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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

It is my honor to personally welcome you to the 33rd 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.

**DIAMOND**

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- WÜRTH ELEKTRONIK

**PLATINUM**

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- power integrations™

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- NEW ENGLAND WIRE TECHNOLOGIES

Our Sponsors
APEC 2018 Sponsors provide financial backing (including liability).
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Industry Session Co-Chair
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Texas Instruments

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Grants and Awards Chair
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University of Texas at San Antonio

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Texas Instruments

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Babak Fahimi
University of Texas at Dallas

Alireza Khaligh
University of Maryland at College Park

Eric Persson
Infineon Technologies

Ernie Parker
Crane Aerospace & Electronics
# Schedule-at-a-Glance

**Sunday, March 4, 2018**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 a.m. – 8:00 a.m.</td>
<td>Registration</td>
<td>WEST REGISTRATION</td>
</tr>
<tr>
<td>8:00 a.m. – 5:00 p.m.</td>
<td>Mobile App Help Desk</td>
<td>MAIN LOBBY</td>
</tr>
<tr>
<td>8:00 a.m. – 9:00 a.m.</td>
<td>Presenter Breakfast</td>
<td>HEMISFAIR BALLROOM C3</td>
</tr>
<tr>
<td>9:30 a.m. – 1:00 p.m.</td>
<td>S01: Fundamentals of Switch Mode Power Conversion</td>
<td>ROOM 217D</td>
</tr>
<tr>
<td>9:30 a.m. – 1:00 p.m.</td>
<td>S02: Modern Soft Switching Technologies</td>
<td>ROOM 206</td>
</tr>
<tr>
<td>9:30 a.m. – 1:00 p.m.</td>
<td>S03: Thermal and Reliability Modelling of Power Electronics Systems</td>
<td>ROOM 217A</td>
</tr>
<tr>
<td>9:30 a.m. – 1:00 p.m.</td>
<td>S04: WBG Switching Circuits: Design, Test, Devices and Applications</td>
<td>ROOM 214AB</td>
</tr>
<tr>
<td>9:30 a.m. – 1:00 p.m.</td>
<td>S05: High-Efficiency Single-Phase Inverter Design – VT-FEEC</td>
<td>ROOM 214CD</td>
</tr>
<tr>
<td>9:30 a.m. – 1:00 p.m.</td>
<td>S06: Power Quality Control in Hybrid AC/DC Microgrids</td>
<td>ROOM 217BC</td>
</tr>
<tr>
<td>11:00 a.m. – 11:30 a.m.</td>
<td>Lunch</td>
<td>PARKVIEW REGISTRATION FOYER</td>
</tr>
<tr>
<td>11:30 a.m. – 1:00 p.m.</td>
<td>Break</td>
<td>On Own</td>
</tr>
<tr>
<td>2:00 p.m. – 6:00 p.m.</td>
<td>S07: Electromagnetic Interference and Compatibility for Power Electronics Engineers</td>
<td>ROOM 217D</td>
</tr>
<tr>
<td>2:00 p.m. – 6:00 p.m.</td>
<td>S08: New High-Frequency Magnetics Circuit Models</td>
<td>ROOM 214CD</td>
</tr>
<tr>
<td>2:00 p.m. – 6:00 p.m.</td>
<td>S09: Advanced Thermal Management Technologies</td>
<td>ROOM 217A</td>
</tr>
<tr>
<td>2:00 p.m. – 6:00 p.m.</td>
<td>S10: Designing Reliable and High Density Power Supplies with GaN</td>
<td>ROOM 214AB</td>
</tr>
<tr>
<td>2:00 p.m. – 6:00 p.m.</td>
<td>S11: Power Semiconductors for Traction Inverters in Vehicles: from Discretes to Power Modules, from Silicon to Wide Band Gap Devices</td>
<td>ROOM 206</td>
</tr>
<tr>
<td>2:00 p.m. – 6:00 p.m.</td>
<td>S12: Power Converters for Energy Storage Applications – Analysis and Design from Theory to Practice</td>
<td>ROOM 217BC</td>
</tr>
<tr>
<td>4:00 p.m. – 4:30 p.m.</td>
<td>Break</td>
<td>PARKVIEW REGISTRATION FOYER</td>
</tr>
</tbody>
</table>

**Monday, March 5, 2018**

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

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

Schedule as of February 15
Schedule-at-a-Glance

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  
.....................1:30 p.m. – 2:00 p.m. 
ROOM 217A

Break  
.....................3:00 p.m. – 3:30 p.m. 
ROOM 214C

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. 
MAIN 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. 
ROOM 212

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

<table>
<thead>
<tr>
<th>Session #1 (Concurrent Sessions)</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhibitor Seminars – Session #1</td>
<td>2:15 p.m. – 2:45 p.m.</td>
<td>See Page 60</td>
</tr>
<tr>
<td>Break</td>
<td>2:45 p.m. – 3:15 p.m.</td>
<td>PARKVIEW REGISTRATION FOYER</td>
</tr>
<tr>
<td>Campfire Connections - Women in</td>
<td>2:45 p.m. – 3:15 p.m.</td>
<td>THE HUB, BOOTH 931</td>
</tr>
<tr>
<td>Engineering.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exhibitor Seminars – Session #2</td>
<td>3:00 p.m. – 3:30 p.m.</td>
<td>See Page 61</td>
</tr>
<tr>
<td>Exhibitor Seminars – Session #3</td>
<td>3:45 p.m. – 4:15 p.m.</td>
<td>See Page 62</td>
</tr>
<tr>
<td>R01: Biggest Impact on Power Conversion- Devices or Magnetics</td>
<td>5:00 p.m. – 6:30 p.m.</td>
<td>HEMISFAIR C1</td>
</tr>
<tr>
<td>R02: Drive Isolation Technologies: Optical, Ganetic, or Capacitive Coupling</td>
<td>5:00 p.m. – 6:30 p.m.</td>
<td>HEMISFAIR C2</td>
</tr>
<tr>
<td>R03: GaN vs.SiC vs Si for next Generation Power Devices</td>
<td>5:00 p.m. – 6:30 p.m.</td>
<td>HEMISFAIR C3</td>
</tr>
<tr>
<td>IEEE PELS-IAS Young Professionals Reception</td>
<td>7:00 p.m. – 10:00 p.m.</td>
<td>RIO RIO CANTINA, ESTRELLA ROOM (3RD FLOOR)</td>
</tr>
<tr>
<td><strong>IEEE PELS Mentorship Round Tables (Registration Required)</strong></td>
<td>7:30 p.m. – 9:30 p.m.</td>
<td>ROOM 4</td>
</tr>
</tbody>
</table>

**Wednesday, March 7, 2018**

<table>
<thead>
<tr>
<th>Session</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Presenter Breakfast</td>
<td>7:00 a.m. – 8:00 a.m.</td>
<td>HEMISFAIR BALLROOM C3</td>
</tr>
<tr>
<td>Registration</td>
<td>7:00 a.m. – 3:00 p.m.</td>
<td>WEST REGISTRATION</td>
</tr>
<tr>
<td>Spouse and Guest Breakfast</td>
<td>8:00 a.m. – 10:00 a.m.</td>
<td>RIO VISTA ROOM at the MARRIOTT RIVERCENTER</td>
</tr>
<tr>
<td>IS06: Wide Bandgap Device Topics</td>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>ROOM 206</td>
</tr>
<tr>
<td>IS07: Power Solutions for Challenging Real-World Applications</td>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>ROOM 207</td>
</tr>
<tr>
<td>IS08: Vehicle Electrification</td>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>ROOM 205</td>
</tr>
<tr>
<td>IS09: Isolation Topics in Power Supplies</td>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>ROOM 212</td>
</tr>
<tr>
<td>IS010: Modeling &amp; Simulation</td>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>ROOM 213</td>
</tr>
<tr>
<td>T09: Resonant Converters</td>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>ROOM 214A</td>
</tr>
<tr>
<td>T10: Power Electronics for Utility Interface – Power Quality &amp; Harmonics</td>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>ROOM 214B</td>
</tr>
<tr>
<td>T11: Control of Inverters and Drives II</td>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>ROOM 214C</td>
</tr>
<tr>
<td>T12: Magnetics</td>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>ROOM 214D</td>
</tr>
<tr>
<td>T13: EMI Detection and Mitigation Methods</td>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>ROOM 217A</td>
</tr>
<tr>
<td>T14: Battery Systems</td>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>ROOM 217B</td>
</tr>
<tr>
<td>T15: Charging and Energy Storage Topics</td>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>ROOM 217C</td>
</tr>
<tr>
<td>T16: New Technology</td>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>ROOM 217D</td>
</tr>
<tr>
<td>Campfire Connections – Magnetics</td>
<td>10:10 a.m. – 10:40 a.m.</td>
<td>THE HUB, BOOTH 931</td>
</tr>
<tr>
<td>Exhibit Hall Open</td>
<td>10:00 a.m. – 2:00 p.m.</td>
<td>EXHIBIT HALL 3/4</td>
</tr>
<tr>
<td>Break</td>
<td>10:10 a.m. – 10:40 a.m.</td>
<td>EXHIBIT HALL 3/4</td>
</tr>
<tr>
<td>Exhibitor Seminars – Session #1 (Concurrent Sessions)</td>
<td>10:30 a.m. – 10:30 a.m.</td>
<td>See Pages 74-75</td>
</tr>
<tr>
<td>Exhibitor Seminars – Session #2 (Concurrent Sessions)</td>
<td>11:15 a.m. – 11:45 a.m.</td>
<td>See Pages 75-76</td>
</tr>
<tr>
<td>Exhibitor Seminars – Session #3 (Concurrent Sessions)</td>
<td>12:00 p.m. – 12:30 p.m.</td>
<td>See Page 76</td>
</tr>
<tr>
<td>Lunch</td>
<td>12:30 p.m. – 2:00 p.m.</td>
<td>EXHIBIT HALL 3/4</td>
</tr>
<tr>
<td>IS11: Enabling High-Volume Wide Bandgap Semiconductor Manufacturing and Applications</td>
<td>2:00 p.m. – 5:25 p.m.</td>
<td>ROOM 206</td>
</tr>
<tr>
<td>KEY:</td>
<td>S = Professional Education Seminars</td>
<td>R = Rap Sessions</td>
</tr>
<tr>
<td>----------------------</td>
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<td>------------------</td>
</tr>
<tr>
<td>IS12:</td>
<td>Vehicle Batteries – It’s More Than Just Stacking Cells Together and an EV1 Retrospective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2:00 p.m. – 5:25 p.m.</td>
<td>ROOM 207</td>
</tr>
<tr>
<td>IS13:</td>
<td>Alternative Energy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2:00 p.m. – 5:25 p.m.</td>
<td>ROOM 205</td>
</tr>
<tr>
<td>IS14:</td>
<td>Innovative Component, Reliability and Manufacturing 3D Power Packaging Solutions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2:00 p.m. – 5:25 p.m.</td>
<td>ROOM 212</td>
</tr>
<tr>
<td>IS15:</td>
<td>Motor Drives, Inverters and Modules</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2:00 p.m. – 5:25 p.m.</td>
<td>ROOM 213</td>
</tr>
<tr>
<td>T17:</td>
<td>Single-Phase AC-DC Converters</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2:00 p.m. – 5:30 p.m.</td>
<td>ROOM 214A</td>
</tr>
<tr>
<td>T18:</td>
<td>Soft Switching Converters</td>
<td></td>
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<td></td>
<td>2:00 p.m. – 5:30 p.m.</td>
<td>ROOM 214B</td>
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<tr>
<td>T19:</td>
<td>Control of Inverters and Drives I</td>
<td></td>
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<tr>
<td></td>
<td>2:00 p.m. – 5:30 p.m.</td>
<td>ROOM 214C</td>
</tr>
<tr>
<td>T20:</td>
<td>GaN Device Opportunities and Challenges</td>
<td></td>
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<td></td>
<td>2:00 p.m. – 5:30 p.m.</td>
<td>ROOM 214D</td>
</tr>
<tr>
<td>T21:</td>
<td>Power Converter Modeling &amp; Control</td>
<td></td>
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<tr>
<td></td>
<td>2:00 p.m. – 5:30 p.m.</td>
<td>ROOM 217A</td>
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<tr>
<td>T22:</td>
<td>Control Strategies for Inverters &amp; Motor Drives</td>
<td></td>
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<tr>
<td></td>
<td>2:00 p.m. – 5:30 p.m.</td>
<td>ROOM 217B</td>
</tr>
<tr>
<td>T23:</td>
<td>Wireless Power Transfer Applications</td>
<td></td>
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<td></td>
<td>2:00 p.m. – 5:30 p.m.</td>
<td>ROOM 217C</td>
</tr>
<tr>
<td>T24:</td>
<td>Photovoltaic &amp; Grid Tie Systems</td>
<td></td>
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<tr>
<td></td>
<td>2:00 p.m. – 5:30 p.m.</td>
<td>ROOM 217D</td>
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<tr>
<td>Break:</td>
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<td></td>
<td>3:40 p.m. – 4:10 p.m.</td>
<td>PARKVIEW REGISTRATION FOYER</td>
</tr>
<tr>
<td>“Western” Evening Social Event (Ticket Required)</td>
<td>6:00 p.m. – 9:00 p.m.</td>
<td>HEMISFAIR BALLROOM</td>
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</table>

**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

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

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.

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<th>On-site</th>
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<tr>
<td>Conference Proceedings (USB Only)</td>
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<td>Seminar Workbook (USB only)</td>
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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/
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: 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](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
## 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 6A
- 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
### Tuesday, March 6, 2018 (continued)

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

### Wednesday, March 7, 2018

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Women In Engineering (WIE) Breakfast</td>
<td>8:00 a.m. – 9:00 a.m.</td>
<td>ROOM 6A</td>
</tr>
<tr>
<td>Cyber Physical Security Meeting</td>
<td>9:00 a.m. – 10:30 a.m.</td>
<td>ROOM 4</td>
</tr>
<tr>
<td>PELS Products Committee</td>
<td>9:30 a.m. – 11:30 a.m.</td>
<td>ROOM 6A</td>
</tr>
<tr>
<td>IEEE Transactions on Power Electronics Editorial Board</td>
<td>11:30 a.m. – 2:00 p.m.</td>
<td>ROOM 6BC</td>
</tr>
<tr>
<td>PELS Standards Committee</td>
<td>2:00 p.m. – 2:30 p.m.</td>
<td>ROOM 7A</td>
</tr>
<tr>
<td>PELS Technical Operations Committee</td>
<td>2:30 p.m. – 4:30 p.m.</td>
<td>ROOM 6A</td>
</tr>
<tr>
<td>ITRW Steering Committee</td>
<td>2:30 p.m. – 4:30 p.m.</td>
<td>ROOM 7A</td>
</tr>
</tbody>
</table>

### Thursday, March 8, 2018

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>PELS Conference Committee Breakfast</td>
<td>8:00 a.m. – 9:00 a.m.</td>
<td>ROOM 6A</td>
</tr>
<tr>
<td>PELS Conferences Committee</td>
<td>9:00 a.m. – 11:30 a.m.</td>
<td>ROOM 6BC</td>
</tr>
<tr>
<td>PELS Administrative Committee</td>
<td>2:00 p.m. – 5:30 p.m.</td>
<td>ROOM 6BC</td>
</tr>
<tr>
<td>PELS Administrative Committee Dinner</td>
<td>6:30 p.m. – 9:30 p.m.</td>
<td>OFFSITE</td>
</tr>
</tbody>
</table>

### Friday, March 9, 2018

<table>
<thead>
<tr>
<th>Event</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>AdCom Breakfast (Companions Welcome)</td>
<td>7:00 a.m. – 8:00 a.m.</td>
<td>ROOM 6A</td>
</tr>
<tr>
<td>PELS Administrative Committee</td>
<td>8:00 a.m. – 11:30 a.m.</td>
<td>ROOM 6BC</td>
</tr>
</tbody>
</table>

*OFFSITE* refers to events taking place outside the main conference area.
# 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
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 Ianuzzo  
*Aalborg University, Denmark*  
ROOM 217A

S04: WBG Switching Circuits: Design, Test, Devices and Applications
Edward Shelton¹, Patrick Palmer², Alan Mantooth³, Brian Zahnstecher², Geoff Haynes¹  
¹Inspirit Ventures, United Kingdom; ²Power Rox Inc, United States; ³University of Arkansas, United States;  
ROOM 214AB

S05: High-Efficiency Single-Phase Inverter Design – VT-FEEC Approach for Google Little Box Challenge
Jason Lai¹, Lanhua Zhang²  
¹Virginia Tech, United States, ²Texas 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 Behesht, Sandeep Bahl, Serkan Dusmez, Ted Chen  
Texas Instruments Inc., United States  
ROOM 214AB

S11: Power Semiconductors for Traction Inverters in Vehicles: from Discrettes 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

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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 Allen¹, Mark Montrose², Jeff Pasternak³  
¹IEEE Product Safety Engineering Society, United States;  
²Montrose Compliance Services, Inc., United States;  
³Intel 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\textsuperscript{2}, Bernhard Eichler\textsuperscript{1}, Paul Drexhage\textsuperscript{2}
\textsuperscript{1}SEMIKRON Elektronik GmbH\&Co. KG, Germany;
\textsuperscript{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\textsuperscript{3}, Rolando Burgos\textsuperscript{2}, Paolo Mattavelli\textsuperscript{1}, Dushan Borovec\textsuperscript{2}
\textsuperscript{1}University of Padova, Italy; \textsuperscript{2}Virginia Tech, United States; \textsuperscript{3}Xi’an Jiaotong University, China
ROOM 217D

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9:00 a.m. – 12:00 p.m.
Spouse and Guest Tour
\textbf{American Indians in Texas Mission Tour}
(Registration Required)
departs from MARRIOT RIVERCENTER LOBBY

1:15 p.m. – 5:00 p.m.
\textbf{Plenary Session}
(for detailed information see page 136)
HEMISFAIR BALLROOM C1/C2

1:30 p.m. – 2:00 p.m.
\textbf{Power: A Fundamental Ingredient of Advanced Science and Applied Technology}
Adam L. Hamilton P.E., President and Chief Executive Officer, Southwest Research Institute (SwRF\textsuperscript{\textregistered})

2:00 p.m. – 2:30 p.m.
\textbf{Vienna Rectifier and Beyond}
Dr. Johann W. Kolar, Director Power Electronic Systems Laboratory, ETH Zurich

2:30 p.m. – 3:00 p.m.
\textbf{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.
\textbf{Break}

3:30 p.m. – 4:00 p.m.
\textbf{WPT: from $\mu$W/cm$^2$ 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.
\textbf{3D Power Packaging made Real with Embedded Component and Substrate Technologies}
Dr. Markandeya R. Pulugurtha, Associate Research Director, Georgia Tech - PRC

4:30 p.m. – 5:00 p.m.
\textbf{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.
\textbf{Exhibit Hall Welcome Reception}
EXHIBIT HALL 3/4

8:00 p.m. – 10:00 p.m.
\textbf{MicroMouse Contest}
EXHIBIT HALL 4B
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 Carlsten, *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

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

9:20 a.m. – 9:45 a.m.

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

9:45 a.m. – 10:10 a.m.

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

10:40 a.m. – 11:05 a.m.

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

11:05 a.m. – 11:30 a.m.

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

11:30 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. – 11:55 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
NWLS, 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
lika 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
Dusan Vuckovic
Delta Force, Denmark

9:45 a.m. – 10:10 a.m.

IS05.4: Challenges and Solutions for Implementing Energy Harvesting Powered Solutions
Ivan O’Connell
MCCI Ireland, Ireland

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

11:30 a.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, Xiongfei Wang, Frede Blaabjerg, Dushan Boroyevich, Rolando Burgos, Fred Lee
1 Aalborg University, Denmark; 2 Virginia Polytechnic Institute and State University, United States
### T01: 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

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Authors</th>
<th>Institution(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:50 a.m. – 9:10 a.m.</td>
<td>T01.2</td>
<td>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</td>
<td>Nidhi Haryani, Bingyao Sun, Rolando Burgos</td>
<td>CPES, VT, United States</td>
</tr>
<tr>
<td>9:10 a.m. – 9:30 a.m.</td>
<td>T01.3</td>
<td>Critical-Mode-Based Soft-Switching Modulation for Three-Phase Rectifiers</td>
<td>Zhengrong Huang², Zhengyang Liu², Fred Lee², Qiang Li², Furong Xiao¹</td>
<td>Beijing Institute of Technology, China;² CPES, Virginia Tech, United States</td>
</tr>
<tr>
<td>9:30 a.m. – 9:50 a.m.</td>
<td>T01.4</td>
<td>An Adaptive Selection of Intermediate Bus Voltage to Optimize Efficiency in a Universal Input Three-Phase Power Factor Correction Circuit</td>
<td>Hamidreza Hafezinasab², Wilson Eberle², Deepak Gautam¹, Chris Botting¹</td>
<td>Delta-Q Technologies Corp, Canada;¹ University of British Columbia, Canada</td>
</tr>
<tr>
<td>9:50 a.m. – 10:10 a.m.</td>
<td>T01.5</td>
<td>Analysis of One Phase Loss Operation of Three-Phase Isolated Buck Matrix-Type Rectifier with a Boost Switch</td>
<td>Jahangir Afsharian², Dewei Xu², Bin Wu², Bing Gong¹, Zhihua Yang¹</td>
<td>¹ Murata Power Solution, Canada;² Ryerson University, Canada</td>
</tr>
<tr>
<td>10:40 a.m. – 11:00 a.m.</td>
<td>T01.6</td>
<td>A Four-Switch Three-Phase AC-DC Converter with Galvanic Isolation</td>
<td>Javad Khodabakhsh, Gerry Moschopoulos</td>
<td>Western University, Canada</td>
</tr>
<tr>
<td>11:00 a.m. – 11:20 a.m.</td>
<td>T01.7</td>
<td>A New Three-Phase Soft-Switched Bridgeless AC/DC Step-Up Converter with Current Fed Voltage Doubler Modules for DC Grid in Wind Systems</td>
<td>Mehdi Abbasti, John Lam</td>
<td>York University, Canada</td>
</tr>
<tr>
<td>11:20 a.m. – 11:40 a.m.</td>
<td>T01.8</td>
<td>Modular Three-Phase AC-DC LED Driver Based on Summing the Light Output of Each Phase</td>
<td>Ignacio Castro, Manuel Arias, Diego G. Lamar, Marta M. Hernando, Javier Sebastian</td>
<td>University of Oviedo, Spain</td>
</tr>
</tbody>
</table>

### T02: Hybrid DC-DC Converters

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Title</th>
<th>Authors</th>
<th>Institution(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30 a.m. – 12:00 p.m.</td>
<td>T02</td>
<td>Hybrid DC-DC Converters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8:30 a.m. – 8:50 a.m.</td>
<td>T02.1</td>
<td>A Multi-Level, Multi-Phase Buck Converter with Shared Flying Capacitor for VRM Applications</td>
<td>Gianluca Roberts, Nenad Vukadinovic, Aleksandar Prodić</td>
<td>University of Toronto, Canada</td>
</tr>
<tr>
<td>8:50 a.m. – 9:10 a.m.</td>
<td>T02.2</td>
<td>An Ultra Efficient Composite Modular Power Delivery Architecture for Solar Farm and Data Center</td>
<td>Dong Cao², Xiaofeng Lyu², Yanhao Lin², Ze Ni², Jalen Johnson², Shuai Jiang¹, Chenhao Nan¹</td>
<td>¹ Google Inc., United States;² North Dakota State University, United States</td>
</tr>
<tr>
<td>9:10 a.m. – 9:30 a.m.</td>
<td>T02.3</td>
<td>Switched Tank Converters</td>
<td>Shuai Jiang, Chenhao Nan, Xin Li, Chee Chung, Mobashar Yazdani</td>
<td>Google Inc., United States</td>
</tr>
<tr>
<td>9:30 a.m. – 9:50 a.m.</td>
<td>T02.4</td>
<td>Switched Tank Converter Based Partial Power Architecture for Voltage Regulation Applications</td>
<td>You He², Shuai Jiang¹, Chenhao Nan¹</td>
<td>¹Google Inc., United States;² Massachusetts Institute of Technology, United States</td>
</tr>
<tr>
<td>9:50 a.m. – 10:10 a.m.</td>
<td>T02.5</td>
<td>PCB Embedded Inductor for High-Frequency ZVS SEPIC Converter</td>
<td>Yi Dou, Ziwei Ouyang, Prasanth Thummalla, Michael Andersen</td>
<td>Technical University of Denmark (DTU), Denmark</td>
</tr>
</tbody>
</table>
Tuesday

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, Giovanni Bonanno, Luca Corradini, Cristian Garbossa
1Infineon Technologies Italia Srl, Italy; 2University 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/in² 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, Li Wang, Liqi Zhang, Alex Q. Huang
1North Carolina State University, United States; 2University 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, Dragan Maksimovic, Brian Johnson
1National Renewable Energy Laboratory, United States; 2University 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
1Macquarie University, Australia; 2University of Texas at Austin, United States

8:30 a.m. – 12:00 p.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

11:00 a.m. – 11:20 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

11:20 a.m. – 11:40 a.m.

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

11:40 a.m. – 12:00 p.m.
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.

**T04.3:** 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 Astronautics, 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 Tang1, Yujing Liu1, Yashovardha Rastogi3, Nimananda Sharma1, Tanmay Shukla2
1Chalmers University of Technology, Sweden; 2Segula Technologies AB, Sweden; 3Volvo 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 He1, Jin Huang1, Min Kang2
1Department of Electrical Engineering, Zhejiang University, China; 2Department of Electrical Engineering, Zhejiang University of Science and Technology & Hangzhou Fushe, China

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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 Hontz2, Rongming Chu1, Raghav Khanna2
1HRL Laboratories, LLC, United States; 2University 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 Duan2, Yong Kang2, Francesco Iannuzzo1, Ionut Trintis1, Frede Blaabjerg1
1Aalborg University, Denmark; 2Huazhong 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 Ordónez, 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; \(^2\)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 Mioannou\(^2\), Yanhui Liu\(^2\), Aleksandar Prodić\(^2\), 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:** \(\Delta V/\Delta t\)-Intervention Control Concept for Improved Transient Response in Digitally Controlled Boost Converters
Samuel Quenzer-Hohmuth\(^2\), Steffen Ritzmann\(^3\), Thoralf Rosahl\(^1\), Bernhard Wicht\(^1\)
\(^1\)Leibniz University Hannover, Germany; \(^2\)Reutlingen University – Robert Bosch Center for Power Electronics, Germany; \(^3\)Robert Bosch GmbH, Germany
8:30 a.m. – 12:00 p.m.

**T07: Inverters for PV Systems**

ROOM 217C

**Renewable Energy Systems**

Afirid 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 Li², Yanfeng Shen¹, Yongheng Yang¹, Zian Qin², Frede Blaabjerg³
¹Aalborg University, Denmark; ²Delft University of Technology, Netherlands; ³The 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 Shaffer², Hassan Hassan², Mark Scott², Saad Ul Hasan¹, Graham E. Town¹, Yamin Siwakoti³
¹Macquarie University, Australia; ²Miami University, United States; ³University 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
**Tuesday**

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

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8:30 a.m. – 8:50 a.m.

**T08.1:** Multilevel Tracking Power Supply for Switch-Mode Audio Power Amplifiers
Niels Iversen¹, Vladan Lazarevic², Miroslav Vasic², Arnold Knott¹, Michael Andersen¹, Jose Cobos²
¹Technical University of Denmark, Germany; ²Technical University of Denmark, Denmark; ³Universidad Politécnica de Madrid, Spain

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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

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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

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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

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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 Abdelmessih², Jose Marcos Alonso², Wen-Tien Tsai¹
¹Industrial Technology Research Institute, Taiwan; ²University of Oviedo, Spain

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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

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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

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11:20 a.m. – 11:40 a.m.

**T08.8:** Performance Assessment of the VSC Using Two Model Predictive Control Schemes
Mohamed Alhasheem¹, Ahmed Abdelhakim³, Tomislav Dragicevic¹, Luca Dalessandro², Frede Blaabjerg¹
¹Aalborg university, Denmark; ²Schaffner EMV AG, Switzerland; ³University of Padova, Italy

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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

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12:00 p.m. – 5:00 p.m.

**Exhibit Hall Open**

EXHIBIT HALL 3/4

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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

SIMPULS 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
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
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: Research 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 vs 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. Pacholok¹, Jim Spangler²
CEC Induction LLC United States¹, Spangler Prototype Inc., United States²

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
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
LTMC 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 Rice¹, Patrick DeRoy²
Texas Instruments, United States¹, CST of America, United States²

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
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\(^1\), Mumu Wu\(^2\), Jianfeng Zhao\(^2\), Wei Quinn 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, Zhongjiao Wang, Janviere Umohuza, 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\(^2\), Juan.C Vasquez\(^1\), Chun-Lien Su\(^3\)
\(^1\)Aalborg university, Denmark; \(^2\)Gdynia Maritime University, Poland; \(^3\)National Kaohsiung Marine University, Taiwan
Wednesday

8:30 a.m. – 10:10 a.m.

T12: Magnetics
ROOM 214D

**Devices and Components**

Matt Wilkowski, Intel
Jason Pries, Oak Ridge National Laboratory

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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

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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 Universität Delft, Netherlands

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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

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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\(^3\), David Perreault\(^2\), Charles Sullivan\(^1\)
\(^1\)Dartmouth, United States; \(^2\)Massachusetts Institute of Technology, United States

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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

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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

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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

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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 Lakshmanan\(^1\), Liang Jia\(^1\)
\(^1\)Google Inc., United States; \(^2\)University of Florida, United States

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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

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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\(^2\), Yinhui Mei\(^1\), Khai D.T. Ngo\(^2\), Guo-Quan Lu\(^2\)
\(^1\)Tianjin University, China; \(^2\)Virginia Tech, United States

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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
### Wednesday

**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*

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**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

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**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

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**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*

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**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*

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**9:50 a.m. – 10:10 a.m.**


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

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**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.*

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**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*

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**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 Popović, Khurram Afridi

*University of Colorado Boulder, United States*

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**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*

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**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*

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**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-Leon¹, Liming Liu¹, Sandeep Bala¹, Giovanni Manchia²
¹ABB Corporate Research Center, United States; ²ABB 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. BurdÀo
Universidad de Zaragoza, Spain

9:10 a.m. – 9:30 a.m.

Mahmoud Shousha, Dragan Dinulovic, Michael Brooks, Martin Haug
Magi3C R&D, WÄhrth 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

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 Nanocrystalline 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

12:00 p.m. – 12:30 p.m.

**Exhibitor Seminars – Session #3**
(for detailed information see pages 205-208)

- **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

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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

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

2:00 p.m. – 2:25 p.m.

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

2:25 p.m. – 2:50 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

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- **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.

**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

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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*

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2:00 p.m. – 5:00 p.m.

**IS13: Alternative Energy**

ROOM 205

**Session Chair:**
Jason Katcha, Present Power Systems

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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,*
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. – 5:25 p.m.

IS14.1: Conductive Fusion Technology: Advanced Die Attach Materials for High Power Applications
Nicholas Krasco¹, Maciej Patelka¹, Steve Anagnostopoulos¹, Sho Ikeda¹, Frank Letizia¹, Toshiyuki Sato¹, Satomi Kawamoto², Miguel Goni², Elbara Ziade², Aaron J. Schmidt²
NAMICS, United States¹, Boston University, United States²

2:00 p.m. – 2:25 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

2:25 p.m. – 2:50 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 Luo¹, Zheng Wang²
¹LG Electronics China R&D Center, China, ²Southeast 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
SEMIRKRON 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 Rogers¹, Junya Sakaï¹, Eric Motto²
¹Mitsubishi Electric Corporation, United States, ²Powerex

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
**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/In³ 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 Chen², Sombuddha Chakraborty³, David Perreault¹
¹Massachusetts Institute of Technology, United States;
²Princeton University, United States; ³Texas 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 Chen², Hongliang Wang², Yan-Fei Liu², P. C. Sen², Xiaodong Liu¹
¹Anhui University of Technology, China;
²Queen’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 Wu², Tsong-Juu Liang², Kai-Hui Chen¹, Cheng-Yuan Li¹
¹National Cheng Kung University, Taiwan;
²National 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
*APEC.2018 Conference and Exposition*

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*

2:40 p.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*
3:00 p.m. – 3:20 p.m.
T18.4: High-Frequency LC³L Resonant DC-DC Converter for Automotive LED Driver Applications
Satyaki Mukherjee1, Alihossein Sepahvand2, Dragan Maksimovic3
1Indian Institute of Technology, Kharagpur, India; 2Texas Instruments, United States; 3University 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 Lim1, June-Seok Lee2, Joon Hyoung Ryu2, Kyo-Beum Lee1
1Ajou University, Korea; 2KRRI, Korea

2:20 p.m. – 2:40 p.m.
Min-Hyo Lee2, Ho-Jin Kim1, Hyeong-Jin Kim2, Jang-Mok Kim3
1Busan Techno-Park, Korea; 2LG Electronics, Korea; 3Pusan 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 Qian2, Wenxi Yao2, Kevin Lee1
1Eaton Corporation, United States; 2Zhejiang University, China
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*

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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, Hitoshi Ishida, Tsuguyaus 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*

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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*

3:40 p.m. – 4:00 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*

4:10 p.m. – 4:30 p.m.

**T20.7:** An Analytical Turn-on Power Loss Model for 650-V GaN eHEMTs  
Yanfeng Shen\(^1\), Huai Wang\(^1\), Zhan Shen\(^1\), Fred Paalbjerg\(^1\), Zian Qin\(^2\)  
\(^1\)Aalborg University, Denmark; \(^2\)Delft University of Technology, Netherlands

4:30 p.m. – 4:50 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*

4:50 p.m. – 5:10 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, Jiahuo 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

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<td>T21.1</td>
<td>Impedance-Based Analysis of DC Link Control in Voltage Source Rectifiers</td>
<td>Dapeng Lu, Xiongfei Wang, Frede Blaabjerg (Aalborg University, Denmark)</td>
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<td>Modeling Resonant Converters in a Rotating, Polar Coordinate</td>
<td>Yi-Hsun Hsieh, Fred C. Lee (Virginia Polytechnic Institute and State University, United States)</td>
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<td>First Order Design by Optimization Method: Application to an Interleaved Buck Converter and Validation</td>
<td>Mylène Delhommais, Jean-Luc Schanen, Frédéric Wirtz, Cécile Rigaud, Sylvain Chardon (TRONICO-ALCEN, France; Institut Polytechnique de Grenoble, France)</td>
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<td>Approaches for Continuous-Time Dynamic Modeling of the Asymmetric Dual-Active Half-Bridge Converter</td>
<td>Shiladri Chakraborty, Manas Palmal, Souvik Chattopadhyay (Indian Institute of Technology Kharagpur, India)</td>
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<td>Analysis and Evaluation of Input Power Splitting Method Between Multiple Transmitters for Maximum Wireless Power Transfer</td>
<td>Yuan Cao, Jaber Abu Qahouq (The University of Alabama, United States)</td>
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<td>Virtual Impedance Based Stability Analysis for Direct Digital Controlled Single-Phase Grid-Connected Inverter with LCL Filter Having Wide Inductance Variation</td>
<td>Tsai-Fu Wu, Mitradatta Misra, Ying-Yi Jhang, Chun-Yi Lin (National Tsing Hua University, Taiwan)</td>
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<td>T22</td>
<td>Control Strategies for Inverters &amp; Motor Drives</td>
<td>Jaber Abu Qahouq (The University of Alabama), Xiong Li (Texas Instrument)</td>
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<td>T22.1</td>
<td>Common-Mode Voltage Elimination of Three-Level T-Type Inverters with a Finite Control Set Model Predictive Control Method</td>
<td>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)</td>
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<td>T22.2</td>
<td>Using One FPGA to Control Two High-Switching-Frequency PMSM Drive Systems Through a Novel Time-Division Multiplexing Method</td>
<td>Wei Qian, Fanning Jin, Kevin Bai, Dingguo Lu, Bing Cheng (Mercedes-Benz Research, United States; University of Michigan-Dearborn, United States)</td>
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**Wednesday**
2:40 p.m. – 3:00 p.m.
T22.3: Improved Virtual Synchronous Generator Control Strategy for Seamless Switching
Zishun Peng\textsuperscript{1}, Jun Wang\textsuperscript{1}, Yuxing Dai\textsuperscript{1}, Yeting Wen\textsuperscript{1},
Z. John Shen\textsuperscript{1}, Zongjian Li\textsuperscript{1}, Daqiang Bi\textsuperscript{2}
\textsuperscript{1}Hunan University, China; \textsuperscript{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\textsuperscript{2}, Milan Ilic\textsuperscript{1}, Dragan Maksimovic\textsuperscript{2}
\textsuperscript{1}Empower Micro Systems, United States; \textsuperscript{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\textsuperscript{2}, Alex Q. Huang\textsuperscript{2}, Xiaobo Dou\textsuperscript{1},
Zaijun Wu\textsuperscript{1}, Minqiang Hu\textsuperscript{1}
\textsuperscript{1}Southeast University, China; \textsuperscript{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 Gural, 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 Saedifard
Georgia Institute of Technology, United States

2:00 p.m. – 5:30 p.m.
T23: Wireless Power Transfer Applications
ROOM 217C

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

2:40 p.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\textsuperscript{2}, Qianhong Chen\textsuperscript{2}, Xiaoyong Ren\textsuperscript{2},
Zhiliang Zhang\textsuperscript{2}, Hui Shi\textsuperscript{1}, Hanzheng Ran\textsuperscript{1}
\textsuperscript{1}China Academy of Engineering Physics, China; \textsuperscript{2}Nanjing University of Aeronautics and Astronautics, China
2:00 p.m. – 5:30 p.m.

T24: Photovoltaic & 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 Shen1, Elizaveta Liivik2, Frede Blaabjerg1, Dmitri Vinnikov2, Huai Wang1, Andrii Chub2
1Aalborg University, Denmark; 2Tallinn University of Technology, Estonia

2:40 p.m. – 3:00 p.m.

Matam Manjunath1, Barry Venugopal Reddy1, Ye Zhao3, Brad Lehman2
1National Institute of Technology Goa, India; 2National Institute of Technology Goa, India; 3Northeastern 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 Tafti2, Ariya Sangwongwanich1, Yongheng Yang1, Georgios Konstantinou2, Josep Pou2, Frede Blaabjerg1
1Aalborg University, Denmark; 2Nanyang Technological University, Singapore; 3University 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 University, 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 Dong1, Hongfei Wu1, Yangjun Lu1, Haibing Hu1, Kai Sun2
1Nanjing University of Aeronautics and Astronautics, China; 2Tsinghua University, China

5:10 p.m. – 5:30 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 Biglarbegian1, Iman Mazhari1, Hamidreza Jafarian1, Namwon Kim1, Babak Parkhidh1, ohan Enslin2
1University of North Carolina at Charlotte, 2Clemson University
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, Daisjiro 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*
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<td>9:45 a.m. – 10:10 a.m.</td>
<td>IS16.4: <em>Gate Oxide and Threshold-Voltage Reliability Considerations for SiC MOSFETs</em>&lt;br&gt;Peter Friedrichs, Thomas Aichinger&lt;br&gt;<em>Infineon Technologies, Germany</em></td>
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<td>10:40 a.m. – 11:05 a.m.</td>
<td>IS15.5: <em>H3TRB-HVDC on SiC: A Relevant Test for Industrial Applications</em>&lt;br&gt;Jonny Ingman, Joni Jormanainen, Elena Mengotti&lt;br&gt;<em>ABB, Finland</em></td>
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<td>11:05 a.m. – 11:30 a.m.</td>
<td>IS16.6: <em>SiC Current Limiting Device (CLD) SOA Determination by Accurate Electro Thermal Spice Model</em>&lt;br&gt;Jean-Baptiste Fonder, Sophie Rollet, Dominique Tournier&lt;br&gt;<em>Caly Technologies, France</em></td>
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<td>8:30 a.m. – 11:30 a.m.</td>
<td>IS17: <em>Powering Servers and Datacenters</em>&lt;br&gt;ROOM 207&lt;br&gt;<strong>Session Chairs:</strong>&lt;br&gt;Harry Soin, <em>Artesyn Embedded Technologies</em>&lt;br&gt;Rick Fishbune, <em>IBM</em></td>
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<tr>
<td>8:30 a.m. – 8:55 a.m.</td>
<td>IS17.1: <em>2-Stage Solution for Data Centers</em>&lt;br&gt;Amin Bemat¹, Qian Ouyang¹, Rohan Samsi², Jinghai Zhou³,&lt;br&gt;<em>HP Enterprise United States¹, Monolithic Power Systems²</em></td>
</tr>
<tr>
<td>8:55 a.m. – 9:20 a.m.</td>
<td>IS17.2: <em>Distributed System Stability in a 48V DC Datacenter</em>&lt;br&gt;Mehran Mirjafari, Lei Wang, Guangyong Zhu, Padmanab Gharpure, John Breen, <em>Dell EMC United States</em></td>
</tr>
<tr>
<td>9:20 a.m. – 9:45 a.m.</td>
<td>IS17.3: <em>Switched Tank Converter Technology for Next-Gen 48V Data Center Power Delivery</em>&lt;br&gt;Shuai Jiang, Chenhao Nan, Xin Li, Chee Chung, Mobashar Yazdani&lt;br&gt;<em>Google, United States</em></td>
</tr>
<tr>
<td>9:45 a.m. – 10:10 a.m.</td>
<td>IS17.4: <em>A Smart Implementation of Switched-Tank Converter System for Next-Gen 48V Data Center Power Delivery</em>&lt;br&gt;Paolo Sandri, Francesco Ghilardi, Roberto Peritore&lt;br&gt;<em>STMicroelectronics, United States</em></td>
</tr>
<tr>
<td>10:40 a.m. – 11:05 a.m.</td>
<td>IS17.5: <em>Heterogeneously Integrated Power Stages Enable Low Profile 12-48V Voltage Regulators</em>&lt;br&gt;Robert Conner, Greg Miller&lt;br&gt;<em>Sarda Technologies, United States</em></td>
</tr>
<tr>
<td>11:05 a.m. – 11:30 a.m.</td>
<td>IS17.6: <em>Smooth Transition between Battery and Power Supply in a Datacenter</em>&lt;br&gt;Lei Wang, Mehran Mirjafari, Kunrong Wang, Guangyong Zhu,&lt;br&gt;<em>Dell EMC United States,</em></td>
</tr>
<tr>
<td>8:30 a.m. – 11:30 a.m.</td>
<td>IS18: <em>Topologies and Control</em>&lt;br&gt;ROOM 205&lt;br&gt;<strong>Session Chairs:</strong>&lt;br&gt;Bill Peterson, <em>E and M Power</em>&lt;br&gt;Laszlo Balogh, <em>ON Semiconductor</em></td>
</tr>
<tr>
<td>8:30 a.m. – 8:55 a.m.</td>
<td>IS18.1: <em>Zero Voltage Switched Interleaved Critical Conduction Mode Totem Pole Bridgeless PFC with GaN Power Stage</em>&lt;br&gt;Hrishikesh Nene, Ted Chen, Salil Chellappan, Igor An&lt;br&gt;<em>Texas Instruments, United States</em></td>
</tr>
<tr>
<td>8:55 a.m. – 9:20 a.m.</td>
<td>IS18.2: <em>E-Mode GaN, 600V, 0.07ohm, Utilized in 3600W LLC 380V to 52V Converter</em>&lt;br&gt;Moshe Domb&lt;br&gt;<em>Infineon Technologies, United States</em></td>
</tr>
<tr>
<td>9:20 a.m. – 9:45 a.m.</td>
<td>IS18.3: <em>A New Buck-Boost Converter that eliminates the Right-Half-Plane-Zero</em>&lt;br&gt;Shingo Hashiguchi, Tetsuo Tateishi&lt;br&gt;<em>ROHM Semiconductor, Japan</em></td>
</tr>
</tbody>
</table>
Thursday

8:30 a.m. – 11:05 a.m.
**IS19: Powering Mobile and Consumer Products**
ROOM 212

**Session Chair:**
Thomas Hopkins, *ST Microelectronics*

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 Szczesny
*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*
### DC-DC Converters

Olivier Trescases, *University of Toronto*
David Reusch, *Efficient Power Conversion Corporation*

**T25: DC-DC Converter Applications**
ROOM 214A

| Time          | Session                                      | Title                                                                 | Speaker(s)                                                                                      | Institution(s)                                                                 |
|---------------|----------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| 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 Li¹, Lei Bai¹, Zhiliang Zhang¹, Shengdong Wang¹, Jiacheng Tang¹, Xiaoyong Ren¹, Jianfei Li² |
|               |                                              | *Nanjing University of Aeronautics and Astronautics, China; 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 Rodrà guez, Daniel G. Aller, Diego G. Lamar, Javier SebastiÀjn |
|               |                                              | *University of Oviedo, Spain*                                        |                                                                                                 |
| 9:50 a.m. – 10:10 a.m. | T25.5:                                         | **High Current Switching Capacitor Converter for on-Package VR**     | Stefano Saggini², Shuai Jiang¹, Mario Ursino², Chenhao Nan¹, Roberto Rizzolatti² |
|               |                                              | *Google, United States; University of Udine, Italy*                   |                                                                                                 |
| 10:40 a.m. – 11:00 a.m. | T25.6:                                         | **Single-Inductor Multiple-Output Converter for High-Power LED Applcations 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* |                                                                                                 |
### Thursday

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

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**T27.1:** A Power Converter Integration Approach with a Multi-Functional Heat Sink Shaped Inductor  
Wenbo Liu¹, Yan-Fei Liu¹, Laili Wang²  
¹Queen’s University, Canada; ²Xi’an Jiaotong University, China

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

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**T27.3:** Gate Driver Design and Continuous Operation of an Improved 1200V/200A FREEDM-Pair Half-Bridge Power Module  
Liqi Zhang³, Xin Zhao³, Xiaoping Song¹, Qianlai Zhu², Souvik Sen³, Pengkun Liu³, Junhong Tong³, Alex Q. Huang³  
¹ABB, United States; ²North Carolina State University, United States; ³University of Texas at Austin, United States

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**T27.4:** Performance Optimization of a 1.2kV SiC High Density Half Bridge Power Module in 3D Package  
Xin Zhao², Bo Gao¹, Liqi Zhang², Douglas Hopkins¹, Alex Q. Huang²  
¹North Carolina State University, United States; ²University of Texas at Austin, United States

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

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**T28.1:** An Improved Burst-Mode Control for VIENNA Rectifiers to Mitigate DC Voltage Ripples at Light Load  
Xinxi Tang², Yang Cao², Yan Xing², Haibin Hu², Lidong Xu¹  
¹JiangSu JinFan Power Technology Co., Ltd, China; ²Nanjing University of Aeronautics and Astronautics, China

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**T28.2:** Control Strategy for Reduction of Current Distortion in Reverse Matrix Converter Under Unbalanced Input Conditions  
Dongho Choi¹, Yeongsu Bak¹, Jong-Pil Lee², Tae-Jin Kim², Kyo-Beum Lee¹  
¹Ajou University, Korea; ²KERI, Korea

---

**T28.3:** Analysis and Design of Enhanced DFT-Based Controller for Selective Harmonic Compensation in Active Power Filters  
Hao Chen¹, Huawu Liu¹, Yan Xing¹, Haibing Hu¹, Kai Sun²  
¹Nanjing University of Aeronautics and Astronautics, China; ²Tsinghua University, China

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**T28.4:** Analysis of Dead-Time Harmonics in Single-Phase Transformerless Full-Bridge PV Inverters  
Yongheng Yang¹, Keliang Zhou², Frede Blaabjerg¹  
¹Aalborg University, Denmark; ²University of Glasgow, United Kingdom
Thursday

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.
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

10:40 a.m. – 11:00 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

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
Thursday

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 Liu¹, Wei Xu¹, Kailiang Yu², Frede Blaabjerg¹
¹Aalborg University, Denmark; ²Huazhong 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 Kaviri¹, Hadis Hajebramih¹, Majid Pahlevani², Praveen Jain¹, Alireza Bakhshai¹
¹Queen's University, Canada; ²University 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 Buticchi², Levy Costa³, Davide Barater⁴, Marco Lisserre³, Eugenio Dominguez¹
¹SerTec S.L., Germany; ²The University of Nottingham; ³University of Kiel, Germany; ⁴University 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 Benzaquen¹, Mohammad Shadmand¹, Arlie Stonestreet II², Behrooz Mirafzal¹
¹Kansas State University, United States; ²Ultra-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 Gangavarapu¹, Akshay Rathore¹, Deepak Fulwani²
¹Concordia University, Canada; ²Indian 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

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8:30 a.m. – 8:50 a.m.
T32.1: Reactive Power Compensation and Resonance Damping for Three-Phase Buck-Type Dynamic Capacitor
Liangli Xiong², Ke Dai², Xinwen Chen², Xiaosheng Wang², Ziwei Dai¹
¹Department of Electrical, Computer and System Engineering Rensselaer Polytechnic Institute, United States; ²School of Electrical and Electronic Engineering, Huazhong University of Science and Technology, China

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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

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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

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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
Eidgenössische Technische Hochschule Zürich, Switzerland

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9:50 a.m. – 10:10 a.m.
T32.5: Energy Storage System Control Strategy to Minimize the Voltage and Frequency Fluctuation in the Microgrid
Qin Lei, Yunpeng Si, Yifu Liu
Arizona State University, United States

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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

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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
Thursday

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  
Zhumin 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 Peng¹, Mengtian Yu², Jin Ke², Ming Xu¹  
¹FSP-Powerland Technology, China; ²Nanjing 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 Vinnikov², Andrii Chub², Elizaveta Liivik¹,  
Frede Blaabjerg¹, Yam Siwakot³  
¹Aalborg University, Denmark; ²Tallinn University of Technology, Estonia; ³University 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 Mostaan², Ahmed Abdelakhim³, Moshen Soltani¹,  
Frede Blaabjerg¹  
¹Aalborg University, Denmark; ²Iranian Central Oil Field Company, Iran; ³University of Padova, Italy
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, Mehdif Ferdowsi, Jonathan Kimball
*Missouri S&T, United States*

5:10 p.m. – 5:30 p.m.
**T33.8:** **A Nonisolated Three-Level Bidirectional DC-DC Converter**
Jianfei Chen¹, Caisheng Wang², Jian Li¹, Chenguang Jiang², Chen Duan²
¹Chongqing University, China; ²Wayne State University, United States

5:30 p.m. – 5:50 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. – 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 Wang², Wei Wang², Dianguo Xu², Xiaonan Lu¹
¹Argonne National Laboratory, United States; ²Harbin 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, Laurenz 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 Gular, 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 Younis¹, Mohamed Ismail¹, Mohamed Orabi¹, Essam Hussain²
¹APEARC, Aswan University, Egypt; ²University of Sheffield, United Kingdom

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**Power Electronics for Utility Interface**

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

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

5:10 p.m. – 5:30 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. – 5:10 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

2:00 p.m. – 2:20 p.m.

T35.2: Quasi Two-Level PWM Operation of a Nine-Arm Modular Multilevel Converter for Six-Phase Medium-Voltage Motor Drives
Mohamed Diab2, Grain Adam2, Barry Williams2, Ahmed Massoud1, Shehab Ahmed3
1Qatar University, Qatar; 2Strathclyde University, United Kingdom; 3Texas A&M University at Qatar, Qatar

2:20 p.m. – 2:40 p.m.

T35.3: Hardware Design of a 1.7 kV SiC MOSFET Based MMC for Medium Voltage Motor Drives
He Li1, Karun Potty2, Ziwei Ke2, Jianyu Pan2, Yingzhuo Chen1, Fan Zhang1, Muneer Al Sabbagh1, Will Perdikakis1, Gengyao Li1, Xi Ye1, Risha Na1, Julia Zhang2, Longya Xu2, Jin Wang2
1Ohio State University, United States; 2The Ohio State University, United States

2:40 p.m. – 3:00 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

3:00 p.m. – 3:20 p.m.

T35.5: Transient Analysis of a Modular Multilevel Converter with Coupled Arm Inductors
Bogdan Dzonlaga, Davi Rabelo Joca, Loi Queval, Jean-Claude Vannier
CentraleSupélec Paris, France

3:20 p.m. – 3:40 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

4:10 p.m. – 4:30 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

4:30 p.m. – 4:50 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

4:50 p.m. – 5:10 p.m.

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 Anurag1, Sayan Acharya1, Yos Prabowo1, Ghanshyaminsinh Gohil2, Hulgize Kassa1, Subhashish Bhattacharya1
1North Carolina State University, United States; 2University of Texas at Dallas, United States

2:40 p.m. – 3:00 p.m.

T36.3: A Comparative Study of SiC MOSFETs and Si IGBTs for High Power Applications
Sahil Meshram, Vivek Bhattacharya
National Institute of Technology, Jamshedpur, India

3:00 p.m. – 3:20 p.m.

T36.4: Techniques for SiC MOSFETs Electrical Characterization
Mohammad Akbar, Mohsen Aminifar
University of Westminster, United Kingdom

3:20 p.m. – 3:40 p.m.

T36.5: An Overview of the Status of SiC and SiC MOSFETs in High Power Electronics
Mark W. Haney, Boeing

3:40 p.m. – 4:00 p.m.
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<thead>
<tr>
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<td>T37: Magnetics Modeling Design &amp; Applications</td>
<td>ROOM 217A</td>
<td>Rolando Burgos, Virginia Tech, Sandeep Bala, ABB Inc. USCRC</td>
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<td>4:30 p.m. – 5:00 p.m.</td>
<td>T36.3: High Voltage SiC Super-Cascode Power Switch Parameter Optimization for Loss Reduction</td>
<td>Thursday 2:40 p.m. – 3:00 p.m.</td>
<td>Xintong Lyu, He Li, Boxue Hu, Zhuxuan Ma, Jin Wang</td>
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<td>3:00 p.m. – 3:20 p.m.</td>
<td>T36.4: High Current Medium Voltage Solid State Circuit Breaker Using Paralleled 15kV SiC ETO</td>
<td>Thursday 3:00 p.m. – 3:20 p.m.</td>
<td>Liqi Zhang, Richard Woodley, Xiaqing Song, Soumik Sen, Xin Zhao, Alex Q. Huang</td>
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<td>T36.5: Experimental Evaluation of IGCT Converters with Reduced di/dt Limiting Inductance</td>
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<td>Tianyu Wei, Qiang Song, Jianguo Li, Biao Zhao, Zhengyu Chen, Rong Zeng</td>
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<td>State Key Lab. of Power Systems, Department of Electrical Engineering, Tsinghua University, China</td>
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<td>T36.6: Optimal Control Strategies for SiC MOSFET and Si IGBT Based Hybrid Switch</td>
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<td>Zongjian Li, Jun Wang, Xi Jiang, Z. John Shen, Xin Yin, Cheng Zeng, Lifeng Deng</td>
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<td>4:00 p.m. – 4:20 p.m.</td>
<td>T36.7: Increasing Emitter Efficiency in 3.3-kV Enhanced Trench IGBTs for Higher Short-Circuit Capability</td>
<td>Thursday 4:00 p.m. – 4:20 p.m.</td>
<td>Paula Diaz Reigosa, Francesco Iannuzzo, Munaf Rahimo, Chiara Corvasce, Freda Blaabjerg</td>
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<td>1Aalborg University, Denmark; 2ABB Switzerland Ltd. Semiconductors, Switzerland</td>
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<td>T36.8: Thermal Resistor and Capacitor Parameter Identification Using Cooling Curve of IGBT Module</td>
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<td>Jun Zhang, Xiong Du, Shuai Zheng, Heng-Ming Tai</td>
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<td>1Chongqing University, China; 2University of Tulsa, United States</td>
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<td>T36.9: Improved Dynamic Voltage Sharing in Multilevel Converters Through Diode Characterization</td>
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<td>Juan Ramirez, Luke Solomon, Daniel Opila</td>
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<td>1GE Healthcare, United States; 2GE Power, United States; 3United States Naval Academy, United States</td>
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Thursday

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 Chattopadhyay¹, Ghanshyam Gohil², Sayan Acharya¹, Viju Nair¹, Subhashish Bhattacharya¹

¹NCSU, United States; ²UT 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

4:30 p.m. – 4:50 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

2:40 p.m. – 3:00 p.m.

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

Zhiyong Xia, Jaber Abu Qahouq

The University of Alabama, United States

3:00 p.m. – 3:20 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 Liu³, Igor Cvetkovic², Zhiyu Shen¹, Dushan Boroyevich⁴, Rolando Burgos², Jinjun Liu³

¹General Electric Global Research Center, United States; ²Virginia Tech, United States; ³Xi’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 Ryan², John Hayes², Richard Morrison¹, Diarmuid Hogan¹

¹Excelsys Technologies, Ireland; ²University College Cork, Ireland

5:10 p.m. – 5:30 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

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2:00 p.m. – 2:20 p.m.

Zhe Zhang, Kevin Tomas-Manez, Yudi Xiao, Michael A. E. Andersen  
Technical University of Denmark, Denmark

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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 Xiao¹, Zhe Zhang², Xingkui Mao¹,  
Kevin Tomas Manez², Michael A. E. Andersen²  
¹Fuzhou University, China; ²Technical University of Denmark, Denmark

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2:40 p.m. – 3:00 p.m.

**T39.3: Hybrid Resonant Half-Bridge DC/DC Converter with Wide Input Voltage Range**  
Bumyun Kim², Sooa Kim², Dong-Young Huh¹,  
Jung-Hwan Choi¹, Minsung Kim²  
¹LG Innotek, Korea; ²Pohang University of Science and Technology, Korea

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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

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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

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4:10 p.m. – 4:30 p.m.

**T39.6: Capacitor Current Compensation Scheme for Flyback Based Photovoltaic AC Module**  
Oscar Montes¹, Sungho Son¹, Jong-Woo Kim²,  
Minsung Kim¹  
¹Pohang University of Science and Technology, Korea; ²Pohang University of Science and Technology, El Salvador

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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

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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

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5:10 p.m. – 5:30 p.m.

**T39.9: Current-Fed Isolated LLC-T Resonant Converter with ZVS and Improved Transformer Utilization**  
Venkata Ratnam Yakcharla¹, Akshay Kumar Rathore¹, Rajesh Kumar²  
¹Concordia University, Canada; ²Malviya National Institute of Technology, India

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2:00 p.m. – 5:30 p.m.

**T40: Industrial Applications**
ROOM 217D

### Power Electronics Applications

Jim Moss, TI  
Lanhua Zhang, Texas Instruments

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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 Gong⁴, Zhi Liu⁴, Yi Wang⁴, Kshitij Gupta⁴, Carlos Da Silva⁴, Todd Liu¹, Z.H. Zheng², W.P. Zhang², Joop van Lammeren³, Henk Jan Bergveld³, C. H. Amon⁴, Olivier Trescases⁴  
¹Datang NXP Semiconductors, China; ²Datang NXP Semiconductors, China; ³NXP Semiconductors, Netherlands; ⁴University of Toronto, Canada

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2:20 p.m. – 2:40 p.m.

**T40.2: An Online Battery Impedance Spectrum Measurement Method with Increased Frequency Resolution**  
Zhiyong Xia¹, Jaber Abu Qahouq²  
¹The University of Alabama, United States; ²The University of Alabama / ECE, United States

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2:40 p.m. – 3:00 p.m.

**T40.3: Design and Implementation of a Distributed Control Structure for Modular Multilevel Matrix Converter**  
Jian Liu³, Wenxi Yao², Zhengyu Lu², Jiankai Ma¹  
¹Newcastle University, United Kingdom; ²Zhejiang University, China
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.

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**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 currents-source 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.
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 magnetic 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.
Session Two, Track 11 (S11)

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.

Session Two, Track 12 (S12)

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 Borovejich
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 and performance, 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
> Wolfgang 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 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.
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 Li1, Jintao Lei2, Qingxin Guan1, Yu Zhang1, Shuai Wang2, David Xu2
1Huazhong University of Science and Technology, China; 2Ryerson University, Canada

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 Qiu1, Wenbo Liu2, Peng Fang2, Yan-Fei Liu2, Paresh C. Sen2
1GaN Systems, Canada; 2Queen’s University at Kingston, Canada

D01.5: Optimum Harmonics Injection to Minimize Bus Capacitance of CRM Boost PFC Converters 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 Huang1, Tsorg-Juu Liang2, Kai-Hui Chen1, Cheng-Yuan Li1
1National Cheng Kung University, Taiwan; 2National Cheng Kung University, Taiwan

D01.13: Single Phase Universal Input PFC Converter Operating at HF
Juan Santiago-Gonzalez2, David Otten2, Seungbum Lim2, Khurram Afridi1, David Perreault2
1CU Boulder, United States; 2MIT, United States

D01.14: Line Power Extension Method for Capacitor Reduction for AC-DC Application
Yang Chen2, Hongliang Wang2, Yan-Fei Liu2, Sucheng Liu1
1Anhui University of Technology, China; 2Queen’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 Huang2, Qingxuan Ma2, Ruiyang Yu2, Tianxiang Chen2, Alex Huang2, Zhuoran Liu1
1University of Chinese Academy of Sciences, China; 2University of Texas at Austin, United States
D02.16: Third Harmonic Compensation in Bridgeless Current Sensorless PFC
Felipe Lopez1, Francisco Javier Azcondo1, Luca Corradini2, Paula Lamo1, Alberto Pigazo1
1University of Cantabria, Spain; 2University of Padova, Italy

D02.17: A Current-Fed DC-DC Converter Using Two Transformers with Reducing Current Ripple and Wide Input Range
Deshang Sha, Ka Liu, Xiao Wang
Beijing Institute of Technology, China

D02.18: 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

D02.19: 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

D02.20: Comparative Analysis of Two Compact and Highly Efficient Resonant Switched Capacitor Converters
Miroslav Vasic1, Petar Grbovic2, Jih-Sheng Lai1, José A. Antonio Cobos2, Lanhua Zhang2, Oscar Yu2, Ido Kolberg2, Doron Shmilovitz2, Shmuel Ben-Yaakov1
1Ben Gurion University, Israel; 2Tel-Aviv University, Israel

D02.21: LLC Resonant Converter with Wide Output Voltage Control Characteristics According to Operating Mode Transition
Eunsoo Kim2, Jicheol Lee2, Yechang Heo1, Takongmo Marius2, Jongseong Ju2, Yoongsang Kook3
1Jeonju University, Korea; 2Jeonju University, Korea; 3Hong Il University, Korea

D02.22: Integrated Magnetics Design for a Full-Bridge Phase-Shifted Converter
Yu-Chen Liu1, Chen Chen2, Shu-Yi Lin2, Cheng-You Xiao2, Katherine Kim3, Yao-Ching Hsieh2, Huang-Jen Chiu2
1National Ilan University, Taiwan; 2National Taiwan University of Science and Technology, Taiwan; 3Ulsan National Institute of Science and Technology, Korea

D02.23: 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 Li2, Mojtaba Ashourloo2, Matthias Rose1, Henkjan Bergveld1, Olivier Trescases2
1NXP semiconductors, Netherlands; 2University of Toronto, Canada

D02.24: Flyback Converter with Hybrid Clamp
Laszlo Huber2, Milan Jovanović3, Haibin Song2, Daofei Xu2, Alpha Zhang2, Chien-Chung Lai1
1Texas Instruments, United States; 2Virginia Tech, United States

D02.25: LLC Resonant Converter with Wide Output Voltage Control Ranges Operating at a Constant Switching Frequency
Eunsoo Kim2, Jicheol Lee2, Yechang Heo1, Takongmo Marius2
1Jeonju University, Korea; 2Jeonju University, Korea

D02.26: LLC Resonant Converter with Wide Output Voltage Control Ranges Operating at a Constant Switching Frequency
Eunsoo Kim2, Jicheol Lee2, Yechang Heo1, Takongmo Marius2
1Jeonju University, Korea; 2Jeonju University, Korea

D02.27: An Improved Analysis Method of Loss for the LLC Multi-Resonant Three-Port Bidirectional DC-DC Converter
Bo Chen, Yifeng Wang, Ping Wang, Wei Li, Fuqiang Han, Liang Yang
Tianjin University, China

D02.28: A Study of Multilevel Resonant DC-DC Converters for Conventional DC Voltage Bus Applications
Javad Khodabakhsh, Gerry Moschopoulos
Western University, Canada

D02.29: Light-Load Efficiency Improvement for LLC Converter with Synchronous Rectification in Solid-State Transformer Application
Chih-Shen Yeh2, Lanhua Zhang1, Jung-Muk Choe2, Cheng-Wei Chen2, Oscar Yu2, Jih-Sheng Lai2
1Texas Instruments, United States; 2Virginia Tech, United States

D02.30: Zero Inductor Voltage Multilevel Bus Converter
Samuel Webb, Tianshu Liu, Yan-Fei Liu
Queen's University, Canada

D02.31: An Improved Analysis Method of Loss for the LLC Multi-Resonant Three-Port Bidirectional DC-DC Converter
Bo Chen, Yifeng Wang, Ping Wang, Wei Li, Fuqiang Han, Liang Yang
Tianjin University, China

D02.32: A General Multi-Phase Coupled-Resonant-Tank Resonant Converter
Hongliang Wang, Yang Chen, Yan-Fei Liu, P.C. Sen
Queen's University, Canada

David Reusch, Suvankar Biswas, Yuanzhe Zhang
Efficient Power Conversion (EPC), United States

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Gabriel Gabian, Jordan Gamble, Benjamin Blalock, Daniel Costinett
University of Tennessee, United States
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DC-DC Converters

Abhijit Pathak, Infineon

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Jinia Roy, Raja Ayyanar
Arizona State University, United States

D03.2: Modeling and Dynamics Investigation of an Active-Clamp Buck Converter
Ziwei Yu1, Chenhao Nan2, Raja Ayyanar1
1Arizona State University, United States; 2Google, United States

D03.3: Real-Time Adaptive Timing Control of Synchronous Rectifiers in High Frequency GaN LLC Converter
Zhuruan Liu1, Ruiyang Yu2, Tianxiang Chen2, Qingyun Huang2, Alex Q. Huang2
1Institute of Electrical Engineering, Chinese Academy of Sciences, China; 2The University of Texas at Austin, United States

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Ye Cikai1, Pritam Das1, Sahoo Sanjib Kumar2, Majid Pahlevaninezhad3
1Cisco, Inc., United States; 2National University of Singapore, Singapore; 3University of Calgary, Canada

D03.5: An Improved Analysis of dv/dt-Induced Low-Side MOSFET False Turn on in Synchronous Buck Converters
Ruqi Li1, Joyce Zhu1, Manjing Xie2
1Cisco, Inc., United States; 2Texas 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 Xu1, Zhiliang Zhang2, Xinlu Chen1, Ke Xu2, Zhou Dong2, Xiaoyong Ren2
1Beijing Century Goldray Semiconductor Co., Ltd., China; 2Nanjing University of Aeronautics and Astronautics, China

D03.9: Air-Core Transformer Integration for GaN VHF Converters
Ke Xu2, Zhiliang Zhang2, Zhi-Wei Xu2, Jiahua Xu2, Xiaoyong Ren2, Qianhong Chen2, Fengbing Yu1
1Mornsun Company, China; 2Nanjing University of Aeronautics and Astronautics, China

D03.10: Discrete-Time Framework for Digital Control Design in a High-Frequency Dual Active Bridge Converter
Avishek Pal2, Santanu Kapat2, Kapil Jha1, Arvind Tiwari1
1GE Global Research, India; 2IIT Kharagpur, India

D03.11: A Self-Bias Supply Scheme for the Control Circuit in Power Converter
Lijuan Shen2, Junjun Zhang1, Junming Zhang2, Shuai Shao2
1Fudan University, State Key Laboratory of Operation and Control of Renewable Energy & Storage, China; 2Zhejiang University, China

D03.12: Analysis, Design and Control of a Resonant Forward-Flyback Converter
Chao Quan1, Yuchuan Geng2, Qianhong Chen2, Ming Xu1, Jiliu Sun1
1FSP-Powerland, China; 2Nanjing University of Aeronautics & Astronautics, China

D03.13: A Sliding Mode Duty-Ratio Control with Current Balancing Algorithm for Interleaved Buck Converters
Shuai Shao1, Majid Pahlevani2, Yue Zhao2, Yuzhi Zhang2
1ABB US Corporate Research Center, United States; 2University of Arkansas, United States

D03.14: Optimal Design of Multi-Winding Planar Transformers in 1 MHz GaN Multiple-Output Forward Converters
Dongdong Hu2, Dongdong Ye1, Zhiliang Zhang2, Binghui He2, Xiaoyong Ren2
1Beijing Institute of Control Engineering, China; 2Nanjing University of Aeronautics and Astronautics, China

D03.15: A SiC-Based Isolated DC/DC Converter for High Density Data Center Applications
1IBM, United States; 2Monolith Semiconductor, Inc., United States; 3The University of Alabama, United States

D03.16: Novel High-Gain Hybrid Current-Driven DC-DC Converter Topology
Snehal Bagawade1, Majid Pahlevani2, Ryan Fernandes3, Praveen Jain1
1Queens University, Canada; 2Sparq Systems Inc., Canada; 3University of Calgary, Canada

D03.17: Half-Bridge Controller with Optimized Pre-Biased Start-Up
Wangxin Huang2, Tobin Hagan2, Maxim Franke2, Brent McDonald2, Oscar Persson1
1Flex Power, Sweden; 2Texas Instruments, United States
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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 ElectromechanicalYaw Power Control Strategies in Small-Scale Grid-Connected Wind Turbines
Ebrahim Mohammadi¹, Roohollah Fadaeinedjad¹, Gerry Moschopoulos²
¹Graduate University of Advanced Technology, Iran; ²University 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 Adib¹, Jacob Lam², Behrooz Mirafzal¹
¹Kansas State University, United States; ²Rockwell 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 He², Chun-Tak Lai¹, Henry Shu-Hung Chung¹, Xin Zhang¹, Weimin Wu¹
¹City University of Hong Kong, Hong Kong; ²Hangzhou Dianzi 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 Zhang², Weiqiang Chen², Ali Bazzi², Scott Ramsay¹, Jeffrey Czapor¹, John Aslanidis¹
¹DRS Consolidated Controls, Inc., United States; ²University 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
D06.1: Starting Current Reduction of Single-Phase Induction Motor for Ultra-Low Temperature Freezer
Seon-Hwan Hwang¹, Jang-Mok Kim²
¹Kyoungnam University, Korea; ²Pusan 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 Costa², Montiê A. Vitorino², Maurício B.R. Corrêa², Filipe A.C. Bahia², Frede Blaabjerg¹
¹Aalborg University, Denmark; ²Federal University of Campina Grande, Brazil

D06.4: Online Stator End Winding Thermography Using Infrared Sensor Array
Padmanabhan Sampath Kumar¹, Lihua Xie¹, Mohamed Sathik Mohamed Hailik¹, Viswanathan Vaiyapur²
¹Nanyang Technological University, Singapore; ²Rolls-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 Cao³, Brandon Grainger³, Xin Wang², Yu Zou¹, Zhi-Hong Mao³
¹Saginaw Valley State University, United States; ²Southern Illinois University Edwardsville, United States; ³University 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 Yu¹, Jian Liu¹, Wenxi Yao¹, Zhengyu Lu¹, Yu Ji²
¹College of Electrical Engineering, Zhejiang University, China; ²State 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 Yang², Jinwu Gong², Jianjun Sun³, Yi Tang², Cheng Cheng³, Xiaoming Zha², Jinmao Gu¹
¹Beijing Xinhang Electrical and Mechanical Equipment Co., Ltd, China; ²Nanyang Technological University, Singapore; ³Wuhan 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
D06.16: An Enhanced PWM Method for Loss Balancing of Five Level T-Type Inverter in PV Systems
Mokhtar Aly¹, Emad M. Ahmed¹, Mohamed Orabi¹, Masahito Shoyama²
¹Aswan University, Egypt; ²Kyushu 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
Mohitab Forouzesh¹, Ahmed Abdelhakim², Yam Siwakoti³, Freda Blaabjerg¹
¹Aalborg University, Denmark; ²University of Padova, Italy; ³University 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 Sakata¹, Masao Taguchi¹, Shoichi Sasaki¹, Tadahiro Kuroda¹, Keiji Toda²
¹Keio University, Japan; ²Toyota Motor Corporation, Japan

D07.5: Research on a Multi-Port Converter with Nine-Switch Cells
Pan Wang², Xiaoming Zha¹, Fei Liu¹, Chao Chen¹, Tianyi Yu¹, Yizhan Zhuang¹, Jinwu Gong¹
¹Wuhan University, China; ²Wuhan 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 Silva¹, Cursino Jacobina¹, Ayslan Maia¹, Isaac Freitas², Reuben Sousa³
¹Federal University of Campina Grande, Brazil; ²Federal 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 Deshpande², Yingzhuo Chen¹, Balaji Narayanasamy², Arvind S Sathyanarayanan¹, Fang Luo²
¹The Ohio State University, United States; ²University 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 Technology, Japan

D07.12: Comparative Performance Evaluation of Common Mode Voltage Reduction Three-Phase Inverter Topologies
Di Han, Woongkul Lee, Silong Li, Bilent Sarlioglu
University of Wisconsin-Madison, United States

D07.13: Dynamic Control Set-Model Predictive Control for Field-Oriented Control of VSI-PMSM
Shuai Wang¹, Dewei Xu², Chushan Li²
¹Ryerson University, Canada; ²Zhejiang University, Canada

D07.14: Fault-Tolerant Operation with 1-Phase Open in Parallel-Connected Motor
Sunkku 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 Dargahi², Keith Corzine³, Johan Enslin³, Mostafa Abarzadeh⁴, Arash Khoshkhab Sadigh⁴, Jose Rodriguez⁶, Freda Blaabjerg¹
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D08: Magnetics and Capacitors

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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 Delhommais1, Jean-Luc Schanen1, Frédéric Wurtz1, Cécile Rigaud2, Sylvain Chardon3, Stephane Vighetti2
1Grenoble Institute of Technology, France; 2SIREPE, France; 3TRONICO-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 Mocevic2, Jun Wang2, Rolando Burgos2, Dushan Boroyevich2, Constantin Stancu1, Marko Jaksic1, Brian Peaslee1
1General Motors, United States; 2Virginia Tech/CPES, United States

D08.4: High Power Density PCB Coil Array Applied to Domestic Induction Heating Appliances
Javier Serrano2, Jesus Acero2, Ignacio Lope1, Claudio Carretero2, JosÃ© Miguel BurdÃ³2
1BSH Home Appliances Group, Spain; 2University 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

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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 Jovanovic
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 Peng1, Kunqi Li2, Xiaoyong Ren2, Ming Xu1
1FSP-Powerland Technology Inc., China; 2Nanjing 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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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 Sathik1, Sundararajan Prasanth1, Firman Sasongko1, Sampath Kumar Padmanabhan1, Josep Pou1, Rejeki Simanjorang2
1*Nanyang Technological University, Singapore; 2Rolls-Royce Rolls-Royce Singapore Pte Ltd, Singapore*

**D10.5:** Short Circuit Characterization of 3rd Generation 10 kV SiC MOSFET

Shiqi Ji2, Marko Laitinen1, Xingxuan Huang2, Jingjing Sun2, William Giewont1, Leon Tolbert2, Fred Wang2
1*Danfoss Drives, United States; 2University of Tennessee, United States*

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**D11: Power Module Packaging, Thermal & Application**

**Power Electronics Integration and Manufacturing**

John Vigars, *Allegro Microsystems*
Yuxiang Shi, *ABB USRC*

**D11.1:** Top Die Surface Reprocessing for Planar Package with Double Sided Cooling

Puqi Ning1, Lei Li1, Xuhui Wen1, Qiongxuan Ge1, Yaohua Li1, Yunhui Mei2
1*Institute of Electrical Engineering Chinese Academy of Sciences, China; 2Tianjin 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*

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**D11.3:** A Dynamic Thermal Controller for Power Semiconductor Devices

Mohamed Halick Mohamed Sathik1, Sundararajan Prasanth1, Firman Sasongko1, Sampath Kumar Padmanabhan1, Josep Pou1, Rejeki Simanjorang2
1*Nanyang Technological University, Singapore; 2Rolls-Royce Rolls-Royce Singapore Pte Ltd, Singapore*

**D11.4:** Modular Heat Sink for Chip-Scale GaN Transistors in Multilevel Converters

Nathan Pallo2, Chirag Kharangate1, Tomas Modeer2, Joseph Schaadt1, Mehdi Asheghi1, Kenneth Goodson1, Robert Pilawa-Podgurski2
1*Stanford University, United States; 2University of Illinois, United States*

**D11.5:** Analysis and Design of an Overcurrent Protection Scheme Based on Parasitic Inductance of SiC MOSFET Power Module

Keyao Sun1, Jun Wang1, Rolando Burgos1, Dushan Boroyevich1, Yonghan Kang2, Edward Choi2
1*CPES, Virginia Tech, United States; 2LG 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 Kuwabara1, Keiji Wada1, Jean-Michel Guichon2, Jean-Luc Schanen2, James Roudet2
1*Tokyo Metropolitan University, Japan; 2Univ. 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 Wang1, Fei Yang2, Steven Campbell1, Madhu Chinthavali1
1*Oak Ridge National Laboratory, United States; 2University of Tennessee, United States*
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-Hems with Embedded Source Field-Plate Structures
Hitoshi Aoki, Hiroyuki Sakairi, Naotaka Kuroda, Yohei Nakamura, K. Chikamatsu, Ken Nakahara
1ROHM Co., Ltd., Japan; 2Teikyo 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, Takeshi Horiguchi, Akinori Nishizawa, Kentaro Konno, Tsubasa Matsuo, Masaki Kuzumoto, Makoto Hagiwara, Hirofumi Akagi
1Mitsubishi Electric Corp., Japan; 2Tokyo Institute of Technology, Japan

D12.4: A Full Power Emulation Platform for Evaluating Power Semiconductors
Juncheng Lucas Lu, Yajie Qiu, Di Chen
1GaN Systems Inc, Canada; 2GaN Systems Inc., Canada

D12.5: Normalization-Based Approach to Electric Motor BVR Related Capacitances Computation
Jero Ahola, Annette Muetze, Markku Niemelä, Aleksei Romanenko
1Graz University of Technology, Austria; 2Lappeenranta 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, Hiroyuki Sakairi, Hirotaka Otake, Naotaka Kuroda, Seiya Kitagawa, Noriyoshi Hashimoto, Ryo Takeda, Ken Nakahara
1Keysight Technologies International Japan GK, Japan; 2Keysight Technologies Japan GK, Japan; 3Rohm Co., Ltd, Japan

D12.7: Ceramic Capacitors: Turning a Deficiency Into an Advantage
Sam Ben-Yaakov, Ilya Zeltser
1Ben-Gurion University of the Negev, Israel; 2Rafael 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, Wei Lai, Zeshen Jiang, Shengyang Kang, Ran Yao, Li Ran, Hui Li, Rui Jin, Jiali Yang, Wen
1Chongqing University, China; 2Global Energy Interconnection Research Institute, China

D12.10: Modeling the Gate Driver IC for GaN Transistor: a Black-Box Approach
Ruiliang Xie, Guangzhao Xu, Xu Yang, Gaofei Tang, Jin Wei, Mofan Tian, Feng Zhang, Wenjie Chen, Laili Wang, Kevin J Chen
1The Hong Kong University of Science and Technology, Hong Kong; 2Xi’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, Weilin Li, Ruihong Zhang, Xiaohua Wu, Xiaobin Zhang, Bei Wang, Guochun Xiao, Shuai Zhang
1Northwestern Polytechnical University, China; 2Xi’an Jiaotong University, China; 3Xi’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, Ruihong Zhang, Weilin Li, Xiaohua Wu, Xiaobin Zhang, Bei Wang, Guochun Xiao, Daoshu Yang
1Northwestern Polytechnical University, China; 2Xi’an Jiaotong University, China; 3Xi’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, Jason Poon, Li Jian, Costas Spanos, Seth R. Sanders, Jian-Xin Xu, Sanjib Kumar Panda
1National University of Singapore, Singapore; 2Northeast Electric Power University, China; 3University of California, Berkeley, United States
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

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 Liang¹, Jiuchun Jiang¹, Olorunfemi Ojo², Josiah Haruna³
¹Beijing Jiaotong University, China; ²Tennessee 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 University, 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
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 Broeck¹, Robert Lorenz², Rik De Doncker¹
¹ISEA RWTH Aachen, Germany; ²WEMPEC 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 Dragičević, Rasool Heydari, Frede Blaabjerg
Aalborg University, Denmark
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 Ma1, Xiongfei Wang2, Frede Blaabjerg1, Wensheng Song2
1Aalborg University, Denmark; 2Southwest 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 Broeck1, Lukas Ruppert1, Robert Lorenz2, Rik De Doncker1
1ISEA RWTH Aachen, Germany; 2WEMPEC 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 Offsettering Based CPM Controller for Multi-Level Flying Capacitor Converters
Liangji Lu2, Sheikh Ahsanuzzaman2, Aleksandar Prodić2, Giacomo Calabrese1, Giovanni Frattini1, Maurizio Granato1
1Texas Instruments, Germany; 2Texas Instruments, Italy; 3University 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 Mannen1, Keiji Wada1, Hidemine Obara2, Koutaro Miyazaki2, Makoto Takamiya2, Takayasu Sakurai2
1Tokyo Metropolitan University, Japan; 2University of Tokyo, Japan; 3Yokohama 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

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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, Xiaojing 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 Li1, Jingyang Fang1, Shuxin Chen1, Yi Tang1, Kangping Wang2
1Nanyang Technological University, Singapore; 2Xi’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 Olaïas
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 Tennessee, 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, Lixin Jiang, Qianhong Chen, Xiaoyong Ren, Zhiliang Zhang, Sui-Chung Wong  
1Hong Kong Polytechnic University, China; 2Nanjing University of Aeronautics and Astronautics, China; 3Nari 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, Fuxin Liu, Chong Jiang, Xuling Chen, Ralph M. Kennel  
1Nanjing University of Aeronautics and Astronautics, China; 2Technical University of Munich, Germany

D17: Wind And Solar Power

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, Yuan Gui, Huimei Liu, Wen Yang, Jinwu Gong  
1Hubei University of Technology, China; 2Wuhan 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, Qinxuan 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, Huimei Liu, Jinwu Gong, Wen Yang, Yuan Gui  
1Hubei University of Technology, China; 2Wuhan University, China

D17.8: Active Gate Driver for SiC MOSFET Based PV Inverter with Enhanced Operating Range  
Sayan Acharya, Xu She, Fengfeng Tao, Tony Frangieh, Maja Harfman Todorovic, Rajib Datta  
1GE Global Research, United States; 2North Carolina State University, United States

D17.9: Comparative Evaluation of Modulation Strategies for a Single-Phase PV Micro-Inverter with High-Frequency Transformer  
Federal University of Campina Grande (UFCG), Brazil

D17.10: Flexible High Efficiency Battery-Ready PV Inverter for Rooftop Systems  
Namwon Kim, Mehrdad Biglarbegan, Babak Parkhideh  
University of North Carolina at Charlotte, United States
**D17.11: Performance Evaluation of Single-Phase Transformer-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*

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**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, Shuxin Zhang, Dianguo Xu, Xiaonan Lu
1*Argonne National Laboratory, United States; 2Harbin 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 Abdelhamid, Frede Blaabjerg, Paolo Mattavelli
1*Aalborg University, Denmark; 2University of Padova, Italy*

**D18.8: A Phase Feedforward Based Virtual Synchronous Generator Control Scheme**
Mingxuan Li, Yue Wang, Hui Zhou, Weihao Hu
1*Aalborg University, Denmark; 2Xi’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 Guerrero
*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 Abdeljabber, Ali Boynuegri, Ali Elrayyah, Yilmaz Sozer
1*Qatar Research Foundation, Qatar; 2University of Akron, United States*

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**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, Yuzhu Feng, Runan Song, Ru Jiang
1*China North Vehicle Research Institute, China; 2Tianjin University, China*

**D19.3: Circuit Parameters Extraction Algorithm for a Lithium-Ion Battery Charging System Incorporated with Electrochemical Impedance Spectroscopy**
SM Rackiul Islam, Sung-Yeul Park, Balakumar Balasingam
1*University of Connecticut, United States; 2University of Windsor, Canada*
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 Kim2, Amit Adhikaree2, Rajendra Pandey2, Daewook Kang1, Myoungho Kim1, Chang-Yeol Oh1, Juwon Back1
1Korea Electrotechnology Research Institute, Korea; 2Texas A&M University-Kingsville, United States

D19.6: Low-Frequency Input Ripple Current Compensation in Single-Phase Fuel Cell Power Systems
Soumya Sinha, Wajicha Shiren, Sumit Pramanick
University of Houston, United States

D19.7: A Hybrid Flyback Led Driver with Utility Grid and Renewable Energy Interface
Awab Ali1, Jonathan Lange3, Ali Elrayyah2, Yilmaz Sozer1, Alex De Abreu-Garcia1, Augustin Mpanda1
1ESIEE-Amiens, France; 2Qatar Research Foundation, Qatar; 3University of Akron, United States

D20: Transportation Power Electronics

D20.1: Frozen Leg Operation of a Three-Phase Dual Active Bridge DC/DC Converter at Light Loads
Saeid Haghsbin1, Fredre Blaabjerg1, Farzad Yazdani2, Amir Sajjad Bahman1
1Aalborg University, Denmark; 2Chalmers University, Sweden; 3Elbind Elektronik AB, Sweden

D20.2: Adaptive Detection of DC Arc Faults Based on Hurst Exponents and Current Envelope
Yousef Abdullah2, Boxue Hu2, Zhuo Wei2, Jin Wang2, Amin Emrani1
1Ford Motor Company, United States; 2The 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, Rining 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
Yunnan Zhao2, Fei Lu1, Hua Zhang1, Chris Mi1
1San Diego State University, United States; 2Xi’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 Mi1
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 Shang1, Chenghui Zhang2, Naxin Cui2, Chris Mi1
1San Diego State University, United States; 2Shandong University, China

D21: LED Applications

D21.1: Cascode Switching Modeling and Improvement in Flyback Converter for LED Lighting Applications
Liang Jia1, Srikanth Lakshmikanth1, Yan-Fei Liu2
1Google Inc, United States; 2Queens University, Canada

D21.2: Controlling the Input Impedance of Constant Power Loads
Manuel Gutierrez1, Peter Lindahl1, Arijit Banerjee2, Steven Leeb1
1Massachusetts Institute of Technology, United States; 2University of Illinois Urbana-Champaign, United States

Stefano Saggini1, Roberto Rizzolatti2, Mario Ursino2, Osvaldo Zambetti1
1SMicroelectronics, Italy; 2University of Udine, Italy
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 Modepalli¹, Leila Parsa²
¹Rensselaer Polytechnic Institute, United States; ²University 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 Park², Mina Kim², Jee-Hoon Jung², Ho-Sung Kim¹
¹Korea Electrotechnology Research Institute, Korea; ²Ulsan National Institute of Science and Technology, Korea

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Songtao Huang², Yougui Guo³, Lie Xu¹, Yu Guo², Yongdong Li¹, Wenlang Deng²
¹Tsinghua University, China; ²University of Illinois at Chicago, China; ³Xiangtan University, China

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Swati Savaliya, Baylon Fernandes
Indian Institute of Technology Bombay, India

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Hector Sarnago, Oscar Lucia, Jose M. Burdào
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 Algarny², Ahmed Abdelrahman², Mohamed Youssef¹
¹University of Technology of Aachen, Germany; ²University of Wisconsin-Milwaukee, United States

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Jong-Woo Kim, Moonhyun Lee, Jih-Sheng Lai
Virginia Tech, United States

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Vivek Raveendran¹, Markus Andresen¹, Marco Liserre¹, Giampaolo Buticchi²
¹University of Kiel, Germany; ²University 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. Burdào
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

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Alan S. Felinto, Cursino B. Jacobina, João P.R. A Mello, Gregory A. A. Carlos, Ivan da Silva
Federal University of Campina Grande, Brazil

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Jun Lee, Jung-Ik Ha
Seoul National University
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Power Electronics Applications

Sombuddha Chakraboty, Texas Instruments

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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 Ahn², Won-Yong Sung², Minkook Kim², Byoung Kuk Lee², Seung-Hee Ryu¹, Chang-Seop Lim¹
¹New Power Plasma Corporation, Korea;
²Sungkyunkwan 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
Convention Center
Floor Plan

Meeting Room Level

Street Level
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

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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: Corey Devalasingh (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 unrivaled 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-
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 inverter 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.
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.

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.

Exhibitor Seminars – Session #3

Tuesday, March 6 – 3:00 p.m. – 3:30 p.m.

Abstract Power Electronics

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

Presented by: Christophe Brayet

This topic demonstrates how to use Real-Time Simulation for a Better, Modern, and Interactive Teaching Experience for Power Electronic and Electric Motors.
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 (MuxCapacitor™), 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 parasitic 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 150°C hotspot using their PEN HV™ 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 band-gap 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 Nanocrystalline 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.
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.

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.

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.

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.

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.
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-461 conducted 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), ULTEM™ 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.
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as of 2.15.18

APEC would like to recognize the following publications for their generous support of the APEC 2018 Conference and Exposition:

**AspenCore**

The publications listed below are all part of AspenCore

- EDN
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- EE Web
- Electronic Products
- Power Electronics News
- Embedded

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**Bodo Arlt**

Editor

Katzbek 17a

D-24235 Laboe Germany

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www.bodospower.com

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**Laurel Zimmerman**

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& Business Development
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P. 484.688.0300
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