The Premier Global Event in Power Electronics

MARCH 20-24
HOUSTON, TX

Sponsored by:

IAS - IEEE Industry Applications Society
PELS - IEEE Power Electronics Society
PSMA - Power Systems Management Association
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WI-FI
Network Name: APEC2022
Password: Houston22 (case sensitive)

STAY CONNECTED WITH APEC
Stay up-to-date on all things APEC throughout the year – follow us on social media:

@APEC-CONF | #APEC2022
APEC: Applied Power Electronics Conference
APEC: Applied Power Electronics Conference

APEC MOBILE APP
Download the APEC 2022 mobile app to access the latest event updates and details, including session and speaker information. The app is accessible through Google Play (Android) and Apple Store (iOS devices) by searching ‘Eventscribe’, downloading, then searching ‘APEC2022’.

apec@apec-conf.org
EDUCATIONAL PROGRAM

PROFESSIONAL EDUCATION SEMINARS
APEC strives to offer seminars with a practical mix of theory and application for the professional working in power electronics. APEC 2022 features 15 Professional Education Seminars with a broad range of topics. All attendees must be registered for the conference. To register or pick up conference materials, visit APEC Registration in the Hall DE Foyer.

PLENARY SESSION
The APEC 2022 Plenary Session is made up of several presentations from respected industry leaders. The session will take place on Monday, March 21 and allows for interactive Q&A at the end of each presentation.

TECHNICAL SESSIONS
APEC professionals like you participated in a rigorous peer review process and have carefully picked hundreds of 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 lecture 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. – 1:30 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
The Industry Session 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. Presentations will be available through the APEC mobile app.

EXHIBITOR SEMINARS
APEC 2022 Exhibitor Seminars will highlight new products or initiatives that companies in the power electronics industry are developing, along with allowing the opportunity for attendees to interact with other companies in the industry.

RAP SESSIONS
The APEC 2022 RAP Sessions feature several exciting and engaging topics. RAP Sessions allow for exciting dialogue amongst attendees and presenters. Admission to all RAP Sessions is open to exhibits only and full conference registration.
FOREWORD

It is with great pleasure that I welcome you to the IEEE Applied Power Electronics Conference and Exposition (APEC 2022) in Houston, Texas. In this 37th year of the conference, APEC continues to address the challenges of the power electronics industry by bringing experts together to explore the recent advancements, opportunities, and challenges in the power electronics systems, subsystems, and components.

Education, health, safety, transportation, energy delivery, manufacturing, agriculture, and quality of life are all important to our society. Power electronics is at the heart of all these facets and is a key enabler to achieve any and all of these with improved efficiency, power density, reliability, and cost-effective power electronic converters. Our lives rely on high-quality, compact, efficient, durable power supplies in all of our everyday activities. In addition, high-performance computing, artificial intelligence, machine learning, additive manufacturing, and unique materials are emerging focus areas in the research and development of power electronics which are covered in all conference activities including the Plenary Session, Professional Education Seminars, Industry Sessions, Technical Sessions, Rap Sessions, and the extensive Exposition and Exhibitor Seminars. Bringing together every aspect of power electronics within these activities is what brands APEC the Premier Global Event in Applied Power Electronics.

I would like to thank the members of the Organizing Committee who put together an excellent program for you, and the Steering Committee for their continuous guidance and support as well as all the Track Chairs of the Technical Program Committee, Session Chairs, and the reviewers. I also appreciate the dedication, expertise, and directions of our sponsoring societies including the Power Sources Manufacturers Association (PSMA), IEEE Power Electronics Society (PELS), and Industry Applications Society (IAS) as well as SmithBucklin, our professional conference management partner who was very essential in facilitating a successful APEC 2022.

We are enthusiastically looking forward to meeting you at APEC 2022 and hope you have a memorable experience in Houston, TX.

Omer C. Onar
General Chair
2022 IEEE Applied Power Electronics Conference and Exposition
We recognize the unique and changing impact the pandemic has had on our practices, families, and plans over the last two years. The health and wellness of APEC attendees is of utmost importance to us. By working closely with the George R. Brown Convention Center and Federal, State and Local public health officials, we are incorporating current best practices to provide you with the best level of protection at APEC 2022. Visit the APEC website for our full guidelines.

LOCAL GUIDELINES

- The Houston Health Department recommends wearing a mask while indoors in public.
- Harris County Public Health recommends following CDC COVID-19 guidelines. It is also recommended that in indoor public spaces, fully vaccinated people continue to wear a mask that fits snugly against the sides of your face and doesn’t have gaps, cover coughs and sneezes, wash hands often, and follow any applicable workplace or school guidance.
- Though there is no mask mandate for the City of Houston, face coverings may still be required by individual businesses.
- Houston hospitality partners have taken a pledge to take every precaution to help keep you safe. Find out what hotel partners are doing to keep visitors safe through the city’s Houston Clean Initiative webpage.
- Visit the Harris County Public Health website to learn more about local guidelines, vaccine availability, COVID-19 testing, and more.

Sources: Harris County Public Health, Houston Health Department, Visit Houston

SOCIAL DISTANCING PINS

APEC recognizes individuals’ preferences by promoting a safe environment and experiences. Please respect each other by following this guide for those wearing colored pins. Pins can be found at registration.
Thank you to our 2022 Sponsors and Partners

**SPONSORS**

APEC 2022 Sponsors provide financial backing (including liability)

**PARTNERS**

**DIAMOND**

**PLATINUM**

**GOLD**

**SILVER**
Thank you to our 2022 Supporting Publications
## Conference-at-a-Glance

<table>
<thead>
<tr>
<th>Event</th>
<th>Saturday March 19</th>
<th>Sunday March 20</th>
<th>Monday March 21</th>
<th>Tuesday March 22</th>
<th>Wednesday March 23</th>
<th>Thursday March 24</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plenary Session</td>
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<td>RAP Session</td>
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<td>Technical Lecture*</td>
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<td>Industry Session*</td>
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<tr>
<td>Professional Education Seminar*</td>
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<td>Exhibitor Seminars</td>
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<tr>
<td>Sponsor Meetings</td>
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</table>

*Paid Registration Required
# SCHEDULE-AT-A-GLANCE

## SATURDAY, MARCH 19

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>4:00 p.m. – 7:00 p.m.</td>
<td>Registration is Open</td>
<td>Hall DE Foyer</td>
</tr>
</tbody>
</table>

## SUNDAY, MARCH 20

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 a.m. – 5:00 p.m.</td>
<td>Registration is Open</td>
<td>Hall DE Foyer</td>
</tr>
<tr>
<td>7:30 a.m. – 8:30 a.m.</td>
<td>Speaker Breakfast</td>
<td>Room 310</td>
</tr>
<tr>
<td>9:30 a.m. – 1:00 p.m.</td>
<td>Professional Education Seminars (concurrent sessions)</td>
<td>see page 19 for specific locations</td>
</tr>
<tr>
<td>2:30 p.m. – 6:00 p.m.</td>
<td>Professional Education Seminars (concurrent sessions)</td>
<td>see page 20 for specific locations</td>
</tr>
</tbody>
</table>

## MONDAY, MARCH 21

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 a.m. – 6:00 p.m.</td>
<td>Registration is Open</td>
<td>Hall DE Foyer</td>
</tr>
<tr>
<td>7:00 a.m. – 8:00 a.m.</td>
<td>Speaker Breakfast</td>
<td>Room 310</td>
</tr>
<tr>
<td>8:00 a.m. – 10:00 a.m.</td>
<td>Spouse/Guest Breakfast</td>
<td>Brazoria (Marriott Marquis)</td>
</tr>
<tr>
<td>8:30 a.m. – 12:00 p.m.</td>
<td>Professional Education Seminars (concurrent sessions)</td>
<td>see page 22 for specific locations</td>
</tr>
<tr>
<td>1:15 p.m. – 5:00 p.m.</td>
<td>Plenary Session</td>
<td>Grand Ballroom ABC</td>
</tr>
<tr>
<td>5:00 p.m. – 8:00 p.m.</td>
<td>Welcome Reception (Expo Hall Open)</td>
<td>Expo Hall</td>
</tr>
</tbody>
</table>

## TUESDAY, MARCH 22

<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>Speaker Breakfast</td>
<td>Room 310</td>
</tr>
<tr>
<td>8:00 a.m. – 5:00 p.m.</td>
<td>Registration is Open</td>
<td>Hall DE Foyer</td>
</tr>
<tr>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>Technical Sessions (concurrent sessions)</td>
<td>see page 30 for specific locations</td>
</tr>
<tr>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>Industry Sessions (concurrent sessions)</td>
<td>see page 27 for specific locations</td>
</tr>
<tr>
<td>9:00 a.m. – 5:00 p.m.</td>
<td>Expo Hall is Open</td>
<td>Expo Hall</td>
</tr>
<tr>
<td>10:40 a.m. – 12:00 p.m.</td>
<td>Technical Sessions (concurrent sessions)</td>
<td>see page 30 for specific locations</td>
</tr>
<tr>
<td>10:40 a.m. – 11:55 a.m.</td>
<td>Industry Sessions (concurrent sessions)</td>
<td>see page 27 for specific locations</td>
</tr>
<tr>
<td>12:00 p.m. – 1:00 p.m.</td>
<td>Lunch</td>
<td>Expo Hall</td>
</tr>
<tr>
<td>1:00 p.m. – 1:30 p.m.</td>
<td>Exhibitor Seminars #1 (concurrent sessions)</td>
<td>see page 36 for specific locations</td>
</tr>
<tr>
<td>1:45 p.m. – 2:15 p.m.</td>
<td>Exhibitor Seminars #2 (concurrent sessions)</td>
<td>see page 37 for specific locations</td>
</tr>
<tr>
<td>2:30 p.m. – 3:00 p.m.</td>
<td>Exhibitor Seminars #3 (concurrent sessions)</td>
<td>see page 38 for specific locations</td>
</tr>
<tr>
<td>3:15 p.m. – 3:45 p.m.</td>
<td>Exhibitor Seminars #4 (concurrent sessions)</td>
<td>see page 39 for specific locations</td>
</tr>
<tr>
<td>5:00 p.m. – 6:30 p.m.</td>
<td>RAP Sessions (concurrent sessions)</td>
<td>see page 35 for specific locations</td>
</tr>
<tr>
<td>7:00 p.m. – 9:00 p.m.</td>
<td>IAS/PELS Young Professionals Reception</td>
<td>The Grotto</td>
</tr>
</tbody>
</table>
## WEDNESDAY, MARCH 23

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>8:00 a.m. – 2:00 p.m.</td>
<td>Registration is Open</td>
<td>Hall DE Foyer</td>
</tr>
<tr>
<td>7:00 a.m. – 8:00 a.m.</td>
<td>Speaker Breakfast</td>
<td>Room 310</td>
</tr>
<tr>
<td>7:30 a.m. – 8:30 a.m.</td>
<td>PELS WIE Breakfast</td>
<td>Room 332D</td>
</tr>
<tr>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>Technical Sessions (concurrent sessions)</td>
<td>see page 45 for specific locations</td>
</tr>
<tr>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>Industry Sessions (concurrent sessions)</td>
<td>see page 40 for specific locations</td>
</tr>
<tr>
<td>9:00 a.m. – 2:30 p.m.</td>
<td>Exhibit Hall is Open</td>
<td>Expo Hall</td>
</tr>
<tr>
<td>10:40 a.m. – 12:00 p.m.</td>
<td>Technical Sessions (concurrent sessions)</td>
<td>see page 45 for specific locations</td>
</tr>
<tr>
<td>10:40 a.m. – 11:55 a.m.</td>
<td>Industry Sessions (concurrent sessions)</td>
<td>see page 40 for specific locations</td>
</tr>
<tr>
<td>11:30 a.m. – 1:30 p.m.</td>
<td>Lunch</td>
<td>Expo Hall</td>
</tr>
<tr>
<td>12:15 p.m. – 12:45 p.m.</td>
<td>Exhibitor Seminars #5 (concurrent sessions)</td>
<td>see page 53 for specific locations</td>
</tr>
<tr>
<td>1:00 p.m. – 1:30 p.m.</td>
<td>Exhibitor Seminars #6 (concurrent sessions)</td>
<td>see page 53 for specific locations</td>
</tr>
<tr>
<td>1:45 p.m. – 2:15 p.m.</td>
<td>Exhibitor Seminars #7 (concurrent sessions)</td>
<td>see page 54 for specific locations</td>
</tr>
<tr>
<td>2:30 p.m. – 4:10 p.m.</td>
<td>Technical Sessions (concurrent sessions)</td>
<td>see page 49 for specific locations</td>
</tr>
<tr>
<td>2:30 p.m. – 4:10 p.m.</td>
<td>Industry Sessions (concurrent sessions)</td>
<td>see page 42 for specific locations</td>
</tr>
<tr>
<td>4:30 p.m. – 5:50 p.m.</td>
<td>Technical Sessions (concurrent sessions)</td>
<td>see page 49 for specific locations</td>
</tr>
<tr>
<td>4:30 p.m. – 5:55 p.m.</td>
<td>Industry Sessions (concurrent sessions)</td>
<td>see page 42 for specific locations</td>
</tr>
<tr>
<td>6:30 p.m. – 9:30 p.m.</td>
<td>Social Event</td>
<td>The Rustic</td>
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## THURSDAY, MARCH 24

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>7:00 a.m. – 8:00 a.m.</td>
<td>Speaker Breakfast</td>
<td>Grand Ballroom</td>
</tr>
<tr>
<td>8:00 a.m. – 12:00 p.m.</td>
<td>Registration is Open</td>
<td>Hall DE Foyer</td>
</tr>
<tr>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>Technical Sessions (concurrent sessions)</td>
<td>see page 60 for specific locations</td>
</tr>
<tr>
<td>8:30 a.m. – 10:10 a.m.</td>
<td>Industry Sessions (concurrent sessions)</td>
<td>see page 56 for specific locations</td>
</tr>
<tr>
<td>10:40 a.m. – 11:20 a.m.</td>
<td>Technical Sessions (concurrent sessions)</td>
<td>see page 60 for specific locations</td>
</tr>
<tr>
<td>10:40 a.m. – 11:30 a.m.</td>
<td>Industry Sessions (concurrent sessions)</td>
<td>see page 56 for specific locations</td>
</tr>
<tr>
<td>11:15 a.m. – 1:45 p.m.</td>
<td>Lunch</td>
<td>Grand Ballroom</td>
</tr>
<tr>
<td>11:30 a.m. – 1:30 p.m.</td>
<td>Dialogue Sessions</td>
<td>Grand Ballroom</td>
</tr>
<tr>
<td>1:45 p.m. – 3:25 p.m.</td>
<td>Technical Sessions (concurrent sessions)</td>
<td>see page 63 for specific locations</td>
</tr>
<tr>
<td>1:45 p.m. – 3:25 p.m.</td>
<td>Industry Sessions (concurrent sessions)</td>
<td>see page 58 for specific locations</td>
</tr>
</tbody>
</table>
# CONFERENCE REGISTRATION

All attendees must be registered for the conference. To register or pick up conference materials, visit APEC Registration in the Hall DE Foyer.

<table>
<thead>
<tr>
<th>Event</th>
<th>Full Registration</th>
<th>Technical Session Only Registration</th>
<th>Professional Education Seminars Only Registration</th>
<th>Exhibits Only Registration</th>
<th>Guest Registration</th>
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<tr>
<td>Plenary Session</td>
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<tr>
<td>RAP Session</td>
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<tr>
<td>Technical Lecture*</td>
<td>✓</td>
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<tr>
<td>Technical Dialogue*</td>
<td>✓</td>
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<tr>
<td>Industry Session*</td>
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<tr>
<td>Professional Education Seminar*</td>
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*Paid Registration Required

## Registration Hours

<table>
<thead>
<tr>
<th>Day</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Saturday, March 19</td>
<td>4:00 p.m. – 7:00 p.m.</td>
</tr>
<tr>
<td>Sunday, March 20</td>
<td>7:00 a.m. – 5:00 p.m.</td>
</tr>
<tr>
<td>Monday, March 21</td>
<td>7:00 a.m. – 6:00 p.m.</td>
</tr>
<tr>
<td>Tuesday, March 22</td>
<td>8:00 a.m. – 5:00 p.m.</td>
</tr>
<tr>
<td>Wednesday, March 23</td>
<td>8:00 a.m. – 2:00 p.m.</td>
</tr>
<tr>
<td>Thursday, March 24</td>
<td>8:00 a.m. – 12:00 p.m.</td>
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</table>

## APEC EXPO HALL

The Expo Hall will open on Monday, March 21 when the Plenary Session concludes.

### Expo Hall Hours

<table>
<thead>
<tr>
<th>Day</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Monday, March 21</td>
<td>5:00 p.m. – 8:00 p.m.</td>
</tr>
<tr>
<td>Tuesday, March 22</td>
<td>9:00 a.m. – 5:00 p.m.</td>
</tr>
<tr>
<td>Wednesday, March 23</td>
<td>9:00 a.m. – 2:30 p.m.</td>
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</table>

### Expo Hall Admission

Entry is granted to persons 18 or older with any APEC badge, including the free Expo Hall badge which also grants admission to the exhibitor seminars, plenary session, and RAP sessions.

## Lunch

Lunch and coffee (when provided) in the Expo Hall is free of charge to all who have access. Lunch on Sunday and Monday will be on your own.

- Tuesday Lunch: 12:00 p.m. – 1:00 p.m.
- Wednesday Lunch: 11:30 a.m. – 1:30 p.m.
- Thursday Lunch + Dialogue Sessions in the Grand Ballroom: 11:15 a.m. – 1:45 p.m.

## Expo Hall Giveaway

During all three days of the Exposition we will be giving out prizes. At registration, everyone (registrants and exhibitors included) will be issued a raffle ticket that you will put in a drop box located in APEC HUB (Booth 924). This will be good for all three days of raffles during the exposition. Winners will be announced in the APEC mobile app.

## Accessibility

GRB Houston and APEC strive to provide an accessible event for all. The convention center offers several ADA entrances, ramps, gender-neutral bathrooms and more. All passenger elevators are clearly marked. Please visit the registration desk for additional accessibility questions and information.
MATERIALS PURCHASE

Purchase of Seminar Workbooks
Conference registrants can purchase extra copies of the Seminar Workbooks through Early Registration for purchase onsite. APEC reserves the right to limit quantities of Seminar Workbooks sold to any one person or institution.

Payment Policy
For payments at the conference, APEC can accept credit cards (Master Card, Visa or American Express) or checks (payable in U.S dollars and drawn on a U.S. bank). Checks returned unpaid will be assessed an additional handling charge of $50. A limited number of copies of the Seminar Workbooks may be available for sale at registration starting at March 20.

> Seminar Workbook: $125

Purchased publications can be picked up at the registration desk.

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Post conference APEC Proceedings may be purchased through the IEEE.

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

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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 Expo Hall floor and at other events. Show Management must be informed of any hospitality suites, and expressed consent must be received prior to the event.
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IEEE Policy #10.1.24 prohibits recruiting at IEEE sponsored conferences. Consequently, recruiters and recruiting advertisements will not be permitted in the APEC 2022 hotel space, meeting facilities or Expo Hall.

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Information Provided Other than Through Registration: People who provide their names to APEC through the APEC website, direct contact, digest submission, volunteering to review, or in any way other than registering for the conference, will not have their names and contact information distributed to anyone 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 exhibitors and media partners. Emails will only be provided to exhibitors through the Lead Retrieval systems used on the Expo Hall floor. Registering for APEC gives permission for your name and contact information to be provided to exhibitors and media partners and for 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.
INFORMATION FOR SPEAKERS

PROFESSIONAL EDUCATION SEMINAR SPEAKERS

Breakfast will be provided for you the morning of your presentation. You should attend the Speaker Breakfast only on the morning of your presentation. During breakfast, you will receive brief instructions from the Professional Education Seminar Chairs.

> Sunday at 7:30 a.m.; Monday at 7:00 a.m. | Room 310

INDUSTRY SESSIONS AND LECTURE TECHNICAL SESSION SPEAKERS

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 confer with your session chairs and/or review your previously uploaded presentation in the speaker ready room.

> Tuesday and Wednesday at 7:00 a.m. | Room 310
> Thursday at 7:00 a.m. | Grand Ballroom

DIALOGUE TECHNICAL SESSION SPEAKERS

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 Hall DE Foyer prefunction area after the breakfast. Thumb tacks will be provided.

> Thursday at 7:00 a.m. | Grand Ballroom

SPEAKER READY ROOM

The Speaker Ready Room, located in Room 322 B, will be available to all speakers should you need to review your presentation in advance of your session or make any edits.

> Sunday | 7:30 a.m. – 5:00 p.m.
> Monday | 7:00 a.m. – 1:30 p.m.
> Tuesday | 7:00 a.m. – 5:00 p.m.
> Wednesday | 7:00 a.m. – 5:30 p.m.
> Thursday | 7:00 a.m. – 3:30 p.m.
SPOUSE AND GUEST ACTIVITY

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

**Guest Tour of Houston**

**Tuesday, March 22 | 10:00 a.m. – 11:30 a.m.**

Focusing on the history of the City of Houston, this 80-minute bus tour will give APEC attendees access to a wealth of information and opportunities to explore. The tour will include lunch and will be available for all attendees for $150.

Following the tour, attendees will be dropped off at the Grotto Downtown in the Convention Center for lunch, taking place at 12:00 p.m.

PELS AND IAS YOUNG PROFESSIONAL NETWORKING RECEPTION

**Tuesday, March 22 | 7:00 p.m. – 9:00 p.m. | The Grotto**

IEEE Power Electronics Society (PELS) and Industry Applications Society (IAS) semiannual Students & Young Professional Reception will be held during the IEEE APEC 2022. Registration for APEC 2022 is not mandatory to attend the reception. This is a great networking opportunity for young professionals and students, as you will meet other fellow students, young professionals, and leaders of the societies in a casual atmosphere over food and drinks.

WIE, YP, AND YOU: HOW TO BECOME INVOLVED WITH IEEE PELS AND PSMA, TOO!

**Wednesday, March 23 | 7:30 a.m. – 8:30 a.m. | Room 332D**

*Free breakfast will be included.*

Join this morning event to learn all the ways you can engage with PELS and PSMA, network with volunteers and officers, and uncover all the exciting opportunities behind these acronyms. This event is hosted by IEEE Power Electronics Society (PELS), Women-in-Engineering (WIE) and Young Professionals (YP) Committees, and the Power Sources Manufacturers Association (PSMA).

WEDNESDAY NIGHT SOCIAL

**Wednesday, March 23 | 6:30 p.m. - 9:30 p.m.**

Join us on Wednesday evening at The Rustic for an evening of connection and celebration as we near the end of APEC 2022. With a “Texas State Fair” theme, look forward to local cuisine and Texas-inspired activities at this conveniently located venue across from the Convention Center. Unwind with classic games from childhood, such as giant versions of Scrabble and Battleship, skee ball, and horse shoes! Plus, it wouldn’t be Texas without a cowboy hat station, trick roper, the Western Magician, a cowboy stilt walker, and more. Musician Gary Kyle will provide the soundtrack to a night filled with fun and community. The APEC community has access to the entirety of the venue!

All full conference attendees will have a ticket included with their registration. Conference attendees can purchase an additional social event ticket through registration for $125 for guests.
# SPONSOR MEETINGS

## PSMA MEETINGS

### SATURDAY, MARCH 19

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:00 a.m. – 5:00 p.m.</td>
<td>PSMA/PELS Workshop on High Frequency Magnetics</td>
<td>352DEF</td>
</tr>
<tr>
<td>7:00 a.m. – 5:00 p.m.</td>
<td>PSMA/PELS Workshop on Capacitors</td>
<td>342</td>
</tr>
</tbody>
</table>

### SUNDAY, MARCH 20

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:00 p.m. – 2:30 p.m.</td>
<td>Friends of PSMA Reception – by invitation only</td>
<td></td>
</tr>
</tbody>
</table>

### MONDAY, MARCH 21

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 a.m. – 1:00 p.m.</td>
<td>PSMA Annual Meeting – followed by March BoD Meeting</td>
<td>342EF</td>
</tr>
</tbody>
</table>

### TUESDAY, MARCH 22

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 a.m. – 10:00 a.m.</td>
<td>PSMA Semiconductor Committee Meeting</td>
<td>332B</td>
</tr>
<tr>
<td>8:00 a.m. – 10:00 a.m.</td>
<td>PSMA Transportation Electronics Committee Meeting</td>
<td>332C</td>
</tr>
<tr>
<td>8:30 a.m. – 11:55 a.m.</td>
<td>PSMA Sponsored Industry Session: Magnetics IS01</td>
<td>360ABC</td>
</tr>
<tr>
<td>8:30 a.m. – 11:55 a.m.</td>
<td>PSMA Sponsored Industry Session: PwrSoC IS05</td>
<td>320C</td>
</tr>
<tr>
<td>10:00 a.m. – 12:00 p.m.</td>
<td>PSMA Capacitor Committee Meeting</td>
<td>332B</td>
</tr>
<tr>
<td>10:00 a.m. – 12:00 p.m.</td>
<td>PSMA Marketing Committee Meeting</td>
<td>332C</td>
</tr>
<tr>
<td>12:00 p.m. – 2:00 p.m.</td>
<td>PSMA Packaging &amp; Manufacturing Committee Meeting</td>
<td>332B</td>
</tr>
<tr>
<td>12:00 p.m. – 2:00 p.m.</td>
<td>PSMA Energy Management Committee Meeting</td>
<td>332C</td>
</tr>
<tr>
<td>2:00 p.m. – 4:00 p.m.</td>
<td>PSMA Magnetics Committee Meeting</td>
<td>332B</td>
</tr>
<tr>
<td>2:00 p.m. – 4:00 p.m.</td>
<td>PSMA Power Technology Roadmap Committee Meeting</td>
<td>332C</td>
</tr>
</tbody>
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### WEDNESDAY, MARCH 23

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 a.m. - 9:00 a.m.</td>
<td>APEC Student Attendance Support Committee Meeting</td>
<td>332C</td>
</tr>
<tr>
<td>8:00 a.m. - 10:00 a.m.</td>
<td>PSMA Energy Harvesting Committee Meeting</td>
<td>332B</td>
</tr>
<tr>
<td>8:30 a.m. – 11:55 a.m.</td>
<td>PSMA Sponsored Industry Session: Marketing IS06</td>
<td>360ABC</td>
</tr>
<tr>
<td>8:30 a.m. – 11:55 a.m.</td>
<td>PSMA Sponsored Industry Session: Semiconductor IS07</td>
<td>360DEF</td>
</tr>
<tr>
<td>8:30 a.m. – 11:55 a.m.</td>
<td>PSMA Sponsored Industry Session: Transportation Electronics IS09</td>
<td>320B</td>
</tr>
<tr>
<td>8:30 a.m. – 11:55 a.m.</td>
<td>PSMA Sponsored Industry Session: Packaging &amp; Manufacturing IS10</td>
<td>320C</td>
</tr>
<tr>
<td>10:00 a.m. – 12:00 p.m.</td>
<td>PSMA Energy Storage Committee Meeting</td>
<td>332B</td>
</tr>
<tr>
<td>10:00 a.m. – 12:00 p.m.</td>
<td>PSMA Safety &amp; Compliance Committee Meeting</td>
<td>332C</td>
</tr>
<tr>
<td>12:00 p.m. - 2:00 p.m.</td>
<td>PSMA Industry-Education Committee Meeting</td>
<td>332B</td>
</tr>
<tr>
<td>2:00 p.m. - 4:00 p.m.</td>
<td>PSMA Reliability Committee Meeting</td>
<td>332B</td>
</tr>
<tr>
<td>2:30 p.m. – 5:45 p.m.</td>
<td>PSMA Sponsored Industry Session: Semiconductor IS11</td>
<td>360ABC</td>
</tr>
<tr>
<td>2:30 p.m. – 5:45 p.m.</td>
<td>PSMA Sponsored Industry Session: Energy Storage IS15</td>
<td>320C</td>
</tr>
<tr>
<td>3:00 p.m. - 5:00 p.m.</td>
<td>PSMA/ IPC-2701 Committee Meeting</td>
<td>332B</td>
</tr>
</tbody>
</table>
## PSMA MEETINGS (continued)

### THURSDAY, MARCH 24

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30 a.m. - 11:30 a.m.</td>
<td>PSMA Sponsored Industry Session: Energy Management IS18</td>
<td>320A</td>
</tr>
<tr>
<td>1:45 p.m. - 3:25 p.m.</td>
<td>PSMA Sponsored Industry Session: Semiconductor IS21</td>
<td>360ABC</td>
</tr>
<tr>
<td>1:45 p.m. - 3:25 p.m.</td>
<td>PSMA Sponsored Industry Session: Capacitor IS22</td>
<td>360DEF</td>
</tr>
<tr>
<td>1:45 p.m. - 3:25 p.m.</td>
<td>PSMA Sponsored Industry Session: Energy Harvesting IS24</td>
<td>320B</td>
</tr>
</tbody>
</table>

## IEEE PELS MEETINGS

### MONDAY, MARCH 21

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 a.m. – 10:00 a.m.</td>
<td>PELS Exec Team Strategy Meeting (PELS Officers Only)</td>
<td>332E</td>
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</tbody>
</table>

### TUESDAY, MARCH 22

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:00 a.m. – 9:30 a.m.</td>
<td>PELS New AdCom Member Orientation Breakfast</td>
<td>332E</td>
</tr>
<tr>
<td>9:00 a.m. – 11:00 a.m.</td>
<td>PELS Technical Operations Committee Meeting</td>
<td>332D</td>
</tr>
<tr>
<td>9:30 a.m. – 11:30 a.m.</td>
<td>PELS Global Relations Committee Meeting</td>
<td>332E</td>
</tr>
<tr>
<td>11:30 a.m. – 1:30 p.m.</td>
<td>PELS VP of Standards Meeting</td>
<td>332E</td>
</tr>
<tr>
<td>1:30 p.m. – 3:30 p.m.</td>
<td>Global Energy Access Forum and Empower a Billion Lives II</td>
<td>332E</td>
</tr>
<tr>
<td>7:00 p.m. – 9:00 p.m.</td>
<td>PELS and IAS Young Professionals Networking Reception</td>
<td>The Grotto 1001 Avenida de las America, Suite A</td>
</tr>
</tbody>
</table>

### WEDNESDAY, MARCH 23

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 a.m. – 8:30 a.m.</td>
<td>WiE, YP, and You: How to become involved with IEEE PELS!</td>
<td>332D</td>
</tr>
<tr>
<td>9:00 a.m. – 12:00 p.m.</td>
<td>PELS Conferences Committee Meeting</td>
<td>332E</td>
</tr>
</tbody>
</table>

### FRIDAY, MARCH 25

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 a.m. – 8:30 a.m.</td>
<td>PELS Administrative Committee Breakfast</td>
<td>Brazoria Marriott, 2nd Level</td>
</tr>
<tr>
<td>8:30 a.m. – 1:00 p.m.</td>
<td>PELS Administrative Committee Meeting</td>
<td>Brazoria Marriott, 2nd Level</td>
</tr>
</tbody>
</table>
SESSION 1
9:30 a.m. – 1:00 p.m.
S01: Insulation and Coordination Design Steps for Power Converters
ROOM 350DEF
TRACK: Control & Design
Ilknur Colak
Maschinenfabrik Reinhausen
Insulation and coordination design is one of the most important topics which needs to be considered at the beginning stage of a power electronics system design. This tutorial reviews the fundamentals of insulation and coordination and defines the relevant norms, requirements and standards for high power medium voltage power electronics systems. The tutorial is intended to address the design steps to provide required clearance and creepage distances through some examples. This guide covers also the electrical tests and measurements to fulfill the electrical withstand capability for a given medium voltage application example. Finally, the insulation and coordination regulations for medium voltage power electronics systems and the differences between the regulations are presented in the tutorial. The scope of the lecture would be very valuable to those power electronics engineers, mechanical engineers and students from university and industry who face with the design problems of implementing insulation and coordination requirements in their applications and who need a guide to the methods that can be used strait away without performing complex mathematics.

SESSION 2
9:30 a.m. – 1:00 p.m.
S02: PCB Layout Techniques for Optimizing Performance of Surface-Mounted Wide-Bandgap Power Electronic Circuits
ROOM 351ABC
TRACK: Design & EMI
Eric Persson
Infineon Technologies Americas Corp
PCB layout is already challenging for power electronic circuits. But as wide-bandgap semiconductors (GaN and SiC) are increasingly adopted, their tenfold increase in switching speed compared to Silicon creates even more challenges for the circuit designer. Layout problems can lead to circuit malfunction, ringing and overshoot voltage spikes, EMI problems, higher loss than expected, and even transistor failure. Application notes often have the same advice to solve these problems: “be sure to minimize all parasitic layout inductance as much as possible.” But what is the best way to approach this, especially when there are multiple conflicting layout goals? It is simply not possible to eliminate all layout impedance everywhere, so how does one make the tradeoffs to optimize the PCB layout for best performance? This seminar addresses these questions, and leads you through a process to understand where parasitic impedances really matter, understand the magnitude of parasitic impedances, evaluate layout options, and make an informed decision on how to proceed. The focus is on the primary-side power circuits, and is intended to cover the range from approximately 50 W to 5 kW.

SESSION 3
9:30 a.m. – 1:00 p.m.
S03: Topology & Control of MHz High Density DC-DC Power Converters
ROOM 361ABC
TRACK: Topologies
Xinke Wu
Zhejiang University
Dong Cao
University of Dayton
Numerous applications need high power density, high efficiency dc-dc power converters with kW/in3 level density. Such as server applications in near future, high voltage dc power distribution is required to feed the server motherboard. A board mount step-down isolated dc/dc converter with low output voltage is necessary, which bring the high density and high efficiency requirements for the step-down dc/dc converter, where the density of the dc-dc stage is almost 1kW/in3. A MHz level dc-dc converter is necessary for achieving such high power density applications. Different topologies and control strategies are investigated and presented in this seminar including the EMI issues, magnetic component design guidelines and optimizations, efficiency optimizations.
SESSION 4

9:30 a.m. – 1:00 p.m.

**S04: High-Voltage SiC-Based Power Electronics for Grid Applications**

ROOM 352DEF

**TRACK: Wide Bandgap**

Fred Wang¹, Shiqi Ji², Haiguo Li³, Ruirui Chen³

¹University of Tennessee & ORNL, ²Tsinghua University, ³University of Tennessee

This seminar will introduce high-voltage SiC based power electronics for grid applications. The high-voltage SiC technology and grid power electronics applications will be overviewed. The benefits of fast switching and low loss SiC in grid applications will be introduced both at the converter and the system levels. The impact of grid conditions on SiC converter design will be discussed. Development of a 10 kV SiC MOSFET based 13.8 kV power conditioning system for distribution grids will be presented. This seminar is developed for engineers and researchers with basic knowledge of power electronics interested in SiC technology and grid applications.

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SESSION 5

9:30 a.m. – 1:00 p.m.

**S05: VA Modelling of the Differential Power**

ROOM 351DEF

**TRACK: Wireless Power & Magnetics**

Jose Cobos

*Differential Power S.L.*

In this talk, the main novelty is the “VA interpretation” of power conversion, that enables the calculation of the minimum required power to be processed in power converters. It is valid for 2-port converters tough it is especially enabling for n-port converters. This methodology also enables the synthesis of specific power topologies to operate in the fundamental limit of power processing. Key applications are stacking of sources (PV cells), loads (data processing cores) or batteries. “Partial power” and “Differential Power Processing, DPP” architectures may also be assessed with the “VA area” approach. Even more relevant is the case of energy buffered converters, as those required in single-phase inverters connected to domestic batteries/PV panels or those required in AC adapters and chargers with Power Factor Correction. The methodology is illustrated for the “Little Box Challenge” (Google and IEEE-PELS) specification and to supply 1000A to A.I. chips from 48V or 1V bus.

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SESSION 6

2:30 p.m. – 6:00 p.m.

**S06: Applications of Model Predictive Control in Power Electronics: Theory, Design, and Implementation**

ROOM 350DEF

**TRACK: Control & Design**

Waqar A. Khan, Iman Hosseini, Nathan Weise, Armin Ebrahimian

*Marquette University*

Predictive control belongs to the category of advanced non-linear control techniques that have been developed and researched since the early 1950’s. Model predictive controllers (MPC) are well suited to the inherently discrete, and non-linear nature of power converters while providing excellent dynamic performance compared to classical linear controllers. This professional education seminar will focus on various classifications of MPC techniques, formulation, limitations as well as real-time implementation on a DSP. Applications will include but are not limited to DC-DC converters, AC motor drives, and grid-connected converters incorporating wideband gap devices, e.g., SiC, GaN.

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SESSION 7

2:30 p.m. – 6:00 p.m.

**S07: Estimation and Mitigation of Conducted EMI in Power Electronic Systems**

ROOM 351ABC

**TRACK: Design & EMI**

Aaron Brovont¹, Andrew Lemmon²

¹Paul C. Krause and Associates, ²University of Alabama

This seminar provides an intermediate-level treatment of techniques for estimation, analysis, and mitigation of conducted electromagnetic interference (EMI) in power electronic systems. The first section introduces foundational EMI concepts and terms. The second section demonstrates the development of equivalent circuit models for predicting common-mode (CM) behavior. The third section provides guidance for performing accurate measurements of conducted emissions, with emphasis on medium-voltage wide band-gap (WBG) converters. The fourth section provides examples of EMI suppression and mitigation through knowledge of system sensitivities and exploitation of CM voltage cancellation. Overall, this seminar will provide insight into underlying causes of emissions behavior and practical guidance for improving emissions performance.
SESSION 8
2:30 p.m. – 6:00 p.m.
S08: The GaNs Impact On The AC-DD Power Adapters
ROOM 332ABC

TRACK: Topologies

Ionel Jitaru
Rompower

The seminar will present a comprehensive overview of the current and latest technologies used in power adapters. The latest generation of AC-DC adapters with power delivery has placed additional demands on the traditional flyback solution. In addition to the 3:1 input voltage range from 90Vac to 265Vac, the PD 3.0 requirements for the output voltage 3.3V to 20V, makes the total range 18:1. To further increase the efficiency of the flyback topology to reduce the size of AC-AD adapters, GaN were introduced for the purpose of decreasing the switching losses. The paper will present in detail the GaN impact for conventional hard switching QR flyback and also for ZVS flyback topology.

SESSION 9
2:30 p.m. – 6:00 p.m.
S09: Wide-Bandgap Bidirectional Switches and Their Impact on Future AC Power Converters and Applications
ROOM 352DEF

TRACK: Wide Bandgap

Victor Veliadis1, Johann Kolar2, Bulent Salioglu3, Thomas Jahns4, Jonas Huber2
1North Carolina State University, 2ETH Zurich, 3WEMPEC University of Wisconsin-Madison, 4University of Wisconsin-Madison

This seminar will discuss the emerging technology of wide-bandgap monolithic bidirectional (M-BD) power switches and the exciting opportunities they open for ac power converter topologies and their applications. We will present the semiconductor technology of M-BD switches and the performance improvement they bring to Matrix converters (MCs) and Current-source Inverters (CSIs) including CSI-based integrated motor drives, which combine motors and drives into the same housing. Opportunities to realize the full potential of M-BD switches in other promising new power converter topologies such as multi-level voltage-source inverters using the T-Type switching cell (TT-SC) will also be explored.
SESSION 11

8:30 a.m. – 12:00 p.m.

**S11: Reliability Analysis Methods and Tools for Power Electronic Components and Systems**

ROOM 332ABC

**TRACK: Control & Design**

Ionut Vernica, Huai Wang, Frede Blaabjerg
Aalborg University

The aim of this seminar is to provide a practical overview of the reliability analysis methods and tools, which are used during the design and development stages of power electronic products. Topics such as, life data analysis, reliability allocation, failure mechanisms of power semiconductor devices and capacitors, testing of power electronic components, and the specific design-for-reliability procedure for power electronic systems, will be covered during the seminar. Finally, a thorough mission-profile-based reliability assessment procedure for power electronic systems, and its software tool implementation, are demonstrated on a realistic motor drive application study-case, and thus, concluding the tutorial.

SESSION 12

8:30 a.m. – 12:00 p.m.

**S12: Theory & Design of Magnetic Components for Electromagnetic Interference Assessment & Suppression**

ROOM 352DEF

**TRACK: Design & EMI**

Shuo Wang
University of Florida

Unlike conventional magnetic component seminars which mostly focus on the power and efficiency of magnetic components, this seminar will address magnetic component theory and design from a different but very important aspect of engineering applications: electromagnetic interference (EMI) assessment and suppression. The seminar will explore the basic theory and design practice for the EMI performance and suppression of conventional magnetic components including transformers, power inductors, differential mode and common mode filter inductors. The theory, evaluation, design, suppression and experimental techniques for the conductive, near-field, and (far-field) radiative EMI emission of magnetic components will be addressed in depth. The seminar is good for all levels of engineers and students.
SESSION 13

8:30 a.m. – 12:00 p.m.

S13: A Primer on LLC Resonant Converter
ROOM 350DEF

TRACK: Topologies

Claudio Adragna, Francesco Gennaro
STMicroelectronics

The seminar offers a guided tour through the intricacies of LLC converters. It will cover the fundamentals (topology description and operating modes, soft-switching mechanism, first-harmonic approximation, etc.) with an in-depth analysis, and will end off with some highlights on the issues that a practicing engineer normally deals with when fine tuning and optimizing his/her design.

SESSION 14

8:30 a.m. – 12:00 p.m.

S14: The Surprising Benefits GaN Brings to BLDC Motor Drives – Design, Performance, Cooling and Reliability
ROOM 351ABC

TRACK: Wide Bandgap

Michael de Rooij, Marco Palma
Efficient Power Conversion Corporation

Gallium nitride (GaN) power semiconductors have seen increased adoption in many power-electronic applications. Recently GaN devices have made inroads into BLDC motor drives with surprising benefits that include ultra-low audible emissions, small size, high DC to mechanical efficiency, reduced component count, and improved precision control when compared to MOSFET based inverters. 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 be able to implement them in BLDC motor drive applications.

SESSION 15

8:30 a.m. – 12:00 p.m.

S15: Wireless Power Transfer: Technologies, Challenges and Opportunities
ROOM 351DEF

TRACK: Wireless Power & Magnetics

Francesco Carobolante
IoTissimo

Wireless Power Transfer (WPT) challenges engineers to find solutions to “cut the cords.” Transferring power is easy, but developing robust implementations that can yield a viable product is much more complicated. Different solutions are required to address the most diverse applications, from well-known use cases like smartphones and wearables to industrial and robotic products as well as medical implants. This presentation will provide a broad analysis of the challenges and trade-offs, from frequency selection to transmitter design, to achieve short and long-distance power transfer, while addressing EMI, safety and interference issues.
The APEC 2022 Plenary Session is made up of several presentations from respected industry leaders. Taking place Monday, March 21, the session allows for interactive Q&A at the end of each presentation.

Presentation 1
Space M: The Magnetics Universe and Challenges
1:30 p.m. – 2:00 p.m.

SPEAKER:
Alex Gerfer
CTO
Würth Elektronik eiSos Group

We have a huge variety of inductors and transformers in the magnetics universe. Orders of magnitude in size and power, a large range of application frequencies into the MHz and hundreds of core materials. Is it any wonder that most designers find it hard to navigate through this deep cosmos to find the best solution for their design goal. This presentation will give a comprehensive overview of new, interesting design tools. It will highlight the importance of increased cooperation between research institutes, manufacturers and consultants to overcome existing design barriers. Solutions are around the corner: AI and 3D printing will more and more help us, to build low loss and volume optimized magnetic components.

Presentation 2
On the Moon to Stay: Challenges Presented to Power Electronics Technology by Sustained Operations on the Lunar Surface
2:00 p.m. – 2:30 p.m.

SPEAKER:
John H. Scott
Principal Technologist, Power and Energy Storage
NASA Space Technology Mission Directorate

NASA’s Artemis Program seeks not only to return humans to the Moon for the first time since the 1970’s but also to provide the technological basis for infrastructure that will enable permanent and expanding scientific and industrial exploitation of the Lunar surface. The primary purpose of this infrastructure is to generate and distribute power to a diverse and growing range of scientific and industrial assets, and the keys to success for this function are power management and control circuits that are highly reliable and maintainable for a decade of operation in the extreme thermal, radiation, and dust environment of the Lunar surface. While various combinations of wide band gap semiconductors, electronic devices, circuit topologies, and shielding schemes have been successfully developed for mission environments ranging from low Earth orbit to the Jovian system, power management technology has not been optimized to meet the full combination of mission requirements for the Lunar surface. To accomplish this, NASA requests the dedicated focus of the power electronics industry.
Presentation 3
Energy Access: Challenges, Opportunities, and our Contributions
2:30 p.m. – 3:00 p.m.

SPEAKERS:
Jelena Popovic
IEEE Empower a Billion Lives (EBL) II Vice-Chair
Associate Professor
University of Twente, The Netherlands

Liuchen Chang
IEEE Power Electronics Society (PELS) President
Professor Emeritus
University of New Brunswick, Fredericton, Canadas

Ensuring universal, affordable and sustainable energy access is one of the biggest societal challenges of our time. Energy poverty has far reaching consequences on health, education and livelihoods for almost 1 billion people with no access to electricity and over 2 billion people with poor and unreliable access. Decentralized approaches, such as solar home systems and minigrids have emerged in response to the shortcomings of centralized grid extension, sparked start-up innovation and are increasingly being integrated in national electrification plans. However, affordability, scalability, quality, interoperability, business models, technology obsolescence and life-cycle sustainability remain challenges. This plenary talk will frame the energy access challenges, benchmark existing solutions, highlight opportunities for the power electronics community, and present the engagement of the IEEE Power Electronics Society with energy access. Flagship initiatives are IEEE Empower a Billion Lives, a recurring global competition aimed at fostering innovation to develop technically, economically and socially viable energy access solutions and IEEE Global Energy Access Forum, a platform to facilitate multistakeholder engagement in discussions on how rapid technology developments, forward leaning policies and new financing mechanisms intersect and can accelerate the development and deployment of scalable solutions for energy access.

BREAK
3:00 p.m. – 3:30 p.m.

Presentation 4
Driving Plasma: Advancing Power Conversion in Critical Semi and Medical Applications
3:30 p.m. – 4:00 p.m.

SPEAKER:
Gideon (Don) van Zyl
Technical Fellow
Advanced Energy

Plasma processing is well established and known in semiconductor wafer manufacturing and for creating highly engineered coatings in advanced industrial applications. The ability to precisely power and drive plasma loads has also enabled electrosurgical applications. For the power electronics engineer, plasma loads present unique challenges, including wide swings in load impedance, the highly nonlinear and time-varying nature of the load, arcing, and the difficulty in precisely measuring and controlling power delivery. In the semiconductor industry, higher etch rate requirements for 3D memory devices result in ever-increasing power being applied to bias the workpiece. This results in severe modulation of the plasma impedance creating problems for other generators that are also coupled to the plasma load. In medical applications, where a small plasma is created at the tip of a powered electrosurgical probe to cut and ablate tissue, challenging plasma impedance variations create the same challenge for power delivery and control. We will show how advances in power electronics devices, circuits, and measurement and control are enabling advanced plasma processing.
Presentation 5
History of PSMA Power Technology Roadmap: from AAA TripTik® to Google Maps®
4:00 p.m. – 4:30 p.m.

SPEAKER:
Ritu Sodhi
PSMA Roadmap Committee
Consultant, Power Transistor R&D
Rohm

Our success as individuals, as companies, and as institutions, depends on anticipating and being equipped to deal with the future. To help the power electronics industry in this endeavor, PSMA published its first Power Technology Roadmap (PTR) in 1994 using a collaborative approach. A lot has changed since then in our industry and in the way that we do the roadmapping. Along with increased participation from the community, our methodology has adapted to the times to stay relevant, with an aim to provide wide ranging perspectives to the growth and evolution of power conversion technology. In this talk, we will walk down memory lane and track the evolution of the PSMA PTR—from a single, in-person, roundtable event in the early years to a multidimensional, multimedia, multiyear activity to track key trends across a broad variety of power conversion markets. See how the community anticipated industry trends such as efficiency, digital control and the shift from silicon to wide bandgap materials. And revisit what we got wrong. The PTR will continue to evolve. Find out how it can continue to be useful to you or better yet, how you can help chart the next 30 years of the industry!

Presentation 6
Inverters for the Future Grid – Challenges and Opportunities
4:30 p.m. – 5:00 p.m.

SPEAKER:
Deepakraj (Deepak) Divan
Professor, John E Pippin Chair and GFA Eminent Scholar
Director, GT Center for Distributed Energy, ECE
Georgia Institute of Technology

Hundreds of gigawatts of PV solar, wind and storage are being deployed globally on the grid every year. Over the next 5-10 years, millions of geo-dispersed inverters will replace the rotating synchronous generators that are the heart of today’s grid. These inverters will have to work together collectively and autonomously to also form and sustain the grid as an ecosystem and will have to do so without causing stability issues or interacting with each other or with other grid elements. This will require new hardware, software and control principles. It will also drive the industry towards multiport power converters that are flexible, modular and scalable, and which can simultaneously and safely interface with PV solar, batteries, generators and loads, managing power flows between various sources/loads and ensuring stable operation under normal, transient and fault conditions. Fast-moving technologies, lagging standards, diverse communications protocols, cybersecurity issues, hundreds of inverter vendors, and hundreds of grid codes to comply with, pose a very challenging set of issues – but they need to be solved soon. Availability of a next generation inverter for the future grid can be a key factor in addressing climate change and saving the only planet that we have.
The Industry Sessions 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. Presentations will be available through the APEC mobile app.

8:30 a.m. – 11:55 a.m.

**ISO1: Magnetics: What It Takes to Commercialize Great Ideas**

**ROOM 360ABC**

**SESSION CHAIR**

Edward Herbert, **PSMA**

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<tr>
<th>Session Time</th>
<th>Session Title</th>
<th>Presenter(s)</th>
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<tbody>
<tr>
<td>8:30 a.m.</td>
<td><strong>IS01.1</strong> Designing for Manufacturability — From the Magnetic Manufacturer’s Point of View</td>
<td>Adam Sullivan, Wurth Electronics Midcom</td>
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<tr>
<td>8:55 a.m.</td>
<td><strong>IS01.2</strong> Planar Transformer Design: Options, Design Rules, and Tools</td>
<td>Sudhakar Chakkirala, Power Integrations</td>
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<tr>
<td>9:20 a.m.</td>
<td><strong>IS01.3</strong> Special Core Shapes, Machining, and Tooling</td>
<td>Chuck Wild, Dexter Magnetic Technologies</td>
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<tr>
<td>9:45 a.m.</td>
<td><strong>IS01.4</strong> Bobbins, Designing for High Volume Production</td>
<td>Brian Hatley, Miles-Platts</td>
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<td>10:40 a.m.</td>
<td><strong>IS01.5</strong> Quantifying Leakage Inductance and Making it Produrable</td>
<td>Rodney Rodgers, All Star Magnetics</td>
</tr>
<tr>
<td>11:05 a.m.</td>
<td><strong>IS01.6</strong> The Supply Chain for Magnetics</td>
<td>Lucas Nicieza, Frenetic</td>
</tr>
<tr>
<td>11:30 a.m.</td>
<td><strong>IS01.7</strong> Safety Requirements and Other Regulatory Pitfalls</td>
<td>Landen Goerdes, Wurth Elektronik</td>
</tr>
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</table>

8:30 a.m. – 11:55 a.m.

**ISO2: Wide-Bandgap Bidirectional Switches & Key Applications**

**ROOM 360DEF**

**SESSION CHAIR**

Victor Veliadis, **North Carolina State University**

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<tr>
<th>Session Time</th>
<th>Session Title</th>
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| 8:30 a.m.    | **IS02.1** Overview of WBG BD Switch Devices and Applications | Victor Veliadis$^1$, Thomas Jahns$^2$  
$^1$North Carolina State University,  
$^2$University of Wisconsin-Madison |
| 8:55 a.m.    | **IS02.2** Efficacy of GaN-on-Si Technology for Realizing Commercially Viable Monolithic Bi-Directional Switches | Mohamed Imam, Infineon |
| 9:20 a.m.    | **IS02.3** GaN Four Quadrant Switches: Ready for Prime Time? | Rakesh Lal, Transphorm |
| 9:45 a.m.    | **IS02.4** Recent Advances on Bidirectional Switch Research for Emerging Applications | Warren Chen, Raytheon Technologies Research Center |
| 10:40 a.m.   | **IS02.5** How Solid-State Circuit Breakers Enable the Energy Transition and the Critical Role of WBG Semiconductors | Michael Harris, Atom Power |
| 11:05 a.m.   | **IS02.6** Solid-State Circuit Breaker: Opportunities and Challenges | Xiaojing Song, ABB, Inc |
11:30 a.m.  
**ISO2.7** Potential Applications of Bi-Directional Fets in Heavy-Duty Vehicle Electrification  
Brij Singh  
John Deere

8:30 a.m. – 11:55 a.m.  
**ISO3: Power Electronics for High Performance Computing: Opportunities & Challenges**  
ROOM 320A  
SESSION CHAIR  
Minjie Chen, Princeton University

8:30 a.m.  
**ISO3.1** Hybrid and Resonant Switched-Capacitor Converters for Efficient and Compact High Step-Down Dc-Dc Power Conversion  
Robert Pilawa-Podgurski  
University of California-Berkeley

8:55 a.m.  
**ISO3.2** Microprocessor Power Delivery Challenges  
Kaladhar Radhakrishnan  
Intel Corporation

9:20 a.m.  
**ISO3.3** Advanced Low-Voltage and Medium-Voltage AC/DC Grid Interfaces for High Performance Computing  
Johann Kolar  
ETH Zurich

9:45 a.m.  
**ISO3.4** Power Conversion and Power Integrity Co-Design: a Holistic Approach for Future Processor Power Delivery  
Houle Gan  
Google LLC

10:40 a.m.  
**ISO3.5** Overcoming Magnetics Limitations for Data Center Power  
Charles Sullivan  
Dartmouth

11:05 a.m.  
**ISO3.6** Efficient and Compact Power, Packaging and Cooling for Future Datacenters  
Xin Zhang  
IBM

11:30 a.m.  
**ISO3.7** Extreme Performance 48V-1V Power Delivery for Ultra High Current Microprocessors  
Minjie Chen  
Princeton University

8:30 a.m. – 11:55 a.m.  
**ISO4: AC-DC Converters & DataCenter**  
ROOM 320B  
SESSION CHAIR  
Alessandro Pevere, Infineon Technologies

8:30 a.m.  
**ISO4.1** Designing a step-Down Converter with a Space Grade Controller  
Daniel Hartung  
Texas Instruments

8:55 a.m.  
**ISO4.2** Fan-Less Low-Profile High Efficiency AC/DC Converters for New 5G Telecom Environment  
Francesco Di Domenico, Alessandro Pevere  
Infineon Technologies

9:20 a.m.  
**ISO4.3** New AC to DC Converter Technologies for Airborne Power Systems  
Travis Sitton  
Crane Aerospace

9:45 a.m.  
**ISO4.4** Seamless Bidirectional Operation of a GaN Based Totem-Pole Active Front-End Rectifier for DC Microgrids and Robotics Applications  
Nour Elsayad, Yalcin Haksoz, Deepak Veereddy  
Infineon Technologies

10:40 a.m.  
**ISO4.5** Addressing Power Delivery Challenges for FPGAs in data-Intensive Accelerator Applications  
Mukund Krishna  
Empower Semiconductor

11:05 a.m.  
**ISO4.6** High Power Magnetics for Datacenter Applications: Alternate Constructions and Efficiency Analysis  
David Wiest, Yosef Zhou  
Pulse Electronics

11:30 a.m.  
**ISO4.7** High Voltage 800-W Sepic Converter Reference Design for Server Battery Backup Charging  
Elisabetta Mahmutovic, Aidan Davidson  
Texas Instruments
8:30 a.m. – 11:55 a.m.

**IS05: PwrSoC for Next Generation Power Delivery & Management**
ROOM 320C

**SESSION CHAIRS**
Matt Wilkowski, EnaChip
Hanh-Phuc Le, University of California-San Diego

**8:30 a.m.**

**IS05.1** Circuits and Topologies: Review and Trends
Bruno Allard
Univ. Lyon

**IS05.2** Integrated Capacitors and Energy Storage Devices for PwrSoC: Trends and Challenges
Mohamed Mehdi Jatlaoui
Murata Integrated Passive Solutions

**8:55 a.m.**

**IS05.4** Wide Bandgap Integration Trends and Opportunities
Bernhard Wicht
Leibniz Universität Hannover

**10:40 a.m.**

**IS05.5** System Integrated Manufacturing and Packaging Trends and Roadmaps
Hongbin Yu
Arizona State University

**11:05 a.m.**

**IS05.6** New Architectures for High Performance Granular Power Supplies
Santosh Kulkarni
Renesas Electronics Corporation

**11:30 a.m.**

**IS05.7** PwrSoC: Industry Adoption in High-Volume Applications
Francesco Carobolante
IoTissimo
TECHNICAL LECTURES

APEC professionals participated in a rigorous peer review process and have carefully picked hundreds of papers, which make up APEC’s Technical Sessions. There are two categories of Technical Sessions. The Technical Lectures consist of papers of broad appeal scheduled for oral presentation. The various technical venues cover all areas of technical interest to the practicing power electronics professional.

8:30 a.m. – 12:00 p.m.
T01: Resonant DC-DC Converters
ROOM 352DEF

Resonant DC-DC Converters

SESSION CHAIRS
Yeonho Jeong, University of Rhode Island
Robert Pilawa-Podgurski, University of California-Berkeley

8:30 a.m.
T01.1 Light Load Efficiency Improvement of Three-Phase CLLC Resonant Converter for On-Board Charger Applications
Feng Jin\textsuperscript{1}, Ahmed Nabih\textsuperscript{2}, Qiang Li\textsuperscript{2}
\textsuperscript{1}CPES, \textsuperscript{2}Virginia Tech

8:50 a.m.
T01.2 A High Efficiency and High Current LLC Resonant Converter with Improved Interleaving Winding Arrangements
Mingxiao Li\textsuperscript{1}, Long Teng\textsuperscript{2}, Michael A.E. Andersen\textsuperscript{1}, Ziwei Guoyang\textsuperscript{1}, Chang Wang\textsuperscript{1}
\textsuperscript{1}Technical University of Denmark, \textsuperscript{2}University of Cambridge

9:10 a.m.
T01.3 Sensing Circuits and Control Mechanisms for Resonant Tank of Soft-Switching Current Source Converters
Mickael J. Mauger, Deepak Divan
Georgia Institute of Technology

9:30 a.m.
T01.4 Automatic Resonant Frequency Tracking Scheme for LLC Resonant Converter Based on Adaptive Extended State Observer
Runhu He, Haoyu Wang, Bo Xue
ShanghaiTech University

9:50 a.m.
T01.5 Termination Design and Optimization for High-Frequency High-Current PCB-Winding Planar Transformers
Pranav Raj Prakash\textsuperscript{1}, Qiang Li\textsuperscript{2}, Ahmed Nabih\textsuperscript{2}
\textsuperscript{1}CPES, \textsuperscript{2}Virginia Tech

10:40 a.m.
T01.6 High Density Hybrid Switched Capacitor Sigma Converter for DATA-Center Applications
Mario Ursino\textsuperscript{1}, Roberto Rizzolatti\textsuperscript{2}, Gerald Deboy\textsuperscript{3}, Stefano Saggini\textsuperscript{3}
\textsuperscript{1}Infineon Technology AT, \textsuperscript{2}Infineon Technologies Austria AG, \textsuperscript{3}Università di Udine DPIA, \textsuperscript{3}Infineon Technologies

11:00 a.m.
T01.7 Design and Control of a High-Power Wide-Gain-Range LLC Resonant Converter
Chunyang Zhao, Yi-Hsun Hsieh\textsuperscript{1}, Fred C. Lee\textsuperscript{2}, Feng Jin\textsuperscript{1}, Zheqing Li\textsuperscript{3}
\textsuperscript{1}Center for power electronics systems, Virginia Tech, \textsuperscript{2}Virginia Polytechnic Institute and State University, \textsuperscript{3}CPES Virginia Tech

11:40 a.m.
T01.9 Optimal Design of Transformer Winding of LLC Converter for Parasitic Capacitance Improvement
Yifeng Wang\textsuperscript{1}, Bo Chen\textsuperscript{1}, Chen Chen\textsuperscript{2}, Ruilin Ji\textsuperscript{3}, Hongqing Zhu\textsuperscript{4}, Mingzhi Zhang\textsuperscript{1}
\textsuperscript{1}Tianjin University, \textsuperscript{2}University of Texas at Dallas, \textsuperscript{3}State Grid Tianjin Power Costumer Service Center, \textsuperscript{4}State Grid Dongying Electric Power

8:30 a.m. – 12:00 p.m.
T02: Power Electronic Converters for Renewable Energy Systems
ROOM 351ABC

Power Electronic Converters for Renewable Energy

SESSION CHAIR
Fang Luo, Stony Brook University
Jingbo Liu

8:30 a.m.
T02.1 Bidirectional Constant Current S2C Battery Equalizer Based on Fixed-Frequency L2C3 Resonant Converter
Zhengqi Wei, Haoyu Wang, Yiqing Lu
ShanghaiTech University
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<td>8:50 a.m.</td>
<td>T02.2</td>
<td>Comparative Study of the Phase Integrated Converter As Universal Power Converter</td>
<td>Oleksandr Husev², Oleksandr Matiushkin¹, Dmitri Vinnikov¹, Naser Vosoughi², Samir Kouro² ¹Tallinn University of Technology, ²Universidad Técnica Federico Santa María</td>
</tr>
<tr>
<td>9:10 a.m.</td>
<td>T02.3</td>
<td>Minimum Phase Hybrid Bipolar Converter for PV Integrated DC Microgrid Applications</td>
<td>Pawan Kumar¹, Ranjit Mahanty², Rajeev Kumar Singh¹ ¹Indian Institute of Technology (BHU), ²IIT BHU Varanasi</td>
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<tr>
<td>9:50 a.m.</td>
<td>T02.4</td>
<td>Triple Phase-Shift Optimization of SiC-Based Dual-Active Bridge Converter</td>
<td>Adithyan Vetivelan, Ruiyang Yu, Wei Xu, Alex Q.Q. Huang University of Texas at Austin</td>
</tr>
<tr>
<td>10:40 a.m.</td>
<td>T02.5</td>
<td>Performance Evaluation of Isolated Three-Phase Differential Flyback Inverter with Ripple-Free Input Current for Grid-Tied Applications</td>
<td>Ahmed Ismail Mohamed Ali², Takaharu Takeshita¹, Mahmoud Sayed² ¹Nagoya Institute of Technology, ²South Valley University</td>
</tr>
<tr>
<td>11:00 a.m.</td>
<td>T02.6</td>
<td>An Interleaved High Step-Up DC-DC Converter with Built-in Transformer-Based Voltage Multiplier for DC Microgrid Applications</td>
<td>Ramin Rahimi, Saeed Habibi, Pourya Shamsi, Mehdi Ferdowsi Missouri University of Science and Technology</td>
</tr>
<tr>
<td>11:20 a.m.</td>
<td>T02.7</td>
<td>Modified Transformerless Boost Derived Hybrid Converter with No Right Half-Plane Zero and Reduced Leakage Current</td>
<td>Simanta Samal¹, Rajeev Kumar Singh², Ranjit Mahanty¹ ¹IIT BHU Varanasi, ²Indian Institute of Technology (BHU)</td>
</tr>
<tr>
<td>11:40 a.m.</td>
<td>T02.9</td>
<td>Bidirectional Parallel Low-Voltage Series High-Voltage DAB-Based Converter Design Analysis</td>
<td>Emanuel Serban¹, Martin Ordonez², Cosmin Pondiche¹, Juergen Wassmuth¹ ¹UBC - EnerSys, ²The University of British Columbia</td>
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**TUESDAY, MARCH 22**

**EDUCATIONAL PROGRAM**

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<td>8:30 a.m. – 12:00 p.m.</td>
<td>T03: Motor Drives</td>
<td>ROOM 351DEF</td>
<td><strong>Motor Drives</strong></td>
</tr>
<tr>
<td>8:30 a.m.</td>
<td>T03.1</td>
<td>Variable Speed Induction Motor Drive Scheme with Very Dense 18-Sided Voltage Space Vector Structure</td>
<td>Mohammed Imthias¹, Mriganka Ghosh Majumder², Umanand L³, Rakesh R¹, Gopakumar K³ ¹Indian Institute of Science, ²Bengaluru, ³University of Houston, ³Indian Institute of Science</td>
</tr>
<tr>
<td>9:10 a.m.</td>
<td>T03.2</td>
<td>High-Precision Parameter Identification Method for High Speed PMMS Based on High Frequency Impedance Model and Current Injection</td>
<td>Zhihao Song¹, Kevin Lee³, Wenxi Yao³ ¹Zhejiang University, ³Eaton Corporation</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>T03.3</td>
<td>Dynamic Interleaving Method to Reduce Dc-Link Ripple for Asymmetric Dual Three-Phase Permanent Magnet Synchronous Machine Drives</td>
<td>Yilmaz Sozer, Md Ehsanul Haque, Anik Chowdhury University of Akron</td>
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<tr>
<td>9:50 a.m.</td>
<td>T03.4</td>
<td>Comparison of Three-Phase and Six-Phase High-Power Ultra-High-Speed Machine for Portable Mechanical Antenna</td>
<td>Md Khurshedul Islam, Seungdeog Choi, Kazi Nishat Tasnim Mississippi State University</td>
</tr>
<tr>
<td>10:40 a.m.</td>
<td>T03.5</td>
<td>One-Digital-Sampling Commutation Method for Low Inductance Brushless DC Motors</td>
<td>Juwon Lee, Jung-Ik Ha, Gyu Cheol Lim Seoul National University</td>
</tr>
<tr>
<td>10:40 a.m.</td>
<td>T03.6</td>
<td>A Novel Speed Controller of 6-Phase Ultra-High-Speed PMSM for A-Mechanically-Based-Antenna (AMEBA)</td>
<td>Kazi Nishat Tasnim¹, Moinul Shahidul Haque², Md Khurshedul Islam¹, Seungdeog Choi¹ ¹Mississippi State University, ²Nexteer Automotive</td>
</tr>
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</table>
11:00 a.m.  
T03.7 UKF-Based offline Estimation of PMSM Magnet Flux Linkage Considering Inverter dead-Time Voltage Error  
Tao Li, Chaohui Liang, Duhuang Su  
Spintral Limited

11:20 a.m.  
T03.8 Self-Limiting Control of Induction Machines  
Vesel Tuftu Buyldekemencii, Philip Kreini  
1Elektra Elektronik San. Tic. A.S.,  
2University of Illinois at Urbana-Champaign

11:40 a.m.  
T03.9 ANN Based On-Board Fault Diagnostic for Induction Motor Drive in Low-Cost Electric Vehicles  
Utkal Ranjan Muduli, Jamal Y. Alsawalhi, Ameera Saad Al-Sumaiti, Khaled Al Jasfani, Ranjan Kumar Behera, Khalifa Al Hosan  
1Khalifa University, 2IIT Patna

8:30 a.m. – 12:00 p.m.  
**T04: GaN/Silicon/Passive Devices**  
ROOM 361ABC

**GaN/Silicon/Passive Devices**

**SESSION CHAIRS**  
Justin Henspeter, IBM  
Fei Yang, Texas Instruments

8:30 a.m.  
T04.1 Overvoltage Ruggedness and Dynamic Breakdown Voltage of P-Gate GaN HEMTs in High-Frequency Switching Up to Megahertz  
Ruizhe Zhang, Qihao Song, Yuhao Zhang, Qiang Li  
Virginia Polytechnic Institute and State University

8:50 a.m.  
T04.2 Short-Circuit Protection for GaN Power Devices with Integrated Current Limiter and Commercial Gate Driver  
Davide Bisi, Tsutomu Hosoda, Masamichi Kamiyama, Umesh Mishra, Philip Zuk, Primit Parikh, Long V. Nguyen, Ashish Gokhale, Ted Liu, Keith Coffey  
1Transphorm Inc., 2Skyworks, 3Silicon Labs

9:10 a.m.  
T04.3 Thermal Design Considerations for GaN-Based Power Adapters with Multi-Heat Sources  
Rahil Samani, Roy Hou, Jimmy Liu, Lucas Lu, Majid Pahlevani, Maryam Alizadeh  
1University of Calgary, 2GaN Systems Inc., 3Queen’s University

8:30 a.m. – 12:00 p.m.  
**T05: Modeling & Simulation of Power Electronics Systems**  
ROOM 361DEF

**Modeling & Simulation of Power Electronics Systems**

**SESSION CHAIRS**  
Sombuddha Chakraborty, Texas Instruments  
Joseph Song-Manguelle, Oak Ridge National Laboratory

8:30 a.m.  
T05.1 Low Temperature Evaluation of Silicon Carbide (SiC) Based Resonant Converter  
Yuqi Wei, Maksudul Hossain, Alan Mantooth  
University of Arkansas
**EDUCATIONAL PROGRAM | TECHNICAL LECTURES**

**TUESDAY, MARCH 22**

**T05: Educational Program**

**8:50 a.m.**

**T05.2** A New Discontinuous Conduction Mode in a Transformer Coupled High Gain DC-DC Converter
Kartikeya Veeramraju¹, Jonathan Kimball¹, Joshua Rovey², Jacob Eisen²
¹Missouri University of Science and Technology, ²University of Illinois Urbana-Champaign

**9:10 a.m.**

**T05.3** Multi-Variable Control-Based Conduction Loss Optimization in Dual Active Bridge Converter Considering Generalized Harmonic Approximation Oriented Steady-State Model
Ayan Mallik, Saikat Dey
Arizona State University

**9:30 a.m.**

**T05.4** A Modular and Performance-Tunable Silicon Carbide Half-Bridge Building Block with Active Gate Driver
Fei Diao¹, Yue Zhao¹, Yufei Li¹, Guangqi Zhu², Yuheng Wu¹
¹University of Arkansas, ²Eaton

**9:50 a.m.**

**T05.5** Modeling and Design of High-Power Radio-Frequency Power Combiners Based on Transmission Lines
Haoquan Zhang¹, Alexander Jurkov², Ky Luu², Grace Cassidy¹, Aaron Radomski², David Perreault¹
¹Massachusetts Institute of Technology, ²MKS Instruments Inc.

**10:40 a.m.**

**T05.6** Discrete-Time Modeling Framework for Analysis of LLC Converters Over a Wide Frequency Range
Gopi Chilukuri¹, Dipayan Chatterjee¹, Santanu Kapat¹, Ranajay Mallik²
¹Indian Institute of Technology (IIT) Kharagpur, ²ST Microelectronics Private Limited

**11:00 a.m.**

**T05.7** Quantitative Analysis of Accelerated Power Electronics Simulation Using Advanced Computing Technology
Yi Li, Zheyu Zhang, Shuangshuang Jin, Cayden Wagner, Christopher Edrington
Clemson University

**11:20 a.m.**

**T05.8** Time-Effective Component Selection Automation in Electric Vehicles Using Openly-Available Data
Gabriel Ferreira Da Silva¹, Ignacio Galindo Zurbriggen², Martin Ordonez¹, Francisco Paz¹
¹University of British Columbia, ²University of Calgary

**11:40 a.m.**

**T05.9** Six-Zone MVDC Architecture Baseline for Fault Analysis and High Speed Breaker Placement
Keith Corzine¹, Robert Ashton²
¹University of California Santa Cruz, ²Ashton Consulting LLC

**T06: Practical Design Considerations for Power Converters**

**ROOM 350DEF**

**8:30 a.m.**

**T06.1** Modeling and Reduction of Radiated EMI Due to Ground Impedance in a High-Density Active-Clamp Flyback Power Adapter
Zhedong Ma¹, Srikanth Lakshmikanthan², Honggang Sheng², Shuo Wang¹
¹University of Florida, ²Google LLC

**8:50 a.m.**

**T06.2** Reliability Assessment of Fault-Tolerant Power Converters Including Wear-Out Failure
Ariya Sangwongwanich, Frede Blaabjerg
Aalborg University

**9:10 a.m.**

**T06.3** Intelligent DC- and AC Power-Cycling Platform for Power Electronic Components
Kaichen Zhang, Francesco Iannuzzo, Martin Bendix Fossgaard
Aalborg University

**9:30 a.m.**

**T06.4** Miniature Liquid cold-Plate Enabled by Metal spraying: a Thermal Management Solution for a Modular 1 Kw bi-Directional GaN-Based dc-ac Converter
Omri Tayyara, Sanjeev Chandra, Cristina Amon, Nameer Ahmed Khan, Olivier Trescases, Miad Nasr, Josh Palumbo, Carlos Da Silva Leal
University of Toronto
9:50 a.m.  
**T06.5**  
**Online Capacitance Estimation Method in Buck Converters with Characteristic Frequency Injection for Optimal Sensitivity**  
Haoyu Wang¹, Kang Yue¹, Yu Liu¹, Xinguo Zhang²  
¹ShanghaiTech University, ²School of Information Science and Technology, ShanghaiTech University

10:40 a.m.  
**T06.6**  
**Physics-Informed Machine Learning for Parameter Estimation of DC-DC Converter**  
Shuai Zhao, Yingzhou Peng, Yi Zhang, Huai Wang  
Aalborg University

11:00 a.m.  
**T06.7**  
**Analysis of Thermal Cycling Effects in Power Devices Under non-Constant Cumulative Stress**  
Alessandro Vaccaro, Paolo Magnone  
University of Padova

11:20 a.m.  
**T06.8**  
**Back-to-Back Geometrical Configuration of Two parallel-Connected double-Sided Cooling Modules for Parasitic Inductance Reduction**  
Hehong Zhang, Tomoyuki Mannen, Takanori Isebe  
University of Tsukuba

11:40 a.m.  
**T06.9**  
**Modular Switching Cell Design for High-Performance Flying Capacitor Multilevel Converter**  
Logan Horowitz, Robert Pilawa-Podgurski  
University of California-Berkeley
RAP SESSIONS

The APEC 2022 RAP Sessions feature several exciting and contentious topics. RAP Sessions allow for exciting dialogue amongst attendees and presenters. Admission to all Rap Sessions is free with an Exhibits Only Registration.

5:00 p.m. – 6:30 p.m.
RAP SESSION #1:
Switch Capacitor vs. Inductor Based Topologies
ROOM 320ABC
CHAIR: Jonathan Kimball, Missouri University
PANELISTS:
> Robert Pilawa, University of California Berkeley
> Loai Salem, University of California Santa Barbara
> Jose Cobos, Universidad Politécnica de Madrid
> Roger Chen, Texas Instruments
> Nicola Femia, University of Salerno
> Dr. Jinghai Zhou, Monolithic Power Systems

In the search for higher power density, higher efficiency, and lower cost, power supply designers have pursued a wide range of alternative topologies. The panelists for this session have explored different topologies that are centered on either switched capacitor structures or inductors. Come explore the benefits of each approach and the applications where they can provide distinct benefits, and learn from experts about their vision for the future of high-density power conversion!

5:00 p.m. – 6:30 p.m.
RAP SESSION #2:
Challenges and Potential of “AI Based Design” vs. “Conventional Design”
ROOM 350DEF
CHAIR: Alan Mantooth, University of Arkansas
PANELISTS:
> Alfonso Martínez, Frenetic
> Minjie Chen, Princeton University
> Joao Pinto, Oakridge National Labs
> Alex Huang, University of Texas at Austin
> P. Markondeya Raj, Florida International University
> Doug Hopkins, North Carolina State University
> Khurram Afridi, Cornell University
> Cian Ó Mathúna, Tyndall National Institute

As the journey to miniaturize the power supply and quest for higher efficiency continues, integration of magnetics creates new challenges and opportunities. To this effect a considerable amount of innovation has been done to integrate magnetics in ICs and PCBs. This includes Magnetics implemented on chip, in package, embedded in PCB, on PCB and new magnetics technologies. Each approach has its own tradeoffs in terms of efficiency, size, power delivered, reliability, cost and EMI. What would be the right approach for your application? Join the panel of experts in a spirited debate to get your questions answered, learn about the state of the art and explore the future of Magnetics integration!

5:00 p.m. – 6:30 p.m.
RAP SESSION #3:
Magnetics in IC vs. Magnetics in PCB
ROOM 310
CHAIR: Kevin Parmenter, Indumini Ranmuthu, Texas Instruments
PANELISTS:
> Matt Wilkowski, Enachip
> Francesco Carobolante, IoTissimo
> Alex Hanson, University of Texas at Austin
> P. Markondeya Raj, Florida International University
> Doug Hopkins, North Carolina State University
> Khurram Afridi, Cornell University
> Cian Ó Mathúna, Tyndall National Institute

The past few years have seen a remarkable growth in artificial intelligence in many applications. Power electronics is no exception in that researchers are investigating new ways to model and design power electronics using some form of artificial intelligence. This panel is comprised of several thought leaders in the area of power electronics design – both utilizing AI techniques and without. They will discuss aspects of power electronics design that AI can improve or at least provide keener insight, and where traditional design methods remain superior or necessary. Come join us to open your mind to whether new approaches are worthy of your consideration in your next design. Hearty participation is welcome!
EXHIBITOR SEMINARS as of February 21, 2022

APEC 2022 Exhibitor Seminars will highlight new products or initiatives that companies in the power electronics industry are developing, along with allowing the opportunity for attendees to interact with other companies in the industry.

1:00 p.m. – 1:30 p.m.
**Exhibitor Seminars – Session 1**

**Advanced Cooling Technologies, Inc.**
ROOM 360ABC
Combatting Higher Power Densities within Power Electronics Cabinets Utilizing Advanced Thermal Management Technology

PRESENTED BY: Seth Ryberg

In this seminar, we will review various advanced thermal management strategies to enhance power electronics performance efficiencies, operational longevity, and reliability while reducing critical impacts to the system. This will include single-phase and two-phase, both active and passive thermal technologies for component and system-level needs. Come check us out!

**Ansys, Inc.**
ROOM 360DEF
Conducted Emission Simulation for Power Electronics

PRESENTED BY: Mark Christini

It is very challenging to determine conducted emissions for power electronics. This presentation will demonstrate how to simulate and then mitigate conducted emissions for a motor drive in order to meet CISPR standards during the pre-compliance process.

**DEWESoft LLC**
ROOM 361DEF
DEWESoft Power Measurement Solutions

PRESENTED BY: John Miller

This seminar will include an introduction to DEWESoft Power measurement solutions and provide a comprehensive demonstration of how a power meter, power quality meter, data logger, transient recorder and oscilloscope are combined into a single instrument providing users with the ultimate flexibility and capability in power measurements.

**Power Integrations**
ROOM THEATER 1 (Expo Hall)
Achieving Over 95% Efficiency by Combining GaN and Silicon Switches for 220 W Universal Input Power Supplies

PRESENTED BY: Doug Bailey

GaN switches bring significant size and efficiency benefits for offline switching applications. The humble silicon MOSFET has also worked extremely well in those applications for many years – indeed silicon devices with appropriate body-diode technology still provide a nearly ideal device for half-bridge conversion techniques. In this session, we will explore how the combination of new PowiGaN™ technology, along with tried-and-trusted silicon switches, enables high performance solutions for compact mid-power switching applications that eliminate heatsinks and ensure high circuit reliability.

**VisIC Technologies**
ROOM 361ABC
D³GaN for Traction Inverter: Practical Guidelines

PRESENTED BY: Dr. Daniel Sherman

EV HPEV and BEV will have significant growth in the next several years. The traction inverter is a key to making the cars efficient and affordable. Moving to the next technology, GaN and specifically D³GaN is essential to meet the industry targets. This session will explain the practicalities of using D³GaN for traction inverters in a way you will be able to design and understand how to build an inverter with D³GaN.

**West Coast Magnetics**
ROOM THEATER 2 (Expo Hall)
Ferrite Core Design for Power

PRESENTED BY: Weyman Lundquist

The choice of a core for power transformers and inductors is critical. Weyman will present some of the approaches to choosing the correct core geometry and core material, review Ansys simulations and present some of the new WCM core and bobbin geometries.
Exhibitor Seminars – Session 2

**Magnetics**
ROOM 360ABC

**Newest Powder Core Materials from Magnetics**
PRESENTED BY: Bill Glass

The development of high frequency and high power magnetic technologies are key drivers for power conversion systems in the energy storage, renewable, and EV markets. Magnetics has developed several new powder core materials which are advantageous for designs which require high density and stable performance across a wide temperature range. This presentation will focus on highlighting the characteristics of these new materials, how they provide advantages in inductor design, and a comparison of powder core material choices.

**Mouser Electronics, Inc.**
ROOM THEATER 2 (Expo Hall)

**Getting the Most from Your Gen 4 SiC FET Design**
PRESENTED BY: Dr. Anup Bhalla

Dr. Bhalla’s presentation will cover SiC FET design best practices when using TO and surface mount packages.

**Navitas**
ROOM 361DEF

**GaNFast Power ICs: “Electrify Our World”**
PRESENTED BY: Stephen Oliver

Upgrade from legacy silicon to next-generation GaN semiconductors to “Electrify Our World” and transition from fossil fuels to clean electric applications, saving up to 2.6Gtons/year of CO2 emissions by 2050.

**Nichicon (America) Corp**
ROOM 361ABC

**Powering Tomorrow’s Designs: The Next Generation in Battery Technology**
PRESENTED BY: Mark Gebbia

Nichicon has expanded its latest product offering, the small Lithium-Ion Battery. We will share the exciting ways that this new technology, that looks like a capacitor can be used.

**Simplis Technologies**
ROOM 360DEF

**AC analysis of PFC Circuits with Constant and Variable Frequency Control Schemes**
PRESENTED BY: Andrija Stupar

This presentation demonstrates a new technique to perform an AC analysis of AC-to-DC converters with Power Factor Correction (PFC) in a simulation environment. We will demonstrate how to measure the loop response as well as input and output impedance. This measurement technique is applicable for PFC systems with either constant-frequency or variable-frequency control schemes.

The SIMPLIS Periodic Operating Point (POP) and AC Analyses are powerful tools for switching power supply designers. A SIMPLIS AC analysis first requires a successful POP Analysis. However, in PFC circuits the AC input voltage is typically not synchronized with the converter switching frequency, making a successful POP Analysis difficult to achieve. This presentation will demonstrate how the operating point of a standard PFC circuit can be slightly shifted to enable a successful POP and AC Analysis. An overview of new features and improvements in SIMetrix/SIMPLIS 9.0 will also be given.

**STMicroelectronics**
ROOM THEATER 1 (Expo Hall)

**2kW Interleaved Totem Pole PFC Solution Featuring ZVS Digital Control**
PRESENTED BY: Gianni Vitale

Achieving 80 PLUS TITANIUM performance from AC/DC power conversion systems requires innovative topology and control solutions. STMicroelectronics is introducing a new evaluation board eclipsing 99% efficiency at 2kW output without relying on wide bandgap transistors. Hear about the hysteresis current control implemented on an STM32G4 microcontroller in a 3-channel interleaved totem pole PFC, and the new analog, power, and digital technologies that bring this comprehensive solution to life.
2:30 p.m. – 3:00 p.m.

**Exhibitor Seminars – Session 3**

**DIOTEC Semiconductor Americas**
ROOM 361ABC

Diotec Semiconductor

PRESENTED BY: Andrew Dixon & Silviu Munteanu

Company Introduction
New Product Roadmap

**Focused Test, Inc.**
ROOM 361DEF

Living with Charge Capture in GaN: Do We Still Need Dynamic Rdson Production Test?

PRESENTED BY: Gordon Leak

Focused Test’s FTI 1000 production test system performs fast Vstress and Rdson with a measure delay of < 2us. This allows DRdson production test times of < 200ms.

**Frenetic**
ROOM 360ABC

The Future of Magnetics Supply

PRESENTED BY: Chema Molina

How will Frenetic contribute to the difficult and demanding magnetics supply worldwide.

**Keysight Technologies**
ROOM THEATER 2 (Expo Hall)

Introducing Curriculum to Elevate the Engineering Students’ Knowledge of EMI Issues in Power Electronics Design

PRESENTED BY: Nicola Femia & Casey Latham

As the switched-mode power supply go toward higher switching frequencies, higher efficiency and lower EMI, the design becomes more challenging, and enhanced system level investigation capabilities are required for effective simulation tools including PCB layout modeling. Keysight’s PathWave Advanced Design System (ADS) has a workflow centered around power electronics engineers, allowing users to analyze the EMI of a device before fabrication. Through a collaboration with the University of Salerno, Keysight has developed a curriculum to help users identify the sources of conducted EMI in DC-DC power converters, investigate the main parameters influencing the conducted EMI, understand the good design practices to reduce conducted EMI, and utilize PathWave ADS to characterize and improve the design from the EMI perspective. This curriculum is available complimentary and is aimed at undergraduate and graduate university students.

**Mersen**
ROOM THEATER 1 (Expo Hall)

Mersen’s Latest Solutions for SiC, EV and Energy Storage Applications

PRESENTED BY: Jean-François De Palma, Jodi Wahl and Oscar Quint

Mersen will introduce its latest technologies in bus bar design and manufacturing to help engineers address the high temperature and high frequencies requirements of SiC applications. The session will also highlight Mersen’s newest line of 1500VDC high speed fuses and Infini-cell Bus Bars technology designed for Energy Storage or EV applications.

**SABIC**
ROOM 360DEF

ELCRES™ HTV150A Film - New Generation Capacitor Films for High Heat Inverter Applications

PRESENTED BY: Adel Bastawros

High efficiency electric vehicles demand efficient AC-DC inverters operating at high voltages and temperatures reaching 150°C. SABIC’s ELCRES™ HTV150A film is a high-heat dielectric film for capacitors that operate up to 150°C. Available in 3µm and 5µm, this film can lead to improved overall inverter performance and potentially eliminate or reduce active cooling systems while offering design flexibility and packaging efficiency. The film exhibits good dielectric performance (Dk of 2.9, Df of 0.002) and BDV of ~ 500 V/µ, which remain relatively stable at 150°C. Capacitors built with 3µm and 5µm metalized films pass standard electrical and life tests at 150°C for 2000 hours with low capacitance change and stable insulation resistance. Performance data and examples of metallization and capacitor building will be discussed.
3:15 p.m. – 3:45 p.m.

**Exhibitor Seminars – Session 4**

**Cambridge GaN Devices**

ROOM 360ABC

CGD: the new player in HV GaN. The ultimate solution developed from deep GaN expertise.

PRESENTED BY: Giorgia Longobardi & Florin Udrea

CGD enters the GaN power transistors and ICs market with revolutionary technology. Ease-of-use is now made available for all applications.

**Microchip Technology, Inc.**

ROOM 360DEF

Secure Your Rugged Silicon Carbide Supply Today

PRESENTED BY: Jason Chiang

In today’s semiconductor component shortage situation, Microchip’s reliable Silicon Carbide (SiC) solutions provide the fastest time to market with low risk and low total solutions costs. Take advantage of our broad SiC portfolio and one-stop shopping for your system design. Learn how to unleash the full potential of Microchip SiC solutions.

**Murata**

ROOM 361DEF

Innovative Charge Pump, Capacitor Divider Technology Improves 48 VIN Intermediate Conversion Efficiency

PRESENTED BY: Gregory Szczeszynski

As system power requirements increase due to faster data rate transmission or faster battery charging, systems continue to migrate to 48V distribution to reduce I2R interconnect and PCB losses. Charge pump capacitor divider technology offers an ultra-high efficiency method of converting from the high-voltage 48V to the intermediate 12V bus. This seminar presents a detailed look at Murata’s unique adiabatic charge pump capacitor divider technology and previews a range of products that enable ultra-high efficiency conversion in compact PSiP, low-profile package designs.

**Rohde & Schwarz USA, Inc.**

ROOM 361ABC

Optimizing EMI Filter Design Using an Oscilloscope

PRESENTED BY: Mike Schnecker

This talk will explain why oscilloscopes are the ideal tool for optimizing EMI filter design. Conducted emissions from power supplies result from both common mode and differential mode currents. Conventional EMI testing determines if the emissions meet compliance but cannot help in the design of EMI filters for mitigation. Oscilloscopes provide multiple coherent channels with spectrum analysis and enable the measurement of both common mode and differential mode noise allowing for the optimization of EMI filter design.

**ROHM Semiconductor**

ROOM THEATER 1 (Expo Hall)

4th Generation SiC Trench MOSFET to Enhance Power System Performance with Higher Efficiency and Reliability

PRESENTED BY: Ming Su

ROHM’s latest generation SiC MOSFET is now production ready with significantly improved conduction and switching losses, flexible gate drive voltages, expanded package options and no compromise in short-circuit ruggedness and reliability. Along with lower cost than earlier technology, these power devices offer more reasons than ever to adopt SiC in advanced power electronics design for energy savings, simplified thermal management, smaller passive components, and increased reliability. Join us to learn more about the product features, updated lineup and application opportunities.

**TT Electronics**

ROOM THEATER 2 (Expo Hall)

Practical Current Sensing With Resistors

PRESENTED BY: Tom Morris

This presentation will assist design engineers with information on the different types of current sense resistors and their proper selection for optimum accuracy, performance, and cost-effectiveness. Also covered is an overview of the various resistor technologies used in current sensing applications, 4 terminal vs 2 terminal board layouts, and new products suitable for this application.
8:30 a.m. – 11:55 a.m.
**IS06: Market & Technology Trends**
ROOM 360ABC

**SESSION CHAIRS**
Ada Cheng, Adaclock
Dinesh Kithany, Wired & Wireless Technologies (WAWT)

8:30 a.m.
**IS06.1** Driving Jobsite Productivity: Smart, Connected, Cordless Power Tools
Timothy Obermann
Milwaukee Tool

8:55 a.m.
**IS06.2** Electric Vehicles: Why the Sudden Acceleration and How Silicon Carbide is in Pole Position to Win
Llew Vaughan-Edmunds
Applied Materials

9:20 a.m.
**IS06.3** How Emerging Wireless Power Technologies are Set to Cut the Cords
Dinesh Kithany
Wired & Wireless Technologies (WAWT)

9:45 a.m.
**IS06.4** GaN Adoption, Market-by-Market
Stephen Oliver, MBA
Navitas Semiconductor

10:40 a.m.
**IS06.5** Advances in Energy Storages Technologies
Babu Chalamala
Sandia National Laboratories

11:05 a.m.
**IS06.6** Slaying Energy Vampires: A Regulatory Roadmap
David Chen
Power Integrations

11:30 a.m.
**IS06.7** Energy Harvesting Powered Sensors/IoT Devices
Loranstä Fökel
Würth Elektronik eiSos GmbH

8:30 a.m. – 11:55 a.m.
**IS07: Integration in WBG Semiconductors: Increased Power Density and Advanced Functionalities at Application Level**
ROOM 360DEF

**SESSION CHAIR**
Andrea Bricconi, Cambridge GaN Devices

8:30 a.m.
**IS07.1** Extending GaN Integration to Higher Power and Faster Speeds: An Examination of the Progress and Roadmaps for GaN Integration
Robert Beach, Alex Lidow
Efficient Power Conversion

8:55 a.m.
**IS07.2** GaN Monolithic Integration Levels: A Journey from Discrete Devices to Power ICs with Complex Functionality
Giorgia Longobardi
Cambridge GaN Devices

9:20 a.m.
**IS07.3** GaN Integration Enables Next Generation USB-C Chargers with Ultra-High Power Density and Wide Output Voltage Range
Gerald Deboy, Matthias Kasper, Jon Azurza
Infineon Technologies, Infineon Technologies Austria AG

9:45 a.m.
**IS07.4** Applications, Technology Optimization, and Mass Manufacturing of 8-inch GaN-on-Si Technology
Denis Marcon
Innoscience

10:40 a.m.
**IS07.5** Monolithically Integrated Protection Circuits in 650V Power GaN
Rajesh Ghosh, Manish Shah, Asif Eqbal
Tagore Technology

11:05 a.m.
**IS07.6** Feature Integration in GaN FETs Leads to Compact and Intelligent System Designs
Nathan Schenm, Fei Yang
Texas Instruments

11:30 a.m.
**IS07.7** Maximizing WBG Value: Smart Integration in Compact AC/DC Converters
Mike Matthews
Power Integrations
8:30 a.m. – 12:00 p.m.

**IS08: Addressing Gate Driver Design Challenges**

**ROOM 320A**

**SESSION CHAIR**

**Ajay Hari, Onsemi**

8:30 a.m.

**IS08.1** Features of Power Semiconductor Gate Drivers for ASIL Safety Standards
David Levett
Infineon Technologies AG

8:55 a.m.

**IS08.2** Driving and Protecting SiC and GaN with an Isolated Gate Driver in EV Inverter Applications
Long Nguyen
Skyworks

9:20 a.m.

**IS08.3** How to Minimize the Parameters Tolerance Impact of SiC MOSFET Gate Driver
Massimo Nania, Simone Buonomo, Domenico Nardo, Vittorio Giuffrida, Marco Latella
STMicroelectronics

9:45 a.m.

**IS08.4** Methodologies to Accurately Measure Gate Drivers' Peak Current
Mamadou Diallo, Wei Zhang
Texas Instruments

10:30 a.m.

**IS08.5** Differences in Gate Driver ICs Output Stage Topologies
Wolfgang Frank, Emanuel-Petre Eni
Infineon Technologies AG

10:55 a.m.

**IS08.6** Traction Inverters Enabled by Advanced Protection and Diagnostic Features of Isolated Gate Drivers
Yongbin Chu, Audrey Dearien
Texas Instruments

11:20 a.m.

**IS08.7** Gate Oscillations in SiC MOSFETs and Mitigations
Tamanna Bhatia, Yuequan Hu
Wolfspeed

8:30 a.m. – 11:55 a.m.

**IS09: Vehicle Electrification: Cheaper Lighter Faster**

**ROOM 320B**

**SESSION CHAIRS**

**Ralph Taylor, PSMA**

**Fred Weber, Future Technologies Worldwide**

8:30 a.m.

**IS09.1** Wireless Charging for EVs
Burak Ozpineci
ORNL

8:55 a.m.

**IS09.2** BiD FET
Subhashish Bhattacharya
North Carolina State University

9:20 a.m.

**IS09.3** Silicon Carbide Traction Inverters
Yue Zhao
University of Arkansas

9:45 a.m.

**IS09.4** DC Fast Charging Systems Including Some Results from Current DOE Funded Projects Specifically Focusing on DCFC Solutions
Fernando Salcedo
Fellow -DOE

10:40 a.m.

**IS09.5** Simulations for Inverters and Chargers
Boris Jovanovic
Typhoon HIL, Inc.

11:05 a.m.

**IS09.6** Wireless EV Charging Infrastructure: Learnings from Oslo Project
Bob Kacergis
Momentum Dynamics

11:30 a.m.

**IS09.7** Static Charging with Focus on Passenger and Light Vehicles for Residential and Commercial Purposes, Using up to 11kW Solutions
Pamposh Zutshi
Witricity
8:30 a.m. – 12:00 p.m.

**IS10: Latest Improvements in 3D-Packaging of Power Electronics**

**ROOM 320C**

**SESSION CHAIRS**

Brian Narveson, Narveson Innovative Consulting

John Bultitude, KEMET Electronics

<table>
<thead>
<tr>
<th>Time</th>
<th>Session Title</th>
<th>Speaker</th>
<th>Company/Institution</th>
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<tr>
<td>8:30 a.m.</td>
<td>IS10.1 Meet the New Aluminum...Busbars</td>
<td>Mike Wingard</td>
<td>Amphenol Global Interconnect Systems</td>
</tr>
<tr>
<td>8:55 a.m.</td>
<td>IS10.2 A Drop-in High-Temperature Lead-free Solder Solution that Outperforms High-Lead</td>
<td>Hongwen Zhang</td>
<td>Indium Corporation</td>
</tr>
<tr>
<td>9:20 a.m.</td>
<td>IS10.3 Application of Soft Magnetic Metal-Flake Composite Material to High Frequency Inductive Components</td>
<td>Ken’Ichi Chatan’in</td>
<td>TOKIN, A KEMET Company</td>
</tr>
<tr>
<td>9:45 a.m.</td>
<td>IS10.4 Addressing Solder Hierarchy Issues in Power Module Packaging with TLPS Pastes</td>
<td>Catherine Shearer</td>
<td>EMD Electronics Inc</td>
</tr>
<tr>
<td>10:40 a.m.</td>
<td>IS10.5 Micro-Magnetics based on Single-Litho Core Laminations</td>
<td>Kamyar Admadi</td>
<td>EnaChip Inc.</td>
</tr>
<tr>
<td>11:05 a.m.</td>
<td>IS10.6 Advanced Interconnection Technologies in Power Electronics for Improved Reliability and Performance</td>
<td>Aarief Syed-Khaja</td>
<td>Heraeus Electronics.</td>
</tr>
<tr>
<td>11:30 a.m.</td>
<td>IS10.7 Highly Thermally Conductive Epoxy Substrates as Ceramic Replacement with High Volume Manufacturing</td>
<td>Douglas Hopkins</td>
<td>North Carolina State University</td>
</tr>
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2:30 p.m. – 5:45 p.m.

**IS11: Power Devices: Performance, Achievements & Road Ahead**

**ROOM 360ABC**

**SESSION CHAIRS**

Reenu Garg, Microchip

Renee Yawger, Efficient Power Conversion Corporation (EPC)

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<th>Speaker</th>
<th>Company/Institution</th>
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<td>2:30 p.m.</td>
<td>IS11.1 A New Comparator-Less Miller Clamp Circuit for SiC MOSFET to Prevent Self-Turn-On</td>
<td>Mitch Van Ochten, Shinya Tajima</td>
<td>ROHM Semiconductor U.S.A., LLC</td>
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<td>2:55 p.m.</td>
<td>IS11.2 GaN-Based Lidar Pulse Generator Achieving 320 A in 6 ns: Design and System Integration Considerations</td>
<td>Edward Jones¹, Marcus Hennecke</td>
<td>Infineon Technologies Austria AG</td>
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<td>3:20 p.m.</td>
<td>IS11.3 1700V SiC MOSFETs: Enhancing Power Conversion from Watts to Megawatts</td>
<td>Xuning Zhang, Kevin Speer</td>
<td>Microchip</td>
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<td>3:45 p.m.</td>
<td>IS11.4 Performance Parameters of SiC MOSFETs for Automotive Inverters</td>
<td>Ranbir Singh</td>
<td>GeneSiC Semiconductor Inc.</td>
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<td>4:30 p.m.</td>
<td>IS11.5 WBG Devices Enable Mainstream Adoption of Totem Pole PFC</td>
<td>Ajay Hari</td>
<td>Onsemi</td>
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<td>4:55 p.m.</td>
<td>IS11.6 Getting the Most Performance Out of SiC With the Latest Generation Cascode FETs</td>
<td>Pete Losee</td>
<td>Qorvo</td>
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<td>5:20 p.m.</td>
<td>IS11.7 No Two Wide Bandgap Technologies are the Same: Switching Advantages of SuperGaN FETs</td>
<td>Philip Zuk</td>
<td>Transphorm</td>
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2:30 p.m. – 5:45 p.m.

**IS12: Chargers, Traction Inverters & DC-DC Converters for EV**

**ROOM 360DEF**

**SESSION CHAIR**

**Dennis Stephens, Continental Automotive**

2:30 p.m.

**IS12.1** Impact of Drive Strength Adjustment on Voltage Overshoot and Efficiency in xEV Traction Inverters

Jerry Rudaki

NXP Semiconductors

2:55 p.m.

**IS12.2** 1.5kW - 2kW Bi-Directional Automotive 48V-12V DC-DC Converters Using eGaN Fets

Yuanzhe Zhang, Michael de Rooij

Efficient Power Conversion Corporation

3:20 p.m.

**IS12.3** Design Optimization of a StackFET Flyback Converter for High Voltage Auxiliary Power Supplies for Automotive Applications

Kaushik Raam

Power Integrations

3:45 p.m.

**IS12.4** Evaluation of Two-Level Slew-Rate Control in a 22 kW Drive Inverter

Michael Ebli, Niclas Thon, Emanuel-Petre Eni, Wolfgang Frank

Infineon Technologies AG

4:30 p.m.

**IS12.5** Integrated Smart GaN Device for High Voltage Power Conversion in Automotive Applications

Federica Cammarata, Francesco Gennaro, Filippo Scrimizzi, Giuseppe Longo

STMicroelectronics

4:55 p.m.

**IS12.6** GaN-Based 10 kW Three-Phase On-Board Charger with Ultra-High Power Density

Gerald Deboy1, Johann Kolar2, Matthias Kasper3, Yunn Li, Jon Azurza3

1Infineon Technologies, 2ETH Zurich, 3Infineon Technologies Austria AG

5:20 p.m.

**IS12.7** Automotive Traction Module Attach by Silver Sintering — Process, Performance & Reliability

Matthew Siebenhuner, Gustavo Greca, Maurizio Fenech, Oscar Khaselev, Jeffrey Arouh, Julien Jogueet, Gyan Dutt

MacDermid Alpha Electronics Solutions

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2:30 p.m. – 5:45 p.m.

**IS13: WBG Devices & Applications**

**ROOM 320A**

**SESSION CHAIR**

**Manish Shah, Tagore Technology**

2:30 p.m.

**IS13.1** Robust Short Circuit Protection Technique for Silicon Carbide (SiC) MOSFET Modules

Eric Motto, Michael Rogers

Mitsubishi Electric US Inc.

2:55 p.m.

**IS13.2** Challenges and Solutions for Dynamic Characterization on GaN Power Devices

Mike Hawes1, Ryo Takeda2

1Automotive Energy Solutions, 2Keysight Technologies

3:20 p.m.

**IS13.3** Miller Turn-on and Threshold Voltage Correlation in SiC MOSFET Based high-Frequency Converters

Angelo Sciacca, Luciano Salvo, Gionatan Montoro, Massimo Nania, Mario Pulvirenti

STMicroelectronics

3:45 p.m.

**IS13.4** Smart Cut™ SiC: Enabling a Larger Adoption of SiC Substrate for Power Devices

Gonzalo Picun, Eric Guiot

SOITEC

4:30 p.m.

**IS13.5** High-density scalable GaN IBC for the new 48 V data center architecture

Edward Jones, Kevin Tomas Márnez

Infineon Technologies Austria AG

4:55 p.m.

**IS13.6** Advancement on GaN Power IC System Integration

Victor Sinow, Marco Giandalia

Navitas Semiconductors

5:20 p.m.

**IS13.7** Latest Generation SiC MOSFETs Allow High Efficiency in High Frequency Bidirectional Three-Phase PFC

Francesco Gennaro, Giuseppe Aiello

STMicroelectronics
2:30 p.m. – 5:45 p.m.
**IS14: Gate Driver Issues & USB Chargers**
ROOM 320B

**SESSION CHAIR**
Deric Waters, Texas Instruments Inc.

2:30 p.m.
**IS14.1 SOI Level Shift Gate Driver with Miller Clamp in Several kW GPI Applications (Power switch: SiC MOS or IGBT)**
Weidong Chu
employee of Infineon Technologies Americas Corp.

2:55 p.m.
**IS14.2 Isolated Self-Powered SiC Gate-Drivers with Flexible User-Configurable Drive Levels and Protections**
Dermot Dobbyn, Bernard Keogh, Joseph Duigan
Heyday Integrated Circuits

3:20 p.m.
**IS14.3 High-density, low-EMI Isolated Bias Supplies for Isolated Gate Drivers**
Bing Lu
Texas Instruments

3:45 p.m.
**IS14.4 Gate Driver Considerations for Pulse Transformers**
Aaron Grgurich, Alex Mazany
Texas Instruments

4:30 p.m.
**IS14.5 Extended Power Range (EPR) USB Power Delivery**
Deric Waters
Texas Instruments Inc.

4:55 p.m.
**IS14.6 GaN Half-Bridge ICs Enable Next Gen Mid-Power, Multi-Port, High-Density Charger Topologies**
Tom Ribarich
Navitas Semiconductor

5:20 p.m.
**IS14.7 Ultra-Efficient Slim Adapter with Non-Complementary Mode Active-Clamp Flyback**
Nico Macahig, Bala Sudhakar Singamaneni
Power Integrations

2:30 p.m. – 5:45 p.m.
**IS15: The Ins & Outs of Energy Storage**
ROOM 320C

**SESSION CHAIRS**
Edward Herbert, PSMA
Eric Schneider, PSMA

2:30 p.m.
**IS15.1 Thermal Management of Battery Systems**
Justin Farrelly
Vercet

2:55 p.m.
**IS15.2 How Lithium Battery Technology is Powering Sustainable Development**
Henrik Lundgren
Polarium

3:20 p.m.
**IS15.3 Ins and Outs of Commercially Available Supercapacitors**
Nihal Kularatna
The University of Waikato

3:45 p.m.
**IS15.4 Control of Distributed Energy Storage Systems for Energy Communities**
Shaﬁ Khadem
The International Energy Research Center

4:30 p.m.
**IS15.5 Grid Systems Integration for Future Electric Charging Infrastructure**
Brian Rowden
Oak Ridge National Laboratory

4:55 p.m.
**IS15.6 Grid Energy Storage and Advanced Power Conversion Systems**
Stanley Atcitty
Sandia National Laboratories
8:30 a.m. – 12:00 p.m.

**T07: Bi-directional DC-DC Converters**

**ROOM 352DEF**

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**Bi-directional DC-DC Converters**

**SESSION CHAIRS**

Sombuddha Chakraborty, Texas Instruments  
Juan Manuel Rivas-Davila, Stanford University

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**8:30 a.m.**

**T07.1 Transformer Current Spike Elimination for Dual Active Bridge Converter Considering Multiple-Phase-Shift Modulation**

Yu Yan¹, Liyan Zhu¹, Hua Bai¹, Ruirui Chen², Fred Wang³, Yang Huang¹  
¹University of Tennessee, Knoxville, ²University of Tennessee, ³University of Tennessee & ORNL

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**8:50 a.m.**

**T07.2 Multi-Variable Multi-Constraint Optimization of Triple Active Bridge DC-DC Converter with Conduction Loss Minimization**

Saikat Dey¹, Akin Akturk², Ayan Mallik¹  
¹Arizona State University, ²CoolCAD Electronics LLC

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**9:10 a.m.**

**T07.3 Performance Evaluation of Two-Level to Three-Level Three-Phase Dual Active Bridge (2L-3L DAB3)**

Apoorv Agarwal, Sagar Rastogi, Subhashish Bhattacharya  
North Carolina State University

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**9:30 a.m.**

**T07.4 Voltage Balancing Feature and Output Regulation in a Multi-Mode Inverter/Rectifier Leg**

Reza Emamalipour, John Lam  
York University

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**9:50 a.m.**

**T07.5 An Isolated Bi-Directional Series Bridge DC Transformer Without Resonant Tank**

Yuliang Cao, Minh Ngo, Dong Dong, Rolando Burgos  
¹Virginia Tech

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**11:00 a.m.**

**T07.7 Mitigation of Dead-Time Effects on Transient DC Bias Elimination in Dual Active Bridge Link Current**

Mik Kharabela Mohanta¹, Amlan Swain¹, Abinash Dash¹, Alberto Castellazzi²,  
Amrit Gaurav Rath¹, Dipankar De¹  
¹IIT Bhubaneswar, ²Kyoto University of Advanced Science

---

10:00 a.m. – 12:00 p.m.

**T07.9 A High-Voltage-Gain ZVS IPOS Bidirectional Converter**

Mohammadreza Mohammad¹, Afshin Amoozeraei², Sayed Ali Khajehoddin², Kambiz Moez²  
¹University of Alberta, ²University of Alberta Elec. and Com. Eng.

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**11:40 a.m.**

**T08: Power Converters for Utility Applications**

**ROOM 351ABC**

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**Power Converters for Utility Applications**

**SESSION CHAIRS**

Maryam Saeedifard, Georgia Institute of Technology  
Stanley Atcitty, Sandia National Laboratories

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**8:30 a.m.**

**T08.1 A Hybrid Voltage Regulation Transformer Based on Interline Power Converters**

Yafeng Wang¹, Tiefu Zhao²  
¹Monolithic Power Systems, ²UNC Charlotte

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**8:50 a.m.**

**T08.2 DC Bus Second Harmonic LC Filter with Solid-State Tuning Restorer**

Anwesha Mukhopadhyay, Vinod John  
Indian Institute of Science

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**9:10 a.m.**

**T08.3 A Single-Stage Converter for Integration of Induction Wind Energy Conversion Systems Into Multilevel Stand-Alone DC Nanogrids**

Javad Khodabakhsh¹, Adel Abosnina¹, Ebrahim Mohammad², Gery Moschopoulos¹  
¹Western University, ²Carleton University

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**9:30 a.m.**

**T08.4 Medium Frequency SST Based Multiport Energy Routers for Subsea — Renewable Interconnection**

Armur Karbozov, Kaushik Rajashekar, Harish Krishnamoorthy, Mriganka Ghosh Majumder  
University of Houston

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**9:50 a.m.**

**T08.5 High Power Density 10 kV SiC MOSFET-Based Modular, Scalable Converter for Medium Voltage Applications**

Slavko Moevic¹, Boran Fan¹, Jianghui Yu¹, Rolando Burgos¹, Dushan Boroyevich¹, Igor Cvetkovic¹, Joshua Stewart², Jun Wang³  
¹Virginia Polytechnic Institute and State University, ²Virginia Tech - Center for Power Electronics Systems (CPES), ³University of Nebraska–Lincoln
10:40 a.m.  
T08.6 Switched Capacitor Based High Voltage DC Auxiliary Power Supply with Self Powering Capability  
Shengdao Ren¹, Chushan Li², Xiangning He², Wuhua Li², Huiqiang Yan¹, Wanyuan Qu¹  
¹College of Electrical Engineering Zhejiang University; ²Zhejiang University; ³College of Micro-Nano Electronics Zhejiang University

11:00 a.m.  
T08.7 A DC Capacitor-Less Two-Terminal Unified Active Capacitor and Inductor  
Anwesha Mukhopadhyay, Vinod John, Manas Palmal  
Indian Institute of Science

11:20 a.m.  
T08.8 Active EMI Filter with Switch-Mode Amplifier for High Efficiency  
Tan Duy Nguyen, Alex Hanson, Elijah Macias  
The University of Texas at Austin

11:40 a.m.  
T08.9 High Isolation, Low Coupling Gate Driver Power Supply for Medium Voltage Converters Using Large Air-Gapped Transformer  
Fei Teng¹, Srdjan Lukic¹, Hao Feng²  
¹North Carolina State University; ²Chongqing University

8:30 a.m. – 12:00 p.m.  
T09: Design of Wireless Power Transfer Systems  
ROOM 351DEF  

Design of Wireless Power Transfer Systems  
SESSION CHAIRS  
Khurram Afridi, Cornell University  
Lingxiao Xue, Oak Ridge National Laboratory

8:30 a.m.  
T09.1 A 20-Kw Integrated AC/DC and DC/DC Oak Ridge Converter for Grid Services and Energy Storage Systems  
Erdem Asa  
Oak Ridge National Laboratory

8:50 a.m.  
T09.2 A 50kW Bi-Directional Step-Up Step-Down DC Oak Ridge Converter for Wireless EV Chargers  
Erdem Asa  
Oak Ridge National Laboratory

9:10 a.m.  
T09.3 Multi-Objective Optimization of ground-Side Coils for Dynamic Wireless Power Transfer Considering Coupling Variations  
Wenbo Wang, Deliang Chen, Zhenpo Wang, Junjun Deng  
Beijing Institute of Technology

9:30 a.m.  
T09.4 Thermal Design and Optimization of High-Power Wireless Charging System  
Mostak Mohammad¹, Omer Oner¹, Jonathan Wilkins¹, Gui-Jia Su¹, Veda Prakash Galigekere²  
¹Oak Ridge National Laboratory; ²UT Battelle ORNL

9:50 a.m.  
T09.5 The Design of Coupler Integrating Infrared Detection and Power Transmission for Wireless Charging of Inspection Robot  
Jiacheng Li¹, Linlin Tan², Xueliang Huang²  
¹Nanjing Tech University; ²Southeast University

10:40 a.m.  
T09.6 Analysis and Design of Post-Regulation Stages for Resonant Capacitively-Coupled Wireless Power Systems  
Eli Abramov, Yotam Schultz, Michael Evzelman, Mor Peretz  
Ben-Gurion University

11:00 a.m.  
T09.7 Performance Evaluation of Inductive Wireless Power Transfer for High-Speed Non-Contact Slip Ring Applications  
Mehmet Anılcan Budak, Emre Durna  
ASELSAN Inc.

11:20 a.m.  
T09.8 Multi-Megahertz Load Independent Synchronous Rectifier for Resonant Wireless Power Transfer Applications  
Amir Tahavorgar  
Solace Power

11:40 a.m.  
T09.9 Advanced Design of Auxiliary Searching Coil for Autonomous Wireless EV Charging Robot Considering Various Shapes of Secondary  
Dong Hyeon Sim, Ju-A Lee, Sangjoon Ann, Won-Jin Son, Byoung Kuk Lee, Man-Jae Kwon  
Sungkyunkwan University
8:30 a.m. – 12:00 p.m.

**T10: Transportation Power Conversion 1**
ROOM 361ABC

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Rasoul Hosseini, General Motors |

8:30 a.m.

**T10.1** 18-Pulse Autotransformer with Differential Delta Connection for MEA Application
Ana Lucia Soares, Gustavo Brito Lima, Vitor Fonseca Barbosa, Antônio de Oliveira Costa Neto, Luiz Carlos Gomes Freitas
Federal University of Uberlandia

8:50 a.m.

**T10.2** Multi-Level Voltage Source Converters Using Coupled Inductors and Parallel Connected Inverter Legs
Marius Takongmo, John Salmon, Chenguang Zhang
University of Alberta

9:10 a.m.

**T10.3** Modeling and Analysis of Impedance of Variable Frequency AC Three-Stage Generator for More Electric Aircraft
Shuang Wang, Chengxiang Zhang, Na Qin, Ning Li, Xinbo Ruan, Zhiheng Lin
1Nanjing University of Aeronautics and Astronautics,  
2Shaanxi Aero Electric Co. Ltd

9:30 a.m.

**T10.4** A 1MHz Oak Ridge AC / DC Converter for UAV Contactless Charger Implementation
Erdem Asa
Oak Ridge National Labaratory

9:50 a.m.

**T10.5** Design and Implementation of a (Flying) Flying Capacitor Multilevel Converter
Samantha Coday, Robert Pilawa-Podgurski, Nicole Stokowski, Nathan Ellis
University of California, Berkeley

10:40 a.m.

**T10.6** A Bidirectional Liquid-Cooled GaN-Based AC/DC Flying Capacitor Multi-Level Converter with Integrated Startup and Additively Manufactured Cold-Plate for Electric Vehicle Charging
Ting Ge, Robert Pilawa-Podgurski, Derek Chou, Zitao Liao, Jiarii Zou, Vaibhav Agarwak, Nenad Miljkovic, Rahul Iyer, Kelly Fernandez
1University of California - Berkeley,  
2University of Illinois Urbana-Champaign

11:00 a.m.

**T10.7** Liquid Nitrogen Immersed and Noise Tolerant Gate Driver for Cryogenically Cooled Power Electronics Applications
Mustafeez Ul Hassan, Vyacheslav Solovyov, Yuxuan Wu, Fang Luo
Stony Brook University

11:20 a.m.

**T10.8** Minimizing RMS Currents in DC-Link Capacitors of Power Conversion Units Through Synchronous Operation
Shamar Christian, Roberto Fantino, Juan Balda, Asim Solangi
University of Arkansas

11:40 a.m.

**T10.9** A Hybrid Deep Learning Aided Model-Based Cyber-Attack Detection for Electric Drive Systems
Shaya Abou Jawdeh, Seungdeog Choi
Mississippi State University

8:30 a.m. – 12:00 p.m.

**T11: High Frequency Magnetics**
ROOM 361DEF

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| **SESSION CHAIRS** | Matt Wilkowski, EnaChip  
George Slama, Würth Elektronik |

8:30 a.m.

**T11.1** Indirect-Coupled Inductors with a Variable Coupling Coefficient to Improve Transient Response for Voltage Regulators
Feiyang Zhu, Qiang Li
Virginia Polytechnic Institute and State University

8:50 a.m.

**T11.2** Design and Demonstration of a 100-Kw 50-Khz Matrix Core Transformer for High Power Dual Active Bridge Converters
Zhe Zhao, Fei Diao, Yue Zhao, Nan Lin, Xinyuan Du, Yuheng Wu
University of Arkansas
9:10 a.m.  
T11.3 MagNet: an Open-Source Database for Data-Driven Magnetic Core Loss Modeling  
Haoran Li¹, Minjie Chen¹, Andrew Nadler², Charles Sullivan³, Thomas Guillod⁴, Evan Dogariu¹, Shukai Wang¹, Min Luo¹, Yuxin Chen¹, Vineet Bansal, Diego Serrano⁴  
¹Princeton University, ²Dartmouth College, ³Plexim GmbH, ⁴Universidad Politécnica de Madrid

9:30 a.m.  
T11.4 A Resonant Approach to Transformer Characterization  
Michael Solomentsev, Alex Hanson, Odinaka Okeke  
The University of Texas at Austin

9:50 a.m.  
T11.5 Modeling and Characterization of Natural-Convection Oil-Based Insulation for Medium Frequency Transformers  
Nikolina Djekanovic¹, Drazen Dujic²  
¹EPFL, ²PEL EPFL

10:40 a.m.  
T11.6 Double-Sided Conduction: a Loss-Reduction Technique for High Frequency Transformers  
Odinaka Okeke, Alex Hanson  
The University of Texas at Austin

11:00 a.m.  
T11.7 Application of Orthogonal Airgaps in High Frequency Coupled Inductors  
Satyaki Mukherjee¹, Dragan Maksimovic²  
¹Delta Electronics (Americas), ²University of Colorado Boulder

11:20 a.m.  
T11.8 At What Frequencies Should Air Core Magnetics Be used?  
Michael Solomentsev, Alex Hanson  
UT Austin

11:40 a.m.  
T11.9 Magnetic Core Losses Under Square-Wave Excitation and DC Bias in High Frequency Regime  
Bima Sanusi¹, Ziwei Ouyang²  
¹Danmarks Tekniske Universitet, ²Technical University of Denmark

8:30 a.m. – 12:00 p.m.  
T12: Control & Applications 1  
ROOM 350DEF

8:30 a.m.  
T12.1 An AC-Coupling Parallel Hybrid Supply Modulator Achieving 100MHz Envelope Tracking for Wireless Communication Power Amplifiers  
Pei-Yu Hsiung, Yen-Ming Chen, Chieh-Ju Tsai, Ching-Jan Chen  
National Taiwan University

8:50 a.m.  
T12.2 Conductive EMI Reduction Techniques for Soft-Switched Half-Bridge Buck Converters in Automotive Applications  
Weijie Han, Hoi Lee, Qi Cheng, Chen Chen  
University of Texas at Dallas

9:10 a.m.  
T12.3 On the Passivity of Grid-Forming Converters — Role of Virtual Impedance  
Mohammadreza Miranbeigi, Pranjal Gajare, Joseph Benzaquen, Prasad Kandula, Deepak Divan  
Georgia Tech

9:30 a.m.  
T12.4 Voltage Balancing Control for Input Series Output Parallel Three-Port Converter Modules  
Mahmoud Mansour, Regan Zane, Dorai Yelaverthi  
Utah State University

9:50 a.m.  
T12.5 Accurate Digital Delay Compensation of Synchronous Frame Current Regulator with Variable Switching Frequencies to Reduce Ripple and Increase Efficiency  
Yang Xu, Yingfeng Ji, Jonathan Hair, Nurani Chandrasekhar  
Ford Motor Company

10:40 a.m.  
T12.6 Virtual Memristor Based Control to Improve Power Converter Stability Under Extreme Large Range of Parameter Uncertainty  
Sihun Song, Yanjun Shi  
Florida State University

11:00 a.m.  
T12.7 A Highly Efficient Hybrid Devices-Based MMC with a Novel Modulation Scheme Using Hardware-in-the Loop System  
Rajat Shahane, Suryanarayana Doola, Anshuman Shukla, Satish Belkhode  
IIT Bombay
11:20 a.m.
T12.8 A Bidirectional Three-Level Converter with Single Point Sensing Technique for Flying Capacitor Balance
Yu-Yu Lin¹, Tsung-Wei Huang², Ching-Jan Chen¹, Yuan-Chih Li
¹National Taiwan University, ²Richtek Technology Corporation

11:40 a.m.
T12.9 A Linear Active Disturbance Rejection Control Based Sensorless Control for PMSMs Considering Harmonic Current Suppression
Lizhi Qu
magniX USA Inc.

2:30 p.m. – 5:50 p.m.
T13: DC-DC Converter Applications
ROOM 352DEF

DC-DC Converter Applications
SESSION CHAIRS
Jeff Niles, Alpha & Omega Semiconductor
Olivier Trescases, University of Toronto

2:30 p.m.
T13.1 Magnetic Integration of Matrix of Four Transformers with High Controllable Leakage Inductance in 5-Leg Core Magnetic Structure
Ahmed Nabih, Fred Lee, Qiang Li
Virginia Tech

2:50 p.m.
T13.2 ON-on and ON-Off Mode ZVS Phase-Shifted Full-Bridge TriMagic Converter IsolatedTM
Changbum Park, Hitoshi Takahashi, Zhi Li, Bin Wu, Fujimoto Mitsuunao
Alpsalpine CO. LTD

3:10 p.m.
T13.3 High Step-Down Single-Stage DC-DC Converter with Improved Planar Matrix Transformer for High-Current Data Center Application
Chang Wang, Ziwei Ouyang, Mingxiao Li, Zhe Zhang, Zsurszan Gabriel
Technical University of Denmark

3:30 p.m.
T13.4 Hybrid CCM-DCM Operation of High Gain Quadratic Extended-Duty-Ratio Boost Converter with Low Device Stress
Ankul Gupta, Nikhil Korada, Raja Ayyanar
Arizona State University

3:50 p.m.
T13.5 Low Cost and Small Component Count Hybrid Converter with Energy Management Control for Unmanned Aerial Vehicle Applications
Xueshen Zhang¹, Yeonho Jeong¹, Keon-Woo Kim²
¹University of Rhode Island, ²Samsung Electronics

4:30 p.m.
T13.6 High Step-Up DC-DC Converter with Active Switched Inductor and Voltage Double Based on Three-Winding Coupled Inductor
Peng Luo
National Cheng Kung University

4:50 p.m.
T13.7 Analysis of Mathematical Modeling of Soft Switching in Synchronous Rectification Boost Converter
Yifeng Wang¹, Zhongjie Wang¹, Hao Wang², Bo Chen¹
¹Tianjin University, ²Tiangong University

5:10 p.m.
T13.8 RMS Current Based Automated Optimal Design Tool for LLC Resonant Converters
Yuqi Wei, Alan Mantooth
University of Arkansas

5:30 p.m.
T13.9 Novel Realization of ZVS and Efficient Energy Transfer for Double-Clamped ZVS Buck-Boost Converter Without Current Sampling
Song Ding¹, Qingsong Gao¹, Qi Liu²
¹Southeast University, ²Southeast University Nanjing

2:30 p.m. – 5:50 p.m.
T14: Analysis & Control of Power Electronics for Grid Integration
ROOM 351ABC

Analysis & Control of Power Electronics for Grid
SESSION CHAIRS
Behrooz Mirafzal, Kansas State University
Yilmaz Sozer, University of Akron

2:30 p.m.
T14.1 Microgrid Structure for Testing a Real-Time Energy Management System Model
Enrique Sanabria-Torres¹, Fabio Andrade-Rengifo¹, Cesar Trujillo², Nelson Diaz², David Rosero-Bennai²
¹University of Puerto Rico, ²Universidad Distrital Francisco Jose de Caldas
2:50 p.m.

**T14.2 Identification of “Trouble Maker(s)” Caused by the PLL in Multi-Paralleled Inverters Systems**

Yanqi Cheng¹, Frede Blaabjerg², Henry Chung¹, Weimin Wu¹, Lixun Zhu¹, Koutroulis Eftychios¹

¹Shanghai Maritime University, ²Aalborg University, ³CityU of Hongkong, ⁴Technical University of Crete

3:10 p.m.

**T14.3 A Medium Voltage Testbed for the Performance and Function Tests of a 13.8 kV Power Conditioning System Converter**

Haiguo Li¹, Zhe Yang¹, Fred Wang², Zihan Gao³, Cheng Nie¹

¹University of Tennessee, ²University of Tennessee & ORNL

3:30 p.m.

**T14.4 Load Current Feedforward Control for the Inverter with Output Transformer Based on Frequency Compensation of Resonant Controller**

Bowei Lin, Li Peng

School of Electrical and Electronic Engineering, Huazhong University of Science and Technology

3:50 p.m.

**T14.5 Partial Fluctuating Power Control of Resonant Converter for Solid-State Transformer**

Zheqing Li¹, Chunyang Zhao¹, Yi-Hsun Hsieh¹, Qiang Li²

¹CPES Virginia Tech, ²Virginia Polytechnic Institute and State University

4:30 p.m.

**T14.6 Comparison of Controllers with Current Droop Capability for Series-Connected Autonomous Distributed Modular Power Converter**

Koki Yamanokuchi, Jun-Ichi Itoh, Hiroki Watanabe

Nagaoka University of Technology

4:50 p.m.

**T14.7 Feedforward-Enhanced Feedback Control of Output Voltage of a GaN-Based High-Power-Density Single-Phase Transformer-Less Online Ups**

Maida Farooq, Khurram Afridi, Danish Shahzad

Cornell University

5:10 p.m.

**T14.8 Analysis and Experimental Verification for Overvoltage Suppression in a Hybrid DC Circuit Breaker**

Zhi Jin Zhang, Maryam Saeedifard

Georgia Institute of Technology

5:30 p.m.

**T14.9 Equivalent Modeling Method for Real-Time Simulation of Multi-Active Bridge Based Solid-State Transformer**

Xuekun Meng, Wei Li

OPAL-RT TECHNOLOGIES

2:30 p.m. – 5:50 p.m.

**T15: Inverters**

ROOM 351DEF

**Inverters**

**SESSION CHAIRS**

Ziaur Rahman, Booz Allen Hamilton

Woongkul Lee, Michigan State University

2:30 p.m.

**T15.1 A Galvanically Isolated Single-Phase Inverter Topology with Flux-Rate Control Based Harmonic Filtering Scheme**

Ruman Kaiyam Mahapatra, Gopakumar K, Umanand L

Indian Institute of Science

2:50 p.m.

**T15.2 Active Reflected Wave Canceller with Partial Discharge Suppression for MV SiC Motor Drive**

Yu Zhang, Hui Li, Rachit Agarwal

Florida State University

3:10 p.m.

**T15.3 A Power Decoupling Technique for High Power-Density Single-Phase Inverters**

Mohammad Ebrahimi, S. Ali Khajehoddin

University of Alberta

3:30 p.m.

**T15.4 A MHz LCLCL Resonant Converter Based Single-Stage Soft-Switching Isolated Inverter with Variable Frequency Modulation**

Hao Wen¹, Johan Strydom², Bing Lu³, Jih-Sheng Lai³, Dong Jiao³

¹Monolithic Power Systems, ²Texas Instrument, ³Virginia Polytechnic Institute and State University

3:50 p.m.

**T15.5 A High-Frequency Compact Zero-Voltage-Transition GaN-Based Single-Phase Inverter**

Mohammadreza Hazratí Karkaragh, Mohammadreza Mohammadi, Morteza Esteki, Ali Khajehoddin

University of Alberta

4:30 p.m.

**T15.6 A Hybrid MMC with SiC-Based Full-Bridge and Si-Based Half-Bridge Sub-Modules with Novel Voltage Sorting Scheme**

Rajat Shahane, Satish Bezkhole, Anshuman Shukla

IIT Bombay

4:50 p.m.

**T15.7 Single-Phase Cascaded Half-Bridge Multilevel Inverter Fed by Single Inductive DC-Link**

Manxin Chen, Poh Chiang Loh

The Chinese University of Hong Kong
5:10 p.m.  
**T15.8** 250 W GaN Hybrid BCM Micro-Inverter Design for Avionic Applications  
Alper Cimendag¹, Murat Yilmaz², Tuncay Duman³  
¹Aselsan, ²Istanbul Technical University, ³AVL List GmbH  

5:30 p.m.  
**T15.9** Flux Minimization in Interphase Coupled Inductors for Parallel-Connected Voltage Source Converters  
Marius Takongmo, Chenhui Zhang, Vishwa Perera, John Salmon  
University of Alberta  

2:30 p.m. – 5:50 p.m.  
**T16: AC-DC Converters 1**  
ROOM 361ABC  

**AC-DC Converters 1**  
SESSION CHAIRS  
Ayan Mallik, Arizona State University  
John Lam, York University  

2:30 p.m.  
**T16.1** A Charge Injection Loss Compensation Method for a Series-Stacked Buffer to Reduce Current and Voltage Ripple in Single-Phase Systems  
Kelly Fernandez, Zitao Liao, Ting Ge, Nathan Brooks  
University of California Berkeley  

2:50 p.m.  
**T16.2** GaN-Based Series-Stacked Energy Decoupling Buffer for Selective DC Ripple Cancellation  
Thibaut Runser¹, Anatolii Tca³, Thiwanka Wijekoon²  
¹Huawei Technologies, ²Hua  

3:10 p.m.  
**T16.3** Semi-Bridgeless Active Line Rectification Power Factor Correction Converter with Minimum Current Sensors and Analog Control  
Alessandro Pevere  
Infineon Technologies  

3:50 p.m.  
**T16.5** Integrated Grid Inductors-Transformer Structure with Reduced Core Loss and Volume in Totem-Pole Single-Stage EV Charger  
Ramadhan Muhammad Hakimør, Junyeong Park¹, Sewan Choi², Huu-Phuc Kieu¹  
¹Seoul National University of Science and Technology, ²Seoultech  

4:30 p.m.  
**T16.6** Modulation Scheme Optimization of an Active Soft-Switching Cell for 1-ph/3-Ph Universal Voltage Input PFC for On-Board Charger Applications  
Tomas Sadilek¹, Peter Barbosa¹, Iqbal Husain²  
¹Delta Electronics, ²North Carolina State University  

4:50 p.m.  
**T16.7** A Novel Soft-Switched Three-Phase Three-Wire Isolated AC-DC Converter  
Abirami Kalathy, Mojtaba Forouzesh, Yan-Fei Liu, Preesh C. Sen  
Queen’s University  

5:10 p.m.  
**T16.8** A Novel Integrated Bidirectional AC to DC Resonant Converter  
Sunil Dube¹, Ramu Nair¹, Kalyan Yenduri¹, Pritam Das²  
¹SUNY Binghamton, ²Binghampton University  

5:30 p.m.  
**T16.9** A Unidirectional Isolated Medium-Voltage AC-DC Converter Using an LC-Resonant Diode-Rectifier-Circuit  
Kohei Budo, Takaharu Takeshita  
Nagoya Institute of Technology  

2:30 p.m. – 5:50 p.m.  
**T17: Modeling & Characterization of Power Electronics Components**  
ROOM 361DEF  

**Modeling & Characterization of Power Electronics Components**  
SESSION CHAIRS  
Ziaur Rahman, Booz Allen Hamilton  
Cahit Gezgin, Infineon Technologies AG  

2:30 p.m.  
**T17.1** Novel Method for Accelerated Thermal Cycling of Gallium Nitride Power Devices to Perform Reliability Assessment  
Hussain Sayed, Harish Krishnamoorthy, Gnana Sambandam Kulothungan  
University of Houston  

2:50 p.m.  
**T17.2** Gaussian Curve Fitting Method for Estimating Switching Loss from Double Pulse Test Waveforms  
Briana Bryant, Christopher New, Brian DeBoi, Andrew Lemmon  
University of Alabama  

3:10 p.m.  
**T17.3** Radiated Noise Direct Quantification on SiC MOSFET Half-Bridge Using Extended Double Pulse Test  
Mark Steiner, Motonobu Joko, Yuki Matsutaka, Michael Rogers, Toshiya Tadakuma  
Mitsubishi Electric
3:30 p.m.

T17.4 Characterization and Modeling of a 1.3 kV Vertical GaN P-N Diode
University of Toledo

4:30 p.m.

T17.6 Predicting Wireless Charging Coils Performance with Permanent Magnets
Tianze Kan¹, Shaohua Lin², Mark Solveson¹
¹ANSYS Inc., ²N/A

4:50 p.m.

T17.7 Analysis of Current Resonances Due to Winding Parasitic Capacitances in Medium-Voltage Medium-Frequency Transformers
Roderick Gomez¹, Juan Balda¹, German Oggier²
¹University of Arkansas, ²Universidad de Rio Cuarto

5:10 p.m.

T17.8 FEA-Tool Estimation of Triple Loop Antenna Measurement Levels of a Double Induction Heater Fed by Independent Inverters
Claudio Carretero¹, Jesus Acero¹, Antonio Munoz², Ignacio Lope², Marta Ribas¹
¹University of Zaragoza, ²BSH Home Appliances Group

2:30 p.m. – 5:50 p.m.

T18: Design Techniques for Wide Bandgap Power Modules
ROOM 350DEF

Design Techniques for Wide Bandgap Power Modules

SESSION CHAIRS
Qing Ye
Ali Safayet, Halla Mechatronics

2:30 p.m.

T18.1 Design and Characterization of 4.5kV/15mΩ SiC SuperMOS Half-Bridge Module
Soumik Sen, Alex Q. Huang
University of Texas at Austin

2:50 p.m.

T18.2 Feasibility Design of Tight Integration of Low Inductance SiC Power Module with Microchannel Cooler
Hao Chen¹, Xiaoling Li¹, Mehdi Asheghi², Yongfeng Lu³, Kenneth Goodson², Alan Mantooth¹, Yue Zhao¹, Yuxiang Chen¹, Tiwei Wei², Nan Li³, Man Prakash Gupta⁴, Qiuchi Zhu⁵, Sougata Hazra²
¹University of Arkansas, ²Stanford University, ³University of Nebraska-Lincoln, ⁴Ford Motor Company

3:30 p.m.

T18.4 Pulsed Overcurrent Capability of Power Semiconductor Devices in Solid-State Circuit Breakers: SiC MOSFET vs. Si IGBT
Xin Yang, Jingcun Liu, Bixuan Wang, Guogang Zhang
Xi’an Jiaotong University

3:50 p.m.

T18.5 In-Package Common-Mode Filter for GaN Power Module with Improved Radiated EMI Performance
Niu Jia¹, Lingxiao Xue², Han Cui¹, Xingyue Tian¹
¹University of Tennessee Knoxville, ²Oak Ridge National Laboratory

4:30 p.m.

T18.6 DC SST Mf Transformer Partial Discharge Characteristics Study with High dv/dt PWM Switching Transients of SiC Devices
Rachit Agarwal¹, Hui Li¹, Peter Cheetham¹, Zhehui Guo²
¹Florida State University, ²Center for Advanced Power Systems, Florida State University

4:50 p.m.

T18.7 Dynamic Remaining Useful Lifetime (RUL) Estimation of Power Converters Based on GaN Power Fets
Hussain Sayed, Gana Sambandam Kulothungan, Harish Krishnamoorthy
University of Houston

5:10 p.m.

T18.8 PCB Layout for Chip-Scale Package GaN Fets Optimizes Both Electrical and Thermal Performance
John Glaser, Assaad Helou, Jianlin Zhu, Michael de Rooij
Efficient Power Conversion Corp.

5:30 p.m.

T18.9 High Voltage SiC Power Module Optimized for Low Parasitics and Compatible System Interface
Xiaoling Li¹, Xianfeng Chen¹, Yuheng Wu¹, William Weber¹, Robert Cuzner², Adel Nasiri², Alan Mantooth¹, Hao Chen¹, Yue Zhao¹
¹University of Arkansas, ²University of Wisconsin-Milwaukee, ³University of South Carolina
12:15 p.m. – 12:45 p.m.

**Exhibitor Seminars – Session 5**

**Murata**
ROOM THEATER 2 (Expo Hall)

Revolutionizing Point-of-Load Conversion with Innovative Two-stage, Step-down Architectures

PRESENTED BY: Laurence McGarry

Murata is changing the PoL power paradigm by introducing the two-stage, step-down architecture where ultra-high efficiency charge pumps combine with low-voltage buck conversion to provide efficiency and EMI improvements in a compact low-profile solution. This seminar provides an overview of the inner workings of the two-stage architecture and previews a range of products (3.3V to 12 VIN) designed for ultra-high density, low-profile applications.

**Nexperia**
ROOM 360DEF

Not All MOSFETs Are The Same

PRESENTED BY: Tom Wolf

The performance of a power MOSFET can make or break a design. With a wealth of MOSFETs available, particularly in the Power-SO8 footprint, what makes Nexperia’s LFPAK family so beneficial to so many applications? Package technology, silicon parameters, and even the support tools available to engineers, in this session we will address why Nexperia Power MOSFETs differentiate to your benefit.

**PMBus**
ROOM THEATER 1 (Expo Hall)

SMBus Revision 3.2 and PMBus 1.4 Have Been Released

PRESENTED BY: Peter Miller

Find out what changed, what’s new, and what the future holds for Power Management digital interfaces. The experts from the System Management Interface Forum (SMIF) PMBus Standards Workgroup will review what has changed in SMBus 3.2 and PMBus 1.4, as well as share the exciting next steps with the future of PMBus 2.0.

**Wolfspeed, Inc.**
ROOM 361ABC

Wolfspeed Silicon Carbide Facilitating Industrial and Energy End Systems

PRESENTED BY: Guy Moxey

From Watts to Megawatts Wolfspeed Silicon Carbide transitions today’s carbon-conscious power solutions with higher efficiency, greater power density and lower cost of ownership.

1:00 p.m. – 1:30 p.m.

**Exhibitor Seminars – Session 6**

**Apex Microtechnology**
ROOM 360ABC

Apex Microtechnology: Pushing the Limits of High-Density SiC Power Modules

PRESENTED BY: HelenAnn Brown & Gina Rotermund

Apex Microtechnology is expanding the limits of density with high-power Silicon Carbide modules. In this discussion, Apex shares how they tackled complex technological problems for analog components, including the expansion of temperature range, reduction of power losses, and overall footprint reduction. Apex will highlight their company and latest product family of power modules, including devices achieving currents up to 32 Amps and voltages up to 650 Volts.

**Dongguan Mentech Optical & Magnetic Co., Ltd.**
ROOM THEATER 1 (Expo Hall)

Magnetics Technologies Now Ready for Prime Time

PRESENTED BY: Roger Gabriel

1) Chip LAN vs. Traditional LAN Transformer
2) 6-pin gull-wing Transformer
3) Case Study: Size-constrained PFC Design for performance & production
4) Planar Technology overview and Magnetic Integrated Planar Transformer Design

**ROHM Semiconductor**
ROOM THEATER 2 (Expo Hall)

150V Rohm GaN HEMT Featuring Superior High Switching Frequency

PRESENTED BY: Brandon Becker

ROHM developed the industry’s highest (8V) gate breakdown voltage (rated gate-source voltage) technology for 150V GaN HEMT devices – optimized for power supply circuits in industrial and communication equipment. In recent years, due to the rising demand for server systems in response to the growing number of IoT devices, improving power conversion efficiency and reducing size have become important social issues that require further advancements in the power device sector. Along with mass-producing industry-leading SiC devices and a variety of feature-rich silicon devices, ROHM has developed GaN devices featuring superior high frequency operation in the medium voltage range. Cultivating technology that increases the rated gate-source voltage (which has been a long-standing problem for existing GaN devices) allows ROHM to propose a wider range of power solutions for a variety of applications.
Nexperia
ROOM 360DEF

Nexperia Introduces Power GaN FETs
PRESENTED BY: Jim Honea

A brief overview of Nexperia’s high-voltage GaN FET technology and product portfolio, including the innovative CCPAK copper-clip surface-mount package. With tips for successful applications.

1:45 p.m. – 2:15 p.m.
Exhibitor Seminars – Session 7

Nexperia
ROOM 360DEF

Nexperia Introduces SiC Schottky Diodes
PRESENTED BY: Upal Sengupta

An introduction to Nexperia’s SiC Schottky diodes including a benchmarking performance comparison along with an efficiency analysis in a 800 W PFC Topology. Details about the SiC Diode portfolio and product roadmap will be presented as well.

Teledyne LeCroy
ROOM THEATER 1 (Expo Hall)

Power Electronics Probing – What to Use and Why
PRESENTED BY: Kenneth Johnson

Power electronics designs have inherent measurement challenge and there are many specialized high and low voltage single-ended and differential probes to meet the specific needs of this market. Proper probe selection and use is critical for operator, equipment and DUT safety and also has a large influence on the accuracy of the measurement. We’ll provide a framework to understand what probe to use and why, with some brief examples.
8:30 a.m. – 11:30 a.m.

**IS16: High Power & Resonant Converters**  
ROOM 360ABC  
SESSION CHAIR  
Bill Peterson, E&M Power

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8:30 a.m.

**IS16.1 1.25MW Bidirectional Converter for Battery Based Energy Storage System: Implementation and Practical Considerations**  
Kevork Haddad  
SEMikRON Inc

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8:55 a.m.

**IS16.2 High Efficiency 3-Phase Power Inverter Using SiC MOSFET and Trans-Linked Neutral-Point-Clamped Topology**  
Ming Su¹, Tatsuya Miyazaki², Yuta Okawauchi², Ken Nakahara², Mamoru Tsuruya³  
¹ROHM Semiconductor USA, LLC, ²Rohm Co., Ltd., ³Power Assist Technology Ltd.

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9:20 a.m.

**IS16.3 The Benefits of 650-V GaN Fets for 800-V Power Converters**  
Ramanan Natarajan  
Texas Instruments

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9:45 a.m.

**IS16.4 GaN HEMT Power Losses Modeling and Evaluation in Resonant LLC Converters**  
Santi Agatino Rizzo¹, ²Unict, ³STMicroelectronics  
Simone Buonomo², Alfio Scuto², Domenico Nardo², Massimiliano Chiantello³

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10:35 a.m.

**IS16.5 Magnetic Resonance Scanner: New Power Electronics Technology Solutions**  
Juan Sabate  
GE Global Research

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11:00 a.m.

**IS16.6 A SiC Based Three Phase Interleaved LLC Converter with Wide Voltage Range**  
Anuj Narain, JChen Wei, Jianwen Shao, Zongzeng Hu, Fulin Zhang  
Wolfspeed

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8:30 a.m. – 11:30 a.m.

**IS17: Thermal Issues in Devices & Magnetics**  
ROOM 360DEF  
SESSION CHAIR  
Devin Pellicone, Advanced Cooling Technologies Inc.

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8:30 a.m.

**IS17.1 A Practical Guide and System-Level Overview on Electrically Isolated Two-Phase Cooling Solutions for Power Electronics Applications**  
Devin Pellicone  
Advanced Cooling Technologies Inc.

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8:55 a.m.

**IS17.2 Meeting the Growing Thermal Requirements with Advanced Magnetics Design and GaN Transistors**  
Rongyong Tang¹, Jeff Chou², Juncheng Lu²  
¹Magwii, ²GaN Systems

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9:20 a.m.

**IS17.3 Improved GaN Thermal Performance in Quasi-Resonant Flybacks Using Novel 650V ICeGaNTM Technology**  
Peter Comiskey  
Cambridge GaN Devices

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9:45 a.m.

**IS17.4 Enhance a Voltage Regulator Module’s Thermal Performance Using an Inductor with a Metal Band and 3D Packaging**  
Ao Sun, Heng Yang, Xin Zhao, George Stathakis  
Monolithic Power Systems

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10:35 a.m.

**IS17.5 Designing SiC Power Modules for High Reliability**  
Jens Eltze  
Apex Microtechnology

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11:00 a.m.

**IS17.6 Thermal Tool for Quick Estimation of Thermal Performance of eGaN® Fets**  
Michael de Rooij, Assaad El Helou  
Efficient Power Conversion Corporation
8:30 a.m. – 11:30 a.m.

**IS18: Are You Throwing Energy Away? Don’t, or Recover it!**
ROOM 320A

**SESSION CHAIRS**
David Chen, *Power Integrations*
Edward Herbert, *PSMA*

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**IS18.1 Grid Integration of Sustainable EV Charging Systems**
Adel Nasiri
*University of South Carolina*

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**IS18.2 Energy Storage System for Land Drilling and Mine Sites**
Dachuan Yu
*Caterpillar*

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**IS18.3 V2G and Wireless Charging for EVs: Perfect Partners**
Milisav Danilovic
*WTricty*

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**IS18.4 Energy Storage Systems and Application**
Omar Abdel-baqi
*Eaton*

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**IS18.5 Emerging Zero-Standby Solutions for Miscellaneous Electric Loads**
Daniel Gerber
*Lawrence Berkeley National Laboratory*

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**IS18.6 Using Leakage Energy to Achieve Zero-Voltage Switching**
Bala Singamaneni
*Power Integrations*

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8:30 a.m. – 11:30 a.m.

**IS19: Novel Devices & Applications**
ROOM 320B

**SESSION CHAIR**
Davide Giacomini, *Infineon Technologies AG*

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**IS19.1 New Control System for SPS’s High Active Clamp Energy**
Mitch Van Ochten, Shuntaro Takahashi, Toru Takuma, Hajime Okuda
*ROHM Semiconductor U.S.A., LLC*

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8:55 a.m.

**IS19.2 The Case for Reconfigurable PMICs**
Anton Baker
*AnDAPT LLC*

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9:20 a.m.

**IS19.3 A New Class of Power MOSFETs with Low On-Resistance, near-Zero Reverse Recovery Losses, 2x Lower Qoss, and sub-30um Substrate**
Leo Mathew¹, Jerry Fossum², Rajesh Rao¹, Vishal Trivedi¹, Bradley Richardson³, Daniel Fine¹, Myles Golden³
¹Applied Novel Devices Inc, ²University of Florida, ³SkyWater Technologies

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9:45 a.m.

**IS19.4 Printed Wiring Board Effects in High Efficiency Switching Power Supplies**
Alan Palevsky¹, Adam Anders², Steven Lee³
¹Alan Palevsky LLC, ²Wolfspeed, ³Keysight Technologies

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10:35 a.m.

**IS19.5 Optimize Switch-Mode Power Modules to Achieve Ultra-Low (μV) Ripple and Noise**
George Statnikos, Heng Yang, Xin Zhao, Ao Sun
*Monolithic Power Systems*

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11:00 a.m.

**IS19.6 Analysis and Design of an LED Driver Based on QBB Insulated Topology**
Matteo Sucameli
*STMicroelectronics*

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8:30 a.m. – 11:30 a.m.

**IS20: EMC Issues & Motor Drives**
ROOM 320C

**SESSION CHAIR**
Lei Han, *Infineon Technologies*

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8:30 a.m.

**IS20.1 Acoustic Noise Reduction Strategies in 3-Phase PMSM Motor Drive Applications**
Lei Han, Aengus Murray
*Infineon Technologies*

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8:55 a.m.

**IS20.2 System-level benefits of GaN-based LV FOC motor drives**
Martin Wattenberg, Edward Jones
*Infineon Technologies Austria AG*

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9:20 a.m.

**IS20.3 EMC Virtual Lab for Power Electronics**
Zheng Luo
*Monolithic Power Systems*
9:45 a.m.

IS20.4 Mythbusting EMC Techniques in Power Converters
Francesc Estragues, Zheng Luo
Monolithic Power Systems

10:35 a.m.

IS20.5 DRSS - New Random Spread Spectrum Technique Targeting Two Resolution Bandwidths
Eric Lee, David Baba, Paul Curtis
Texas Instruments

11:00 a.m.

IS20.6 Extending Active EMI Filtering for High Frequencies and High Power
Orlando Murray
Texas Instruments

1:45 p.m. – 3:25 p.m.

IS21: SiC and GaN Product and Technology reliability, Robustness and Qualification
ROOM 360ABC
SESSION CHAIRS
Tim McDonald, Infineon Technologies AG
Darshan Gandhi, Navitas Semiconductor

1:45 p.m.

IS21.1 Transient Voltage Specification and Reliability for GaN Power Devices
Sandeep Bahl1, Stephanie Butler2, Tod Wootton, Jungwoo Joh
1Texas Instruments, 2Independent Consultant

2:10 p.m.

IS21.2 Wide Bandgap Quality and Reliability Standards: JEDEC Delivers!
Tim McDonald1, Stephanie Butler2
1Infineon Technologies AG, 2Independent Consultant

2:35 p.m.

IS21.3 New Failure Mechanisms Relevant for SiC Power Devices: Background and How to Tackle Them
Peter Friedchirs
Infineon Technologies AG

3:00 p.m.

IS21.4 Recent Advancements in the Understanding of Dynamic On-Resistance and Electromigration in Enhancement Mode GaN Devices
Robert Strittmatter
Efficient Power Conversion Corporation

1:45 p.m. – 3:25 p.m.

IS22: The Latest and Greatest Capacitor Technology Improvements for Wide Bandgap Applications
ROOM 360DEF
SESSION CHAIRS
Fred Weber, Future Technologies Worldwide
Andrew Mikulski, KEMET Electronics

1:45 p.m.

IS22.1 Capacitor Technology Trends for Wide Bandgap Semiconductors
Daniel West
AVX Corporation

2:10 p.m.

IS22.2 Multiple Capacitor Dielectrics Support Wide Bandgap Power Solutions
Philip Lessner
KEMET Electronics

2:35 p.m.

IS22.3 Mind the Gap: E-Cap Technologies for Wide Bandgap Solutions
Stephan Menzel
CapXon

3:00 p.m.

IS22.4 High-Density Low-Profile Capacitors Toward 3D Heterogeneous Integration
Raj Pulugurtha
Florida International University

1:45 p.m. – 3:25 p.m.

IS23: New Developments in the SiC & GaN Technology Ecosystem
SESSION CHAIR
Victor Veliadis, North Carolina State University

1:45 p.m.

IS23.1 Innovating Cooling Solutions for Wide Bandgap Devices Thermal Management
Philippe Roussel
Mersen

2:10 p.m.

IS23.2 Tame the SiC Beast - Unlock the Full Capability of Silicon Carbide with Digital Gate Drivers
Perry Schugart
Microchip
THURSDAY, MARCH 24
EDUCATIONAL PROGRAM | INDUSTRY SESSIONS

2:35 p.m.
IS23.3 Packaging Considerations to Get the Most Benefit from SiC in Traction Applications
Ole Muehlfeld
Danfoss Silicon Power

3:00 p.m.
IS23.4 Reliable and Efficient Silicon Carbide MOSFETs in High Volume Production
Sauvik Chowdhury, Hong Kim
onsemi

1:45 p.m. – 3:25 p.m.
IS24: Energy Harvesting State-of-the-Art with Functional Demos
ROOM 320B
SESSION CHAIRS
Mike Hayes, Tyndall National Institute
Brian Zahnstecher, PowerRox LLC

1:45 p.m.
IS24.1 EnABLES — Free of charge power IoT feasibility studies for real world applications
Mike Hayes
Tyndall National Institute

2:10 p.m.
IS24.2 Electromagnetic Energy Harvesting System Enabling 20 mW Output Power for IoT Application
Mahmoud Shousha
MagI3C PU, Wurth Electronik eiSos

2:35 p.m.
IS23.3 How to turbo charge the Internet of Things with Ultra Capacitors and Energy Harvesting
Ronald de Graaf
NAWA Technologies

3:00 p.m.
IS23.4 Interactive Energy Harvesting Demo Session
Brian Zahnstecher
PowerRox LLC

1:45 p.m. – 3:25 p.m.
IS25: Passive Components
ROOM 320C
SESSION CHAIR
John Gallagher, 1:45 p.m. Pulse Electronics, Inc

1:45 p.m.
IS25.1 High Performance Pulse Load SURFACE-Mount Resistors
Breno Albuquerque
Vishay Intertechnology, Inc

2:10 p.m.
IS25.2 High Frequency Transformer Design: Bridging Between Magnetics and Circuits
Dongbin Hou, Yuki Sato, Sombuddha Chakraborty, Kenji Kawano
Texas Instruments

2:35 p.m.
IS25.3 Trans-Inductor Voltage Regulator (TLVR): Circuit Operation, Power Magnetic Construction, Efficiency and Cost Trade-Offs
David Wiest, Yosef Zhou
Pulse Electronics
8:30 a.m. – 11:15 a.m.

**T19: PoL & Multi-phase DC-DC Converters**
ROOM 352DEF

**PoL & Multi-phase DC-DC Converters**

**SESSION CHAIRS**

Cahit Gezgin, Infineon Technologies AG

Luke Jenkins, IBM

8:30 a.m.

**T19.1**

300A Single-Stage 48V Voltage Regulator with Multiphase Current Doubler Rectifier and Integrated Transformer

Xin Lou, Qiang Li

Virginia Tech

8:50 a.m.

**T19.2**

Dual-Path Hybrid Synchronous Rectifier in Active Clamp Forward Converter for Inductor Current Reduction

Katsuhiro Hata¹, Sadanori Suzuki², Makoto Takamiya¹

¹The University of Tokyo, ²Toyota Industries Corporation

9:10 a.m.

**T19.3**

Direct Power Converter -DPx- for High Gain & High Current Applications

Jose Cobos, Juan Cruz, Oscar Garcia, Alvaro Cobos, Alejandro Castro

Differential Power S.L.

9:30 a.m.

**T19.4**

Modelling of Quasi-Parallel Sigma DC-DC Converter for High Efficiency Single-Stage Voltage Regulator

Lingyun Li, Shen Xu, Weifeng Sun, Yijie Qian, Limin Yu

Southeast University

9:50 a.m.

**T19.5**

Per-Core Configurable Power Supply for Multi-Core Processors with Ultra-Fast DVS Voltage Transitions

Inder Kumar¹, Santanu Kapat²

¹University of Colorado Boulder, ²Indian Institute of Technology (IIT) Kharagpur

10:35 a.m.

**T19.6**

MC-SEPIC: Matrix Coupled Sepic Converter with Planar Integrated Magnetics

Ping Wang, Youssef Elasser, Minjie Chen

Princeton University

10:55 a.m.

**T19.7**

A 3D Integrated Nonlinear Coupled Inductor for Improving Light Load Efficiency of Voltage Regulator Modules

Longyang Yu

xjtu

8:30 a.m. – 11:15 a.m.

**T20: Energy Storage Systems & Grids**
ROOM 351ABC

**Energy Storage Systems & Grids**

**SESSION CHAIRS**

Rajeev Kumar Singh, Indian Institute of Technology (BHU)

Hanyu Wang, Huazhong University of Science and Technology

8:30 a.m.

**T20.1**

High Gain Non-Isolated Interleaved Current-Fed 3-Phase Partial Series Resonance Pulse Based ZCS Voltage Quadrupler

Koyelia Khatun¹, Regan Zane¹, Akshay Rathore²

¹Utah State University, ²Concordia University

8:50 a.m.

**T20.2**

In-Situ EV Battery Electrochemical Impedance Spectroscopy with Pack-Level Current Perturbation from a 400V-to-12V Triple-Active-Bridge

Seyed Amir Assadi, Zhe Gong, Cheng Feng Wang, James Xu, Joshua Piruzza, Diana Jokic, Olivier Trescases

University of Toronto

9:10 a.m.

**T20.3**

The Partial Power Processing Converter System with Robust DC-Link Voltage for Islanded DC Microgrid

Nie Hou¹, Yunwei Li², Pasan Gunawardena², Yue Zhang²

¹Department of Electrical and Computer Engineering, University of Alberta, ²University of Alberta

9:30 a.m.

**T20.4**


Ali Alenezi, Hussain Hussain

Kuwait University

9:50 a.m.

**T20.5**

A Low Communication Dependency Control Strategy for Hybrid Series-Parallel Microgrid

Xiaohai Ge, Xin Zhang, Bin Guo

Zhejiang University

10:35 a.m.

**T20.6**

Internal Resistance Measurement of Lithium-Ion Batteries Using LC Resonant Tank

Abdulaouf Benshatti, M Rakhiul Islam, Thomas Link, Sung-Yeul Park, Desmon Simatupang

University of Connecticut
10:55 a.m.

T20.7 Power Oscillation Characterization and Component Sizing for Asymmetrical Fault Ride Through of Grid Forming Converters
Md Rifat Kaisar Rachi¹, Iqbal Husain¹, M A Awal²
¹North Carolina State University; ²Danfoss

8:30 a.m. – 11:15 a.m.

T21: Control of Wireless Power Transfer Systems
ROOM 351DEF

Control of Wireless Power Transfer Systems

SESSION CHAIRS
Emre Gurpinar, Oak Ridge National Laboratory
Jungwon Choi, University of Minnesota Twin Cities

8:30 a.m.

T21.1 Design and Validation of a High-Power Dynamic Wireless Charging for Electric Vehicles
Lingxiao Xue¹, Ömer Oner¹, Rong Zeng¹, Veda Prakash Galigekere², Mostak Mohammad³, Gui-Jia Su³
¹Oak Ridge National Laboratory, ²UT Battelle ORNL

8:50 a.m.

T21.2 A High Misalignment-Tolerant IPT System Based on Dual Decoupled Receiver Coils with Voltage Doubler Rectifier
Yihao Wu¹, Shunpan Liu², Lingyun Zhou², Ruikun Mai², Jiaqi Yu², Yong Li²
¹Imperial College London, ²Southwest Jiaotong University

9:30 a.m.

T21.4 Pulsed Current Constant Voltage (PCCV) Controller for Wireless Electric Vehicle Charger
Reynaldo Gonzalez, Sara Ahmed, Ayetullah Biten
University of Texas at San Antonio

9:50 a.m.

T21.5 Development of a Fast-Charging Platform for Buried Sensors Using High Frequency IPT for Agricultural Applications
Juan Arteaga, Paul Mitcheson, Eric Yeatman
Imperial College London

10:35 a.m.

T21.6 A ZVS Pulsedwidth Modulation Scheme for Active Class E Rectifier Based IPT Systems
Bo Xue, Peng Zhao, Yu Liu, Haoyu Wang, Minfan Fu, Rong He
ShanghaiTech University

10:55 a.m.

T21.7 Identifying Complete Set of Parameters Using Transmitter Side Information for two-TX-one-RX Wireless Power Transfer Systems
Kang Yue¹, Yu Liu¹, Minfan Fu¹, Rong He¹, Xinguo Zhang²
¹ShanghaiTech University, ²School of Information Science and Technology ShanghaiTech University
### T23: Power Applications: LED, Heating, USB, Magnetics

**SESSION CHAIRS**
- Yingyi Yan, Analog Devices
- Khorshed Alam, General Motors

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<tr>
<th>Time</th>
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<th>Authors</th>
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</thead>
<tbody>
<tr>
<td>8:30 a.m.</td>
<td><strong>T23.1</strong> Precise Luminous Flux and Color Temperature Control of Dimmable Bi-Color White Light-Emitting Diode Systems</td>
<td>Yuchen He¹, Siew-Chong Tan², Albert Ting Leung Lee², Germaine Cheuk Ping Wong², Ron Shu Yuen Hui³ ¹Florida State University, ²The University of Hong Kong, ³Nanyang Technological University</td>
</tr>
<tr>
<td>8:50 a.m.</td>
<td><strong>T23.2</strong> Discrete-Time Trajectory Based Control of DC-DC Converters and Applications to Led Driving</td>
<td>Raktim Roy, K Hariharan, Santanu Kapat Indian Institute of Technology (IIT) Kharagpur</td>
</tr>
<tr>
<td>9:10 a.m.</td>
<td><strong>T23.3</strong> A Boost Converter with Lossless Passive Snubber for Powering the 5G Small Cell Station</td>
<td>Yeu-Torng Yau¹, Tsung-Liang Hung², Kuo-Ing Hwu³ ¹National Chin-Yi University of Technology, ²Asian Power Device Inc., ³National Taipei University of Technology</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td><strong>T23.4</strong> Low-Noise, 24 V, 1 A, 2.1 MHz GaN DC/DC Converter for Variable Power Supply of a GaN-Based Solid-State Power Amplifier</td>
<td>Dominik Koch, Ingmar Kalffass, Benjamin Schoch University of Stuttgart</td>
</tr>
</tbody>
</table>

### T24: Control of DC-DC Converters

**SESSION CHAIR**
- Grant Pitel, Univ. of Illinois - Urbana Champaign

<table>
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<th>Time</th>
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<th>Authors</th>
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<tbody>
<tr>
<td>8:30 a.m.</td>
<td><strong>T24.1</strong> Constant Switch Stress Control of Hybrid Switched Capacitor DC-DC Converters</td>
<td>Ziyu Xia, Jason Stauth Dartmouth College</td>
</tr>
<tr>
<td>9:10 a.m.</td>
<td><strong>T24.3</strong> A Novel Multi-Mode Control Method for Double-Clamped ZVS Converter with Reduced Loss</td>
<td>Song Ding¹, Qi Li², Qinsong Qian³ ¹Southeast University, ²Southeast University Nanjing ³University of Ulsan</td>
</tr>
<tr>
<td>9:50 a.m.</td>
<td><strong>T24.5</strong> Transient Suppression Scheme for Mitigation of High-Performance VRM Intricate Load Profiles</td>
<td>Bar Halvni, Tom Urkin, Mor Peretz Ben-Gurion University of the Negev - PEMIC</td>
</tr>
<tr>
<td>10:35 a.m.</td>
<td><strong>T24.6</strong> Chattering-Free Event-Trigger Fast Recovery Stable Digital Sliding Mode Control in DC-DC Converters</td>
<td>Santanu Kapat Indian Institute of Technology (IIT) Kharagpur</td>
</tr>
<tr>
<td>10:55 a.m.</td>
<td><strong>T24.7</strong> Real-Time Reconfiguration in Digital Current Mode Control for Fast Transient with Robust Stability</td>
<td>Santanu Kapat Indian Institute of Technology (IIT) Kharagpur</td>
</tr>
</tbody>
</table>
1:45 p.m. – 3:25 p.m.  
**T25: Hybrid DC-DC Converters**  
ROOM 352DEF  

**Hybrid DC-DC Converters**  

**SESSION CHAIR**  
Xin Zhang, IBM  

1:45 p.m.  
**T25.1 Vertical Stacked LEGO-Pol CPU VRM with 1 A/mm² Current Density**  
Youssef Elasser¹, Harish Krishnamurthy², Houle Gan³, Kaladhar Radhakrishnan³, Jonathan Douglas², Xin Li³, Shuai Jiang³, Jaeil Baek¹, Charles Sullivan⁴, Minjie Chen¹  
¹Princeton University, ²Intel, ³Google LLC, ⁴Dartmouth  

2:05 p.m.  
**T25.2 A Symmetric Dual-Inductor Hybrid Dickson Converter for Direct 48V-to-Pol Conversion**  
Nathan Ellis, Robert Pilawa-Podgurski  
University of California Berkeley  

2:25 p.m.  
**T25.3 A Dickson-Squared Hybrid Switched-Capacitor Converter for Direct 48 V to Point-of-Load Conversion**  
Yicheng Zhu, Zichao Ye, Robert Pilawa-Podgurski, Ting Ge  
University of California Berkeley  

2:45 p.m.  
**T25.4 A Capacitively-Isolated Dual Extended LC-Tank Converter with 50% Two-Phase Operation at Even Conversion Ratios**  
Amanda Jackson, Nathan Ellis, Robert Pilawa-Podgurski  
University of California Berkeley  

3:05 p.m.  
**T25.5 Multiphase FCML Converter with Coupled Inductors for Ripple Reduction and Intrinsic Flying Capacitor Voltage Balancing**  
Daniel H Zhou, Avi Bendory, Minjie Chen  
Princeton University  

1:45 p.m. – 3:25 p.m.  
**T26: Renewable Energy System Control**  
ROOM 351ABC  

**Renewable Energy System Control**  

**SESSION CHAIRS**  
Jingbo Liu  
Seunghoon Baek, Virginia Tech  

1:45 p.m.  
**T26.1 A Novel Grid-Tied Dual-PV LLC Converter MPPT Using Adaptive Neuro Fuzzy Interface System (ANFIS)**  
Sumana Ghosh, Issa Batarseh, Abdullah Alhatlani  
University of Central Florida  

2:05 p.m.  
**T26.2 An Advanced PLL-Less Control Scheme for LVRT Capability with Harmonics Current Mitigations in Grid-Tied PV System Under Weak and Distorted Grid**  
Manash Kumar Mishram, Ankit Mishra, Vivek Nandan Lal  
Indian Institute of Technology(Bhu)Varanasi  

2:25 p.m.  
**T26.3 MPPT Based Performance Analysis of Minimum Phase Multi-Output Hybrid Bipolar Converter**  
Pawan Kumar¹, Rajeev Kumar Singh¹, Ranjit Mahanty²  
¹Indian Institute of Technology (BHU), ²IIT BHU Varanasi  

2:45 p.m.  
**T26.4 Optimization of Self-Adaptive INR-MPPT for R-Mode Red Stacks**  
Zhihong Yan¹, Yuchen He², Li Wang³, Ron Shu Yuen Hui³, Siew-ChongTan¹, Ying Huang¹, Chuyang Tang¹  
¹The University of Hong Kong, ²Florida State University, ³Nanyang Technological University  

3:05 p.m.  
**T26.5 Comparisons of Filter Volume, Loss and Temperature Rise in 3Φ3W LCL Converters withDirect Digital Control and Different Filter-Inductance-Drop Rates**  
Tsai-Fu Wu, Yun-Hsiang Chang, Hsin-Yi Wu, Kuan-Chen Lin, Yun-Taung Liu  
National Tsing Hua University
1:45 p.m. – 3:25 p.m.

**T27: Inverters & Others**  
**ROOM 351DEF**

**Inverters & Others**

**SESSION CHAIRS**

Ali Safayet, Halla Mechatronics  
Dinesh Kumar, Global Research & Development Center, Danfoss Drives A/S

1:45 p.m.

**T27.1** High Frequency Modular Multi-Cell Arbitrary Waveform Generator  
Luis Gómez Navajas\(^1\), Diego Serrano\(^2\), Miroslav Vasic\(^2\)  
\(^1\)Centro de Electrónica Industrial,  
\(^2\)Universidad Politécnica de Madrid

2:05 p.m.

**T27.2** Temperature Estimation Technique for Induction Heating Vessels by Tracking Resistance Difference Under Operating Frequency Variation  
Kyung-Wook Heo, Jee-Hoon Jung, Geun-Wook Kim  
UNIST

2:25 p.m.

**T27.3** Design and Optimization of a SiC-Based Versatile Bidirectional high-Voltage Waveform Generator  
Ignacio Alvarez, Hector Sarnago, Jose M. Burdio, Oscar Lucia  
University of Zaragoza

2:45 p.m.

**T27.4** Hybrid-SoRo: Hybrid Switched Capacitor Power Management Architecture for Multi-Channel Piezoelectric Soft Robot  
Hsin Cheng\(^1\), Yenan Chen\(^2\), Minjie Chen\(^1\), Zhiwu Zheng\(^1\), Prakhar Kumar\(^1\)  
\(^1\)Princeton University,  
\(^2\)Advanced Semiconductor Research Institute, Hangzhou Global Scientific and Technological Innovation Center, Zhejiang University

3:05 p.m.

**T27.5** Equivalent Circuit and Modified Unipolar Pulse Width Modulation Technique for High Efficiency SiC Based Class-D Power Amplifiers in Underwater Acoustic Applications  
Muhammed Yusuf Candan\(^1\), Hüseyin Mele\(^2\), Murat Hacıosmanoğlu\(^1\)  
\(^1\)Aselsan,  
\(^2\)Tegg

1:45 p.m. – 3:25 p.m.

**T28: SiC Devices**  
**ROOM 361ABC**

**SiC Devices**

**SESSION CHAIRS**

Zheyu Zhang, Clemson University  
Jingbo Liu

1:45 p.m.

**T28.1** Design Guideline and Practical Solution of PCB-Type Rogowski Current Sensor for SiC MOSFET Short-Circuit Protection Based on Frequency Analysis  
Ju-A Lee, Dong Hyeon Sim, Sangjoon Ann, Byoung Kuk Lee  
Sungkyunkwan University

2:05 p.m.

**T28.2** Improved Switching Performance of 3.3kV SiC MOSFETs using Synchronous Rectification in A Voltage Source Inverter  
Anirban Pal, Rishad Ahmed, Naresh Pilli, Christian Klumpner  
University of Nottingham

2:25 p.m.

**T28.3** Impact of Forward Recovery Effects in Different Si-IGBT Technologies Used in Hybrid Si-IGBT, SiC-MOSFET Based ANPC Topology  
Srikanth Lakshmeesha\(^1\), Civan Lezgin Kahraman\(^2\), Thiwanka Wijekoon\(^3\), Sebastian Rosado\(^2\)  
\(^1\)Nexperia,  
\(^2\)Huawei Technologies - Germany,  
\(^3\)Hua

2:45 p.m.

**T28.4** Spurious Miller turn-on Evaluation for SiC MOSFET Body Diode in High-Frequency Converters  
Luciano Salvo, Angelo Sciacca, Massimo Nania, Mario Pulvirenti  
STMicroelectronics

3:05 p.m.

**T28.5** A Four-Level Active Gate Driver with Continuously Adjustable Intermediate Gate Voltages  
Xia Du, Yuqi Wei, Liyang Du, Alan Mantooth, Venkata Samhitha Machireddy  
University of Arkansas
1:45 p.m. – 3:25 p.m.
T29: Gate Drive Circuits
ROOM 361DEF

Gate Drive Circuits

SESSION CHAIR
Seungdeog Choi, Mississippi State University

1:45 p.m.
T29.1 Gate Driver Development and Stray Inductance Extraction of 10 kV SiC MOSFET Module for Switched-Capacitor MMC Application
Zhehui Guo1, Hui Li2, Fang Peng2
1Center for Advanced Power Systems, Florida State University, 2Florida State University

2:05 p.m.
T29.2 A Very-High-Frequency Isolated Gate Driver Power Supply Using Solid Dielectrics for Medium Voltage SiC MOSFETs
Zhehui Guo1, Hui Li2
1Center for Advanced Power Systems, Florida State University, 2Florida State University

2:25 p.m.
T29.3 Transient Overvoltage Detection Technique for GaN HEMTs Integrated in a 200-V GaN-on-SOI Process
Samantha Murray1, Peter Moens2, Jaume Roig2, Olivier Trescases1, Herbert De Vleeschouwer2, Mohammed Shawkat Zaman1, Wanlin Jiang1
1University of Toronto, 2ON Semiconductor

2:45 p.m.
T29.4 Equalization of DC and Surge Components of Drain Current of Two Parallel-Connected SiC MOSFETs Using Single-Input Dual-Output Digital Gate Driver IC
Kohei Horii1, Makoto Takamiya1, Ryuho Morikawa1, Ryunosuke Katada1, Shin-Ichi Hayashi2, Takayasu Sakurai1, Katsuhito Hata1, Koji Wada2, Ichiro Omura2
1The University of Tokyo, 2Tokyo Metropolitan University, 3Kyushu Institute of Technology

3:05 p.m.
T29.5 An Integrated Active Gate Driver for Half-Bridge SiC MOSFET Power Modules
Dongwoo Han1, Sanghun Kim2, Yuan Li1, Jinyeong Moon1, Xiaofeng Dong2, Zhehui Guo2, Hui Li1, Fang Peng1
1Florida State University, 2Center for Advanced Power Systems/Florida State University

1:45 p.m. – 3:25 p.m.
T30: Control & Applications 2
ROOM 350DEF

Control & Applications 2

SESSION CHAIR
Xiaonan Lu, Temple University

1:45 p.m.
T30.1 Grid Forming Control in Switching Frequency Constrained Medium Voltage Multi-Megawatt Voltage Source Converters
MA Awal, Stefan Schroeder
Danfoss

2:05 p.m.
T30.2 An Inner-Loop Control Method for the Filterless, Voltage Sensor-less, and PLL-Less Grid-Following Inverter-Based Resource
Bokang Zhou, Fang Peng, Yuchen He, Yuan Li, Yuntao Zou
Florida State University

2:25 p.m.
T30.3 Control Technique for Transformerless Regenerative Testing of Grid-Connected Power Converters
Partha Pratim Das, Debanjan Chatterjee
ABB

2:45 p.m.
T30.4 A Close-Loop Current Balancing Method for High Power Silicon Carbide Inverter with Paralleled Power Modules
Nan Lin, Yue Zhao
University of Arkansas

3:05 p.m.
T30.5 Multi-Sampling with Real-Time Update PWM for Time-Delay Minimization of FPGA-Based Voltage-Controlled Converters
Zejie Li1, Fangzhou Zhao1, Xiongfei Wang2, Shan He1, Munk-Nielsen Stig1
1Department of Energy, Aalborg University, 2Aalborg University
TECHNICAL DIALOGUE SESSIONS

APEC professionals participated in a rigorous peer review process and have carefully picked hundreds of papers, making up APEC’s Technical Sessions. There are two categories of Technical Sessions. The Technical Dialogue Sessions feature papers with a more specialized focus and provide opportunities for discussion with authors.

11:30 AM – 1:30 PM

**D01: AC-DC Converters 2**

**POSTER AREA**

**AC-DC Converters 2**

**SESSION CHAIRS**

Edward Herbert, PSMA
George Slama, Würth Elektronik

**D01.1** A New Power Factor Improving Algorithm Under High Line and Light Load Conditions
Ruqi Li, Xiqun Zhu, Douglas Arduini, Sung Baek Cisco Inc.

**D01.2** Feasibility and Accuracy Analysis of Input Power Estimation for Boost PFC Converter Without Additional Sensor
Siran Wang, Hao Wang
Monolithic Power Systems

**D01.3** Practical Switching Frequency Control for Improved Efficiency in Hard-Switched CCM Boost PFC Converters at Light Load
Rytis Beinarys, Trong Tue Vu

1ICERGi Ltd.

11:30 AM – 1:30 PM

**D02: High Frequency Inductors**

**POSTER AREA**

**High Frequency Inductors**

**SESSION CHAIRS**

Edward Herbert, PSMA
George Slama, Würth Elektronik

**D02.1** Exploiting the Benefits of Partially Saturating Inductors on switch-Mode Power Supplies Electro-Magnetic Compatibility and Efficiency
Nicola Feinia1, Giulia Di Capua2
1University of Salerno, 2University of Cassino and Southern Lazio

**D02.2** A Highly Compact 2-Phase Interleaving ZVS Buck Converter with Integrated Inductor
Bima Sanusi, Ziwei Ouyang, Cathrine Frandsen, Anders Jørgensen, Marco Beleggia
Technical University of Denmark

**D02.3** A Fast Non-Iterative Design Approach of One-Turn Inductor with Significant AC Flux Using Commercially Available Components
Cong Tu1, Rengang Chen2, Khai Ngo1
1Virginia Polytechnic Institute and State University, 2Texas Instruments

11:30 AM – 1:30 PM

**D03: Design & Control of Power Converters for Utility Applications**

**POSTER AREA**

**Design & Control of Power Converters for Utility Applications**

**SESSION CHAIRS**

Madhav Manjrekar, UNC Charlotte
Jacob Mueller, Sandia National Laboratories

**D03.1** Var Control Capability Analysis for a Hybrid Voltage Regulation Transformer
Yafeng Wang1, Tiefu Zhao1
1Monolithic Power Systems, 2UNC Charlotte

**D03.2** Control Strategy of Delta-Connected Solid State Transformer Under Unbalanced Grid Voltage
Shaoxi Ouyang
Xi’an Jiaotong University
D03.4 SiC-Based Intelligent Power Stage with Device Prognostics/Diagnostics and ZVRT Capability for Smart Universal Power Electronic Regulators (SUPER) Application
Xiaofeng Dong\(^1\), Dongwoo Han\(^2\), Yuan Li\(^2\), Hui Li\(^2\), Madhu Sudhan Chinthavali\(^2\), Jinyeong Moon\(^2\), Radha Krishna Moorthy\(^3\), Sandro P. Martin\(^2\), Sanghun Kim\(^1\), Fang Peng\(^2\)
\(^1\)Center for Advanced Power Systems, Florida State University, \(^2\)Florida State University, \(^3\)Oak Ridge National Laboratory

THURSDAY, MARCH 24
EDUCATIONAL PROGRAM | TECHNICAL DIALOGUE SESSIONS

D03.5 A Zero Current Switching Hybrid DC Circuit Breaker for DC Grid Applications
Satish Naik Banavath\(^1\), Nandakumar Saminathan\(^1\), Kaushik Rajashekar\(^2\), Muhammed Ajmal Cn\(^1\)
\(^1\)Indian Institute of Technology Dharwad, \(^2\)University of Houston

D03.7 Shunt Compensation for DC Microgrid Stabilization Utilizing T-Type Modular DC Circuit Breaker (T-Breaker)
Faisal Alsafi\(^1\), Yue Zhang\(^2\), Xiao Li\(^1\), Jin Wang\(^1\)
\(^1\)The Ohio State University, \(^2\)University of Alberta

D03.8 Flexible Transfer Converter to Enable Autonomous Control of Grid-Connected and Interconnected Microgrids
Ronghui An, Jinjun Liu, Zhaoqi Song, Zeng Liu, Yai Deng
Xi’an Jiaotong University

D03.10 Enhancing Inverter-Based AC Microgrid Communication Using Two-Frequency Shift Keying (2FSK) Method
Ayetullah Biten, Sara Ahmed
University of Texas at San Antonio

D03.12 A SiC & Si Hybrid Four-Level ANPC Converter with Multi-Step Soft-Switching Modulation Achieving Capacitor Voltage Balancing
Jiazhuan Dong, Yifan Zhang, Wuhua Li, Chushan Li, Xiangning He, Shilei Zhang
Zhejiang University

11:30 AM – 1:30 PM
D04: Drives & Inverter
POSTER AREA

Drives & Inverter

SESSION CHAIRS
Ali Safayet, Halla Mechatronics
Woongkul Lee, Michigan State University

D04.1 Quantitative Harmonics Performance Evaluation of High Speed Permanent Magnet Synchronous Machine Under Various Synchronous SVM PWM Strategies
Kevin Lee\(^1\), Wenci Yao\(^2\), Zhicuo Song\(^2\)
\(^1\)Eaton Corporation, \(^2\)Zhejiang University

D04.3 Real Time dq0 Analysis of FOC Systems
Jonathan Tucker\(^1\), Bharghavi Vempati\(^2\), Niranjan Hegde\(^2\), Srikrishna N H\(^2\)
\(^1\)Tektronix, \(^2\)Tektronix India Pvt. Ltd.

D04.4 Space Vector Modulation Technique for Reducing Harmonics in Current with Zero Common-Mode Voltage for Two-Parallel Three-Level Converters
Jun-Hyung Jung\(^1\), Marco Liserre\(^2\), Sante Pugliese\(^3\)
\(^1\)Kiel University, \(^2\)Christian-Albrechts-Universität zu Kiel

D04.5 A Comprehensive Analysis of Current Spikes in a Split-Phase Inverter
Abdul Basit Mirza, Fang Luo, Asif Imran Emon, Sama Salehi Vala
Stony Brook University

D04.6 Current Balancing Methods for a High Power Silicon Carbide Inverter with Paralleled Modules
Nan Lin, Yue Zhao, Yuheng Wu, Mohammad Mahmud University of Arkansas

D04.7 Auxiliary Resonant Committed Pole Inverter (ARCI) Operation Using Online Voltage Measurements
Markus Zocher\(^1\), Norbert Grass\(^2\), Ralph Kennel\(^3\)
\(^1\)Institute ELSYS, \(^2\)Christian-Albrechts-Universität zu Kiel

D04.10 Stacking Approach for Multiple Hybrid Binary Cascaded Multilevel Converter Modules with Reduced Scalability Complexity
Bryan Gutierrez, Jin-Sheng Lai
Virginia Polytechnic Institute and State University

D04.12 A SiC & Si Hybrid Four-Level ANPC Converter with Multi-Step Soft-Switching Modulation Achieving Capacitor Voltage Balancing
Jiazhuan Dong, Yifan Zhang, Wuhua Li, Chushan Li, Xiangning He, Shilei Zhang
Zhejiang University

11:30 AM – 1:30 PM
D05: Devices & Components
POSTER AREA

Devices & Components

SESSION CHAIRS
Jason Neely, Sandia National Laboratories
Hengzhao Yang, New Mexico Institute of Mining and Technology

D05.1 The Application of Series-Connected SiC MOSFETs in Buck Converter Based on Active Driving Signal Delay Control for Voltage Balancing
Min Zhao, Hua Lin, Tao Wang
Huazhong University of Science and Technology
D05.2 An Adaptive Driving Signals Delay Control for Voltage Balancing of Multiple Series-Connected SiC MOSFETs
Min Zhao, Tao Wang, Hua Lin
Huazhong University of Science and Technology

D05.3 Comparative Study of Three Different Clamping Circuits for Series-Connected IGBTs
Xiangyu Yang, Tao Wang, Xingwei Wang, Hua Lin
Huazhong University of Science and Technology

D05.4 Silicon Application Extension Versus WBG Due to Partial Power Processing
Jon Anzola¹, Shrivatsal Sharma², Iosu Aizpuru¹, Subhashish Bhattacharya²
¹Mondragon Unibertsitatea, ²North Carolina State University

D05.5 GaN HEMT Power Losses Modeling and Evaluation in Resonant LLC Converters
Domenico Nardo¹, Alfio Scuto¹, Simone Buonomo¹, Santi Agatino Rizzo², Massimiliano Chiantello¹
¹STMicroelectronics, ²UniCT

D05.6 Experimental Validation of a Chip Area Optimized 3.3 kV SiC Half Bridge for HVDC Converters
Lukas Bergmann¹, Marcus Wahle², Mark-M. Bakran¹
¹University of Bayreuth, ²Siemens Energy

D05.8 Sensitivities in High-Bandwidth, High-Current Shunt Measurements for Silicon-Carbide Multi-Chip Power Modules
Christopher New, Andrew Lemmon, Brian DeBoi
The University of Alabama

D05.9 An Improved Turn-on Switching Transient Model of 10-kV SiC MOSFET
Ruirui Chen¹, Min Lin¹, Leon Tolbert², Fred Wang³, Xingxuan Huang⁴
¹University of Tennessee, ²University of Tennessee & NASA Glenn Research Center, ³University of Tennessee & ORNL, ⁴University of Tennessee Knoxville

D06.1 Pol Tile As a Small Package for a Power Module
Kei Murayama, Amane Kaneko, Mitsuhiro Aizawa, Kiyoshi Oi, Shingo Hayashibe
Shinko Electric Industries Co. Ltd.

D06.2 Design Trade-Offs and Considerations on Improving the PCB Current Carrying Capacity in High Power Density Applications
Veysel Tutku Buyukdegerimenci, Omer Faruk Kozarva
Elektra Elektronik San. Tic. A.S.

D06.3 Investigation and Reduction of Common Mode Current in Center-Tapped Transformer of LLC Resonant Converters
Binghui He, Yan-Fei Liu, Yang Chen, Bo Sheng, Paresh C. Sen, Wenbo Liu
Queen’s University

D06.4 A Comprehensive Approach Towards Multi-Objective EMI Filter Design Optimization in High Frequency SiC-Based Motor Drives
Likhita Ravuri
FREEDM Systems Center NC State University
Srdjan Lukic
North Carolina State University

D06.5 An Off-Line Estimation Method of DC-Link LC Parameters
Bo Yao, Haoran Wang, Huai Wang
Aalborg University

D06.6 Unsupervised Anomaly Detection for Electric Drives Based on Variational Auto-Encoder
Jaehoon Shim, Jung-Ik Ha
Seoul National University

D06.7 Adaptive Outlier Detection for Power MOSFETs Based on Gaussian Process Regression
Kyohei Shimozato¹, Michihiro Shintani², Takashi Sato¹
¹Kyoto University, ²Nara Institute of Science and Technology

D06.8 A Practical Application of Commercial 3.3KV, 750A SiC Modules
Eric Motto¹, Jeff Reichard²
¹Mitsubishi Electric US Inc., ²Abstract Power Electronics

D06.9 Packaging and Characterization of a Novel 7.2kV85A SiC Austin SuperMOS Half-Bridge Intelligent Power Module (IPM)
Junhong Tong
University of Texas at Austin
D06.10  Digital Twin Approach for Degradation Parameters Identification of a Single-Phase DC-AC Inverter
Qunfang Wu, Wanquan Wang, Hang Shi, Qin Wang, Lan Xiao
Nanjing University of Aeronautics and Astronautics

11:30 AM – 1:30 PM
D07: Modeling & Simulation of Power Electronics
POSTER AREA

Modeling & Simulation of Power Electronics
SESSION CHAIRS
Matt Wilkowski, EnaChip
Shajjad Chowdhury

D07.1  Modeling Substrate Voltage Effects on GaN I-V Characteristics with ASM-HEMT Model
Sourabh Khandelwal1, Gordon Stecklein2, Tom Herman2
1Macquarie University, 2EPC

D07.2  Simple, Low Cost, Method for Measuring Single Phase Line Impedance
Mark Didat1, Seungdeog Choi2
1GE Appliances, 2Mississippi State University

D07.3  A Novel Auxiliary Power Supply Based on Self-Excited Buck converter for High Power Density Switching Power Supply
Sincere Valley
Southeast University

D07.4  An Open-Source Transistor Database and Toolbox As a Unified Software Engineering Tool for Managing and Evaluating Power Transistors
Nikolas Förster, Frank Schafmeister, Joachim Böcker, Philipp Rehländer, Oliver Wallscheid
Paderborn University

D07.5  LLC Converters with GaN: Commutation Loop Capacitance
Jan Hammer, Martin Ordonez, Mohammad Ali Saket
University of British Columbia

D07.6  Impacts of Switching Parameters on Thermal and Mechanical Characteristics in IGBT Modules
Jiahao Wang, Cong Chen, Libing Bai, Jie Zhang, Quan Zhou, Lulu Tian, Yuhua Cheng
University of Electronic Science and Technology of China

D07.7  Accurate MOSFET Modeling Approach with Equivalent Series Resistance of Output Capacitance for Simulating Turn-Off Oscillation
Ryo Shirai, Keiji Wada
Tokyo Metropolitan University

D07.11  RC Assisted close-Loop Active Gate Control (AGC) for Solid-State DC Circuit Breaker (DCCB)
Satara Bapai, Jehyuk Won, Brian Rowden, Madhu Sudhan Chinthavali
Oak Ridge National Laboratory

D08: Control 1
POSTER AREA

Control 1
SESSION CHAIRS
Jaber Abu Qahouq,
The University of Alabama
Xiaonian Lu,
Temple University

D08.1  Power Cycle Modulation Control of LLC Resonant Converters for Wide Voltage Gain Range Applications
Yang Chen, Yan-Fei Liu, Paresh C. Sen, Bo Sheng, Wenbo Liu, Binghui He
Queen’s University

D08.3  Impacts of Discretization of the Capacitor-Current-Feedback Path Phase Lead Compensator on Digitally Controlled LCL-Type Grid-Connected Inverter Stability and Robustness
Yuanzhe Ren, Xingwei Wang, Hua Lin, Shaojie Li
Huazhong University of Science and Technology

D08.4  Start-Up Method for Hybrid Switched Capacitor Converter
Roberto Rizzolatti1, Stefano Saggini2, Christian Rainer1, Mario Ursino1, Venugopal Reddy Chintala Cheruvu4
1Infineon Technologies Austria AG, 2Università di Udine, DIPA, 3Infineon Technology AT, 4Infineon Technologies Americas Corp.

D08.5  A Single-Sensor-Based Circulating Current Controller for a Modified Three-Level Modular Multilevel Converter
Paolo Mattavelli1, Iginio Toigo2, Michele Corradin2, Tarek Younis1
1University of Padova, 2Socomec

D08.6  Reliability of DC-Link Capacitors in Three-Level NPC Inverters Under Different PWM Methods
Ariya Sangwongwanich1, Frede Blaabjerg2, Mateja Novak1, Sornboon Sangwongwanich2
1Aalborg University, 2Chulalongkorn University

D08.7  HSS Modeling and Stability Analysis of Single-Phase PFC Converters
Guoqing Gao, Xiongfei Wang, Tianhua Zhu, Yicheng Liao
Aalborg University
11:30 AM – 1:30 PM
**D09: Control 2**

**POSTER AREA**

**Control 2**

**SESSION CHAIR**

*Emanuel Serban, UBC – EnerSys*

**D09.1** I-F Starting Smooth and Rapid Transition Method of Full-Speed Sensorless Control for Low Current Harmonic Ultra-high-Speed PMSM
Yao Xu, Jilei Xing, Qingtan Zeng, Cheng Lin
Beijing Institute of Technology

**D09.2** PID Controller Tuning of Voltage Mode Controlled Buck Converter for Fast Recovery Up to Slew Limit
Santanu Kapat
Indian Institute of Technology (IIT) Kharagpur

**D09.3** Novel Power Decoupling Methods for Three-Port Triple-Active-Bridge Converters
Hui Cao¹, Fei Diao¹, Guangqi Zhu², Yue Zhao¹
¹University of Arkansas, ²Eaton

**D09.4** Gate Drive Circuit Having In-Situ Condition Monitoring System for Detecting Gate Oxide Degradation of SiC MOSFETs
Shin-Ichiro Hayashi, Keiji Wada
Tokyo Metropolitan University

**D09.5** High-Frequency Digital Current Mode Control Architectures for Class-D Audio Amplifiers
Prateek Singh, K Hariharan, Santanu Kapat
Indian Institute of Technology (IIT) Kharagpur

**D09.6** Push-Pull Current-Fed DC-DC Converter Start-Up Operation
Alexey Bodrov, James Green, Pavankumar Puligundla, Mathews Tomy, Sarath Mohan
CRRC TIEC UK

**D09.7** Decentralized Interleaving of Cascaded H-Bridge Multi-Level Converters
Oscar Andres Montes¹, Wensong Yu¹, Iqbal Husain¹, M A Awal², Srdjan Lukic¹
¹North Carolina State University, ²Danfoss

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11:30 AM – 1:30 PM
**D10: Wireless Power Transfer Systems**

**POSTER AREA**

**Wireless Power Transfer Systems**

**SESSION CHAIRS**

*Joseph Song-Manguelle, Oak Ridge National Laboratory*

**D10.1** Non-Isolated Buck-Boost Hybrid Converter with AC to AC or DC Power Conversion for Simultaneous Wired and Wireless Power Transfer
Yuchen He¹, Jiayang Wu², Ron Shu Yuen Hui³, Siwei-Chong Tan², Albert Ting Leung Lee²
¹Florida State University, ²The University of Hong Kong, ³Nanyang Technological University

**D10.2** A Novel Power Combining Strategy for Rectenna Array of Microwave Power Transmission System
Zehao Zhai, Ke Jin, Weiyang Zhou, Xue Wang
Nanjing University of Aeronautics and Astronautics

**D10.3** Simultaneous Wireless Power and Data Transmission for Laser Power Transfer System Based on Frequency-Shift Keying Modulation Method
Han Zhang, Weiyang Zhou, Ke Jin
Nanjing University of Aeronautics and Astronautics

**D10.4** Design of Multi-Receiver IPT System for Electric Vehicles Considering Transfer Efficiency and Different Power Requirements
Zhi Feng, Baokun Zhang, Lantian Li, Zhenpo Wang, Deng Junjun
Beijing Institute of Technology

**D10.5** Modeling and Analysis of a Polyphase Wireless Power Transfer System for EV Charging
Rong Zeng¹, Gui-Jia Su¹, Mostak Mohammad¹, Veda Prakash Galigekere², Erdem Asa³, Omer Oner¹
¹Oak Ridge National Laboratory, ²UT Battelle ORNL

**D10.6** Frequency Domain Analysis of a Wireless Power Transfer System Operating in a Wide Load and Coupling Range Using Frequency Modulation of Inverter for Voltage Regulation
Abirami Kalathy, Arpan Laha, Praveen Jain
Queen's University
THURSDAY, MARCH 24
EDUCATIONAL PROGRAM | TECHNICAL DIALOGUE SESSIONS

11:30 AM – 1:30 PM
D11: Renewable Energy Systems

POSTER AREA

Renewable Energy Systems

SESSION CHAIRS
Rajeev Kumar Singh, Indian Institute of Technology (BHU)
Luocheng Wang, University of North Carolina at Charlotte

D11.1 Battery Equalizer for SERIES-Connected Batteries Based on HALF-Bridge LLC Topology
Xinyu Sun, Chunjian Cai, Jianglin Nie, Zeliang Shu, Yuhao Deng
Southwest Jiaotong University

D11.2 Flexible Provision of Ancillary Services by Grid-Tied Inverters
Anastasis Charalambous, Lenos Hadjidemetriou, Marios Polycarpou
KIOS Research and Innovation Center of Excellence and Department of ECE

D11.3 Ancillary Services Provision with Junction Temperature Control to Ensure Reliability of Photovoltaic Inverters
Anastasis Charalambous, Marios Polycarpou, Lenos Hadjidemetriou
KIOS Research and Innovation Center of Excellence and Department of ECE

D11.4 A Reactive Power Distribution Method for the Reactive Power Control of Cascaded Photovoltaic Converter Under Active Power Imbalance Condition
Gongheng Li, Chu Wang, Yufei Jie, Min Chen
Zhengzhou University

D11.5 Data-Driven cyber-Attack Detection for Photovoltaic systems: a Transfer Learning Approach
Qi Li, Jin Ye, Wenzhan Song
University of Georgia

D11.6 A Droop Control Algorithm with Frequency Partitioning Capability and SoC Balancing for Different Energy Storage Systems
Nilofar Ghanbari, Subhashish Bhattacharya
North Carolina State University

D11.7 Model-Based cyber-Attack Detection for ANPC PV Converter Using Kalman Filter
Jinjin Liu, Jinxing Li, Zihao Wang
University of North Carolina at Charlotte

D11.8 Power Processing Reduction in Energy Storage Systems by Using a Fractional Power Converter with Bipolar Output Voltage
Yiqiang Huang, Hong Guo, Zhenyu Shan
Beihang University

D11.9 Negative Virtual Inductance Based Active Damping and Direct Power Control of a Soft Switching Solid State Transformer for PV Application
Vikram Roy Chowdhury
Georgia Institute of Technology

D11.10 Farm-Level Interactions Study of a Novel Tri-Port Soft-Switching Medium-Voltage String Inverter (MVSI) Based Large-Scale PV-Plus-Storage Farms
Vikram Roy Chowdhury
Georgia Institute of Technology

D11.11 Resilient Operation of Hybrid AC/DC Microgrid with Interlinking Converter Based on Modular Multilevel Converter with Integrated BESS
Jean Marco Lobo Da Fonseca, Kaushik Rajashekar, Ravi Prakash Reddy Siddavatam
University of Houston

D11.12 DQ Impedance-Based Analysis of an APF-Type Active Damper to Stabilize the Grid-Tied Inverter System
Yiming Tu, Jinjun Liu, Wei Chen
Xi’an Jiaotong University

D11.13 100kW Three-Level Bidirectional DC-DC Converter for 1500V Grid Forming Photovoltaic Synchronous Generator (PVSG) Power Plants
Zibo Chen, Ruiyang Yu, Alex Huang, Wei Xu, Houshang Salimian Rizi
University of Texas at Austin

11:30 AM – 1:30 PM
D12: Transportation Power Conversion 3

POSTER AREA

Transportation Power Conversion 3

SESSION CHAIRS
Rasoul Hosseini, General Motors
Woongkuk Lee, Michigan State University

D12.1 A non-Cascading step-up/Down DC-DC Converter with non-Pulsating Input Current for Lithium-Ion batteries: Analysis and Design
Jesus Leyva-Ramos1, Juan Antonio Villanueva-Loredo1, Ma Guadalupe Ortiz-Lopez2, Luis Humberto Diaz-Saldier1
1IPICYT, 2UPSLP

D12.2 Variables Decoupling and Multi-Objective Optimization for High-Power Bidirectional Interleaved Converters in Electric Vehicles
Xiaoyong Ma, Ping Wang, Yifeng Wang, Danfeng Zhao, Pengyu Cheng, Long Tao

D12.4 Isolated Three-Port Bidirectional DC-DC Converter for Electric Vehicle Applications
Misha Kumar1, Juan Ruiz1, Peter Barbosa2, Sun Hao3, Jia Minli3
1Delta Electronics (Americas) Ltd., 2Delta Electronics, 3Delta Electronics (Shanghai) Co. Ltd.
D12.5 Three-Loop Multi-Variable Control of Triple Active Bridge Converter with Power Flow Optimization
Ashwin Chandwani, Ayan Mallik
Arizona State University

D12.6 Performance Comparison and Modelling of Instantaneous Current Sharing Amongst GaN-HEMT Switch Configurations for Current Source Inverters (CSI)
Mustafeez Ul Hassan1, Fang Luo1, Asif Imran Emon1, Zhao Yuan2, Hongwu Peng2
1Stony Brook University, 2University of Arkansas, 3University of Connecticut

D12.7 Isolated 4-Level DC-DC Converter with Enhanced Soft-Switching Adaptability and Output Voltage Flexibility for High-Power Fast Charger Applications
Dakai Wang, Wensong Yu
NC State University

11:30 AM – 1:30 PM
D13: Power Applications
POSTER AREA

Power Applications

SESSION CHAIRS
Khosred Alam,
General Motors
Jeff Niles,
Alpha & Omega Semiconductor

D13.1 A Non-Isolated Dual-Output High-Step-Down Converter
Yeu-Torng Yau
National Chin-Yi University of Technology

D13.2 Temperature Dependent Characterization-Based Design Optimization of a DC-DC Converter for High-Temperature Space Applications
Sakat Dey1, Neil Goldsman2, Zeynep Dilli2, Ayan Mallik1
1Arizona State University, 2CoolCAD Electronics LLC

D13.4 DC Fault Detection of Naval Shipboard Pulsed Power Loads Using Logistic Regression
Lalithsai Posam, Yue Ma, Keith Corzine
University of California Santa Cruz

11:30 AM – 1:30 PM
D14: DC-DC Converters 1
POSTER AREA

DC-DC Converters 1

SESSION CHAIR
Cahit Gezgin, Infineon

D14.1 Hybrid Switched-Capacitor LLC Converter with Ultra Wide Input Voltage Range and High Efficiency
Rudy Rice, Peng Fang
University of Minnesota Duluth

D14.2 Exact-Order Discrete-Time Modeling of a Dab Derived Hybrid Switched-Capacitor Converter
Somnath Khattua, Debaprasad Kastha, Santanu Kapat
Indian Institute of Technology (IIT) Kharagpur

D14.3 A Bidirectional DC-DC Converter with Wide-Range Input Voltage for the Electrical Vehicle Application
Reza Rezaii, Fahad Alaqil, Issa Batarseh
University of Central Florida

D14.4 Multiphase 3-Level Buck Passives Analysis Including 2-Phase Coupled Inductors
Youssef Kandeel, Maeve Duffy
National University of Ireland Galway

D14.5 Charge Sharing LAU Switched-Capacitor Converter with Reducing Power Loss
Jaesoon Choi1, Seokmun Choi1, Inkuk Baek1, Kin Keung Lau2
1Silicon Mitus, 2Empower Semiconductor

D14.6 Deep-Learning-Based Steady-State Modeling and Model Predictive Control for CLLC DC-DC Resonant Converter in DC Distribution System
Feng Wang, Fang Zhuo, Kefan Yu
Xian Jiaotong University

D14.7 Fast Transient State Feedback Digital Current Mode Control Design in Series Capacitor Buck Converters
Prantik Majumder, Debaprasad Kastha, Santanu Kapat
Indian Institute of Technology (IIT) Kharagpur

D14.8 Modular Single-Stage Photovoltaic Step-Up Converter with Integrated Power Balancing Featuring High-Frequency Inter-Connecting Soft-Switched Active Voltage Quadruplers
Kajanan Kanathipan, John Lam
York University

D14.9 A Novel Five-Level Hybrid Dual Active Bridge Converter with Optimized Switching Scheme
Gautam Ratnapuri, Satish Belkhode, Anshuman Shukla
IIT Bombay
THURSDAY, MARCH 24
EDUCATIONAL PROGRAM | TECHNICAL DIALOGUE SESSIONS

11:30 AM – 1:30 PM
D15: DC-DC Converters 2
POSTER AREA
DC-DC Converters 2

SESSION CHAIRS
Olivier Trescases, University of Toronto

D15.2 High-Frequency LLC Converter with Narrow Frequency Variations for Aircraft Applications
Aurora de Juan¹, Diego Serrano², Miroslav Vasic³, Pedro Alou², Jean-Nöel Mamousse³, Romain Deniéport³
¹Centro de Electrónica Industrial (CEI), ²Universidad Politécnica de Madrid, ³Gaia Converter

D15.3 Analytical Modelling of single-Phase and three-Phase DC/DC LLC Converters
Aurora de Juan¹, Romain Deniéport², Jean-Nöel Mamousse², Pedro Alou³, Miroslav Vasic³, Diego Serrano³
¹Centro de Electrónica Industrial (CEI), ²Gaia Converter, ³Universidad Politecnica de Madrid

D15.4 A Series-Stacked Modular DC-DC Converter Configuration for Data Center Power Applications
Mohamed Badawy, Ali El Rayyah
San Jose State University

D15.5 High Efficiency Dual-Output LLC Resonant Converter with Synchronous Rectifier Control
Keon-Woo Kim¹, Yeonho Jeong², Moon-Young Kim¹, Jeong-II Kang³
¹Samsung Electronics, ²University of Rhode Island

D15.6 Analysis and Design of a 2 MHz GaN-Based Active-Clamped Isolated Sepic Converter for Low-Power Automotive Subnets
Stefano Cabizza, Luca Corradini, Giorgio Spiazzi
University of Padova

D15.7 Oscillation Analyses for Voltage Regulators in Telecom Power System Based on Harmonic State Space Model
Xiaolong Yue, Mikael Högrud, Conny Engelund
Ericsson AB

D15.8 Design and Magnetic Optimization of a Dual Active Bridge for Energy Storage Application
Amin Khakparvarayazdi, Morteza Mahdavifard, Neda Mazloum, S. Ali Khajehoddin
University of Alberta

D15.9 A Monolithic 200V GaN Half Bridge IC with Integrated Gate Drivers and Level-Shifters Achieving 98.3% Peak Efficiency
Mike Wens¹, Deniz Aygün¹, Marc Fossion², Stefaan Decoutere², Andrew Barnes³, Christophe Delepaut³, Jef Thoné³
¹MinDCet NV, ²Thales Alenia Space Belgium, ³Imec, ⁴European Space Agency, ⁵MinDCet NV

D15.10 A Novel Three Phase LCL Dual Active Bridge Converter to Reduce RMS Phase Current
Hui Chen, Xianzao Li, Sixing Du, Jinjun Liu, Shaodi Ouyang
Xi’an Jiaotong University
72 ROUNDS OF 10 CHAIRS = 720 CHAIRS

TOTAL POSTER BOARD SIDES = 140
LEVEL 300

Industry Sessions
320 A | 320 B | 320 C
360 ABC | 360 DEF

Technical Sessions
350 DEF | 351 ABC
351 DEF | 352 DEF
361 ABC | 361 DEF

RAP Sessions (Tuesday)
310 | 320 ABC | 350 DEF

Professional Education Seminars
332 ABC | 350 DEF | 351 ABC
351 DEF | 352 DEF | 361 ABC

Sponsor Rooms
332 B | 332 C
332 D | 332 E
342 | 352 DEF

Plenary & Dialogue Sessions

Speaker Breakfast

Speaker Ready Room
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as of February 21, 2022
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MARCH 19-23, 2023

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2023

Orlando,
FLORIDA