including specialized core materials, winding design, more efficient packaging. This presentation will first focus on improvements that are available through improved packaging and the future for lower loss core materials. Next, parameters that influence winding loss will be presented, for example, different winding techniques and the relative advantages of different types of windings including the patented shaped foil technology developed by WCM and the Thayer School of Engineering at Dartmouth. Finally, the effect of switching frequency on the size of magnetic components and the improvements available today and in the future from going to increased switching frequencies will be presented.

Danfoss Silicon Power GmbH
ROOM 214D

Automotive Traction Module Platform

PRESENTED BY: Siegbert Haumann

Based on several years of experience, Danfoss has developed a new, scalable power module platform that lives up to stringent automotive requirements. The module family combines Danfoss' unique technologies; the high performance direct liquid cooling system (ShowerPower® 3D), advanced sintering die attach and copper-wire-bonding (Danfoss Bond Buffer™) all in utilizing the robust encapsulation method of transfer molding. The platform will allow for flexible use of Si and SiC power semiconductors and will be designed to meet the customers' specific mission profiles. The design will be able to adapt to both 700V and 1200V Si and SiC devices and with battery voltages of 400V or 800V.

ITG Electronics Inc.
ROOM 217A

COTS Filters for MIL-STD-461 Applications

PRESENTED BY: Rafik Stepanian

How to mitigate and select a Commercial Off the Shelf (COTS) EMI filter for MIL-STD-461 applications. EMI requirements are often ignored during product and system design. This is because there are typically no set parameters to design an EMI solution during the product design cycle. Design engineers today are tasked to provide low cost COTS EMI filter solutions for military applications to mitigate unwanted EMI emissions. This presentation identifies EMI noise generators, provides EMI test methods, their limits, the failure modes and finally how to choose proper EMI filter solutions that meets the MIL-STD-461conducted emissions from 10KHz to 10MHz requirements, and maintain filter attenuation up to 1GHZ and above when installed in the system with additional shielding and isolation between input and output terminations.

United Silicon Carbide Inc.
ROOM 217B

USCi Gen 3 Cascode and Diode products

PRESENTED BY: Anup Bhalla

SiC devices from USCi have been assessed in Totem-Pole PFC and Vehicle On-board charger applications. Demo boards provided by USCi are discussed in this session, to aid evaluation of the USCi devices. The standard gate drive, excellent switching and Qrr characteristics are shown to result in excellent efficiency performance with ease-of-use. Attendees will get a clear understanding of the device characteristics and how they drive performance in these and similar power conversion applications.

SABIC

ROOM 217C

ULTEM UTF120 High Temperature Dielectric Film For Capacitor Applications

PRESENTED BY: Dr. Neal Pfeiffenberger

A new class of high temperature capacitor films, based on polyetherimide (PEI) chemistry, has been developed and electrically characterized versus other common dielectric capacitor films. From fiber optics to high temperature flame resistant personal protection equipment (PPE), ULTEMTM resin has long been used in applications which demand long-term high temperature resistance and dimensional stability. SABIC's ULTEM UTF120 film has been developed to offer excellent handling and processing through common metallization and capacitor winding equipment for both round and squashed capacitors. Additionally, ULTEM UTF120 film can provide stable electrical performance through temperature and frequency, making it an outstanding candidate for DC applications such as electric compressors and DC-DC converters. SABIC is a global leader in diversified chemicals with manufacturing and R&D facilities in the Americas, Europe, Middle East and Asia Pacific. We support our customers by collaborating and developing solutions in key end markets such as electrical and electronics, construction, medical devices, packaging, agri-nutrients, transportation and clean energy.

Mitsubishi Electric US, Inc.

ROOM 217D

Latest Power Semiconductor Packaging and Chip Technology

PRESENTED BY: Eric Motto

This session will highlight the latest power semiconductor modules from Mitsubishi Electric, featuring state of the art silicon and silicon carbide chip technology along with new high reliability packaging, to provide increased efficiency and higher performance for industrial, automotive, and alternative energy applications.

Exhibit Hall

Exhibitor Listing

as of 2.15.18

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