The Premier Global Event in Power Electronics

APEC®

2023

MARCH 19-23, 2023

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PSMA

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APEC MOBILE APP

Download the APEC 2023 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 **'APEC 2023'**.

WI-FI

apec@apec-conf.org

Network Name: APEC2023

Password: Orlando2023 *(case sensitive)*

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APEC: Applied Power Electronics Conference

APEC: Applied Power Electronics Conference

PROGRAM KEY

EDUCATIONAL PROGRAM

PROFESSIONAL EDUCATION SEMINARS

Professional Education Seminars focus on practical aspects of the power electronics profession and provide in-depth discussion of important and complex power electronics topics. Seminars combine practical application with theory and are designed to further educate the working professional in power electronics. A Full Conference or Professional Education Seminar Only Registration is required to attend.

PLENARY SESSION

The APEC Plenary Session continues the long-standing tradition of addressing issues of immediate and long-term interest to the practicing power electronics engineer. Taking place on Monday, March 20, the Plenary Session will provide expert insights and feature an interactive Q&A period.

TECHNICAL SESSIONS

The Technical Program features lecture and dialogue presentations from accepted authors of peer-reviewed papers that cover all areas of technical interest for the practicing power electronics professional. 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.

INDUSTRY SESSIONS

The Industry Session track runs parallel with the Technical Session 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 a technical conference. While many of these sessions are technical in nature, some will cover business-oriented topics, which hold interest not only for those in technical roles but for professionals who support the power electronics industry. Presentations will be available through the APEC mobile app and through the digital download located on the APEC website..

EXHIBITOR SEMINARS

APEC 2023 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 RAP Sessions feature several exciting and contentious topics. RAP Sessions allow for lively dialogue among attendees and presenters.

FOREWORD

Greetings APEC Attendees!

I am delighted to welcome you to the IEEE Applied Power Electronics Conference and Exposition (APEC 2023) in Orlando, Florida. This is the 38th annual installment of the ***Premier Global Event in Applied Power Electronics***. It is an exciting time for people to gather from all over the world to connect, explore, and present the latest in the field of power electronics.

After a few challenging years, we are thrilled to be back completely in person. The benefits of face-to-face interactions are hard to overstate. The expo hall and conference program are packed full of sessions and activities to foster meaningful connections on the challenges and opportunities we face. For the first time, APEC is hosting a student job fair to help bridge the gap between companies aiming to hire the best talent and students looking for a place to launch their career.

APEC would not be possible without the sustained efforts of hundreds of volunteers who serve on the organizing committee, as track or session chairs, as reviewers, or as presenters. Please join me in extending heartfelt gratitude for everything they do. I would like to express appreciation for the three sponsoring organizations – the Power Sources Manufacturers Association (PSMA), the IEEE Power Electronics Society (PELS), and the IEEE Industry Applications Society (IAS) – for their support. I also want to thank our professional conference management partner, Smithbucklin, for turning our dreams into reality and making APEC the flagship event in the power electronics business.

Lastly, thank you for attending APEC. Whether this is your first time or your 38th time, I truly hope your experience this week is memorable and impactful.

Pradeep Shenoy, Ph.D
General Chair
2023 IEEE Applied Power Electronics Conference and Exposition

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NOTES

CONFERENCE-AT-A-GLANCE

	Saturday March 18	Sunday March 19	Monday March 20	Tuesday March 21	Wednesday March 22	Thursday March 23
Plenary Session			✓			
RAP Session				✓		
Technical Lecture*				✓	✓	✓
Technical Dialogue*						✓
Industry Session*				✓	✓	✓
Professional Education Seminar*		✓	✓			
Exhibitor Seminars				✓	✓	
Expo Hall Open			✓	✓	✓	
Sponsor Meetings	✓	✓	✓	✓	✓	✓

**Paid Registration Required*

SCHEDULE-AT-A-GLANCE

SATURDAY, MARCH 18

4:00 p.m. – 7:00 p.m.	**Registration is Open**	West A Lobby

SUNDAY, MARCH 19

8:00 a.m. – 5:00 p.m.	**Registration is Open**	West A Lobby
8:00 a.m. – 5:00 p.m.	**Speaker Ready Room Hours**	W107
8:00 a.m. – 9:00 a.m.	**Professional Education Seminar** **Speaker Breakfast** (speakers only)	W110
9:30 a.m. – 1:00 p.m.	**Professional Education Seminars** (concurrent sessions)	Various – see page 22 for specific locations
1:00 p.m. – 2:30 p.m.	**Lunch on Own**	
2:30 p.m. – 6:00 p.m.	**Professional Education Seminars** (concurrent sessions)	Various – see page 24 for specific locations

MONDAY, MARCH 20

7:00 a.m. – 1:30 p.m.	**Speaker Ready Room Hours**	W107
7:00 a.m. – 7:00 p.m.	**Registration is Open**	West A Lobby
7:00 a.m. – 8:00 a.m.	**Professional Education Seminar** **Speaker Breakfast** (speakers only)	W110
8:30 a.m. – 12:00 p.m.	**Professional Education Seminars** (concurrent sessions)	Various – see page 27 for specific locations
12:00 p.m. – 1:15 p.m.	**Lunch on Own**	
1:15 p.m. – 5:00 p.m.	**Plenary Session**	West Hall A3
5:00 p.m. – 8:00 p.m.	**Welcome Reception** (Brought to you by Rohm Semiconductor, Bar Partner)	Expo Hall (West Hall A1 & A2)
7:30 p.m. – 9:30 p.m.	**Micromouse Contest**	Expo Hall (West Hall A1 & A2)
7:30 p.m. – 9:30 p.m.	**FIRST Robotics**	Expo Hall (West Hall A1 & A2)

SCHEDULE-AT-A-GLANCE

TUESDAY, MARCH 21

7:00 a.m. – 8:00 a.m.	**Technical Session & Industry Session Speaker Breakfast** (speakers only)	W110
7:00 a.m. – 5:00 p.m.	**Speaker Ready Room Hours**	W107
8:00 a.m. – 10:00 a.m.	**Spouse/Guest Breakfast**	Salon 22 at Rosen Centre
8:00 a.m. – 3:00 p.m.	**Registration is Open**	West A Lobby
8:30 a.m. – 10:10 a.m.	**Technical Sessions** (concurrent sessions)	Various – see page 36 for specific locations
8:30 a.m. – 10:10 a.m.	**Industry Sessions** (concurrent sessions)	Various – see page 33 for specific locations
9:00 a.m. – 4:30 p.m.	**Expo Hall is Open**	Expo Hall (West Hall A1 & A2)
10:10 a.m. – 10:40 a.m.	**Break** (Brought to you by iNRCORE, Diamond Partner)	Expo Hall (West Hall A1 & A2)
10:40 a.m. – 11:55 a.m.	**Industry Sessions** (concurrent sessions)	Various – see page 33 for specific locations
10:40 a.m. – 12:00 p.m.	**Technical Sessions** (concurrent sessions)	Various – see page 36 for specific locations
12:00 p.m. – 1:30 p.m.	**Lunch** (Brought to you by ST Microelectronics, Platinum Partner)	Expo Hall (West Hall A1 & A2)
1:30 p.m. – 5:00 p.m.	**Student Job Fair** (Partnered by Wolfspeed)	West Hall A3
1:30 p.m. – 2:00 p.m.	**Exhibitor Seminars #1** (concurrent sessions)	Various – see page 44
2:15 p.m. – 2:45 p.m.	**Exhibitor Seminars #2** (concurrent sessions)	Various – see page 45
2:45 p.m. – 3:00 p.m.	**Break** (Brought to you by Mentech, Diamond Partner)	
3:00 p.m. – 3:30 p.m.	**Exhibitor Seminars #3** (concurrent sessions)	Various – see page 47
3:45 p.m. – 4:15 p.m.	**Exhibitor Seminars #4** (concurrent sessions)	Various – see page 49
4:30 p.m. – 6:00 p.m.	**RAP Sessions** (concurrent sessions)	Various – see page 43 for specific locations
7:00 p.m. – 9:00 p.m.	**IAS/PELS/PSMA Young Professionals Reception**	Taverna Opa

SCHEDULE-AT-A-GLANCE

WEDNESDAY, MARCH 22

7:00 a.m. – 8:00 a.m.	**Technical Session & Industry Session Speaker Breakfast** (speakers only)	W110
7:00 a.m. – 5:30 p.m.	**Speaker Ready Room Hours**	W107
8:00 a.m. – 9:00 a.m.	**WIE, YP, and You: How To Become Involved with IEEE PELS and PSMA, Too!**	Salon 21 (Rosen Centre)
8:00 a.m. – 2:00 p.m.	**Registration is Open**	West A Lobby
8:30 a.m. – 10:10 a.m.	**Technical Sessions** (concurrent sessions)	Various – see page 57 for specific locations
8:30 a.m. – 10:10 a.m.	**Industry Sessions** (concurrent sessions)	Various – see page 51 for specific locations
9:00 a.m. – 2:00 p.m.	**Expo Hall is Open**	Expo Hall (West Hall A1 & A2)
10:10 a.m. – 10:40 a.m.	**Break** (Brought to you by Mouser, Platinum Partner)	Expo Hall (West Hall A1 & A2)
10:40 a.m. – 11:55 a.m.	**Industry Sessions** (concurrent sessions)	Various – see page 51 for specific locations
10:40 a.m. – 12:00 p.m.	**Technical Sessions** (concurrent sessions)	Various – see page 57 for specific locations
11:45 a.m. – 1:30 p.m.	**Lunch** (Brought to you by Power Integrations, Platinum Partner)	Expo Hall (West Hall A1 & A2)
12:00 p.m. – 12:30 p.m.	**Exhibitor Seminars #5** (concurrent sessions)	Various – see page 72
12:45 p.m. – 1:15 p.m.	**Exhibitor Seminars #6** (concurrent sessions)	Various – see page 73
1:30 p.m. – 3:10 p.m.	**Industry Sessions** (concurrent sessions)	Various – see page 54 for specific locations
1:30 p.m. – 3:10 p.m.	**Technical Sessions** (concurrent sessions)	Various – see page 63 for specific locations
3:10 p.m. – 3:30 p.m.	**Break**	
3:30 p.m. – 4:45 p.m.	**Industry Sessions** (concurrent sessions)	Various – see page 54 for specific locations
3:30 p.m. – 4:50 p.m.	**Technical Sessions** (concurrent sessions)	Various – see page 63 for specific locations
5:00 p.m. – 9:00 p.m.	**Shuttles to/from Disney Hollywood Studios**	Orange County Convention Center – West Concourse
7:00 p.m. – 9:00 p.m.	**Social Event: Hospitality Area at Indiana Jones Epic Stunt Theater**	Disney Hollywood Studios

SCHEDULE-AT-A-GLANCE

THURSDAY, MARCH 23

7:00 a.m. – 8:00 a.m.	**Dialogue, Technical Session & Industry Session Speaker Breakfast** (speakers only)	W110
7:00 a.m. – 2:00 p.m.	**Speaker Ready Room Hours**	W107
8:00 a.m. – 12:00 p.m.	**Registration is Open**	West A Lobby
8:30 a.m. – 10:10 a.m.	**Technical Sessions** (concurrent sessions)	Various – see page 81 for specific locations
8:30 a.m. – 10:10 a.m.	**Industry Sessions** (concurrent sessions)	Various – see page 76 for specific locations
10:10 a.m. – 10:40 a.m.	**Break**	
10:40 a.m. – 11:20 a.m.	**Technical Sessions** (concurrent sessions)	Various – see page 81 for specific locations
10:40 a.m. – 11:20 a.m.	**Industry Sessions** (concurrent sessions)	Various – see page 76 for specific locations
11:15 a.m. – 1:45 p.m.	**Lunch**	West Hall A3
11:30 a.m. – 1:30 p.m.	**Dialogue Sessions**	West Hall A3
1:45 p.m. – 3:25 p.m.	**Technical Sessions** (concurrent sessions)	Various – see page 86 for specific locations
1:45 p.m. – 3:25 p.m.	**Industry Sessions** (concurrent sessions)	Various – see page 78 for specific locations

GENERAL INFORMATION

CONFERENCE REGISTRATION

All attendees must be registered for the conference. To register or pick up conference materials, visit APEC Registration in the West A Lobby.

	Full Registration	Technical Session Only Registration	Professional Education Seminars Only Registration	Exhibits Only Registration	Guest Registration
Plenary Session	✓	✓	✓	✓	
RAP Session	✓	✓	✓	✓	
Technical Lecture*	✓	✓			
Technical Dialogue*	✓	✓			
Industry Session*	✓	✓			
Professional Education Seminar*	✓		✓		
Exhibitor Seminars	✓	✓	✓	✓	✓
Expo Hall	✓	✓	✓	✓	✓
Wednesday Night Social	✓	✓			

**Paid Registration Required*

Registration Hours

Saturday, March 18 . . . . . 4:00 p.m. – 7:00 p.m.
Sunday, March 19 . . . . . 8:00 a.m. – 5:00 p.m.
Monday, March 20 . . . . . 7:00 a.m. – 7:00 p.m.
Tuesday, March 21 . . . . . 8:00 a.m. – 3:00 p.m.
Wednesday, March 22 . . . . . 8:00 a.m. – 2:00 p.m.
Thursday, March 23 . . . . . 8:00 a.m. – 12:00 p.m.

APEC EXPO HALL

The Expo Hall will open on Monday, March 20 when the Plenary Session concludes.

Expo Hall Hours

Monday, March 20 . . . . . 5:00 p.m. – 8:00 p.m.
Tuesday, March 21 . . . . . 9:00 a.m. – 4:30 p.m.
Wednesday, March 22 . . . . . 9:00 a.m. – 2:00 p.m.

Expo Hall Admission

Entry is granted to persons 18 or older with any APEC badge, including the Expo Hall badge which also grants admission to the exhibitor seminars, plenary session, and RAP sessions. Registration for The Expo Hall only badge is $50 after March 3, 2023.

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. – 1:30 p.m.
Wednesday Lunch . . . . . 11:45 a.m. – 1:30 p.m.
Thursday Lunch + Dialogue Sessions in the West Hall A3. . . . . 11:15 a.m. – 1:45 p.m.

Expo Hall Raffle

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 542). This will be good for all three days of raffles during the exposition. Winners will be announced in the APEC mobile app.

Accessibility

The Orange County Convention Center and APEC strive to provide an accessible event for all. The convention center is designed with wheelchair ramps, automatic doors, passenger elevators and handicap-accessible restroom facilities. All passenger elevators are clearly marked. Please visit the registration desk for additional accessibility questions and information.

NEW THIS YEAR!

PSMA PASSPORT TO PRIZES is on the Mobile App!

Bon voyage! Visit participating PSMA member company booths, scan the QR code, answer the question and see your name rise to the top! You will find QR Codes to scan dotted around the exhibit hall. Participants who visit PSMA booths by Wednesday, March 22 at 12:45 p.m. will automatically be entered into the prize drawing.

Winners will be randomly selected from all eligible participants, Wednesday, March 22 at 1:00 p.m. Winners will be announced via the APEC mobile app and must claim their prize by 1:30 p.m. on Wednesday or a runner up will be selected. Prize pick up is at the PSMA Booth in the APEC Hub, #542. Exhibitors are not eligible to participate.

Play to win one of the following prizes: 1) Holy Stone GPS Drone 2) Bose Quiet Comfort Earbuds II; 3) Samsung Galaxy Tab S6 Lite 10.4" 64GB Tablet with Pen; 4) Bose Bluetooth Speaker.

MATERIALS PURCHASE

Purchasing through the IEEE

Post conference APEC Proceedings may be purchased through the IEEE.

IEEE Single Copy Sales

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IMPORTANT RULES, NOTICES, AND CONFERENCE POLICIES

Badges Required for Admission

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

Recording and Photography

Attendee Recording/Photography: Video and audio recording may be conducted in the Expo Hall area, and public areas of APEC, but nowhere else except with written permission from the Conference Chair. Still photography at APEC is permitted, but with limitations. The general principle is that people may be photographed but photographing presentations and other content is prohibited by all attendees except for the professional APEC photographer. For more details, please see Show Management.

APEC Photography for Marketing Purposes: By registering for APEC 2023, you agree that any photos taken of you while at the conference by our professional photographer may be used by APEC in the future.

Showcasing/Suitcasing Policy

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.

GENERAL INFORMATION

Recruitment Policy

IEEE Policy #10.1.25 requires a publicly stated policy concerning recruiting at IEEE sponsored conferences. Consequently, recruiters and recruiting advertisements will not be permitted in the APEC hotel space, meeting facilities or Exposition Hall. Also, ads or postings seeking positions are not permitted.

APEC reserves the right to remove without notice any materials in violation of this policy.

APEC does allow for the facilitation of a student job fair that is organized by the conference. Only students registered for the conference may participate. Only companies that have registered for the student job fair and paid any required participation fees may recruit at the job fair.

Distribution of Commercial Material at APEC

Rules for Non-Exhibitors: Distribution of commercial material in the APEC 2023 hotel space (including directly to the hotel rooms of APEC participants), meeting space and Expo Hall by people or organizations not participating in the Exposition is prohibited. APEC reserves the right to remove without notice any materials not in compliance with this policy.

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

Privacy Policy

Information Provided During Registration: Contact information, which includes your name, affiliation, and mailing address, may be provided upon request to any partners and/or supporting publication participating in the APEC 2023 Exposition. In addition, APEC may use the information you provide to contact you with information about APEC 2023 or any future APEC events. No other use will be made of the information you provide. Your information will not be sold, distributed, leased or provided to any other person or organization except as described above.

Information Provided Other than Through Registration: People who provide their names to APEC through the APEC 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

SPEAKER READY ROOM

The Speaker Ready Room, **located in W107**, is to be utilized by all speakers to prepare for their presentations. **PLEASE NOTE:** If you changed your presentation after the deadline, you must bring your newest presentation to the Speaker Ready Room as soon as you arrive to Orlando to switch it out. You can also do this directly after the instructional PowerPoint is presented during Speaker Breakfast.

- Sunday, March 19 | 8:00 a.m. – 5:00 p.m.
- Monday, March 20 | 7:00 a.m. – 1:30 p.m.
- Tuesday, March 21 | 7:00 a.m. – 5:00 p.m.
- Wednesday, March 22 | 7:00 a.m. – 5:30 p.m.
- Thursday, March 23 | 7:00 a.m. – 2:00 p.m.

SPEAKER BREAKFAST

All Professional Education Seminar, Technical, and Industry Session Speakers must attend Speaker Breakfast on the morning of their presentation to receive instructions from their Session Chairs.

Remember, if you changed your presentation, you must visit the Speaker Ready Room first before going to Speaker Breakfast.

Please note: Exhibitor Seminar Speakers are not required to attend any speaker breakfasts. Expect to receive separate detailed instructions from the APEC team.

Professional Education Seminar Speaker Breakfast

- Sunday, March 19, at 8:00 a.m. and Monday, March 20, at 7:00 a.m. | W110

Industry Session and Technical Session Lecture Speaker Breakfast

- Tuesday, March 21, Wednesday, March 22 and Thursday, March 23 at 7:00 a.m. | W110

Technical Session Dialogue Speaker Breakfast

- Thursday, March 23 at 7:00 a.m. | W110

SPECIAL EVENTS

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 Orlando

Tuesday, March 21 | 9:00 a.m. – 3:30 p.m.

Explore Orlando beyond the theme parks! During this tour, attendees will first visit the historical Charles Hosmer Morse Museum of American Art, featuring iconic work by Louis Comfort Tiffany including jewelry, paintings, his chapel interior from the 1893 World's Columbian Exposition in Chicago, and more. Next, guests will head to lunch at the top rated Mexican and Tex-Mex kitchen at Cocina 214. Finally, end the tour by strolling the great shopping of Winter Park before heading back to the Rosen Centre with the group.

MICROMOUSE CONTEST

Monday, March 20 | 7:30 p.m. – 9:30 p.m. | Expo Hall WA1 & WA2

Enter the annual APEC Micromouse contest or join us as a spectator for this exciting event. Participants design, build, and program robotic mice and compete to see who can navigate their way through the maze in the shortest time. The rules for the contest use a scoring system with a penalty for the time taken to map and run the maze, and a bonus for not touching the mouse. They are similar to those used at the IEEE World Final held in London in 1987 except that the touch penalty has been reduced from 10 seconds to 2 seconds. The time for each contestant has also been reduced from 15 to 7 minutes. Within this time limit, the Micromouse may make up to five runs. Only one mouse per handler will be allowed this year. Trophies and cash prizes will be awarded in the following categories based on score:

- **1st Place** **$500**
- **2nd Place** **$250**
- **3rd Place** **$125**

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

- **Best Student (based on score)** **$500**
- **Fastest Run (based on run time)** **$150**

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

Wednesday, March 22 | 8:00 a.m. – 9:00 a.m. | Salon 20 & 21 (Rosen Centre)

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). During the event we will be raffling off two vouchers for a complimentary IEEE & PELS Membership. Please note: you must be present to receive the membership voucher.

FIRST® ROBOTICS EVENT

Monday, March 20 | 7:30 p.m. – 9:30 p.m. |
Expo Hall WA1 & WA2

FIRST® (For Inspiration and Recognition of Science and Technology) is a global not-for-profit organization that prepares young people for the future through a suite of inclusive, team-based robotics programs for ages 4-18 (PreK-12) that can be facilitated in school or in structured afterschool programs. Boosted by a global support system, teams operate under a signature set of FIRST Core Values to conduct research, fundraise, design, build, and showcase their achievements during annual challenges. With over $80 million in scholarships available to our students, the mission of FIRST is to inspire young people to be science and technology leaders and innovators, by engaging them in exciting mentor-based programs that build science, engineering, and technology skills, that inspire innovation, and that foster well-rounded life capabilities including self-confidence, communication, and leadership.

STUDENT JOB FAIR

Tuesday, March 21 | 1:30 p.m. – 5:00 p.m. |
Hall WA3

APEC is excited to present our first-ever career fair at APEC 2023! Opportunity is in the air in Orlando and this new event conveniently takes place in the Orange County Convention Center on Tuesday, March 21. Meet with participating companies, or get to know potential new employees. We're excited to bridge the gap between employers and prospective new hires. Only students registered for the conference may participate.

Thank you to Wolfspeed, exclusive Student Job Fair Partner

Wolfspeed®

PELS-IAS-PSMA SPONSORED YOUNG PROFESSIONALS RECEPTION

Tuesday, March 21 | 7:00 p.m. – 9:00 p.m. |
Taverna Opa

IEEE Power Electronics Society (PELS), Industry Applications Society (IAS) and Power Source Manufacturers Association (PSMA) semiannual Students & Young Professional Reception will be held during the IEEE APEC 2023. 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.

WEDNESDAY NIGHT SOCIAL

Walt Disney World®

Wednesday, March 22 | 5:00 p.m. – 9:00 p.m. | Shuttles to/from Disney Hollywood Studios
| 7:00 p.m. – 9:00 p.m. | Hospitality Area at Indiana Jones Epic Stunt Theater

Join us for the APEC Social Event at Disney Hollywood Studios! Shuttles will depart the Orange County Convention Center starting at 5:00 p.m. Explore all the park has to offer, including Star Wars: Galaxy's Edge, Toy Story Land, and more. Then, head to Indiana Jones Stunt Theater at 7:00 p.m. to enjoy dessert with fellow APEC attendees.

All full conference and technical session only attendees have a ticket included with their registration. Conference attendees can purchase an additional social event ticket through registration for $175 for guests. **Tickets are limited.** Tickets include access to the Disney Hollywood Studios and a gift card, which can be used for food at the park. APEC will not replace lost tickets or gift cards.

SPONSOR MEETINGS

PSMA MEETINGS

SATURDAY, 18 MARCH

7:00 a.m. – 5:00 p.m.	**PSMA/PELS Workshop on High Frequency Magnetics** (separate registration required)	Convention Center

MONDAY, 20 MARCH

7:30 a.m. – 1:00 p.m.	**PSMA Annual Meeting – followed by March BoD Meeting**	Rosen Centre Salon 13/14

TUESDAY, 21 MARCH

8:00 a.m – 10:00 a.m.	**PSMA Reliability Committee Meeting**	Rosen Centre Salon 14
8:00 a.m – 10:00 a.m.	**PSMA Capacitor Committee Meeting**	Rosen Centre Salon 13
8:30 a.m. – 11:55 a.m.	**PSMA Sponsored Industry Session: Magnetics IS01**	Convention Center, W203ABC
8:30 a.m. – 11:55 a.m.	**PSMA Sponsored Industry Session: Semiconductor IS03**	Convention Center, W204ABC
8:30 a.m. – 11:55 a.m.	**PSMA Sponsored Industry Session: Energy Management IS05**	Convention Center, W205BC
10:00 a.m. – 12:00 p.m.	**PSMA Industry-Education Committee Meeting**	Rosen Centre Salon 14
12:00 p.m. – 2:00 p.m.	**PSMA Power Technology Roadmap/iNEMI Meeting** (by invitation only)	Rosen Centre Salon 14
2:00 p.m. – 4:00 p.m.	**PSMA Energy Management Committee Meeting**	Rosen Centre Salon 14
2:00 p.m. – 4:00 p.m.	**PSMA Semiconductor Committee Meeting**	Rosen Centre Salon 13
6:30 p.m. – 8:00 p.m.	**IAS/PELS/PSMA Young Professionals Reception**	Taverna Opa

PSMA MEETINGS

WEDNESDAY, 22 MARCH

8:00 a.m – 9:00 a.m.	**PELS/PSMA Women in Engineering Breakfast**	Rosen Centre Salon 20/21
8:00 a.m – 10:00 a.m.	**PSMA Transportation Electronics Committee Meeting**	Rosen Centre Salon 13
8:30 a.m. – 11:55 a.m.	**PSMA Sponsored Industry Session: Semiconductor IS08**	Convention Center, W206
8:30 a.m. – 11:55 a.m.	**PSMA Sponsored Industry Session: Packaging & Manufacturing IS10**	Convention Center, W205BC
8:30 a.m. – 11:55 a.m.	**PSMA Sponsored Industry Session: Reliability IS12**	Convention Center, W205A
9:00 a.m – 10:00 a.m.	**APEC Student Attendance Support Committee Meeting**	Rosen Centre Salon 14
10:00 a.m. – 12:00 p.m.	**PSMA Energy Storage Committee Meeting**	Rosen Centre Salon 14
10:00 a.m. – 12:00 p.m.	**PSMA Marketing Committee Meeting**	Rosen Centre Salon 13
12:00 p.m. – 2:00 p.m.	**PSMA Energy Harvesting Committee Meeting**	Rosen Centre Salon 14
12:00 p.m. – 2:00 p.m.	**PSMA Magnetics Committee Meeting**	Rosen Centre Salon 13
1:30 p.m. – 4:45 p.m.	**PSMA Sponsored Industry Session: Marketing IS15**	Convention Center, W202BC
1:30 p.m. – 4:45 p.m.	**PSMA Sponsored Industry Session: Transportation Electronics IS16**	Convention Center, W205BC
1:30 p.m. – 4:45 p.m.	**PSMA Sponsored Industry Session: Semiconductor IS17**	Convention Center, W204ABC
2:00 p.m. – 4:00 p.m.	**PSMA Packaging & Manufacturing Committee Meeting**	Rosen Centre Salon 14

THURSDAY, 23 MARCH

8:30 a.m. – 11:20 a.m.	**PSMA Sponsored Industry Session: Energy Storage IS24**	Convention Center, W205BC

IEEE PELS MEETINGS

SUNDAY, 19 MARCH

2:00 p.m. – 4:30 p.m.	PELS Exec Meeting (Officers Only)	Salon 15
8:00 a.m. – 5:00 p.m.	International Future Energy Challenge (IFEC) Information Session	Salon 16
	The 2023 International Power Magnetics Challenge (MagNet 2023)	Salon 18

MONDAY, 20 MARCH

8:30 a.m. – 10:00 a.m.	PELS TC 9: Wireless Power Transfer Systems	Salon 18
9:00 a.m. – 12:00 p.m.	PELS VP of Membership Meeting	Salon 15
9:00 a.m. – 11:00 a.m.	PELS - The International Technology Roadmap for Wide Bandgap Power Semiconductors (ITRW)	Salon 16
9:00 a.m. – 10:30 a.m.	IEEE Journal of Emerging and Selected Topics in Power Electronics (JESTPE) Steering Committee	Salon 17
10:00 a.m. – 11:00 a.m.	PELS History Committee Meeting	Salon 18
11:00 a.m. – 12:00 p.m.	PELS TC 12: Energy Access and Off-Grid Systems	Salon 16
11:00 a.m. – 12:00 p.m.	PELS Long Rang Planning Meeting	Salon 17
11:30 a.m. – 1:00 p.m.	PELS TC3: Electrical Machines, Drives and Automation	Salon 18
12:00 p.m. – 1:00 p.m.	PELS Chapter Chair Forum/Luncheon	Salon 15

TUESDAY, 21 MARCH

8:00 a.m. – 9:30 a.m.	PELS & CPSS Meeting	Salon 15
8:00 a.m. – 9:00 a.m.	PELS TC7: Critical Power and Energy Storage Systems	Salon 16
8:00 a.m. – 10:00 a.m.	IEEE Journal of Emerging and Selected Topics in Power Electronics (JESTPE) Awards and Editorial Board	Salon 18
10:00 a.m. – 11:30 a.m.	PELS TC1: Control and Modelling of Power Electronics	Salon 18
9:30 a.m. – 11:00 am	PELS TC2: Power Components, Integration, and Power ICs	Salon 16
10:00 a.m. – 1:00 p.m.	PELS TC10: Design Methodologies	Salon 15
10:00 a.m. – 11:00 am	PELS Digital Media Committee	Salon 17
11:00 a.m. – 12:00 p.m.	WIE Committee Meeting	Salon 16
11:00 a.m. – 12:00 p.m.	PELS Day 2023 Committee Meeting	Salon 17

IEEE PELS MEETINGS

TUESDAY, 21 MARCH (continued)

1:30 p.m. – 3:30 p.m.	PELS TC6: Emerging Power Electronic Technologies	Salon 17
1:00 p.m. – 2:00 p.m.	PEDG Steering Committee Meeting	Salon 16
1:00 p.m. – 3:00 p.m.	PELS VP of Global Intersociety Relations Committee	Salon 18
2:00 p.m. – 3:30 p.m.	PELS TC5: Sustainable Energy Systems	Salon 16
2:00 p.m. – 3:00 p.m.	PELS TC4: Electrified Transportation Systems	Salon 15
3:30 p.m. – 5:00 p.m.	PELS TC11: Aerospace Power	Salon 15
7:00 p.m. – 9:00 p.m.	IEEE IAS/PELS/PSMA Young Professional Reception	Taverna Opa

WEDNESDAY, 22 MARCH

8:00 a.m. – 9:00 a.m.	WIE, YP, and you breakfast! How to get involved with PELS and PSMA	Salon 21-22
9:00 a.m. – 11:00 a.m.	PELS VP of Products Committee Meeting	Salon 17
9:00 a.m. – 10:00 a.m.	PELS TC 8: Electronic Power Grid Systems	Salon 15-16
10:00 a.m. – 11:00 a.m.	Standard Initiative about Solid State Transformer (P3105)	Salon 15-16
9:00 a.m. – 10:30 a.m.	ECCE Asia Coordniation Committee Meeting	Salon 18
11:00 a.m. – 12:00 p.m.	PELS Members Congress Meeting	Salon 18
12:00 p.m. – 2:00 p.m.	IEEE Transactions on Power Electronics (TPELS) Paper Awards and Editorial Board Meeting	Salon 15-16
12:00 p.m. – 1:00 p.m.	PELS Conferences Committee Meeting Luncheon	Salon 17
1:00 p.m. – 4:30 p.m.	PELS VP of Conferences Committee Meeting	Salon 17
4:30 p.m. – 5:30 p.m.	PELS Conferences Committee Appriciation Reception	Salon 17
1:30 p.m. – 2:30 p.m.	PELS DE&I Committee Meeting	Salon 18

THURSDAY, 23 MARCH

8:30 a.m. – 9:00 a.m.	PELS Technical Operations Committee Breakfast	Salon 17
9:00 a.m. – 12:00 p.m.	PELS VP of Technical Operations	Salon 17
9:00 a.m. – 10:30 a.m.	PELS VP of Standards Committee	Salon 18
12:00 p.m. – 1:00 p.m.	PELS Administrative Committee Luncheon	Salon 15-16
1:00 p.m. – 5:00 p.m.	PELS Administrative Committee Meeting	Salon 15-16

PROFESSIONAL EDUCATION SEMINARS

APEC Professional Education Seminars focus on practical aspects of the power electronics profession and provide in-depth discussion of important and complex power electronics topics. Seminars combine practical application with theory and are designed to further educate the working professional in power electronics. APEC 2023 features 18 Professional Education Seminars with a broad range of topics.

SESSION 1

9:30 a.m. – 12:00 p.m.

S01: Power Electronics in Electrified Powertrain: From Electrical Vehicle Market to Semiconductor Selection Guidance

ROOM W101

TRACK: Applications

Andre Christmann

Infineon Technologies AG, Germany

This seminar will provide an overview of power semiconductors in typical automotive xEV applications such as traction inverter, on-board charger and DC/DC with the focus on the main inverter.

The intention is to give a general picture starting from the highest level (OEMs & the Car Market) and going down stepwise to the Semiconductor itself touching Driveline Architectures as well as Semiconductor Power Packages.

After presenting the typical characteristics of the different semiconductor solutions, the presenter will discuss design measures for optimizing Silicon as well as SiC, which devices could be used in which application, the chip market and the wafer supply, and a method how to maximize the number of chips coming from a SiC raw wafer to give engineers and managers insight.

SESSION 2

9:30 a.m. – 1:00 p.m.

S02: Core Loss Measurement Data for Everyone

ROOM W102

TRACK: EMI & Magnetics

George Slama

Würth Elektronik, USA

This seminar provides a practical look at the various methods used to measure core loss based on the work of the PELS SA committee ETTC which is updating IEEE 393 Standard for Test Procedures for Magnetic Cores to meet the needs of magnetic design for modern power supplies operating at high frequencies. A core loss data file exchange format for use on an open-source database is proposed to help everyone share and get the data they need.

SESSION 3

9:30 a.m. – 12:00 p.m.

S03: Switch Mode Power Concepts

ROOM W103

TRACK: Power Supply Design

Robert White

Embedded Power Labs, USA

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

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

In the second half, the basics of controlling a switch mode power converter are explained. A quick review of systems and feedback starts the discussion. A detailed example of designing a control loop for a voltage mode controlled buck converter shows how the theory reduces to practice. The seminar concludes with an overview of current mode control.

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

SESSION 4

9:30 a.m. – 1:00 p.m.

S04: Switching Losses Associated with Output-Capacitance Hysteresis: Now You See Me in Power Devices

ROOM W104

TRACK: Power Devices

Jaume Roig[1], Juan Rivas-Davila[2], Elison Matioli[3]
[1]Onsemi, Belgium, [2]Stanford University, USA, [3]Ecole Polytechnique Federale du Lausanne, Switzerland

Increasing the switching frequency brings opportunities to reduce the size and weight of power converters. At high-frequencies, soft-switching converters are ubiquitous in adapters, datacenters, EV/HEV, and PV inverters. In optimal soft-switching conditions, it is often assumed that the energy stored in the output capacitance of power devices (Coss or Cak) is completely recovered. In the past ten years, disruptive studies evidenced the existence of an energy loss associated with Coss hysteresis due to displacement currents in the absence of channel and diode conduction.

This seminar provides in-depth coverage of Coss hysteresis losses. We will provide a background showing early experimental evidence. Also, we will show Coss losses can dominate at MHz, even when using WBG. We will describe the circuits used to test hysteresis loss in semiconductors over a vast range of voltages and frequencies (Sawyer- Tower circuit, non-linear resonance). We will discuss the physical origins Coss loss in different devices, including diodes and transistors, in Si, SiC, and GaN. We will describe how to simulate and model the Coss loss using FEA and SPICE. Lastly, we will provide insight into the JEDEC action toward standardizing testing procedures.

We expect it to interest professionals working on devices, testing and application fields.

SESSION 5

9:30 a.m. – 12:00 p.m.

S05: Gate-Drive Circuit Design for Wide-Bandgap Power Transistors

ROOM W109

TRACK: Gate Drive & Protection

Eric Persson
Infineon Technologies, USA

The adoption-rate of GaN and SiC power transistors continues to grow in modern power electronic circuits. These Wide-Bandgap devices can have high transconductance, gain-bandwidth product and fast switching. While the fast switching characteristics offer improved converter performance, they can also create challenges for the design and implementation of the gate drive circuit, including its power and isolation. These system challenges are shared not only by discrete transistors, but also those with co-packaged or integrated gate drive functions. In addition, designers today often want to enable multi-sourced transistor options, yet in many cases, the specifications, requirements and footprints are not the same between manufacturers. And finally, the system partitioning and PCB layout of the gate drive, its power and isolation circuits can be particularly challenging due to the fast slew-rates (dv/dt) that can occur in wide-bandgap power converters. Even small parasitic capacitances can cause common-mode currents that induce unexpected behavior, resulting in increased EMI, instability, or even failures.

This seminar addresses all of these topics, and is designed to provide a clear, concise overview of the commonly available transistor types on the market today, and what their gate-drive requirements are. Then we will cover the common output-stage topologies for gate drivers, Isolation technologies, and system partitioning, followed by methods for powering the high and low-side drivers. Then we cover best-practices examples, PCB layout recommendations, and testing/troubleshooting measurement techniques.

The seminar covers transistors in the 600 – 650 V class, and is intended for power levels from 50 W up to about 5 kW (will not cover higher voltage, high-power SiC modules).

SESSION 6

9:30 a.m. – 1:00 p.m.

S06: Simplified Universal Analysis Techniques for DC-DC Switching Power Converter Feedback Loops Using Matrices and Spreadsheets

ROOM W105

TRACK: Control

Haachitaba Mweene

Nexperia USA Inc., USA

This seminar presents a detailed step-by-step analytical method of closing switch-mode power converter feedback regulation loops. The hand derivation and solution of the pertinent converter equations is typically error-riddled and difficult for higher order converters (e.g., SEPIC), or if parasitics are added. Therefore, the method presented here circumvents this problem by using a spreadsheet program such as Mathcad or Excel to do the for the calculations. In particular, the state equations of the averaged and linearized power stage are formulated in matrix form, to allow for the system transfer functions to be evaluated using Cramer's Rule, thereby greatly reducing errors. A universal system block diagram that automatically caters for both voltage and current mode control is used as a framework for investigating the closed-loop system behavior. All the calculations are done by the spreadsheet program. The target audience is intermediate to advanced power supply designers.

SESSION 7

2:30 p.m. – 6:00 p.m.

S07: Practical Considerations for the Application of Power Si and SiC Modules

ROOM W101

TRACK: Applications

John Donlon, Eric Motto, Mark Steiner, Michael Rogers

Mitsubishi Electric US, USA

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

SESSION 8

2:30 p.m. – 6:00 p.m.

S08: Modeling, Measurement and Suppression of Conductive, Near-Field and Radiated Electromagnetic Interference in Power Electronics Systems

ROOM W109

TRACK: EMI & Magnetics

Shuo Wang

University of Florida, USA

Within the last 20 years, especially with the adoption of wide bandgap (WBG) semiconductor devices, the switching speed and switching frequencies of power conversion systems have significantly increased to achieve high power densities. On the other hand, high switching speed and high frequencies have generated high electromagnetic interference (EMI) not only in the conventional conductive EMI frequency range but also in radiated EMI frequency range, which has not been fully investigated. Furthermore, high power density designs lead to strong near magnetic and electric field couplings which can transform into both conductive and radiated EMI noise. This further complicates the EMI suppression design.

This seminar will help power electronics researchers and engineers to understand and solve the EMI issues in power electronics systems by introducing the modeling, measurement, and suppression techniques across the conductive, near field, and radiated frequency domains. The seminar will introduce the basic EMI theories, the EMI measurement and diagnostic approaches, and various EMI suppression techniques for power electronics systems in depth. These theories, approaches, and techniques were based on the technical development of the presenter in the last more than 20 years in power electronics EMI/EMC. The seminar is good for all levels of engineers and students.

SESSION 9

2:30 p.m. – 6:00 p.m.

S09: Common Mistakes in Power Supply Designs

ROOM W102

TRACK: Power Supply Design

Sheng-Yang Yu, Fei Yang, Brian King, Pradeep Shenoy

Texas Instruments, USA

This presentation will summarize common mistakes an engineer could make when designing power supplies. The presentation will be conducted in an interactive way by first showing an issue with an actual measurement (phenomenon) and then letting the audience brainstorm and comment on what could be wrong. After that, we reveal the root cause of the issue, how to avoid the issue, and related design suggestions. Common mistakes in three key areas – non-isolated DC-DC converter, AC-DC Flyback converter, and power supply layout will be discussed. Ten common mistakes on each area will be discussed. After 30 common mistakes are discussed, we will extend the discussion to where engineers need to take extra care of when designing with wide bandgap devices (such as gallium nitride (GaN) FETs) that have high dV/dt.

SESSION 10

2:30 p.m. – 6:00 p.m.

S10: Silicon Is Still Here: A Refresher on the Narrow Band Gap Power MOSFETs

ROOM W103

TRACK: Power Devices

Sanjay Havanur, David Grey

Vishay Siliconix, USA

Since their introduction in the early 1980s, silicon Mosfets have been the mainstay of power conversion technology, in particular for high frequency switching power convertors. The device technology has evolved over the decades, from planar to split gate trench and superjunction platforms. Far from being obsolete or stagnant, innovations continue steadily in silicon technology.

This seminar will cover characteristics of state of the art, high performance Mosfets using their datasheets as reference. Instead of explaining away datasheet numbers line by line, we will be grouping them functionally, explain how they are characterized by the manufacturers and how they should be interpreted for real world applications. Unique features such as extremely nonlinear capacitances and body diode behavior will be discussed in depth. Mosfet datasheets carry a number of legacy parameters, specifically those relating to current and power ratings, that are no longer relevant in today's design environments. These will be highlighted during the course.

Recently there has been an explosive growth in power applications other than high frequency switching, such as motor control and automotive electronics. The seminar is aimed at Mosfet users in all these application areas and will be useful to engineers both at the beginner and intermediate levels.

SESSION 11

2:30 p.m. – 6:00 p.m.

S11: Silicon Carbide Power semiconductors: Characterization, Modeling and Advanced Gate Drivers

ROOM W104

TRACK: Gate Drive & Protection

Dimosthenis Peftitsis, Daniel Alexander Philipps

Norwegian University of Science and Technology (NTNU), Norway

To fully exploit the benefits of SiC technology for designing high-performance power electronic converters, three key aspects emerge, namely, accurate device characterization, modeling, and advanced gate drivers designs. The first two aspects allow for fast validation of converter designs, reducing development and prototyping effort. Advanced gate drivers are integral components for manipulating the switching performance of SiC power devices. This professional education seminar will provide an overview of static and dynamic characterization of SiC metal oxide semiconductor field- effect transistors (MOSFETs) in 1.2-3.3-kV classes. Besides, the development process of accurate SiC MOSFETs models for both traditional and real-time simulations will be presented. Moreover, the design, operation, and system-integration principles of adaptive voltage-source and current-source gate drivers for SiC MOSFETs will be analyzed. The main benefit of this seminar is the dissemination of knowledge concerning the design of high-performance converters by integrating and operating SiC MOSFETs. The seminar content is based on the research conducted by the power electronics group at the Norwegian University of Science and Technology (NTNU). The intended audience is design engineers, PhD students, senior researchers and professors dealing with design of SiC-based power converters.

SESSION 12

2:30 p.m. – 6:00 p.m.

S12: How Power Integrity Is Changing the World of Power Electronics

ROOM W105

TRACK: Control

Heidi Barnes[1], Steve Sandler[2], Benjamin Dannan[3]
1Keysight Technologies, USA, [2]Picotest, USA, [3]Signal Edge Solutions, USA

Power delivery to high-speed digital loads has a growing set of challenges as dynamic loads demand power from DC to GHz frequencies while at the same time power rail voltages are dropping below 1 volt to drive 1000's of amps. Design margins are narrowing and even the small parasitics of the PCB and package interconnects must be EM simulated to avoid late in the design noise ripple and EMI failures. This tutorial will take a deep dive into the Power Integrity world of designing with Target Impedance and takes it a step further to show how designing in the frequency domain can be expanded to "hack" the end-to-end power delivery eco-system.

This tutorial covers the basic entry level concepts of power integrity by analyzing power delivery in both the frequency domain and the time domain to show the advantages of designing for flat target impedance. Intermediate concepts will cover the latest in state-space behavioral modeling of switched mode power supplies. Learn how a few simple measurements of a regulator's output impedance can enable a sophisticated behavioral model that enables simulation of an end-to-end power delivery ecosystem for even the most advanced multi-phase designs using wide bandgap SiC and GaN technologies.

SESSION 13

8:30 a.m. – 12:00 p.m.

S13: The Essence of Solid-State Transformers: Fundamentals, Design Challenges, R&D Overview Comparative Evaluation, Outlook

ROOM W109

TRACK: Applications

Johann Kolar, Jonas Huber

ETH Zurich, Switzerland

This seminar introduces participants to the Solid-State Transformer (SST) concept in a comprehensive and easy-to-follow fashion. After a brief review of transformer basics, the SST concept history, and the various intended SST application areas, main SST technology concepts and key design aspects are discussed. These include, e.g., medium-frequency (MF) power conversion, power electronic interfaces connected to medium voltage (MV), key SST topologies, MF transformer design, and isolation coordination.

The second half of the tutorial then showcases latest SST concepts and demonstrator systems from University and Industry R&D activities to establish an overview on the state of the art and the most relevant developments. Based on recent industrial SST realizations, we then discuss benefits and challenges for SST applications in datacenter power supply systems and high-power EV charging by providing a comparative evaluation against alternative approaches (e.g., solutions based on low-frequency transformers and highly efficient low-voltage SiC converters).

Based on this comparative evaluation, the remaining challenges, the most promising SST and Power- Electronic-Building-Block-(PEBB)-based realization concepts and their application potentials, and finally the future research vectors are identified. The tutorial closes with an outlook on future performance targets beyond efficiency/power density, i.e., compatibility with future sustainable circular economy concepts.

SESSION 14

8:30 a.m. – 12:00 p.m.

S14: Improving EMC Performance for Switch-Mode Power Converters

ROOM W101

TRACK: EMI & Magnetics

Michael Schutten

Schutten Technical Consulting LLC, USA

This seminar is intended as a comprehensive introduction for engineers wanting a fundamental understanding of electromagnetic compatibility (EMC) issues associated with switch-mode power converters, and experienced engineers desiring a detailed understanding of electromagnetic interference (EMI) causes and fixes for power converters.

The seminar begins with an introduction to noise coupling mechanisms and their properties. The concept of impedance mismatch is presented as a basis for understanding filtering concepts. Differential-mode (DM) and common-mode (CM) separation and filtering approaches are derived, and measurement and separation techniques presented. DM & CM measurement and EMI reduction techniques are presented for an experimental flyback converter. Converter layout techniques and principles are derived, and experimentally verified. The seminar provides an emphasis on how DM and CM currents are created in power converters, and layout and construction techniques to minimize the need for costly filtering. Several practical EMI reduction techniques and construction methods are provided throughout the presentation. Frequency-domain and time-domain comparisons are presented for silicon carbide (SiC) and silicon (Si) power semiconductors.

SESSION 15

8:30 a.m. – 12:00 p.m.

S15: PMBus™: What, How and Why

ROOM W102

TRACK: Power Supply Design

Peter James Miller
Texas Instruments, USA

Since being introduced at APEC in 2005 the PMBus™ power management protocol has been widely adopted and is the accepted standard for digital power management. With the introduction of security features in PMBus 1.5 and the Secure VR Application Profile, use of PMBus is expected to grow broadly across the market. However, 17 years after it's introduction, common problem and misconceptions about what PMBus is and isn't abound. This professional development seminar is intended to build attendee's basic understand of the PMBus 2-wire serial protocol. How it is similar to, and different from I2C and SMBus and provide them with useful guides and functions to build systems leveraging the capabilities of PMBus.

The first half of the seminar reviews the basics of the 2-wire SMBus including the electrical interface and how bits, bytes, and complete messages are transferred from one device to another. Comparing and Contrasting with I2C, and how to use an I2C controller peripheral to build PMBus transactions. PMBus specific features such as CONTROL, ALERT# and the ALERT RESPONSE ADDRESS (ARA) are also reviewed. Next a summary the organization of the PMBus command language and numerical formats, setting and adjusting the output voltage, fault management, and status reporting.

The second half of the seminar takes a deeper look at how PMBus features can be used in different stages of the Power Supply and Product Life-Cycle. From shortening the product development cycle by eliminating schematic dependencies through in-circuit programming, improving product verification, qualification and reliability testing through in-circuit test, margin and warnings, to in-field diagnostics and update capabilities.

SESSION 16

8:30 a.m. – 12:00 p.m.

S16: Is SiC High Performance Technology Reliable Enough for Your Application?

ROOM W103

TRACK: Power Devices

Xuning Zhang[1], Cesare Bocchiola[2]
[1]Microchip Technology Inc., USA,
[2]Microchip Technology, Inc., Italy

Silicon Carbide (SiC) devices improve the power density of various converters by shrinking the size of passive components and improving the power conversion efficiency; and most importantly, only proper SiC device design can guarantee the level of reliability required by most professional, industrial or hi-rel. applications. This seminar presents an in-depth summary of SiC devices and their applications to help converter designers at different levels to achieve the full benefits, and face the challenges found, when using SiC devices; additionally, proper design guidelines are needed to extract the maximum benefit from using SiC devices.

The presentation will begin with an introduction of SiC technology status. A summary of internal device structure and principle of operation will be discussed to understand the potential benefits achievable with devices built on SiC technology's reliable design. Detailed static and dynamic characteristics, thermal performance and device ruggedness will be discussed with related datasheet parameters to also assess the superior performance of SiC devices over Si. Optimal implementation of SiC MOSFETs will be discussed in detail: starting from driving voltage selection, driving circuit design and advanced driving concepts to then cover converter level optimization aspects such as thermal management and EMI noise control. This will provide power converter designers with the design guidelines to implement SiC devices appropriately and ensure their maximum benefits. Specific design examples in real applications such as EV chargers and DC Solid State Circuit Breakers will be presented with real hardware and test results to verify the benefit of using SiC devices in system size, weight and cost reduction compared with Si devices.

SESSION 17

8:30 a.m. – 12:00 p.m.

S17: Design & Integration of SOLID-State Circuit Protection

ROOM W104

TRACK: Gate Drive & Protection

Douglas Hopkins, Sourish Sinha

NC State University, USA

This seminar targets designers responsible for integrating solid-state protection at the circuits and systems levels, and is a comprehensive tutorial that shows, with examples, how fundamental design of a Solid-State Circuit Breakers (SSCB) scales in lower voltage to MV applications. Topics include design of all-solid-state and hybrid breakers, fundamentals of I2t trip curves, use of bidirectional GaN and SiC devices for <1200V applications, and use of high- voltage and supercascode switches for MV (6.5kV to >25kV). Also included are applicable standards, design of sensing and control circuits for ultra-fast response or slow RMS overload response, design of peripherals such as currents sensors, and electrothermal design of high transient energy absorbing components such as high-thermal mass packaged semiconductors and MOVs. The attendee is provided brief tutorials in heat transfer and mechanics to understand what is behind maximum operating limits and reliability drivers, and provided procedures to iterate an electrical-physical design. Actual SSCB design demonstrations are given that incorporate back-to-back GaN 450V/25A, SiC monolithic BiDFET (Bi-Directional FET)1200V/25A, and 6.5kV/100A supercascode devices. The 6.5kV application is compared to an off-the-shelf mechanical breaker.

SESSION 18

8:30 a.m. – 12:00 p.m.

S18: Three-Level Neutral-Point-Clamped Converters: State-of-the-Art and Recent Advances in Control Solutions and Reliability

ROOM W105

TRACK: Control

Mateja Novak, Ariya Sangwongwanich, Frede Blaabjerg

Aalborg University, Denmark

The three-level neutral-point-clamped (3L-NPC) converters have been widely applied in several applications including motor drives and grid integration such as wind and solar energy systems. Key performance metrics of the 3L-NPC converters like power quality, efficiency, power density and reliability are strongly affected by the used control methods. Therefore, different control methods have been proposed for the 3L-NPC topology to address certain aspects.

This seminar aims to address basic concepts and control design challenges of NPC converter applications. It will start with basic operating principles of the topology and their control challenges such as neutral point voltage balancing and thermal stress distribution. Then, two different control approaches will be presented: 1) carrier-based PWM techniques and 2) model predictive control techniques. For each control technique, basic concept and step-by-step implementation guideline will be provided, followed by more application-oriented examples and implementation challenges.

An approach to analyze the reliability of power electronics converters will also be introduced, which includes thermal stress modeling, lifetime prediction, and reliability evaluation (Monte Carlo simulation). It will be demonstrated that control algorithm selection has a major impact on the reliability of semiconductor devices and DC-link capacitors in NPC converters.

PLENARY SESSION

The APEC Plenary Session, taking place Monday, March 20, 1:15 p.m. – 5:00 p.m., continues the long-standing tradition of addressing issues of immediate and long-term interest to the practicing power electronic engineer.

Opening Welcome by General Chair (Pradeep Shenoy)

1:15 p.m. – 1:30 p.m.

Presentation 1
Recycling, Refining, and Remanufacturing Battery Materials

1:30 p.m. – 2:00 p.m.

SPEAKER:

Patrick Chapman
Vice President,
Electrical Engineering
Redwood Materials

The supply of lithium-ion batteries is limiting the adoption of electric vehicles and stationary storage. This battery supply, in turn, is limited by the availability of critical materials for both anode and cathode components. Dr. Chapman will discuss how these battery-grade materials can be manufactured from recycled batteries and how this promotes a circular supply chain, thereby reducing their cost and environmental footprint. He will also discuss the challenges for power electronics technology with respect to battery materials recycling, refining, and remanufacturing.

Presentation 2
Developing the Tools of Tomorrow: Efficient and Effective Power Electronics for Power Tools

2:00 p.m. – 2:30 p.m.

SPEAKER:

Brandon Verbrugge
Senior Vice President – Cordless Systems and Technology
Milwaukee Tools

The power tool industry has been revolutionized by significant advances in power electronics and digitalization. Cordless battery-operated tools are rapidly displacing corded power tools and products with small gas engines. Significant advances in power devices and embedded electronics helped fuel this conversion as most power tools now utilize high performance lithium ion batteries and brushless motors with advanced control algorithms. Through these advances, the construction space has naturally benefited from products with significantly higher capability, more user functionality, and much higher energy conversion efficiency. Looking forward, the journey will continue to achieve a completely digital and green jobsite fueled by higher capability energy conversion devices and microelectronics. This Plenary will walk through key aspects of the recent revolution in the power tool industry and will explain the fundamental attributes that will continue to deliver Efficient and Effective Electronics for Power Tools.

Presentation 3
Designing for Manufacturability with Software-Based Constraints: Shortening the Iterative Design Cycle

2:30 p.m. – 3:00 p.m.

SPEAKER:

Grant Pitel
CTO
Magna-Power Electronics

With a small diverse team of engineers, Magna-Power Electronics offers over 365,0000 different programmable power supplies and electronic loads, spanning ratings up to 10,000 Adc, 10,000 Vdc, and 3,000 kW. Such a high mix is supported by parameterizing design inputs, creating frameworks, and platforming hardware whenever possible. Hardware reuse and limiting new complexity ensures prototypes are manufacturable, reduces costly revisions, and helps launch new products faster. Constraints based on physics, machinery tolerances, and human error were discovered, and programmed into software as a way to consistently and continuously improve designs and processes over the company's 42-year history. This keynote demonstrates the advanced features available in commercial software packages leveraged by Magna-Power engineers to achieve work efficiency as well as custom

**speakers, times, and topics subject to change.*

tools it has developed independently. The talk focuses on areas of PCB design, electronic packaging, and large-scale embedded software development by following prototypes through to production, illustrating the impact rules/recipes/platforms have on machinery, testing, and staff.

BREAK
3:00 p.m. – 3:30 p.m.

Presentation 4
GaN for EV Power Train: Breakthroughs and Challenges
3:30 p.m. – 4:00 p.m.

SPEAKER:

Tamara Baksht
CEO & Co-Founder
VisIC Technologies

The mobility industry is living through the most dramatic changes since the invention of the internal combustion engine and the standardization of the manufacturing process. Society and governments are looking for zero-emission transport, while car makers are seeking the most efficient way to manufacture low-cost and long-distance electric cars. In this context, inverter efficiency became the critical performance parameter, and semiconductors with low loss switching energy, such as SiC and GaN are getting into the spotlight. In this keynote, the successful development of a three-phase GaN-based inverter reference design with 400V bus voltage and 400A RMS current is discussed and the results are presented. The major steps on the way from semiconductor chip design, through module development and to full current inverter operation are discussed, chosen solutions explained and results are presented. The main challenges include robust high current > 100A GaN die, with low parametric shift because of repetitive unclamped switching tests up to 1600V; driving 4 dies in parallel to obtain equal current sharing, smooth waveform at needed current and obtaining low voltage overshoots on the gate and on the drain.

Presentation 5
Silicon Carbide Mass Commercialization and Future Trends
4:00 p.m. – 4:30 p.m.

SPEAKER:

Victor Veliadis
Executive Director & CTO
Power America

Silicon devices are dominating power electronics due to their excellent starting material quality, streamlined fabrication, low-cost volume production, proven reliability and ruggedness, and design/circuit legacy. Although Si power devices continue to make progress, they are approaching their operational limits primarily due to their relatively low bandgap and critical electric field that result in high conduction and switching losses, and poor high temperature performance. SiC power devices offer compelling system benefits including high efficiency, high voltage/temperature operation, and low weight and volume. In particular, SiC is key in addressing environmental concerns and is gaining significant market share boosted by volume insertion in electric vehicles. This keynote will explore remaining barriers to SiC commercialization including higher than silicon device cost, reliability and ruggedness concerns, and the need for a trained workforce to skillfully insert SiC into power electronics systems. Fab models and the vibrant SiC manufacturing infrastructure, which mirrors that of Si, will be presented in terms of the rapid expansion to meet demand. Finally, the co-existence of Si, SiC, and GaN will be discussed, and their respective competitive advantages highlighted.

Presentation 6
Developing the Power Electronics Workforce Through MOOC Degree Programs and Public Educational Videos

4:30 p.m. – 5:00 p.m.

SPEAKERS:

Robert W. Erickson
Professor, Electrical Computer and Energy Engineering
Department of Electrical, Computer, and Energy Engineering
University of Colorado Boulder

Katherine A. Kim
Associate Professor of Electrical Engineering
National Taiwan University

Cultivation of a workforce with expertise in power electronics is crucial to building the future of clean energy, transportation electrification, and other emerging technologies. Until recently, traditional on-campus degree programs were the only way to gain a comprehensive power electronics education. Online education has opened the doors to broader accessibility of power electronics education. This talk will discuss a massively open online course (MOOC) degree program and public educational videos to develop the power electronics workforce, including survey results, successes, and challenges.

A unique MOOC-based MSEE program has been offered by the University of Colorado Boulder, with emphasis in Power Electronics and Embedded Systems Engineering. The program is tailored to the needs of working professionals. The courses are taught at the same level as regular on-campus graduate courses, with online homework assignments that feature automated grading and that foster high student engagement at a distance. A performance-based admissions policy provides an egalitarian and streamlined online admission process. A new curricular structure employs short course lengths based on the subject requirements rather than on the traditional 15-week semester. This accredited program offers both noncredit and credit-bearing versions of its courses, graduate certificates, and MSEE degree. A recent survey of enrolled MSEE students showed that 92% are employed, none are resident students, 68% are 30-49 years old, and that tuition price is an important consideration.

Public educational videos are another expanding area for learning about power electronics. During the coronavirus pandemic, many educators moved their lectures to online videos, but the structure of the lecture did not necessarily change. Today, many video-sharing platforms are widely accessible and well-used by students (such as YouTube), but the videos on these platforms utilize different qualities to engage the viewer. By leveraging shorter videos on one topic, a YouTube style to engage viewers, and making them public on a searchable video platform, power electronics education can reach a wider audience. Positive comments have been left by people around the world at all points of their careers (high school to retirement). These kinds of videos can also be used in on-campus courses using a flipped learning classroom approach that benefits students with various learning styles. Education videos can more effectively engage students and save instructors' time in the long run. IEEE PELS is also building up IEEE Educational Videos on Power Electronics (PELS Tube), peer-reviewed videos by power electronics experts available to all.

INDUSTRY SESSIONS *as of February 2, 2023*

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.

IS01: Core Loss Measurements for Different Materials and Excitations

ROOM W203ABC

SESSION CHAIRS

Ed Herbert, *PSMA*

George Slama, *Würth Elektronik*

8:30 a.m.

IS01.1 **Core Loss Mechanism in Different Soft Magnetic Materials**
Hasan Baghbaderani, *Tyndall*

8:55 a.m.

IS01.2 **Core Loss Measurement Techniques to Address Impact of Signal and Frequency Ranges**
Mike Ranjram, *Arizona State University*

9:20 a.m.

IS01.3 **Core Specifications vs. Component Specifications**
Bharadwaj Andapally, *North Carolina State University*

9:45 a.m.

IS01.4 **Practical Core Loss Measurements Across Different Materials**
Dominic Heye, *Dexter Magnetic Technologies*

10:40 a.m.

IS01.5 **Core Loss Measurements Across Power Levels, Frequencies and Materials**
Frank Oberlitner, *Magnetics*

11:05 a.m.

IS01.6 **Power Loss Measurements with Non-sinusoidal Waveforms**
Mike Wens, *MinDCet NV*

11:30 a.m.

IS01.7 **Validating Quality and Verification of Core Loss Measurements For Databases**
Diego Serrano, *Princeton*

8:30 a.m. – 11:55 a.m.

IS02: Solutions for Data Center and Server Power

ROOM W206

SESSION CHAIRS

Harry Soin, *AEI*

Richard Chung, *ST Microelectronics*

8:30 a.m.

IS02.1 **Key Features of Next Generation 48 V Power and BBU Shelves Used in Datacenters**
Harry Soin, *AEI*

8:55 a.m.

IS02.2 **Using a Microcontroller-Based Hybrid Hysteretic Control (HHC) of an LLC Converter to Solve Transient Response Challenges in Server PSU Applications**
Chen Jiang, *Texas Instruments*

9:20 a.m.

IS02.3 **Design of a Compact Auxiliary Power Supply Using GaN for Server Applications**
Brian King, *Texas Instruments*

9:45 a.m.

IS02.4 **Data Center VR Power Delivery Solutions**
Evan Reutzel, *Texas Instruments*

10:40 a.m.

IS02.5 **Considerations in Deploying Lateral and Vertical Power Delivery Solutions for High Performance Processors**
Anna Giasson, *Vicor*

11:05 a.m.

IS02.6 **Immersion-Cooling Power Supply Unit for Data Center**
Cai Youzhun, *Delta electronic Shanghai Inc. Hangzhou Design Center*

11:30 a.m.

IS02.7 **Tips and Tricks to Improve the Density and Performance of a Data Center PSU**
Yifei Zheng, *Infineon Technologies*

8:30 a.m. – 11:55 a.m.

IS03: Modern Power Semiconductor Technology Ambitions & Applications

ROOM W204ABC

SESSION CHAIRS

Sandeep Bahl, *Texas Instruments*

Renee Yawger, *Efficient Power Conversion Corporation (EPC)*

8:30 a.m.

IS03.1 **High-Power 650-V and 1200-V GaN Devices for EVs Applications**
Davide Bisi, *Transphorm Inc.*

8:55 a.m.

IS03.2 **Impact of SiC Power Devices on Emerging Applications and Mainstream Trends**
Peter Friedrichs, *Infineon Technologies AG*

9:20 a.m.

IS03.3 **Using Test to Fail Methodology to Accurately Predict How Enhancement Mode GaN Devices Can Last More than 25 Years in Solar Applications**
Shengke Zhang, *Efficient Power Conversion*

9:45 a.m.

IS03.4 **Microchip SiC-Based Auxiliary E-Fuse Overview**
Ehab Tarmoom, *Microchip*

10:40 a.m.

IS03.5 **Performance Analysis and Cost Comparison of High-Efficiency Power Factor Correction Topologies for High Power AC/DC Converters**
Chi Xu, *Texas Instruments*

11:05 a.m.

IS03.6 **An Overview of GaN Dynamic Rds(ON) and Quantifying Performance Benefits of 0V GOFF in Real Applications**
John Findlay, *Cambridge GaN Devices*

11:30 a.m.

IS03.7 **High Performance GaN Switches for LV and HV Applications on Cost-optimized 8-inch GaN-on-Si Technology Platforms**
Denis Marcon, *Innoscience*

8:30 a.m. – 11:55 a.m.

IS04: Wireless Power Industry Showcase

ROOM W205A

SESSION CHAIRS

Sanjay Gupta, *AirFuel Alliance*

Trish Thomas, *AirFuel Alliance*

8:30 a.m.

IS04.1 **How GaN is Advancing Wireless Power Technology**
Paul Wiener, *GaN Systems*

8:55 a.m.

IS04.2 **Wireless Power in Industrial and Automotive Applications**
Josh Yank, *Yank Technologies*

9:20 a.m.

IS04.3 **Magically Convenient Wireless EV Charging**
Milisav Danilovic, *WiTricity*

9:45 a.m.

IS04.4 **The Rise of RF Wireless Power**
Cesar Johnston, *Energous*

10:40 a.m.

IS04.5 **Why Energy Harvesting in IoT Matters**
Nick Dutton, *Atmosic*

11:05 a.m.

IS04.6 **Ambient IoT – The Path to Connecting Trillions of Things**
Steve Statler, *Wiliot / Bluetooth SiG*

11:30 a.m.

IS04.7 **The Future of Wireless Power**
Sanjay Gupta, *AirFuel Alliance*

8:30 a.m. – 11:55 a.m.

IS05: Power Innovations and Technologies Enabling Smart Buildings and Cities

ROOM W205BC

SESSION CHAIRS

David Chen, *Power Integrations*

Lincoln Xue, *Oak Ridge National Lab*

8:30 a.m.

IS05.1 **Interoperability of Power Conversion Systems**
Dusan Brhlik, *Direct Energy Partners*

8:55 a.m.

IS05.2 **Fault Analysis and Predictive Maintenance for BLDC motors**
John Emmanuel, *Power Integrations*

9:20 a.m.

IS05.3 **Micro-power Energy Harvesting for Retrofitted Wireless Sensors in Buildings**
Mike Hayes, *Tyndall National Institute*

9:45 a.m.

IS05.4 **Powering Future Indoor Farming Facilities**
Frank Cirolia, *Advanced Energy*

10:40 a.m.

IS05.5 **Bidirectional Wireless Power Transfer System Design and Integration for Medium-Duty Electric Vehicles**
Omer Onar, *Oak Ridge National Laboratory*

11:05 a.m.

IS05.6 **Meeting Carbon Goals with GaN**
Giorgia Longobardi, *Cambridge GaN Devices*

11:30 a.m.

IS05.7 **Grid-interactive Modeling and Community-scale Energy Planning**
Ben Polly, *National Renewable Energy Laboratory*

8:30 a.m. – 11:55 a.m.

IS06: Other Perspectives of Power Electronics – Markets, Society and Policies

ROOM W202BC

SESSION CHAIRS

Stephen Oliver, *Navitas Semiconductor*

Elena Barbarini, *System Plus Consulting*

8:30 a.m.

IS06.1 **How to Protect Your Valuable Intellectual Property (IP)**
Brian Rosenbloom, *Rothwell Figg*

8:55 a.m.

IS06.2 **EV Powertrain Trends – Now and in the Future**
Milan Rosina, *Yole Intelligence*

9:20 a.m.

IS06.3 **State of the Art of SiC Transistors and Modules: Technology and Cost Overview**
Elena Barbarini, *System Plus Consulting*

9:45 a.m.

IS06.4 **The Past, Present, and Future of Current Sensing**
John Stevens, *NAVITAS SEMICONDUCTOR*

10:40 a.m.

IS06.5 **Sustainability Benefits of GaNFast Power ICs**
Anthony Schiro, *Navitas Semiconductor*

11:05 a.m.

IS06.6 **How Do Vehicle System Level Considerations Affect Power Electronic Technology Choices and Market**
Adam Dawson, *Exawatt*

11:30 a.m.

IS06.7 **Power Electronics Role in Future Hydrogen Systems**
Ahmed Abdelhakim, *ABB*

TECHNICAL LECTURES *as of February 2, 2023*

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: DC-DC Converter Applications

ROOM W109A

SESSION CHAIRS

Xin Zhang, *IBM*

Kang Wei, *Texas Instruments*

8:30 a.m.

T01.1 **A Novel Digital Energy Management Control Strategy of a Fully Active Hybrid Converter for Unmanned Aerial Vehicle Applications**

Xueshen Zhang, *University of Rhode Island*

Hard- and Soft-Switched

AUTHORS: Xueshen Zhang, Ronald Rorrer, Yeonho Jeong

8:50 a.m.

T01.2 **A Converter Based Switching Loss Measurement Method for WBG Device**

Qiuzhe Yang, *Virginia Tech*

Hard- and Soft-Switched

AUTHORS: Qiuzhe Yang, Ahmed Nabih, Ruizhe Zhang, Qiang Li, Yuhao Zhang

9:10 a.m.

T01.3 **ZVS Clamp-Switch Quasi Z-Source DC/DC Boost Converters**

Burkhard Ulrich, *Reutlingen University*

Hard- and Soft-Switched

AUTHOR: Burkhard Ulrich

9:30 a.m.

T01.4 **Coupled Inductor Based Non-Isolated High Conversion Ratio Boost Extender**

Vikas Kumar, *Ben-Gurion University of the Negev*

Hard- and Soft-Switched

AUTHORS: Vikas Kumar Rathore, Michael Evzelman, Mor Mordechai Peretz

9:50 a.m.

T01.5 **Design and Implementation of a Multiport System for Solar EV Applications**

Reza Rezaii, *University of Central Florida*

Bidirectional dc/dc Converters

AUTHORS: Reza Rezaii, Mohammad Nilian, Sumana Ghosh, Mohamed Tamasas Elrais, Md Safayatullah, Fahad Alaqi, Issa Batarseh

10:40 a.m.

T01.6 **Wide Output Range High Efficiency MHz DC/DC for PD3.1 Charger**

Gao Fan, *silergy*

Hard- and Soft-Switched

AUTHORS: Gao Fan, Yu Qi, Wei Chen, Chen Zhao, Kaiwei Yao

11:00 a.m.

T01.7 **A 40W Dual-Inductor Hybrid Converter with Flying-Capacitor-Tapped Auxiliary Stage for Fast Transient Response in 48V PoL Automotive Applications**

Nameer Khan, *University of Toronto*

Point-of-Load (PoL) and Multi-Phase Converters

AUTHORS: Nameer Khan, Katherine Liang, Tristan Robitaille, Gerard Villar Piqué, John Pigott, Henk Jan Bergveld, Olivier Trescases

11:20 a.m.

T01.8 **A Power Boost Technique for the Isolated Modular Multilevel DC-DC Converter Based on Sub-Module Capacitor Voltages Ripple**

Shiyuan Yin, *Georgia Institute of Technology*

Bidirectional dc/dc Converters

AUTHORS: Shiyuan Yin, Mahmoud Mehrabankhomartash, Deepak Divan, Maryam Saeedifard

8:30 a.m. – 12:00 p.m.

T02: Modeling & Design of Power Converters

ROOM W101

SESSION CHAIRS

Satarupa Bal, *Eaton*

Suman Debnath, *Oak Ridge National Laboratory*

8:30 a.m.

T02.1 **Modeling and Validation of Common-Mode Emissions of SiC MOSFET-Based Voltage Source Inverter Motor Drive**

Tianchen Li, *University of Wisconsin-Milwaukee*

Circuits and Systems

AUTHORS: Tianchen Li, Jacob Gudex, Ryan Olson, Hassan Abdallah, Robert Cuzner, Jason Katcha

8:50 a.m.

T02.2 **Simple Radiated Noise Estimation Based on Datasets of SiC and Si IPMs for Inverter Use**

Toshiya Tadakuma, *Mitsubishi Electric Corporation*

Rapid Prototyping

AUTHORS: Toshiya Tadakuma, Michael Rogers, Motonobu Joko

9:10 a.m.

T02.3 **Frequency Response Characterization of High-Bandwidth Current Viewing Resistors Used in Dynamic Testing of Power Semiconductors**

Sergio Jimenez, *The University of Alabama*

Device and Component Modeling

AUTHORS: Sergio Jimenez, Blake Nelson, Austin Curbow, Andrew Lemmon, Christopher New

9:30 a.m.

T02.4 **Inductance and Parasitic Capacitance Modeling of Spiral Air-Core Inductor in MHz Inductive Power Transfer System**

Jiasheng Huang, *Technical University of Denmark*

Parasitics

AUTHORS: Jiasheng Huang, Yi Dou, Pinhe Wang, Ziwei Ouyang, Michael A. E. Andersen

9:50 a.m.

T02.5 **Loss Estimation and Design of DC-DC Converters Using Physics- and Data-Based Component Models**

Skye Reese, *University of Colorado Boulder*

Circuits and Systems

AUTHORS: Skye Reese, Bailey Sauter, Subodh Khandelwal, Aakash Kamalapur, Thomas Byrd, John Haddon, Dragan Maksimović

10:40 a.m.

T02.6 **Analytical Modelling of SiC MOSFET Based on Datasheet Parameters Considering the Dynamic Transfer Characteristics and Channel Resistance Dependency on the Drain Voltage**

Hemanth Betha, *University of Sheffield*

Device and Component Modeling

AUTHORS: Hemanth Betha, Milijana Odavic, Kais Atallah

11:00 a.m.

T02.7 **Modeling Non-Linearities of Power Electronic Converters Using Artificial Neural Networks**

Andrea Zilio, *University Of Padova*

Circuits and Systems

AUTHORS: Andrea Zilio, Davide Biadene, Tommaso Caldognetto, Paolo Mattavelli

11:20 a.m.

T02.8 **Novel Gerber File-Based Numerical Modeling and Simulation for Thermal Analysis of Printed Circuit Boards**

Paul Ziegenfelder, *Utah State University*

Software Tools

AUTHORS: Paul Ziegenfelder, Hongjie Wang, Nicholas Roberts

11:40 a.m.

T02.9 **An Empirical Capacity Estimation Model for Lithium-Ion Battery Cells Using Surface Temperature and Terminal Voltage Measurements**

Ala Hussein, *University of Central Florida*

Device and Component Modeling

AUTHOR: Ala Hussein

8:30 a.m. – 12:00 p.m.

T03: Power Electronic Converters for Renewable Energy System Applications

ROOM W102

SESSION CHAIRS

Qingxuan Ma, *ABB*

Weiqiang Chen, *ABB*

8:30 a.m.

T03.1 **A Novel Transformerless Single-Phase Three-Level Buck-Boost Inverter**

Eyyup Demirkutlu, *ASELSAN*

Photovoltaic (PV) Inverters and Micro Inverters

AUTHORS: Eyyup Demirkutlu, Ires Iskender

8:50 a.m.

T03.2 **Circulating Current Reduction of Back-to-Back MMC with Advanced Grid-Support Functionalities for Medium-Voltage Applications**

Vikram Roy, *National Renewable Energy Laboratory*

Grid-Tied Systems

AUTHORS: Vikram Roy Chowdhury, Akanksha Singh, Barry Mather

9:10 a.m.

T03.3 **A Line-Frequency Transformer-Less High Frequency Medium Voltage PV Grid Connected Inverter with Extended High Voltage Gain Range**

Mehdi Abbasi, *York University*

Photovoltaic (PV) Inverters and Micro Inverters

AUTHORS: Mehdi Abbasi, Kajanan Kanathipan, Muhammad Ali Masood Cheema, John Lam

9:30 a.m.

T03.4 **A Three-Port Non-Isolated High Voltage Conversion Ratio DC-DC Converter for MPPT Extraction of Photovoltaic Systems**

Pedram Chavoshipour, *University of Arkansas*

Maximum power point tracking (MPPT)

AUTHORS: Pedram Chavoshipour Heris, Zahra Saadatizadeh, H. Alan Mantooth

9:50 a.m.

T03.5 **Active Power Filter Capability of a 10 kV SiC MOSFET-Based Asynchronous Microgrid Power Conditioning System**

Dingrui Li, *The University of Tennessee*

Microgrid Systems

AUTHORS: Dingrui Li, Cheng Nie, Xingxuan Huang, Min Lin, Fei Fred Wang, Leon M. Tolbert

10:40 a.m.

T03.6 **A Novel Beat Frequency Modulated Single-Stage Soft-Switched Microinverter**

Milad Heidari, *University of Alberta*

Photovoltaic (PV) Inverters and Micro Inverters

AUTHORS: Milad Heidari Khouzani, Mohammad Ebrahimi, Sayed Ali Khajehoddin

11:00 a.m.

T03.7 **A GaN Variable-Frequency Series Resonant Dual-Active-Bridge Bidirectional AC-DC Converter for Battery Energy Storage System**

Huanghaohe Zou, *The University of Texas at Austin*

Bi-directional Power Converters

AUTHORS: Huanghaohe Zou, Ruiyang Yu, Rishab Anand, Junhong Tong, Alex Q. Huang

11:20 a.m.

T03.8 **Design and Testing of a 13.8 kV/ 1.1MVA 3-Phase 5-Level Flying Capacitor Converter with 10 kV SiC MOSFETs**

Xiang Lin, *Virginia Polytechnic Institute and State University*

Grid-Tied Systems

AUTHORS: Xiang Lin, David Nam, Ning Yan, Joshua Stewart, Arthur Mendes, Dong Dong, Rolando Burgos, Dushan Boroyevich

11:40 a.m.

T03.9 **A Single-Stage Isolated Bi-Directional Micro-Inverter Building Block for Off-Grid Energy Access**

Ruomu Hao, *Georgia Institute of Technology*

Photovoltaic (PV) Inverters and Micro Inverters

AUTHORS: Ruomu Hao, Bradford Houska, Decheng Yan, Kartavya Agarwal, Aniruddh Marellapudi, Shreyas Kulkarni, Joseph Benzaquen, Deepak Divan

8:30 a.m. – 12:00 p.m.

T04: SiC Power Devices

ROOM W103

SESSION CHAIRS

Fei Yang, *Texas Instruments*

Fang Luo, *Stony Brook University*

8:30 a.m.

T04.1 **Comparison of SiC MOSFET Thermal Performance Under Different PWM Strategies**

Yu Zou, *Saginaw Valley State Univ.*

SiC MOSFETs and BJTs

AUTHORS: Yu Zou, Jonathon Damzyn, Sandun Kuruppu

8:50 a.m.

T04.2 **ClampDRIVE: An Improved Technique for SiC Cascode FET Switching Behavior Control**

Xueqing Larry, *United Silicon Carbide, Inc Qorvo*

SiC MOSFETs and BJTs

AUTHORS: Xueqing Larry Li, Anup Bhalla, Pete Losee

9:10 a.m.

T04.3 **10 kV SiC Thyristor for High Voltage Pulsed Power Generators**

Koji Nakayama, *National Institute of Advanced Industrial Science and Technology*

SiC MOSFETs and BJTs

AUTHORS: Koji Nakayama, Yasunori Tanaka, Tomohisa Kato, Kazutoshi Kojima, Mitsuru Sometani, Yoshiyuki Yonezawa

9:30 a.m.

T04.4 **Using a Digital Gate Driver to Improve the Performance of Silicon Carbide MOSFETs**
Vipin Gaonkar, *Microchip Technology (India) Private Limited*
SiC MOSFETs and BJTs
AUTHORS: Vipin Gaonkar, Nitesh Satheesh

9:50 a.m.

T04.5 **A Self-Powered Bidirectional DC Solid-State Circuit Breaker Based on SiC JFETs**
Daixin Chen, *Hunan University*
SiC MOSFETs and BJTs
AUTHORS: Daixin Chen, Wei Wang, Lili He, Yang Li, Zhikang Shuai

10:40 a.m.

T04.6 **Impact of Diode Characteristics on 1.2 kV SiC MOSFET and Cascode JFET Efficiency: Body Diodes Vs SiC Schottky Barrier Diodes**
Mohammed Amer, *University of Warwick*
SiC MOSFETs and BJTs
AUTHORS: Mohammed Amer Karout, Mohamed Taha, Olayiwola Alatise, Arkadeep Deb, Craig A. Fisher, Philip Mawby

11:00 a.m.

T04.7 **Analysis and Characterization of Four-Quadrant Switches Based Commutation Cell**
Ramandeep Narwal, *North Carolina State University*
SiC MOSFETs and BJTs
AUTHORS: Ramandeep Narwal, Shubham Rawat, Ajit Kanale, Tzu-Hsuan Cheng, Aditi Agarwal, Subhashish Bhattacharya, Bantval Jayant Baliga, Douglas C. Hopkins

11:20 a.m.

T04.8 **Design Considerations for Series-Connected SiC MOSFETs Operating at 100 kV/µs**
Tobias Nieckula, *Norwegian University of Science and Technology*
SiC MOSFETs and BJTs
AUTHORS: Tobias Nieckula Ubostad, Dimosthenis Peftitsis

8:30 a.m. – 12:00 p.m.

T05: Multilevel Inverter & Modulation Techniques

ROOM W109B

SESSION CHAIRS

Ali Safayet, *Michigan State University*

Woongkul Lee, *Michigan State University*

8:30 a.m.

T05.1 **A Segmented Electric Aircraft Drivetrain Employing 10-Level Flying Capacitor Multi-Level Dual-Interleaved Power Modules**
Roderick Bayliss, *University of California, Berkeley*
High Performance Drives
AUTHORS: Roderick Bayliss III, Rahul Iyer, Richard Liou, Robert Pilawa-Podgurski

8:50 a.m.

T05.2 **An Enhanced PWM Scheme of Three-Level T-Type Inverter for Loss Balance and Reduction**
Xingchen Zhao, *Virginia Polytechnic Institute and State University Center for Power Electronics (CPES)*
Single- and Multi-Phase Inverters
AUTHORS: Xingchen Zhao, Che-Wei Chang, Ripun Phukan, Rolando Burgos, Dong Dong

9:10 a.m.

T05.3 **Comprehensive Electromagnetic Interference Analysis of Neutral-Point-Less (NPL) Multilevel Inverter with Active Common-Mode Voltage Cancellation**
Kangbeen Lee, *Michigan State University*
High Performance Drives
AUTHORS: Kangbeen Lee, Mikayla Benson, Mostafa Fereydoonian, Xiaofeng Dong, Jinyeong Moon, Woongkul Lee

9:30 a.m.

T05.4 **Voltage Balancing of a New Five-Level Multilevel Inverter with a Modified Carrier Pulse Width Modulation Scheme**
Mohan Ram, *Lakehead University*
Single- and Multi-Phase Inverters
AUTHORS: Mohan Ram Selvaraj, Apparao Dekka, Deepak Ronanki, Abdul R Beig

9:50 a.m.

T05.5 **A Novel One-Dimension Space Vector Strategy for Multilevel Cascaded Inverters**
Jiale Zhou, *University of North Carolina at Charlotte*
Single- and Multi-Phase Inverters
AUTHORS: Jiale Zhou, Haichen Liu, Tiefu Zhao, Xiaoqiang Guo

10:40 a.m.

T05.6 **Four Legs Clamping Modulation Technique of Dual Inverter with Isolated DC Bus for Reduction of Switching Loss Considering Power Factor**

Tae-Hyeong Kim, *Dankook University*

Single- and Multi-Phase Inverters

AUTHORS: Tae-Hyeong Kim, Bum-Ryeol Yoon, June-Hee Lee, June-Seok Lee

11:00 a.m.

T05.7 **LLC Resonant Converter Based Single-Stage Inverter with Multi-Resonant Branches Using Variable Frequency Modulation**

Dong Jiao, *Virginia Polytechnic Institute and State University*

Single- and Multi-Phase Inverters

AUTHORS: Dong Jiao, Hao Wen, Jih-Sheng Lai

11:20 a.m.

T05.8 **Analytical Device Currents Formulation for a Space-Vector Modulated Voltage Source Inverter with Dead-Time Consideration**

Kaushik Mirdoddi, *Indian Institute of Technology Delhi*

Single- and Multi-Phase Inverters

AUTHORS: Kaushik Mirdoddi, K Gopikrishnan, Soumya Shubhra Nag

8:30 a.m. – 12:00 p.m.

T06: Gate Drive Circuits

ROOM W104

SESSION CHAIRS

Seungdeog Choi, *Mississippi State University*

Davide Giacomini, *Infineon Technologies AG*

8:30 a.m.

T06.1 **Active Clamp Circuit for Online ON-State Voltage Measurement of High Voltage SiC MOSFETs Power Module**

Antoine Laspeyres, *Nantes Université CNRS IETR UMR 6164 F-44000 Nantes*

Gate Drive Circuits

AUTHORS: Antoine Laspeyres, Anne-Sophie Descamps, Christophe Batard, Nicolas Ginot, Thanh-Long Le, Stéphane Azzopardi

8:50 a.m.

T06.2 **A Gate Driver IC for GaN-Based Synchronous Buck Converter with a Double-Sided Adaptive Dead-Time Generator**

Giao Huu, *Department of Electrical Engineering National Taiwan University*

Gate Drive Circuits

AUTHORS: Giao Huu Thuc, Ching-Jan Chen

9:10 a.m.

T06.3 **A Novel Series-Parallel Design of the 3.6kV/400A SiC Austin SuperMOS**

Liqi Zhang, *UT AUSTIN*

Gate Drive Circuits

AUTHORS: Liqi Zhang, Zhicheng Guo, Soumik Sen, Chen Chen, Alex Q. Huang

9:30 a.m.

T06.4 **Gate Driver Chip-Set Using Low Volt-Second Pulse Transformer for Galvanic Signal Isolation**

Brendan O'Sullivan, *Tyndall National Institute, University College Cork*

Gate Drive Circuits

AUTHORS: Brendan O'Sullivan, Zoran Pavlovic, Norbert Fiebig, Cian O'Mathuna, Séamus O'Driscoll

9:50 a.m.

T06.5 **Partial Discharge Characterization of Solid-Dielectric-Based Transformer Under High Frequency High dv/dt PWM Voltage for MV Applications**

Zhehui Guo, *Center for Advanced Power Systems Florida State University*

Gate Drive Circuits

AUTHORS: Zhehui Guo, Hui Li, Peter Cheetham, Nagaraju Guvvala

10:40 a.m.

T06.6 **Design of High Isolation and Compact Gate Driver for 6.5 kV IGBT Module in Medium Voltage Converters**

Yihui Zhang, *Chongqing University*

Gate Drive Circuits

AUTHORS: Yihui Zhang, Yawei Wang, Dongsheng Wang, Hao Feng, Li Ran

11:00 a.m.

T06.7 **A Build-In Gate Driver Design for 1.7kV SiC MOSFET Module with 32-Chip Paralleled**

Liyang Du, *University of Arkansas*

Gate Drive Circuits

AUTHORS: Liyang Du, Yuxiang Chen, Xia Du, Haodong Yang, Hao Chen, H. Alan Mantooth

11:20 a.m.

T06.8 **Intelligent Gate Drive for Cryogenic Solid-State Circuit Breaker with Current Limitation Capability for Aviation Application**

Dehao Qin, *Clemson University*

Gate Drive Circuits

AUTHORS: Dehao Qin, Zheyu Zhang, Shimul K. Dam, Ching-Hsiang Yang, Zhou Dong, Ruirui Chen, Hua Kevin Bai, Fei Fred Wang

11:40 a.m.

T06.9 **Dynamic Gate Drive for SiC Power MOSFETs with Sub-Nanosecond Timings**
Rophina Li, *University of Toronto*
Gate Drive Circuits
AUTHORS: Rophina Li, Zhaozheng Hou, Tiantian Liu, Mohamed Elshazly, Sut Leung, Xingqiang Peng, Wai Tung Ng

8:30 a.m. – 12:00 p.m.

T07: Design Techniques for SiC Power Modules

ROOM W105

SESSION CHAIRS

Qing Ye, *Texas Instruments*

Dorai Yelaverthi, *Utah State University*

8:30 a.m.

T07.1 **Design, Fabrication and Testing of 3.3 kV/200A SiC Half-Bridge Power Module**
Yang Li, *Stony Brook University*
Power Electronics Packaging
AUTHORS: Yang Li, Mustafeez Ul-Hassan, Yuxuan Wu, Asif Imran Emon, Yang Xie, Shiyue Deng, Fang Luo, Amol Deshpande, Zhao Yuan, Michael McKeown

8:50 a.m.

T07.2 **10 kV SiC MOSFET Power Module with Double-Sided Jet-Impingement Cooling**
Mark Cairnie, *Virginia Tech*
Power Modules / High Density Design
AUTHORS: Mark Cairnie, Christina Dimarino

9:10 a.m.

T07.3 **A 10 kV SiC Power Module Stacked Substrate Design with Patterned Middle-Layer for Partial Discharge Reduction**
Xiaoling Li, *Univerity of Arkansas*
Power Modules / High Density Design
AUTHORS: Xiaoling Li, Hao Chen, Riya Paul, Shilpi Mukherjee, Xia Du, Robert Cuzner, Xiaoqing Song, Yue Zhao, H. Alan Mantooth

9:30 a.m.

T07.4 **Design Considerations of a 3.3 kV SiC-Based Reverse Voltage Blocking Module for Current Source Inverter Application**
Sneha Narasimhan, *NCSU*
Power Modules / High Density Design
AUTHORS: Sneha Narasimhan, Colton Sisson, Scott Leslie, Keval Parmar, Sagar Kumar Rastogi, Subhashish Bhattacharya

9:50 a.m.

T07.5 **Common Source Inductance Compensation Technique for Dynamic Current Balancing in SiC MOSFETs Parallel Operations**
Boyi Zhang, *Delta Electronics (Americas) Ltd.*
Power Modules / High Density Design
AUTHORS: Boyi Zhang, Ruxi Rudy Wang, Peter Barbosa, Yu-Hsuan Tsai, Wen-Sheng Wang, Wen-Shang Lai

10:40 a.m.

T07.6 **Fabrication and Experimental Validation of Low Inductance SiC Power Module with Integrated Microchannel Cooler**
Hao Chen, *University of Arkansas*
Power Modules / High Density Design
AUTHORS: Hao Chen, Yujui Lin, Tiwei Wei, Xiaoling Li, Riya Paul, Reece Whitt, Xiaoqing Song, Yue Zhao, Mehdi Asheghi, H. Alan Mantooth

11:00 a.m.

T07.7 **A Novel Integrated 1.2 kV Double-Sided Cooled Power Module**
Riya Paul, *University of Arkansas*
Power Modules / High Density Design
AUTHORS: Riya Paul, Rayna Alizadeh, Hao Chen, Xiaoling Li, Yuxiang Chen, H. Alan Mantooth

11:20 a.m.

T07.8 **A Guideline for Silicon Carbide MOSFET Thermal Characterization Based on Source-Drain Voltage**
Yi Zhang, *Aalborg University*
Thermal and EMC Management
AUTHORS: Yi Zhang, Yichi Zhang, Zhiliang Xu, Zhongxu Wang, Hon Wong, Zhebie Lu, Antonio Caruso

11:40 a.m.

T07.9 **A Smart Silicon Carbide Power Module with Pulse Width Modulation Over Wi-Fi and Wireless Power Transfer-Enabled Gate Driver**
Faisal Khan, *National Renewable Energy Laboratory*
Power Modules / High Density Design
AUTHORS: Faisal Khan, Sarwar Islam, Joshua Major, Adil Usman, Gilbert Moreno, Sreekant Narumanchi

8:30 a.m. – 12:00 p.m.

T08: Magnetic Technology

ROOM W108

SESSION CHAIRS

Matt Wilkowski, *EnaChip*

Adam Skorek, *University of Québec at Trois-Rivières*

8:30 a.m.

T08.1 **Vertically Stacked Piezoelectric Transformer for High-Frequency Power Amplifier**

Yuetao Hou, *Cornell University*

Advanced Magnetic Materials and Geometries

AUTHORS: Yuetao Hou, Meera Garud, Qing Ji, Arun Persaud, Peter Seidl, Thomas Schenkel, Amit Lal, Khurram Khan Afridi

8:50 a.m.

T08.2 **Origami Inductors: Foldable 3-D Polyhedron Air-Coupled Inductors for MHz Power Conversion**

Tanuj Sen, *Princeton University*

Advanced Magnetic Materials and Geometries

AUTHORS: Tanuj Sen, Youssef Elasser, Minjie Chen

9:10 a.m.

T08.3 **Diamond-Window Resonant Inductor with Significant AC Flux**

Cong Tu, *Virginia Polytechnic Institute and State University*

Advanced Magnetic Materials and Geometries

AUTHORS: Cong Tu, Khai Ngo, Xipei Yu

9:30 a.m.

T08.4 **Extra Switching Losses Caused by Parasitic Capacitance in Medium-Voltage Filter Inductors with Grounded Cores**

Hongbo Zhao, *AAU Energy*

Magnetics Applications

AUTHORS: Hongbo Zhao, Gao Liu, Morten Rahr Nielsen, Martin Kjær, Benjamin Futtrup Kjærsgaard, Zhixing Yan, Rui Wang, Dipen Narendra Dalal, Bjørn Rannestad, Stig Munk-Nielsen

9:50 a.m.

T08.5 **PCB Winding-Based Coupled Inductor for a High-Frequency DC/DC Converter with 99% Efficiency**

Shuo Wang, *Virginia Tech*

Magnetics Applications

AUTHORS: Shuo Wang, Phu Hieu Pham, Qiang Li, Ahmed Nabih, Pranav Raj Prakash

10:40 a.m.

T08.6 **Design and Comparison of FR4 and Flex PCB Transformers for High Frequency High Current, Low Profile Applications**

Minh Ngo, *Virginia Polytechnic Institute and State University*

High-frequency Magnetics

AUTHORS: Minh Ngo, Yuliang Cao, Dong Dong, Rolando Burgos, John Noon, Heath Kouns

11:00 a.m.

T08.7 **A High Frequency Resonant Push-Pull Converter with a Single Integrated Magnetic Component**

Nikolai Weitz, *Friedrich-Alexander-Universität Erlangen-Nürnberg*

High-frequency Magnetics

AUTHORS: Nikolai Weitz, Stefan Ehrlich, Patrizia Freundl, Jens Schültzke, Martin März

11:20 a.m.

T08.8 **Transformer Structure of Bifilar Primary Winding with Advanced Common Mode Noise Attenuation Performance for Isolated DC-DC Converters**

Qinghui Huang, *University of Florida*

High-frequency Magnetics

AUTHORS: Qinghui Huang, Yirui Yang, Zhedong Ma, Yanwen Lai, Shuo Wang

11:40 a.m.

T08.9 **A High-Efficiency Modular Air-Cooling Method for PCB Winding with the Additive Manufacturing**

Yizhi Ruan, *Virginia Tech*

Additive Manufacturing

AUTHORS: Yizhi Ruan, Yuliang Cao, Dong Dong, Qiang Li

RAP SESSIONS

The APEC 2023 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.

4:30 p.m. – 6:00 p.m.

RAP SESSION 1:
Batteries Versus Fuel Cells for Future Electrification Applications

ROOM: W109A

CHAIR:
Sheldon Williamson, *Ontario Tech University*

PANELISTS:

- **Gui-Jia Su,** *Oak Ridge National Laboratory (ORNL)*
- **Deeana Ahmed,** *Our Next Energy (ONE)*
- **Uday Deshpande,** *D&V Electronics*
- **Rick Szymczyk,** *Upstartz Energy*

This RAP Session will discuss the opportunities and challenges posed by both batteries and fuel cells for electrified transportation and e-mobility of the future. The discussion will highlight the inherent differences in the current state of batteries and hydrogen fuel cell technologies as it relates to e-propulsion and related charging infrastructure. Some of the key technological barriers for current and future batteries, as well as fuel cells, will be discussed. Topics that will be discussed include, but are not limited to, driving range, powertrain efficiency, well-to-wheels efficiency, practicality of implementation, charging/refueling facilities, durability, sustainability, and availability.

4:30 p.m. – 6:00 p.m.

RAP SESSION 2:
Topologies and Circuits for Power Supply on Chip (PWRSOC) Versus Discrete Implementations

ROOM: W110

CHAIR:
Hanh-Phuc Le, *University of San Diego Jacobs School of Engineering*

PANELISTS:

- **Alex Prodic,** *University of Toronto, Edward S. Rogers Sr. Department of Electrical & Computer Engineering*
- **Santosh Kulkarni,** *Renesas Electronics Corporation*
- **Dragan Maksimovic,** *University of Colorado Boulder*
- **Robert Pilawa-Podgurski,** *University of California, Berkley Electrical Engineering and Computer Sciences*

Efficient power delivery and management has never been more critically needed across virtually all electronic devices and systems. The challenges for power management in these systems are emerging simultaneously in power efficiency, power density, size, reliability, cost and EMI. We, those who identify ourselves as power electronics circuit designers at APEC, often deploy our expertise in topologies and circuits to address these needs and challenges. However, there are also different and sometimes conflicting opinions and ideas about what topologies and circuits are suitable for different applications, particularly for Power Supply on chip (PwrSoC) versus Discrete implementations on PCB. How many more new topologies and circuits do we still need for each of these application directions? And what's next in the future for topologies and circuits? Come join the panel of experts in a very interactive debate to get your questions answered, learn about the state-of-the-art, debate your opinion, and explore the future of topologies and circuits design in PwrSoC and discrete implementations!

4:30 p.m. – 6:00 p.m.

RAP SESSION 3:
Where Does High Impact Innovation in Power Electronics Come From: Academia or Industry?

ROOM: W109B

CHAIR:
Eric Persson, *Infineon Technologies*

PANELISTS:

- **Christina DiMarino,** *Virginia Tech, Center for Power Electronics Systems*
- **Johann W. Kolar,** *ETH Zurich, Power Electronic Systems Laboratory*
- **Thomas Byrd,** *Lockheed Martin, Power Electronics and Power Systems*
- **Laszlo Balogh,** *Texas Instruments*

This RAP session will feature a panel of academic versus industry research leaders. We will cover a range of topics including which institutions are better suited for different types of research, the role of government funding, how intellectual property rights are handled and how to structure research partnerships that deliver the best results for both parties. Come join the panel of experts from the industry and academia in a very interactive debate to learn about research in academia versus industry and get your questions answered.

EXHIBITOR SEMINARS *as of February 2, 2023*

APEC 2023 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.

1:30 p.m. – 2:00 p.m.

Exhibitor Seminars – Session 1

Aehr Test Systems
ROOM W102B

Wafer Level Test & Burn-in of Silicon Carbide and Gallium Nitride Devices

PRESENTED BY: **Vernon Rogers**

To meet the quality and reliability needs of the automotive industry, silicon carbide and gallium nitride manufacturers are moving to wafer level test & burn-in for their devices. Aehr Test Systems FOX-P platform provides complete production solutions for improving yield and reliability of semiconductors for electric vehicles and electrification of the worldwide infrastructure along with consumer applications and for photovoltaic and automotive applications.

Alpha and Omega Semiconductor
ROOM W103A

TOLL4Tough™

PRESENTED BY: **Steven Goldman**

This brief presentation will explain the benefits of TO-Leadless (TOLL) packaging and the advantages of the Alpha & Omega TOLL specifically. Improve performance physically, current handling, power density, etc. Learn the benefits of Motor Drive, Load Switch, and Power Supply designs. TOLL4Tools™, TOLL4Torque™, TOLL-4Tough™.

CAEN Technologies
ROOM W202B

Battery Cell Testing with 24-bit Multi-functional Testers

PRESENTED BY: **Erik Soiman**

This session will showcase 24-bit multi-functional battery cell testers from CAEN ELS. The various types of battery tests possible from a single unit will be showcased, along with the high-sampling rates and graphical interfaces available for visualizing and offloading large amounts of data for R&D.

Cambridge GaN Devices
ROOM W203A

ICeGaN™ 650V Power GaN ICs Bring Efficiency, Robustness and Reliability for High Power Applications to the Next Level

PRESENTED BY: **Giorgia Longobardi**

Cambridge GaN Devices (CGD) have introduced ICeGaN™ technology at APEC2022: this is a SOC solution for HV GaN which greatly improves robustness and reliability of enhancement mode 650V GaN transistors by combining power and logic in the same chip. In this seminar CGD will demonstrate the scalability of the technology as well as stable, reliable and easy to use drive, thanks to a GaN interface attached to the gate and by bringing Vth to unprecedented levels (3V). The benefits of extended voltage range, up to 20 V, are also discussed: no negative voltage required and external components, integrated current sensing and Miller clamp for safe turn-off and gate protection and integrated ESD protection.

Cleverscope
ROOM W204A

Using a High Bandwidth Loss Probe to Measure SiC and GAN FETs Losses with a Lower Bandwidth Oscilloscope

PRESENTED BY: **Ken Henderson**

Describes a 2GHz Bandwidth Loss Probe for measuring GAN and SicFET losses using analog techniques to avoid the cost of very high bandwidth isolated probes and oscilloscope.

Nexperia
EXPO HALL THEATER #1

Enabling the Future with Nexperia Wide Bandgap and High Voltage Technologies

PRESENTED BY: **Jim Honea**

The need for new energy solutions is growing rapidly. Wide bandgap materials, especially Silicon Carbide and Gallium Nitride, are the future of energy conversion designs. Nexperia is combining it's long tradition of reliable manufacturing expertise with strong innovation in the latest technologies to bring ideal solutions for a broad range of energy conversion requirements.

OPAL-RT TECHNOLOGIES
ROOM W205A

Please check the mobile app for more information.

Soitec
ROOM W205B

Soitec Solutions, a Must-Have for EV and Autonomous Mobility Applications?

PRESENTED BY: **Alex Lim**

Soitec powers electric and autonomous vehicles. Its semiconductor materials unlock greater energy efficiency and performance, supporting sustainable automotive and industrial products and platforms. Learn more about how Our Auto Power-SOI product line addresses the requirements for integrating high- and low-voltage functions in intelligent, safer and sustainable power IC devices for automotive and industrial markets. and How Our Auto SmartSiC™ product line enables us to reach new levels of ultra high conductivity and performances of devices and of improved manufacturing yields and to reduce the environmental footprints of eMobility, industrial and smart grids applications.

STMicroelectronics
EXPO HALL THEATER #2

High Efficiency Bidirectional Dual Active Bridge (DAB) for Battery Charging Applications

PRESENTED BY: **Giuseppe Aiello**

The demand of grid interaction with battery-operated systems requires the bidirectional operating capability of battery chargers. The typical charger design is based on dual stage converter with an AC/DC section for grid connection and a DC/DC section for battery charging. In this presentation, a 25kW high voltage DAB converter with optimized modulation technique for battery charging is introduced, showing the efficiency benefits of the latest generation SiC MOSFETs combined with the high performance of a dedicated microcontroller for power conversion applications.

Wolfspeed, Inc.
ROOM W206A

The $5B Inflection Point for Motor Drives

PRESENTED BY: **Austin Curbow**

Electric motors account for 45% of global electricity consumption today, and with the adoption of standards like IEC 60034-1-30 mandating further reduction in power losses, designers will soon be scrambling to re-think their PFC and inverters designs. Join this session to see two simple ways to quickly meet impending IE4 standards with Silicon Carbide (SiC).

2:15 p.m. – 2:45 p.m.

Exhibitor Seminars – Session 2

Infineon Technologies
ROOM W204A

A new Top Side Cooling Is Setting the Future for SMD Power FETs

PRESENTED BY: **Waqas Syed**

Package parasitic limits the usage of through-hole (TH) packages in high frequency designs. This lead to the development of surface mounted device (SMD) packages. With the increasing demand of even higher power in SMPS and other applications, thermal performance of SMD packages is pushing the designs to their limits. To break free from these limitations, the top side cooled (TSC) concept from Infineon Technologies is the next step in the evolution of SMD packages. TSC packages offer all the benefits of SMD while enabling cost efficient high power density designs, system volume reduction, readiness for liquid cooling and longer system lifetime.

Lodestone Pacific
ROOM W205A

Surge Residual to Measure Surge Protection Effectiveness

PRESENTED BY: **Rich Barden**

Bantam Power Conditioners and Surge protectors keeps over 99% of destructive surge energy away from protected devices, is an excellent power conditioner, filtering EMI, RFI and harmonic distortion, improving capacitance power factor. Bantam filters Line, Neutral and Ground, maintaining a zero-ground reference and eliminating Power Line Exploitation (PLE) hacker threat. We will share actual applications with test results and explain the unique magnetic field physics that make this circuit so effective.

Navitas Semiconductor
ROOM W202B

Pure-Play, High-Speed GaNFast and GeneSiC: the Leading Edge of Next-Gen Power Semiconductors

PRESENTED BY: **Stephen Oliver**

Wide bandgap GaN and SiC power semiconductors are predicted to win 30% of the $22B/yr legacy silicon market by 2027. Even as more suppliers enter the market, the next generations of GaNFast power ICs and GeneSiC MOSFETs show clear device leadership, with demonstrated system performance, cost and sustainability advantages. From 20 W smartphone chargers, through 20 kW bi-directional EV chargers, and on to 20 MW grid

applications, proprietary monolithic GaN integration at 650/700 V and trench-assisted planar gate SiC MOSFET designs lead the charge over legacy technologies.

Nichicon (America) Corp
ROOM W102B

Energy Harvesting and the Nichicon LTO Battery

PRESENTED BY: **Jesus Torres**

Nichicon is now making batteries that are ideal for energy harvesting applications as well as battery backup. The SLB will give you design advantages over Li-ion batteries. This presentation will give you ideas on how to use the SLB.

NXP Semiconductors
ROOM W103A

High Voltage Gate Driver Trends

PRESENTED BY: **Namrata Pandya**

We will present the NXP gate drivers and solutions that help engineers improve the efficiency and the system safety in traction inverters.

PMK Mess- und Kommunikationstechnik GmbH
ROOM W205B

Please check the mobile app for more information.

Power Integrations
EXPO HALL THEATER #1

Breakdown Voltage and Reinforced Isolation – How a Better Flyback Converter is Reshaping EV Architectures

PRESENTED BY: **Peter Vaughan**

The EV industry is in a rapid cycle of innovation, striving for the automotive goal of simpler, smaller and lighter weight designs. This presentation describes how the use of a 1.7 kV flyback converter with integrated reinforced isolation provides benefits both for the converter but also new choices for the systems engineer. By simultaneously hitting all three goals while increasing performance opens architectural changes to the vehicle itself. Comparison of performance between solutions will be given, key design decisions and challenges, especially when designing for 800 V vehicles provided and the options enabled by an integrated solution discussed.

Qorvo
EXPO HALL THEATER #2

Putting Qorvo Intelligence Into a 20-cell Battery Pack with a Single-chip Solution

PRESENTED BY: **John Carpenter**

The scope and applications using battery packs are seeing exponential growth worldwide. With this trend, designers of high cell count applications such as garden and power tools, e-transportation, generators and broad industrial products are challenged with delivering more efficient, compact and cost-effective solutions. In this session, we'll introduce Qorvo's new intelligent battery management single-chip solutions that offer support for up to 20 cells in series and show how their high level of integration can save designers 50% PCB board space, lower overall BOM cost by 30% and accelerate time to market.

Semikron Danfoss
ROOM W203A

Combine Semikron Danfoss Packaging Excellence with SiC for EV Charging and Motor Drives

PRESENTED BY: **Stefan Haeuser**

From compact EV chargers to efficient motor drives, Semikron Danfoss combines reliable, flexible packaging with silicon carbide from multiple sources. This presentation explains how the newest generation of SiC chips opens the door to new possibilities for power electronics, increasing efficiency and power density.

SIMPLIS Technologies
ROOM W206A

SIMPLIS AC Analysis of PFC Circuits Using New PFC POP Trigger

PRESENTED BY: **Andrija Stupar**

The new SIMPLIS PFC POP Trigger feature enables SIMPLIS to perform a Periodic Operating Point and AC Analysis on Power Factor Correction circuits. We demonstrate how the PFC POP Trigger can be used to measure Bode plots of control loop response as well as input and output impedance.

3:00 p.m. – 3:30 p.m.

Exhibitor Seminars – Session 3

Infineon Technologies
ROOM W204A

Gate Driver ICs are Key System Components to Enable High Efficiency and Extreme Power Density in SMPS for Telecom, Data Center and Computing Applications Using the Latest GaN and SiC power Semiconductors

PRESENTED BY: **Diogo Varajao**

Overall power levels have been going up in Telecom with the introduction of 5G. Likewise, power levels increased in Data Center and Computing to supply the GPUs and CPUs used in emerging applications such as Artificial Intelligence, Computer Vision, and Machine Learning. Consequently, ever-increasing power density and efficiency requirements drive adoption of GaN and SiC switch technologies in all power conversion stages, from PFC to high-voltage and low-voltage DC-DC converters. The operation of these wide-bandgap (WBG) power transistors from hundreds of kHz to MHz, combined with fast switching transients pose new challenges for the gate driving circuit, that has to ensure safe and reliable operation in these critical infrastructure applications. In this seminar, the world's smallest dual-channel low-side gate driver ICs will be introduced. The two new package variants (TSNP-6 and SOT23-6) associated with a strong output stage enable innovative 48 V DC-DC intermediate bus converter (IBC) topologies to achieve ultra-high power density designs in high performance computing systems. Furthermore, the high accuracy of propagation delay, allows to parallel the two outputs to double the current capability and also, to minimize dead-time losses in order to reach high system efficiency. Galvanic isolated gate driver ICs are also key system components in order to provide basic and reinforced isolation to the high-voltage conversion stages (PFC and HV DC-DC). A new generation of dual-channel isolated gate driver ICs, with dedicated variants for GaN HEMTs and SiC MOSFETs will also be introduced in this seminar. These products are certified according to state-of-the-art component-level standards, IEC 60747-17 and VDE 0884-11, that introduce strict requirements regarding lifetime predictions of the isolation, specifying a total time-to-failure of at least 20 years. This product family brings new safety features such as dead-time control (DTC) and shoot-through protection (STP). Furthermore, faster undervoltage-lockout (UVLO) timing for quick reaction at start-up or after burst mode, results in fewer missing pulses, and robust system operation. The driver features a strong output stage with 5 A source/9 A sink capability and active output clamping, whilst VDD is still below UVLOon, to prevent shoot-through of boot-strapped half-bridges during start-up phase or after a burst mode. Multiple package variants (DSO 150mil/300mil, LGA 5x5 and 4x4) give flexibility to the system designer to choose the one that best fits the isolation requirements and target power density. An overview of available evaluation boards and reference designs will also be given, showing the benefits at system level provided by the featured gate driver ICs. Some of these demos will be available at the Infineon booth so that the participants can have a live closer look during the tradeshow.

Mersen
ROOM W205B

DC Fuses and Protection Strategy for EES and EV Charging Infrastructure

PRESENTED BY: **Narayan Mohan**

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.

Nexperia
EXPO HALL THEATER #1

NBM7100 – An Integrated Power Management Solution for Extending Coin Cell Battery Life In Pulsed Load IoT Applications

PRESENTED BY: **Zachary Cline**

Coin cell batteries are ubiquitous, small, economical primary battery energy sources useful for powering low voltage, low power applications. Their main disadvantages are high internal resistance and difficulty suppling pulsed loads such as common in RF IoT devices. The NBM7100 is a new, novel power management IC from Nexperia designed extend the number of Tx/Rx cycles a RF IoT device can achieve and by extension the time between battery replacement.

PowerELab Limited
ROOM W203A

Optimize Power Supply Design in Minutes - PowerEsim

PRESENTED BY: **Dr. Franki**

PowerEsim is a free on-line simulation and design tool for power supply , it give a virtual space for engineer to wind their transformer working with the whole circuit and see results in a fraction of second.

Premier Magnetics
ROOM W202B

Please check the mobile app for more information.

Rohde & Schwarz USA
ROOM W205A

Measurement Principles for Optimizing your Power Electronics Design

PRESENTED BY: **Tom Neville**

The benefits of a power electronics design can only be achieved when the half-bridge circuit, the gate drive circuit, and layout, are all properly designed and optimized. As WBG modules are not drop-in replacements, the key to successfully leveraging these improvements, especially at faster switching speeds, requires paying careful attention to measurement methodology.

Skyworks Solutions
ROOM W206A

Skyworks's Power Products Arrive in Sunny Florida

PRESENTED BY: **Rudye McGlothlin**

Skyworks has an extensive, and growing, portfolio of Isolation devices for all types of power systems. Demand for this category of product grows with every EV added to the global fleet, every solar inverter capturing energy from the bright Florida sun, and every 5G power supply energizing a base station. This exhibitor session will introduce isolation technology and Skyworks' implementation. Focus will be placed on key markets and the products showcased at the event.

Speedgoat
ROOM W102B

Full-switching Electric Drive FPGA-based Hardware-in-the-Loop Simulation

PRESENTED BY: **Steve Liu**

Learn how to perform hardware-in-the-loop testing of power electronics controllers, without leaving the MATLAB and Simulink environment. Speedgoat FPGA I/O modules are used to execute electric drive models with the required resolution and fidelity for simulating high frequency switching dynamics such as current ripple and spatial harmonics. We'll explain how to:

> Use HDL Coder Workflow Advisor and Simulink Real-Time build process to transition from desktop simulation to hardware-in-the-loop testing

> Build and execute electric motor drive models on Speedgoat FPGA-based I/O modules and connect to TI F28379D development kit

> Deploy ready-to-run reference applications to easily get started with hardware-in-the-loop testing without going through advanced modeling aspects

Stellar Industries Corp.
ROOM W103A

Please check the mobile app for more information.

Tektronix Inc.
EXPO HALL THEATER #2

Tips for Efficient Testing in Wide Bandgap Semiconductors – Double Pulse & High Power Safety

PRESENTED BY: **Chris Loberg**

With the growth in wide bandgap (WBG) semiconductor power devices, there is a growing need to understand the unique challenges tied to essential validation test capabilities. Double Pulse Testing is the standard method for measuring the switching parameters of WBG devices. Historically this has been a time-consuming process to set up the double pulse test. Engineers typically have to write their automation software since the instruments do not necessarily have a built-in way to configure and set up the test. Additionally, as WBG devices exceed 1000 volts and 10's if not 100's of amps when performing I-V Characterization, safety becomes more critical to protect the engineer or technician running the test. Proper safety protective gear is more important today as the world develops new high-power technologies to electrify the world. It requires that we understand how to properly enclose devices under test, properly use safety fixtures with automatic safety interlocks, correct cabling, and connectors, and wear the proper safety protective gear. This session, presented by Tektronix, will show various tips on making double pulse tests, including how to automate them. We will also cover proper safety precautions when working with high voltage, high current WBG devices and high-power instruments.

3:45 p.m. – 4:15 p.m.

Exhibitor Seminars – Session 4

ACME Electronics Corporation
ROOM W206A

A Hybrid Core Design for High Frequency Power Converters

PRESENTED BY: **Justin Lee**

The conventional approach to power inductor design for the applications of high-frequency power converters is to adopt gapped ferrite cores, while the air gap reluctance normally deteriorates the hysteresis loss. As a result of that, the power modules always suffer from the thermal and efficiency issues. In this session a novel hybrid PQ core design, as one of the examples, is demonstrated in use of ferrite P61 grade material and nanocrystalline powder cores which are specifically suitable for high-frequency applications. It leads to the further reduction on flux fringing effect and air-gap reluctance, which in turn benefits your power choke design.

Amber Semiconductor, Inc.
ROOM W203A

AC Direct Digitization of Electricity – The NEW Emerging Solid-State Standard for Power Management

PRESENTED BY: **Thar Casey**

AmberSemi is creating a new standard in power management and sensing through disruptive and patented technologies that enable electricity to be digitally controlled by software in silicon chip architecture. The technologies transform the performance capabilities and the feature potential of electrical products like solid-state circuit breakers, outlets, lighting controllers, and of semiconductor products like microcontrollers, wireless radios, sensors and others. The breakthrough technologies include:

> AC DIRECT POWER DELIVERY: DC extraction directly from the AC mains without rectifier bridges, input filtering or transformers.

> AC DIRECT POWER MANAGEMENT: Indestructible AC switch control and transient protection with arc free switching in silicon chipsets.

> AC DIRECT SENSING: Realtime, continuous sensing – thousands of times per second – of the normal and abnormal states of the AC mains.

IBS Electronics, Inc.
EXPO HALL THEATER #1

Semiconductors & Electronic Components Keeping Your Designs Ahead

PRESENTED BY: **Aldo Vasquez**

Introducing the latest semiconductor and electronic component technology for 2023 and beyond from IBS Electronics Group. Discover the widest selection of alternative semiconductor and electronic component brands for your AVL with microcontroller lead times as low as 2-4 weeks. Build supply chain resiliency and stabilize your design supply chain with IBS Electronics Group.

Keysight Technologies
ROOM W204A

New Solutions for Battery Modeling and Emulation

PRESENTED BY: **Alan Wadsworth**

Batteries are ubiquitous in our modern lives, ranging from small cells powering IoT devices and mobile phones all the way up to high-capacity batteries fueling electric vehicles. Being able to accurately model and emulate batteries across wide power ranges is therefore essential to guarantee reliable performance for small through large scale devices and development efforts. In this session, Keysight will show new software and hardware solutions that support the precise modeling, emulation, and life-cycle testing of batteries from milliwatts up to hundreds of kilowatts.

KYOCERA AVX
ROOM W103A

Please check the mobile app for more information.

Magnetics
EXPO HALL THEATER #2

High Performance Inductor Designs Using the Latest Magnetics Materials

PRESENTED BY: **Chris Turocy**

Higher frequencies and size limitations demand optimization of material choices in magnetic design. With the help of Magnetics' online design tools and high performance soft magnetic materials, engineers can quickly find high density, high efficiency, low cost solutions. This session will compare Magnetics design software estimates with measured results to evaluate material and geometry options for inductor designs.

onsemi
ROOM W205A

Online Silicon Carbide (SiC) System Level Simulation Driven by Advanced PLECS Models

PRESENTED BY: **Didier Balocco**

onsemi's new online system level simulator allows power electronic engineers to virtually test and validate onsemi's complete silicon carbide (SiC) lineup through an expansive library of customizable circuit topologies. Ultimate power is given to the user when the simulator is deployed in conjunction with advanced PLECS models where the user can control system parasitics. The simulator and PLECS models provide meaningful insights at an early stage of the power application development cycle through simulation instead of hardware fabrication and testing.

ROHM Semiconductor
ROOM W205B

Mid-Voltage GaN HEMT (EcoGaN) and Gate Driving Technology

PRESENTED BY: **Kengo Ohmori**

In general, the rated 6V gate-source voltage of GaN HEMT is far lower than that of Si such as 12V. This causes the degradation and destruction of the device, making it difficult to safely operate in ultra high-speed switching of GaN HEMT. To solve the problem, we propose [1] 8V rated gate voltage GaN HEMT (EcoGaN). [2] unique 2 step overshoot gate-source voltage reduction circuit. By combining the two technologies, we achieved high efficiency of 94 % at 1 MHz, 48 Vin, 12 Vo / 8A half-bridge topology.

Sumida America Inc.
ROOM W102B

Please check the mobile app for more information.

TT Electronics
ROOM W202B

Resistor Selection for Pulse Sensitive Applications

PRESENTED BY: **Tom Morris**

In this presentation, various resistor types are discussed, such as thick film, metal film, metal oxide, wirewound, and composition, along with thru hole and surface mounted configurations. Each has unique characteristics in pulse and surge conditions. Additionally, construction features of various resistor technologies are reviewed to help the design and quality engineer to select and help ascertain the pulse/surge characteristics and to optimally select the proper resistor for the application. Finally, failure modes and failure characteristics for pulse/surge conditions are discussed for various resistor types.

8:30 a.m. – 11:55 a.m.

IS07: Power Modules for Traction Drive Applications

ROOM W203ABC

SESSION CHAIRS

Lincoln Xue, *Oak Ridge National Lab*

Shajjad Chowdhury, *Oak Ridge National Lab*

8:30 a.m.

IS07.1 **Power-dense Engine Coolant Capable 200kw 1050vdc Inverter Enabled by Highly Integrated Six-pack Sic Power Module**
Brij Singh, *John Deere*

8:55 a.m.

IS07.2 **Advanced Substrate Materials for Power Modules**
Glenn Catlin, *DuPont Silicon Valley Technology Center (SVTC)*

9:20 a.m.

IS07.3 **Improving Heat Conduction of Insulated Metal Substrate with Advanced Ceramic Materials for SiC Power Module Packaging**
Wei Fan, *Momentive Technologies Inc*

9:45 a.m.

IS07.4 **Packaging of Double-Side Cooled SiC Power Module for 100 kW/Liter Traction Inverter**
Guo-Quan (GQ), *Virginia Tech*

10:40 a.m.

IS07.5 **Power Module Architectures for Traction Drive Applications**
Alan Mantooth, *University of Arkansas*

11:05 a.m.

IS07.6 **Power Module with Electrical and Thermal Integration**
Lincoln Xue, *Oak Ridge National Lab*

11:30 a.m.

IS07.7 **Thermomechanical Reliability Aspects of Automotive Power Electronics Current Status and Future Trends**
Douglas DeVoto, *NREL*

8:30 a.m. – 11:55 a.m.

IS08: Integrated WBG Semiconductors – Enhancing Power Density and Reducing Part Count

ROOM W206

SESSION CHAIRS

Ajay Hari, *Onsemi*

Llew Vaughan-Edmunds, *Navitas Semiconductor*

8:30 a.m.

IS08.1 **Power Steering Application Using eGaN® Integrated Circuit**
Marco Palma, *Efficient Power Conversion*

8:55 a.m.

IS08.2 **Half Bridge GaN Power IC Simplify Active Clamp Fly-back Design for High Power Density Chargers**
Max Wang, *Texas Instruments*

9:20 a.m.

IS08.3 **High-Voltage GaN Power ICs: Strengths, Gaps, and Opportunities**
Olivier Trescases, *University of Toronto*

9:45 a.m.

IS08.4 **Future Prospects on Monolithic GaN Versus Discrete GaN for Power**
Mike Wens, *MinDCet NV*

10:40 a.m.

IS08.5 **Integrated GaN Solution for LV Applications: Bringing Efficiency and Operating Frequency to the Next Level**
Pengju Kong, *Innoscience*

11:05 a.m.

IS08.6 **Integrated GaN Partitioning: Challenges and Solutions**
Anthony Sanders, *Infineon*

11:30 a.m.

IS08.7 **Optimizing Your Plate at the Power Semiconductor Technology Buffet**
Doug Bailey, *POWi*

8:30 a.m. – 11:55 a.m.

IS09: AC-DC Converter Applications

ROOM W204ABC

SESSION CHAIRS

Francesco Di, *Infineon Technologies*

Alessandro Pevere, *Infineon Technologies*

8:30 a.m.

IS09.1 **Control Challenges in a Totem Pole Bridgeless PFC**
Sheng-Yang Yu, *Texas Instruments, Inc.*

8:55 a.m.

IS09.2 **Compact and Efficient AC/DC Power Supply for Edge Computing Outdoor Applications**
Alessandro Pevere, *Infineon Technologies*

9:20 a.m.

IS09.3 **EMI Filter and Modulation Optimization for Power Factor Correction in Avionic Applications**
Roberto Scibilia, *Texas Instruments*

9:45 a.m.

IS09.4 **Comparison of ZVS Topologies for 250W AC/DC Battery Chargers**
Sarmad Abedin, *Texas Instruments*

10:40 a.m.

IS09.5 **Design Optimization of Hybrid Technology PFC Stage in Bidirectional on Board Charger with WBG Power Semiconductors**
Giuseppe Aiello, *STMicroelectronics*

11:05 a.m.

IS09.6 **Comparison of Methods for Parallel Operation of Boost Power Factor Converters**
Richard Hester, *Power Integrations*

11:30 a.m.

IS09.7 **The Effect of Power Factor Correction (PFC) in Optimizing Efficiency and Regulation in a 720 W LLC Resonant SMPS**
MC De, *Power Integrations*

8:30 a.m. – 11:55 a.m.

IS10: Latest 3D-Packaging Technology for Power Electronics

ROOM W205BC

SESSION CHAIRS

John Bultitude, *Kemet Corporation*

Brian Narveson, *Narveson Innovative Consulting*

8:30 a.m.

IS10.1 **Manufacturing Challenges and Qualification of 3D Packaging**
Charles Woychik, *Skywater Technology Foundry*

8:55 a.m.

IS10.2 **Sintering Innovations for Power Electronics Packaging & Assembly**
Gyan Dutt, *MacDermid Alpha Electronics Solutions*

9:20 a.m.

IS10.3 **Voice of the Customer presentation on Form Factor by IBM**
Eric Swenson, *IBM*

9:45 a.m.

IS10.4 **Aluminium liquid cooled heatsink and Friction Stir Welding (FSW): a High Efficiency and Low-cost Solution for EV Thermal Management**
Laurent Dubourg, *Stirweld*

10:40 a.m.

IS10.5 **Power Module Packaging Using Direct Write Technology**
Mark Poliks, *Binghamton University*

11:05 a.m.

IS10.6 **Power Electronics Packaging – Engineering Art and System Perspective**
Richard Zhang, *Virginia Tech CPES*

11:30 a.m.

IS10.7 **Scalable Magnetic Thin Film Multilayering Technology for Power Inductor Integration in Laminates**
Pulugurtha Raj, *Florida International University*

8:30 a.m. – 11:55 a.m.

IS11: Motor Drives and Control

ROOM W202BC

SESSION CHAIRS

Lei Han, *Infineon Technologies*

Nathan Croft, *Dyson*

8:30 a.m.

IS11.1 **High Frequency Impact on Electrical Motors and Drives**
Eslam Alfawy, *Infineon technologies AG*

8:55 a.m.

IS11.2 **A Novel Method for Sensorless Control of a Single-Phase Brushless DC Motor Based on Flux Observation**
John Emmanuel, *Power Integrations*

9:20 a.m.

IS11.3 **Novel Alignment and Start-Up Methodology for Sensorless Single-Phase BLDC Motors with an Asymmetric Air Gap**
Emmanuel Antonio, *Power Integrations*

9:45 a.m.

IS11.4 **Design Considerations for Ultra-High Speed 3-Phase Motor Drive Applications**
Lei Han, *Infineon Technologies*

10:40 a.m.

IS11.5 **How to Test an Existing Power Supply for Stability and Dynamic Response**
Josh Mandelcorn, *Texas Instruments*

11:05 a.m.

IS11.6 **Finite Control Set Model Predictive Control for Power Converters Enabled by Recent 32-bit Microcontrollers**
Giuseppe Aiello, *STMicroelectronics*

11:30 a.m.

IS11.7 **Type III Voltage Compensation Strategy for Digital Average Current Control in Single-Phase Unipolar Inverters**
Lotfi Beghou, *DRS Pivotal Power Inc*

8:30 a.m. – 11:55 a.m.

IS12: Reliability – the Good, the Bad, the Risky in Preventing Catastrophe in the Industry

ROOM W205A

SESSION CHAIRS

Crystal Yannarella, *L3Harris*

Brian Zahnstecher, *PowerRox LLC*

8:30 a.m.

IS12.1 **Case for Standardized Mission Profiles for Automotive**
Peter Turlo, *onsemi*

8:55 a.m.

IS12.2 **The Safety-related Challenges of Using Lithium-ion Batteries**
Michael Pecht, *UMD*

9:20 a.m.

IS12.3 **900V GaN –Designing for Reliability**
Likun Shen, *Transphorm*

9:45 a.m.

IS12.4 **A Heirarchy of Failure Modes affecting the reliability of Embedded Software in Marine Power Conversion Applications**
Benjamin Morris, *L3Harris*

10:40 a.m.

IS12.5 **Intelligent Design of Fanless Power Supplies for Optimizing Thermal Management**
Christoph Butzhammer, *RECOM-Power*

11:05 a.m.

IS12.6 **Impacts and Methods for Design Reliability in Military Power System Applications**
Joaquin Gabriels, *L3Harris*

11:30 a.m.

IS12.7 **Electrolytic Capacitors – How to Make Sure to Achieve Desired Reliability and Application Life Performance**
Stephan Menzel, *CapXon*

1:30 p.m. – 4:45 p.m.

IS13: Gate Driver Applications

ROOM W206

SESSION CHAIRS

Joe Duigan, *Allegro Microsystems*

Emanuel-Petre Eni, *Infineon Technologies AG*

1:30 p.m.

IS13.1 **Driving GaNFETS – a Comparative Overview**
Bernard Keogh, *Allegro Microsystems*

1:55 p.m.

IS13.2 **Eliminating Unwanted Side Effects of Cross-Isolation Capacitance in High Power Switching**
Long Nguyen, *Skyworks*

2:20 p.m.

IS13.3 **Flexible SiC Gate Driver Power Supply Design Strategies**
Brett Sparkman, *Wolfspeed*

2:45 p.m.

IS13.4 **How to Achieve High Power Density for Isolated Bias Supply of SiC/IGBT Gate Drivers**
Dongbin Hou, *Texas Instruments*

3:30 p.m.

IS13.5 **How to Break an Isolated Gate Driver**
Asa Kirby, *Skyworks Solutions Inc.*

3:55 p.m.

IS13.6 **NextGen Isolated Gate Driver Features for EV/HEV Traction Inverter**
Andy Robles, *Texas Instruments*

4:20 p.m.

IS13.7 **Pushing the Frontiers of Wide-Bandgap Converters: High Performance SiC Gate-Driving**
Mike Wens, *MinDCet NV*

1:30 p.m. – 4:45 p.m.

IS14: DC-DC Converter Applications

ROOM W203ABC

SESSION CHAIRS

Diego Raffo, *Infineon Technologies*

Joseph Khayat, *Texas Instruments*

1:30 p.m.

IS14.1 **Integrated Smart GaN Device for Low Voltage Bidirectional Buck Converter in Mild Hybrid Applications**
Federica Cammarata, *STMicroelectronics*

1:55 p.m.

IS14.2 **Input Power Sharing and Limiting for Dual Input Power Over Ethernet Converters**
Darwin Fernandez, *Texas Instruments*

2:20 p.m.

IS14.3 **Evolution and Comparison of Magnetics for the Multiphase DC-DC Applications**
Alexandr Ikriannikov, *Analog Devices*

2:45 p.m.

IS14.4 **Achieving Low, 1-mV Output Voltage Ripple Noise from a 15-a Synchronous Buck Converter**
Sarmad Abedin, *texas instruments*

3:30 p.m.

IS14.5 **Best Practices for Driving High Power Parallel MOSFETs in a Half-Bridge Configuration**
Leslie Marquez, *Texas Instruments*

3:55 p.m.

IS14.6 **Designing an LLC Resonant Converter for Audio Applications with High Peak Load**
Ben Genereaux, *Texas Instruments*

1:30 p.m. – 4:45 p.m.

IS15: Industry Trends Driving Power Electronics

ROOM W202BC

SESSION CHAIRS

Ada Cheng, *Adaclock*

Dinesh Kithany, *Wired & Wireless Technologies (WAWT)*

1:30 p.m.

IS15.1 **A Peek Into Global Energy Revolution Policies Across Sectors**
Michael Willis, *The Color Nine Group*

1:55 p.m.

IS15.2 **How Wireless Charging Facilitates the Journey Towards Autonomous Driving**
Milisav Danilovic, *WiTricity*

2:20 p.m.

IS15.3 **Energy Storage Market and Manufacturing: Challenges and Opportunities**
Brian Casey, *Celestica*

2:45 p.m.

IS15.4 **Wireless Power Gains Adoption Across Low and Ultra-High-Powered Applications**
Dinesh Kithany, *Wired & Wireless Technologies (WAWT)*

3:30 p.m.

IS15.5 **Roadmap for Smart Manufacturing in Electronics Manufacturing**
Francis Mullany, *International Electronics Manufacturing Initiative (iNEMI)*

3:55 p.m.

IS15.6 **Power at the Heart of Medical Innovations**
Hafiz Khalid, *XP Power*

4:20 p.m.

IS15.7 **Bend the Curve! Efficiency as a Driver for a Greener Future**
Alexander Gerfer, *Würth Elektronik eiSos GmbH & Co. KG*

1:30 p.m. – 4:45 p.m.

IS16: With New Government Focus on Electrification, What Needs to Happen? What is in the Near Future?

ROOM W205BC

SESSION CHAIRS

Fred Weber, *Future Technologies Worldwide*

Fernando Salcedo, *Vehicle Technologies Office (VTO), Department of Energy (DOE)*

1:30 p.m.

IS16.1 **What are the Gaps in the Charging Infrastructure?**
Chris Whaling, *Synthesis Partners*

1:55 p.m.

IS16.2 **Bi-directional Charging Topologies – Best Ways to Get Power On and Off the Grid**
Matthias Preindl, *Columbia University*

2:20 p.m.

IS16.3 **A Summary of EVs@Scale Consortium**
John Kisacikoglu, *National Renewable Energy Laboratory (NREL)*

2:45 p.m.

IS16.4 **Key Component Advancements in Traction Inverter Technology**
Burak Ozpineci, *Oak Ridge National Laboratory*

3:30 p.m.

IS16.5 **Performance Limits of Magnetic Components and How to Achieve Them**
Lukas Mueller, *MicroMetals Inc.*

3:55 p.m.

IS16.6 **Avoiding the Speed Trap: How We Need to Rethink the EV Charging Paradigm**
Milisav Danilovic, *WiTricity*

4:20 p.m.

IS16.7 **AC vs. DC Charging: What is the Best Direction?**
Fernando Salcedo, *Vehicle Technologies Office (VTO), Department of Energy (DOE)*

1:30 p.m. – 4:45 p.m.

IS17: New Challenges and Solutions in Test and Characterization of WBG Power Devices

ROOM W204ABC

SESSION CHAIRS

Jaume Roig, *ON Semiconductor*

Stephanie Watts Butler, *WattsButler LLC*

1:30 p.m.

IS17.1 **How to Improve Power Device/Module Development Efficiency**
Michael Zimmerman, *Keysight*

1:55 p.m.

IS17.2 **Characterization of Threshold Voltage Instabilities in SiC Power MOSFETs**
Thomas Aichinger, *Infineon*

2:20 p.m.

IS17.3 **How to Correctly Select an Oscilloscope Probe for Testing WBG Power Devices**
William Kaunds, *Teledyne*

2:45 p.m.

IS17.4 **Evaluating SiC Gate Bias Voltage Instability at Wafer Level**
Vernon Rogers, *Aehr*

3:30 p.m.

IS17.5 **Testing SCSOA in SiC FETs: The Challenge of Delivering 1000A Safely at High Voltage**
Gordon Leak, *Focused Test*

3:55 p.m.

IS17.6 **Flexible WBG Device Testing Methodology to Debug and Improve Reference Design Boards**
Srikrishna N, *Tektronix India Pvt. Ltd.*

4:20 p.m.

IS17.7 **Measurement Principles for Optimizing Your Power Electronics Design**
Mike Schnecker, *Rohde & Schwarz*

1:30 p.m. – 4:45 p.m.

IS18: Safety and Reliability

ROOM W205A

SESSION CHAIRS

Bridget O'Gorman, *Trane Technologies*

Justin Stricula, *Curtiss Wright*

1:30 p.m.

IS18.1 **105 °C Capable Supercapacitor with AEC-Q200 Qualification**
Satoshi Nishishita, *TOKIN corporation*

1:55 p.m.

IS18.2 **Designing and Testing an Automotive Power Tree to Achieve Functional Safety Goals**
Darwin Fernandez, *Texas Instruments*

2:20 p.m.

IS18.3 **Reliability Analysis of Multisource Discrete SiC MOSFET in High Performance, Long Lifetime Converters**
Andrea Bianchi, *ABB*

2:45 p.m.

IS18.4 **High End Servo Drive with Real Time Connectivity and Safety Functions**
Davide Cristaldi, *STMicroelectronics*

3:30 p.m.

IS18.5 **Replacing Electromechanical Relays in Control Systems: Are Solid-State Relays an Option?**
Wolfgang Frank, *Infineon Technologies AG*

3:55 p.m.

IS18.6 **Smarter Voltage Supervision for Future Autonomous Driving Platform**
Xiaodan Wang, *Monolithic Power System Inc.*

4:20 p.m.

IS18.7 **Reliability of Gallium Nitride Technology for Energy Conversion**
Kurt V., *VisIC Technologies Ltd.*

8:30 a.m. – 12:00 p.m.

T09: Resonant Converters

ROOM W101

SESSION CHAIRS

Bing Lu, *University of Rhode Island*

Yeonho Jeong, *University of Rhode Island*

8:30 a.m.

T09.1 **Automatic Resonant Frequency Tracking for Primary-Side Regulation LLC Based on Magnetizing Current Cancellation**

Cheng Gu, *Southeast University*

Resonant Converters

AUTHORS: Cheng Gu, Dalin Xu, Song Ding, Ziyan Zhou, Tianhao Tan, Qinsong Qian

8:50 a.m.

T09.2 **Evaluation of a High-Frequency Wide-Gain Range Series Resonant Converter with Delay Time Control for Electric Vehicle Charging**

Satyaki Mukherjee, *Delta Electronics (Americas)*

Resonant Converters

AUTHORS: Satyaki Mukherjee, Peter Barbosa

9:10 a.m.

T09.3 **Design of Series-Resonator Buck Converter with Minimal Circulating Energy**

Cong Tu, *Virginia Polytechnic Institute and State University*

Hard- and Soft-Switched

AUTHORS: Cong Tu, Khai Ngo, Xin Lou

9:30 a.m.

T09.4 **MHz-Driving Current-Fed Snubber-Less ZCS Multi-Resonant DC-DC Converter with High Step-Up Voltage Ratio**

Tomokazu Mishima, *Kobe University*

Resonant Converters

AUTHORS: Tomokazu Mishima, Shoma Shimizu, Ching-Ming Lai

9:50 a.m.

T09.5 **A Series/Parallel Magnetic-Less Step-Down Converter Based on Piezoelectric Resonators**

Wen-Chin Liu, *UCSD*

Resonant Converters

AUTHORS: Wen-Chin Liu, Patrick Mercier

10:40 a.m.

T09.6 **Load-Independent Constant-Current/Zero-Current Switching Inverter with Series Resonant Filter**

Yutaro Komiyama, *Chiba University*

Resonant Converters

AUTHORS: Yutaro Komiyama, Wenqi Zhu, Kien Nguyen, Hiroo Sekiya

11:00 a.m.

T09.7 **Design and Control of a Wide-Output-Voltage-Range Resistance Compression Network-Based Resonant DC-DC Converter with Synchronous Rectifiers**

Firehiwot Gurara, *Cornell University*

Resonant Converters

AUTHORS: Firehiwot Gurara, Mausamjeet Khatua, Khurram Khan Afridi

11:20 a.m.

T09.8 **Utilization of EMI Shielding in PCB Matrix Transformer for Inductor Integration in High Power Density Resonant Converter**

Ahmed Nabih, *Virginia Tech*

Resonant Converters

AUTHORS: Ahmed Nabih, Jin Feng, Qiang Li

11:40 a.m.

T09.9 **Multilevel Pulse Width Modulation Resonant Converter with Excellent Efficiency Under a Wide Input Voltage Range**

PENG FANG, *University of Minnesota Duluth*

Resonant Converters

AUTHORS: Peng Fang, Rudy Rice

8:30 a.m. – 12:00 p.m.

T10: Power Quality & Grid Interface

ROOM W102

SESSION CHAIRS

Khurram Afridi, *Cornell University*

Omid Beik, *North Dakota State University*

8:30 a.m.

T10.1 **Complementary Commutation-Based Π-Type DC SSCB**

Reza Kheirollahi, *Drexel University*

Power Generation, Transmission and

AUTHORS: Reza Kheirollahi, Shuyan Zhao, Hua Zhang, Fei Lu

8:50 a.m.

T10.2 **A Novel Two-Degrees-of-Freedom Current Controller Based on Virtual Impedance for Grid-Connected Inverters Under Unbalanced Conditions**

Lukas Antonio, *Yeungnam University*

Power Quality, UPS, Filters

AUTHORS: Lukas Antonio Budiwicaksana, Dong-Choon Lee

9:10 a.m.

T10.3 **Asymmetrical Faults Correction Capability in a Power Insertion and Voltage Compensation System**

Jefferson Assis, *Federal University of Campina Grande*

Power Quality, UPS, Filters

AUTHORS: Jefferson Assis, Juan Silva, Paulo Leandro, Darlan Fernandes, Mauricio Corrêa, Fabiano Costa, Alfeu Sguarezi Filho, Edison Silva

9:30 a.m.

T10.4 **An Efficient High-Power-Density Integrated Trap-LCL Filter for Inverters**

Neda Mazloum, *University of Alberta*

Power Quality, UPS, Filters

AUTHORS: Neda Mazloum, Sayed Ali Khajehoddin

9:50 a.m.

T10.5 **MDSOGI Based Selective Virtual Impedance Method for Grid-Connected Inverters in an Unbalanced and Distorted Weak Grid**

Mehmet Akdogan, *The University of Texas at San Antonio*

Power Quality, UPS, Filters

AUTHORS: Mehmet Akdogan, Deepak Ramasubramanian, Sara Ahmed

10:40 a.m.

T10.6 **Common-Mode Current Reduction of Paralleled Dual Converters for Bipolar DC Distribution**

Bowei Li, *University of Alberta*

Power Generation, Transmission and Distribution

AUTHORS: Bowei Li, Li Ding, Xuesong Wu, Gregory Kish, Yunwei Li

11:00 a.m.

T10.7 **Direct Digital Control and Capacitor Current Compensation to Improve Grid-Current Distortion for Three-Phase Three-Wire LCL Grid-Connected Inverter Under Distorted Grid Voltages**

Tsai-Fu Wu, *National Tsing Hua University*

Power Quality, UPS, Filters

AUTHORS: Tsai-Fu Wu, Yun-Hsiang Chang, Jui-Yang Chiu, Chien-Chih Hung, Tzu-Hsien Chuang

11:20 a.m.

T10.8 **Simultaneous Overvoltage and Overcurrent Mitigation of Grid-Forming Inverters Under a Single-Line-Ground Fault**

Han Zhang, *University of Alberta*

SmartGrid

AUTHORS: Han Zhang, Rui Liu, Cheng Xue, Yunwei Li

11:40 a.m.

T10.9 **Output Voltage Control via Dynamic Cancellation of a GaN-Based High-Power-Density Single-Phase Transformer-Less Online UPS**

Maida Farooq, *Cornell University*

UPS

AUTHORS: Maida Farooq, Khurram Khan Afridi

8:30 a.m. – 12:00 p.m.

T11: Energy Management & Control Within Renewable Energy Systems

ROOM W103

SESSION CHAIRS

Adam Skorek, *Shell*

Ran Mo, *Shell*

8:30 a.m.

T11.1 **State-of-Energy Balancing Control with Cascaded H-Bridge for Second-Life Batteries**

Ariya Sangwongwanich, *Aalborg University*

Energy Storage Systems

AUTHORS: Jorge Suárez Porras, Ariya Sangwongwanich, Daniel-Ioan Stroe

8:50 a.m.

T11.2 **An MPC Based Power Management Method for Renewable Energy Hydrogen Based DC Microgrids**

Mengfan Zhang, *KTH Royal Institute of Technology*

Microgrid Systems

AUTHORS: Mengfan Zhang, Qianwen Xu

9:10 a.m.

T11.3 **An Optimal Clustering Algorithm for Second Use of Retired EV Batteries Using DBSCAN and PCA Schemes Considering Performance Deviation**

Je Yeong, *Sungkyunkwan University*

Energy Storage Systems

AUTHORS: Je Yeong Lim, Eui-Seong Han, Dong-Hwan Kim, Byoung Kuk Lee

9:30 a.m.

T11.4 **Multi-Time Scale Synchronization and Adaptive Power Sharing Control Scheme for Grid Forming Inverters in a Power Electronics Dominated Grid**

Silvanus D'Silva, *University of Illinois Chicago*

Microgrid Systems

AUTHORS: Silvanus D'Silva, Muhammad Farooq Umar, Alireza Zare, Mohammad B. Shadmand, Sertac Bayhan, Haitham Abu-Rub

9:50 a.m.

T11.5 **Seamless Grid-Following to Grid-Forming Transition of Inverters Supplying a Microgrid**

Fahmid Sadeque, *Kansas State University*

Microgrid Systems

AUTHORS: Fahmid Sadeque, Dushyant Sharma, Behrooz Mirafzal

10:40 a.m.

T11.6 **Rapid Curve Scanning Global MPPT for PV Applications Under Partial Shading**

Ignacio Galiano, *University of Calgary*

Maximum power point tracking (MPPT)

AUTHORS: Ignacio Galiano Zurbriggen, Nicolás Agüero Meineri, Ignacio Santana, Anastasiya Rybitska

11:00 a.m.

T11.7 **DAB-Based Energy Storage System with Flexible Voltage Configuration and Extended Power Capability**

Emanuel Serban, *UBC - EnerSys*

Energy Storage Systems

AUTHORS: Emanuel Serban, Cosmin Pondiche, Martin Ordonez

11:20 a.m.

T11.8 **State-of-Charge Equalizations Comparison in a Multi-Prosumer Environment Based on Real-Time Energy Management Systems with IoT-Support**

Enrique Sanabria-Torres, *University of Puerto Rico*

Microgrid Systems

AUTHORS: Adriana Luna Hernandez, Enrique Sanabria-Torres, Nelson Diaz Aldana, Fabio Andrade-Rengifo

11:40 a.m.

T11.9 **Frequency Model for EMI Study of Three-Phase Grid Connected Photovoltaic Inverter on Both DC and AC Sides**

Morteza Tadbiri, *Univ Grenoble Alpes*

Photovoltaic (PV) Inverters and Micro Inverters

AUTHORS: Morteza Tadbiri Nooshabadi, Jean-Luc Schanen, Shahrokh Farhangi, Hossein Iman-Eini

8:30 a.m. – 12:00 p.m.

T12: GaN Power Devices

ROOM W109A

SESSION CHAIRS

Hengzhao Yang, *Shanghai Tech University*

Jason Neely, *Sandia National Laboratories*

8:30 a.m.

T12.1 **GaN HEMT Improves Overall Performance in ZVS Totem Pole PFC Converters**

Marco Torrisi, *STMicroelectronics s.r.l.*

GaN HEMTs

AUTHORS: Marco Torrisi, Sebastiano Messina, Daniele Giovanni Sfilio, Giuseppina Fiore, Giuseppe Di Stefano, Mario Cacciato

8:50 a.m.

T12.2 **Factors Affecting Self-Sustained Switching Oscillations of Cascode GaN Devices and Mitigation Strategy During Parameter Design**

Francesco Iannuzzo, *Aalborg University*

GaN HEMTs

AUTHORS: Zhebie Lu, Francesco Iannuzzo

9:10 a.m.

T12.3 **A Fast On-State Drain-to-Source Voltage Amplifier for the Dynamic Characterization of GaN Power Transistors**

Mathias Weiser, *University of Stuttgart*

GaN HEMTs

AUTHORS: Mathias Weiser, Kevin Muñoz Barón, Tobias Fink, Ingmar Kallfass

9:30 a.m.

T12.4 **PCB Design Impact on GaN-Based Converter Operation**

Oleksandr Husev, *Tallinn University of Technology*

GaN HEMTs

AUTHORS: Oleksandr Husev, Eric Persson, Tanel Jalakas, Dmitri Vinnikov, Naser Vosoughi

9:50 a.m.

T12.5 **Investigation on Physical Origins of Output Capacitance Loss in Cascode GaN HEMTs**

Qihao Song, *Virginia Tech*

GaN HEMTs

AUTHORS: Qihao Song, Ruizhe Zhang, Qiang Li, Yuhao Zhang

10:40 a.m.

T12.6 **High Current Turn-Off of GaN HEMT for Solid-State Circuit Breaker at Cryogenic Temperatures**
Zhou Dong, *University of Tennessee at Knoxville*
GaN HEMTs
AUTHORS: Zhou Dong, Ching-Hsiang Yang, Shimul K. Dam, Dehao Qin, Ruirui Chen, Fei Fred Wang, Hua Kevin Bai, Zheyu Zhang

11:00 a.m.

T12.7 **Superior Threshold-Voltage and On-Resistance Stabtility in GaN HEMTs Enabled by a Gate ESD Protection Circuit**
Bixuan Wang, *CPES Virginia Tech*
GaN HEMTs
AUTHORS: Bixuan Wang, Qihao Song, Ruizhe Zhang, Yi Sun, Pengju Kong, Qiang Li, Yuhao Zhang

11:20 a.m.

T12.8 **GaN HEMTs in High-Frequency Overvoltage Switching: Electrical or Thermal Failure?**
Ruizhe Zhang, *Virginia Polytechnic Institute and State University*
GaN HEMTs
AUTHORS: Ruizhe Zhang, Qihao Song, Qiang Li, Yuhao Zhang

11:40 a.m.

T12.9 **Voltage Reference and Zero Current Detector Monolithically Integrated on p-GaN Technology Designed for Process Corners Compensation**
Plinio Bau, *Wise-Integration*
GaN HEMTs
AUTHORS: Plinio Bau, Sebastian Gavira-Duque, Frederic Rothan, Cedric Reymond, Dominique Bergogne

8:30 a.m. – 12:00 p.m.

T13: Inverters & Emerging Applications

ROOM W104

SESSION CHAIRS

Woongkul Lee, *Michigan State University*

Ali Safayet, *Halla Mechatronics*

8:30 a.m.

T13.1 **Chattering Suppression of Sliding Mode Observer in Load Torque Estimation**
Hyunjun Lee, *Seoul National University*
AC, DC, BLDC Motor Drives
AUTHORS: Hyunjun Lee, Juwon Lee, Jung-Ik Ha

8:50 a.m.

T13.2 **Heterotypic Current Transformer Design for Overcurrent Protection of SiC MOSFET**
Xia Du, *University of Arkansas*
Sensor Integration
AUTHORS: Xia Du, Liyang Du, Yuxiang Chen, Andrea Stratta, Yuqi Wei, Xiaoling Li, H. Alan Mantooth

9:10 a.m.

T13.3 **Electrosurgery Power Electronics: A Revolution in the Making**
Sudip Mazumder, *University of Illinois at Chicago*
Single- and Multi-Phase Inverters
AUTHORS: Sudip Mazumder, Congbo Bao, Hamza El-Kebir, Yongseok Lee, Joseph Bentsman, Richard Berlin

9:30 a.m.

T13.4 **Simple Active Short Circuit Strategy for Air Conditioning Systems**
Bumun Jung, *Samsung Electronics*
AC, DC, BLDC Motor Drives
AUTHORS: Bumun Jung, Wonhee Lee, Jongwon Choi, Yoonjae Kim

9:50 a.m.

T13.5 **Demonstration of a Class E Push-Pull Resonant Inverter for MHz Induction Heating**
Thore Stig, *Aalborg University*
Single- and Multi-Phase Inverters
AUTHORS: Thore Stig Aunsborg, Benoît Bidoggia, Sune Bro Duun, Benjamin Futtrup Kjærsgaard, Janus Dybdahl Meinert, Asger Bjørn Jørgensen, Stig Munk-Nielsen

10:40 a.m.

T13.6 **Design and Optimization of a High-Current Versatile Arbitrary Waveform Generator**
Ignacio Álvarez-Gariburo, *University of Zaragoza*
Single- and Multi-Phase Inverters
AUTHORS: Ignacio Álvarez-Gariburo, Héctor Sarnago, Oscar Lucía, José Miguel Burdío

11:00 a.m.

T13.7 **Frequency Spectrum Analysis of Partial Discharge Activities in WBG-Based AC Machine Drives**
Kangbeen Lee, *Michigan State University*
AC, DC, BLDC Motor Drives
AUTHORS: Kangbeen Lee, Sam Sanjari Nia, Woongkul Lee

8:30 a.m. – 12:00 p.m.

T14: Control of Power Electronic Converters I

ROOM W105

SESSION CHAIRS

Jaber Abu, *Trane Technologies*

Bridget O'Gorman, *Trane Technologies*

8:30 a.m.

T14.1 **Relative Gain Array Based Decoupled Controller Design for GaN-Based Multiple Output Flyback Converter**

Arnab Sarkar, *Indian Institute of Technology Bombay*

Control of Power Electronic Converters

AUTHORS: Arnab Sarkar, Nachiketa Deshmukh, Sandeep Anand

8:50 a.m.

T14.2 **Minimum Deviation Controller for 3 Level Flying Capacitor Boost Converters**

Ksenija Josipovic, *University of Toronto*

Control of Power Electronic Converters

AUTHORS: Ksenija Josipovic, Aleksandar Prodic, Giacomo Calabrese, Florian Neveu

9:10 a.m.

T14.3 **A Simplified Quadrangle Current Modulation for Four-Switched Buck-Boost Converter (FSBB) with a Novel Small Signal Model**

Yijie Bai, *Virginia Polytechnic Institute and State University*

Control of Power Electronic Converters

AUTHORS: Yijie Bai, Yuliang Cao, Vladimir Mitrovic, Boran Fan, Rolando Burgos, Dushan Boroyevich

9:30 a.m.

T14.4 **An Optimized Modulation Scheme for the Triple-Active-Bridge Converter Containing Current-Fed Full-Bridge Terminal**

Yue Zhang, *University of Alberta*

Control of Power Electronic Converters

AUTHORS: Yue Zhang, Li Ding, Nie Hou, Zheng Wang, Yunwei Li

9:50 a.m.

T14.5 **Control Architecture for Full Bridge LLC Series Resonant Converters Using Output Diode Current**

Anuj Maheshwari, *UIUC*

Control of Power Electronic Converters

AUTHORS: Anuj Maheshwari, Furkan Karakaya, Arijit Banerjee, John Donnal

10:40 a.m.

T14.6 **A Novel Starting-Up Method for Dual Active Bridge Converter Based on Computer Assistant Simulation**

Haoyuan Jin, *Xi'an Jiaotong University*

Control of Power Electronic Converters

AUTHORS: Haoyuan Jin, Xiaobo Dong, Junduo Wen, Hang Kong, Yunqing Pei, Laili Wang

11:00 a.m.

T14.7 **Frequency Domain Design Techniques in Digitally Voltage and Current Mode Controlled DC-DC Converters with Fast Transient Performance**

Anirban Nanda, *IIT Kharagpur*

Digital Control

AUTHORS: Anirban Nanda, Gopi Reddy Chilukuri, Santanu Kapat

11:20 a.m.

T14.8 **An On-Chip DC to 42.8 MHz Bandwidth Readout Interface for Hybrid Current Sensor**

Ayesha Hassan, *University of Arkansas*

Sensor and Sensor-less Control

AUTHORS: Asma Mahar, Ayesha Hassan, Robert Murphree, Asif Faruque, Jeffrey De La Rosa Garcia, Babak Parkhideh, H. Alan Mantooth

11:40 a.m.

T14.9 **A High-Bandwidth Parallel Active Balancing Controller for Current-Controlled Flying Capacitor Multilevel Converters**

Rahul Iyer, *University of California Berkeley*

Control of Power Electronic Converters

AUTHORS: Rahul Iyer, Ivan Petric, Roderick Bayliss III, Nathan Brooks, Robert Pilawa-Podgurski

8:30 a.m. – 12:00 p.m.

T15: Wireless Power Transfer I

ROOM W109B

SESSION CHAIRS

Chris Mi, *San Diego State University*

Jungwon Choi, *Mississippi State University*

8:30 a.m.

T15.1 **Filter-Integrated LCC Compensation for Wireless Charging System**

Taeyeon Lee, *Wipowerone*

Wireless charging

AUTHORS: Taeyeon Lee, Dong-Ho Cho

8:50 a.m.

T15.2 **A Reconfigurable LCC-P/S Compensated Three-Phase Wireless Charging Topology with Constant Current and Constant Voltage Output**

Yuming Chen, *Texas A&M University*

Wireless charging

AUTHORS: Yuming Chen, Hamid Toliyat

9:10 a.m.

T15.3 **Fully Compensated Self-Resonant Coil with Low E-Field and Low Profile for Consumer Electronics Wireless Charging**

Ruiyang Qin, *The University of Tennessee Knoxville*

Wireless charging

AUTHORS: Ruiyang Qin, Jie Li, Jingjing Sun, Daniel Costinett

9:30 a.m.

T15.4 **Optimization of Efficiency and Receiver-Coil Mass in an Autonomous 700-W S-S IPT System for UAV Applications**

Muhammad Abdelraziq, *North Carolina State University*

Wireless charging

AUTHORS: Muhammad Abdelraziq, Stephen Paul, Franklin Bartels, Zeljko Pantic

9:50 a.m.

T15.5 **A Wireless Charging and NFC Integration Technique Based on High-Frequency Impedance Characterization of Wireless Charging Coils**

Zhedong Ma, *University of Florida*

Wireless charging

AUTHORS: Zhedong Ma, Qinghui Huang, Yirui Yang, Shuo Wang

10:40 a.m.

T15.6 **A Sandwich Structure for Cost-Effective Printed-Circuit-Board Wireless Power Resonator**

Kerui Li, *Nanyang Technological University*

Wireless charging

AUTHORS: Kerui Li, Jiayang Wu, Mingyu Wang, Abdulkadir C. Yucel, Shu Yuen Ron Hui

11:00 a.m.

T15.7 **Optimization of Spiral Coil Design for WPT Systems Using Machine Learning**

Minki Kim, *University of Minnesota Twin Cities*

Wireless charging

AUTHORS: Minki Kim, Minoh Jeong, Martina Cardone, Jungwon Choi

11:20 a.m.

T15.8 **An Integrated Capacitive Power Transfer System for Field Excitation of Wound Field Synchronous Machine**

Stefano Savio, *North Carolina State University*

Wireless charging

AUTHORS: Stefano Savio, Syed Muhammad Hassan Gillani, Ujjwal Pratik, Ritvik Chattopadhyay, Iqbal Husain, Zeljko Pantic

11:40 a.m.

T15.9 **A Frequency Quadrupler Inverter Architecture for High-Power High-Frequency Capacitive Wireless Power Transfer Systems**

Sounak Maji, *Cornell University*

Wireless charging

AUTHORS: Sounak Maji, Dheeraj Etta, Khurram Khan Afridi

8:30 a.m. – 12:00 p.m.

T16: Transportation Electrification Applications

ROOM W108

SESSION CHAIRS

Sheldon Williamson, *ABB US Corporate Research*

Eddy Aeloiza, *ABB US Corporate Research*

8:30 a.m.

T16.1 **A Modified Modulation Scheme for T-Type Traction Inverters to Enhance Low-Speed Range Efficiency in Electric Vehicles**

Yousefreza Jafarian, *Queen's University*

Power Electronics for Hybrid and Electric Cars

AUTHORS: Yousefreza Jafarian, Javad Ebrahimi, Omid Salari, Alireza Bakhshai, Mohamed Youssef

8:50 a.m.

T16.2 **A Medium-Voltage Multilevel Hybrid Converter Using 3.3 kV Silicon Carbide MOSFETs and Silicon IGBT Modules**

Fei Diao, *University of Arkansas*

Power Electronics for Aerospace

AUTHORS: Fei Diao, Pengyu Lai, Feng Guo, Xinyuan Du, Peng Sun, Yue Zhao, Zhong Chen, Yufei Li

9:10 a.m.

T16.3 **Electrical-Thermal-Mechanical Considerations for the Design of a Compact Two-Level Current Source Inverter Using GaN Devices**

Mustafeez Ul-Hassan, *State University of New York at Stony Brook*

Vehicular Power Electronic Circuits and Systems

AUTHORS: Mustafeez Ul-Hassan, Yuxuan Wu, Asif Imran Emon, Zhao Yuan, Fang Luo

9:30 a.m.

T16.4 **Combined Data Driven and Online Impedance Measurement-Based Lithium-Ion Battery State of Health Estimation for Electric Vehicle Battery Management Systems**

Akash Samanta, *Ontario Tech University*

Power Electronics for Hybrid and Electric Cars

AUTHORS: Akash Samanta, Alvin Huynh, Niranjan Shrestha, Sheldon Williamson

9:50 a.m.

T16.5 **Power Loss Balancing Method of Single Source Dual Inverter**

Bum-Ryeol Yoon, *Dankook University*

Vehicular Power Electronic Circuits and Systems

AUTHORS: Bum-Ryeol Yoon, Tae-Hyeong Kim, June-Seok Lee

10:40 a.m.

T16.6 **Seven-Level Flying-Capacitor Multi-Level Converter for a Differential Power-Processing Interface in Multi-Chemistry EV Battery Packs**

Cheng Feng, *University of Toronto*

Vehicular Power Electronic Circuits and Systems

AUTHORS: Cheng Feng Wang, Satyam Sa, Ramgopal Varma Ramaraju, Sanjeev Chandra, Olivier Trescases

11:00 a.m.

T16.7 **Reconfiguration of Multilevel Inverters and Their Impact on Insulation Breakdown Time**

Arshiah Mirza, *University of Connecticut*

Power Electronics for Hybrid and Electric Cars

AUTHORS: Arshiah Mirza, Ali Bazzi, Yang Cao

11:20 a.m.

T16.8 **An Ultra-High Gain Current-Fed Universal Auxiliary Power Module for 400V/800V Electric Vehicles**

Liyan Zhu, *University of Tennessee-Knoxville*

Charging Systems

AUTHORS: Liyan Zhu, Hua Kevin Bai, Alan Brown, André Körner

11:40 a.m.

T16.9 **GaN-Based Multiport Resonant Converter for Automotive Applications**

Fabian Groon, *Kiel University*

Power Electronics for Hybrid and Electric Cars

AUTHORS: Fabian Groon, Thiago Pereira, Hamzeh Beiranvand, Sergej Schikowski, Dario Metschies, Marco Liserre

1:30 p.m. – 4:50 p.m.

T17: Hybrid/Switched Capacitor Converters

ROOM W109A

SESSION CHAIRS

Sombuddha Chakraborty, *Texas Instruments Inc.*

Min Chen, *ABB*

1:30 p.m.

T17.1 **1.2 kW, 12 V Regulated Sigma Converter for 48 V Data Centers with 1 kW/in3 Power Density**

Mario Ursino, *Infineon Technology AT*

Hard- and Soft-Switched

AUTHORS: Mario Ursino, Stefano Saggini, Roberto Rizzolatti, Gerald Deboy, Kevin Zufferli

1:50 p.m.

T17.2 **2-Phase Series Capacitor Synchronous Rectifier in Active Clamp Forward Converter**

Katsuhiro Hata, *The University of Tokyo*

Voltage Regulator Modules (VRM)

AUTHORS: Katsuhiro Hata, Sadanori Suzuki, Kenichi Watanabe, Kenichi Nagayoshi, Makoto Takamiya

2:10 p.m.

T17.3 **A GaN-Based Reconfigurable Series-Parallel Hybrid Converter Supporting 48/24/12V Input and 0.8-1.2V Output with 83.7/87.8/90.7% Peak Efficiency**

Minxiang Gong, *Georgia Institute of Technology*

Hard- and Soft-Switched

AUTHORS: Minxiang Gong, Hua Chen, Muya Chang, Jong-Hyeok Yoon, Xin Zhang, Rinkle Jain, Arijit Raychowdhury

2:30 p.m.

T17.4 **Fully Soft-Switching Flying Capacitor Based Quasi-Resonant Boost Converter**

Kumar Joy, *University of Toronto*

Hard- and Soft-Switched

AUTHORS: Kumar Joy Nag, Aleksandar Prodic

2:50 p.m.

T17.5 **High Power Density 4:1 Resonant Switched-Capacitor DC-DC Converter for PoI Applications**

Alessandro Dago, *Politecnico di Milano*

Point-of-Load (PoL) and Multi-Phase Converters

AUTHORS: Alessandro Dago, Mauro Leoncini, Alberto Brunero, Alessandro Gasparini, Osvaldo Zambetti, Salvatore Levantino, Massimo Ghioni

3:30 p.m.

T17.6 **A Zero-Voltage-Switching 3-Level Buck Converter Achieving 30% Loss Reduction at Light Load for USB-C Charger Applications**

Tianshi Xie, *UC San Diego*

Hard- and Soft-Switched

AUTHORS: Tianshi Xie, Hanh-Phuc Le

3:50 p.m.

T17.7 **Quasi-Regulation and Mismatch Mitigation Technique for Switched Tank Converters**

Mattia Balutto, *University of Udine*

Hard- and Soft-Switched

AUTHORS: Mattia Balutto, Giacomo Ripamonti, Pablo Antoszczuk, Stefano Michelis, Stefano Saggini, Federico Iob, Alessandro Dago

4:10 p.m.

T17.8 **Multi-Inductor Multi-Output Hybrid (MiMoH) Converter for Large Conversion Ratio and Multiple Outputs**

Ratul Das, *University of California San Diego*

Point-of-Load (PoL) and Multi-Phase Converters

AUTHORS: Ratul Das, Hanh-Phuc Le

4:30 p.m.

T17.9 **Novel Highly Efficient Two-Stage Regulated 48V-to-12V Converter with Dual Phase 3-Level Buck Converter Featuring Natural Voltage Balancing**

Roberto Rizzolatti, *Infineon Technologies Austria AG*

Hard- and Soft-Switched

AUTHORS: Roberto Rizzolatti, Stefano Saggini, Christian Rainer, Mario Ursino

1:30 p.m. – 4:50 p.m.

T18: Converters for Bidirectional Power & Renewable Energy

ROOM W101

SESSION CHAIRS

Rolando Burgos, *Virginia Tech*

Behrooz Mirafzal, *Kansas State University*

1:30 p.m.

T18.1 **Fault Detection Method by Utilizing Instantaneous Power Theory for Inverter-Based Distributed Generation**

Nattapat Praisuwanna, *University of Tennessee Knoxville*

Distributed Energy Systems

AUTHORS: Nattapat Praisuwanna, Leon M. Tolbert, Jingxin Wang, Fangxing Li

1:50 p.m.

T18.2 **Grid-Forming Control of Single- and Two-Stage Solar PV Systems with Mode Transition**

Lizhi Ding, *Purdue University*

Distributed Energy Systems

AUTHORS: Lizhi Ding, Nan Xue, Zhihua Qu

2:10 p.m.

T18.3 **An Enhanced Voltage Control Method for Multilevel-Converter-Based Electric Spring at the Distribution Voltage Level**

Hin Sang, *School of Electrical and Electronic Engineering Nanyang Technology University*

Distributed Energy Systems

AUTHORS: Hin Sang Lam, Huawei Yuan, Neha Beniwal, Josep Pou, Shu Yuen Ron Hui

2:30 p.m.

T18.4 **Realizing a Virtual Synchronous Generator Inverter with Overcurrent and Fault Handling Capability as Synchronous Generator**

Haiguo Li, *ABB Inc*

Distributed Energy Systems

AUTHORS: Haiguo Li, Fei Fred Wang

2:50 p.m.

T18.5 **Hardware Design and Implementation of a 75 kVA 3-D Integrated Intelligent Power Stage**

Abdul Basit, *Stony Brook University*

Bidirectional grid interface converters

AUTHORS: Abdul Basit Mirza, Asif Imran Emon, Kushan Choksi, Sama Salehi Vala, Fang Luo, Radha Krishna Moorthy, Madhu Sudhan Chinthavali

3:30 p.m.

T18.6 **Modular Series-Stacked Bidirectional AC/DC Architecture for 3-Phase Grid-Tied Applications**

Trent Martin, *University of Colorado Boulder*

Bidirectional grid interface converters

AUTHORS: Trent Martin, Branko Majmunović, Vedula Inder Kumar, Milan Ilic, Dragan Maksimović

3:50 p.m.

T18.7 **Design and Demonstration of an 850 V DC to 13.8 kV AC 100 kW Three-Phase Four-Wire Power Conditioning System Converter Using 10 kV SiC MOSFETs**

Haiguo Li, *ABB Inc*

Bidirectional grid interface converters

AUTHORS: Haiguo Li, Zihan Gao, Fei Fred Wang

4:10 p.m.

T18.8 **Performance Comparison of 10 kV and Series-Connected 3.3 kV SiC MOSFETs Based VSCs for MV Grid Interfacing Applications**

Raj Kumar, *North Carolina State University*

Bidirectional grid interface converters

AUTHORS: Raj Kumar Kokkonda, Sanket Parashar, Subhashish Bhattacharya

4:30 p.m.

T18.9 **Improving Transients for Droop-Controlled Inverters**

Mahmoud Alsadat, *Skoltech*

SmartGrid

AUTHORS: Mahmoud AlSadat, Federico Ibanez, Yaroslav Vlasov, Petr Vorobev, Vedran Perić, Vladimir Terzija

1:30 p.m. – 4:50 p.m.

T19: Electric Aircraft Application

ROOM W102

SESSION CHAIRS

Sheldon Williamson, *Ontario Tech University*

Eddy Aeloiza, *ABB US Corporate Research*

1:30 p.m.

T19.1 **Design and Optimization of 2×211-kW SiC-Based Aircraft Propulsion Inverter System with High Power Density and High Efficiency**

Xingchen Zhao, *Virginia Polytechnic Institute and State University Center for Power Electronics (CPES)*

Power Electronics for Aerospace

AUTHORS: Xingchen Zhao, Ripun Phukan, Che-Wei Chang, Rolando Burgos, Dong Dong, Pascal Asfaux

1:50 p.m.

T19.2 **500 kW 3-Phase Interleaved SiC Switched Tank Converter for Transportation Electrification**

Xiaoyan Liu, *University of Dayton*

Power Electronics for Hybrid and Electric Cars

AUTHORS: Xiaoyan Liu, Mengxuan Wei, Maohang Qiu, Kevin Hobbs, Ahmed Dahneem, Dong Cao

2:10 p.m.

T19.3 **Design of a 20 kW Bidirectional Dual Active Bridge Converter for Aerospace Applications**

Rachit Pradhan, *McMaster Automotive Resource Centre*

Power Electronics for Aerospace

AUTHORS: Rachit Pradhan, Mohamed I. Hassan, Zhenxuan Wang, Jiaqi Yuan, Giorgio Pietrini, Piranavan Suntharalingam, Mario F. Cruz, Ali Emadi

2:30 p.m.

T19.4 **PCB Busbar Design and Verification for a Multiphase 250 kW SiC Based All-Electric Aircraft Powertrain Converter**

Junming Liang, *CPES Virginia Tech*

Power Electronics for Aerospace

AUTHORS: Junming Liang, Boran Fan, Che-Wei Chang, Rolando Burgos, Dong Dong, Jagadeesh Tangudu, Suman Dwari

2:50 p.m.

T19.5 **An Enhanced Carrier-Based PWM with Reconstructed Modulation Waves for Three-Level T-Type NPC Inverters in Electric Aircraft Propulsion Applications**

Feng Guo, *University of Arkansas*

Power Electronics for Aerospace

AUTHORS: Feng Guo, Zhuxuan Ma, Fei Diao, Hui Cao, Yue Zhao

3:30 p.m.

T19.6 **Modified O-Z-Source DC Circuit Breaker for Electrical Power System Protection of Future Aircrafts**

Aditya P, *Indian Institute of Technology Dharwad*

Power Electronics for Aerospace

AUTHORS: Aditya P, Venkata Raghavendra Itte, Satish Naik Banavath, Xiaoqing Song, Alessandro Lidozzi, Luigi Piegari

3:50 p.m.

T19.7 **Modified Q-Z-Source DC Circuit Breaker for Next-Generation Electric Aircrafts**

Aditya P, *Indian Institute of Technology Dharwad*

Power Electronics for Aerospace

AUTHORS: Aditya P, Venkata Raghavendra Itte, Satish Naik Banavath, Andrii Chub, Xiaoqing Song, Dmitri Vinnikov, Fei Fred Wang

4:10 p.m.

T19.8 **1MHz, 200W, GaN-Based Cascaded Buck-LLC for Aerospace**

Thomas Cook, *University of Pittsburgh*

Power Electronics for Aerospace

AUTHORS: Thomas Cook, Ansel Barchowsky, Brandon Grainger

4:30 p.m.

T19.9 **High Power Density Flying Capacitor Multilevel Inverter for Electric Aircraft with a Stacked PCB Interleaved Hybrid Commutation Loop Design**

Logan Horowitz, *UC Berkeley*

Power Electronics for Aerospace

AUTHORS: Logan Horowitz, Robert Pilawa-Podgurski

1:30 p.m. – 4:50 p.m.

T20: Control of Power Electronic Converters II

ROOM W103

SESSION CHAIRS

Xiaonan Lu, *Purdue University*

Nidhi Haryani, *Onsemi*

1:30 p.m.

T20.1 **Design of High-Frequency, Load-Independent Resonant Inverter Using Phase-Shift Control Method**

Yu Zhou, *University of Minnesota Twin Cities*

Control of Power Electronic Converters

AUTHORS: Yu Zhou, Jungwon Choi

1:50 p.m.

T20.2 **A Multi-Segment SVM Scheme for the Capacitor Size Minimization in SiC Devices-Based Active Neutral-Point-Clamped Converters**

Satish Belkhode, *IIT Bombay*

Control of Power Electronic Converters

AUTHORS: Satish Belkhode, Rajat Shahane, Naeem Bharmal, Anshuman Shukla, Jin Wang

2:10 p.m.

T20.3 **Energy Optimization Based Multi-Objective Circulating Current Control of MMC**

Govind Avinash, *Indian Institute of Technology Bombay*

Control of Power Electronic Converters

AUTHORS: Govind Avinash Reddy, Anshuman Shukla

2:30 p.m.

T20.4 **Hybrid Pulse Width Modulation with Current Derivative Measurement for PMSM Sensorless Control**

Juwon Lee, *Seoul National University*

Sensor and Sensor-less Control

AUTHORS: Juwon Lee, Byung Ryang Park, Gyu Cheol Lim, Jung-Ik Ha

2:50 p.m.

T20.5 **Passivity-Based Co-Design of Active Damping and Voltage Controller for Converter-Based Grid Emulator**

Zejie Li, *Department of Energy Aalborg University*

Control of Power Electronic Converters

AUTHORS: Zejie Li, Fangzhou Zhao, Stig Munk-Nielsen, Xiongfei Wang

3:30 p.m.

T20.6 **Novel Control for Active Power Compensation Using DSCC-MMC Based ES-STATCOM**

Harshit Nath, *FREEDM Systems Center North Carolina State University*

Control of Power Electronic Converters

AUTHORS: Harshit Nath, Semih Isik, Vasishta Burugula, Subhashish Bhattacharya

3:50 p.m.

T20.7 **Controller Verification of a Smart-Grid Compatible 200kHz Single-Stage Photovoltaic Microinverter**

Arafat Hasnain, *University of Maryland*

Control of Power Electronic Converters

AUTHORS: Daniel Zakzewski, Rakesh Resalayyan, Arafat Hasnain, Chanaka Singhabahu, Alireza Khaligh

4:10 p.m.

T20.8 **Limited States Multi-Objective Direct Model Predictive Control of a Grid-Tied 3L-Active Neutral-Point Clamped Converter with an LCL Filter**

Waqar A., *Marquette University*

Control of Power Electronic Converters

AUTHORS: Waqar A. Khan, Armin Ebrahimian, S. Iman Hosseini S., Mostafa Abarzadeh, Nathan Weise

4:30 p.m.

T20.9 **Phase Shifted Power Control Strategy for Efficiency Improvement at Medium Power Region in Induction Cooktops Using Full-Bridge Series-Resonant Inverters**

Yun Seong, *Sungkyunkwan University*

Control of Power Electronic Converters

AUTHORS: Yun Seong Hwang, Joo Seung Lee, Seung Hyun Kang, Man Jae Kwon, Eunsu Jang, Byoung Kuk Lee

1:30 p.m. – 4:50 p.m.

T21: Reliability & Thermal Performance of Power Modules

ROOM W104

SESSION CHAIRS

Chunmeng Xu, *Payton Planar*

Chunmeng Xu, *ABB*

1:30 p.m.

T21.1 **Power Module Thermal Characterization Considering Aging Towards Online State-of-Health Monitoring**

Animesh Kundu, *University of Windsor*

Quality and System Reliability

AUTHORS: Animesh Kundu Anik, Philip Korta, Lakshmi Varaha Iyer, Narayan Kar

1:50 p.m.

T21.2 **Thermal Characteristics of Liquid Metal Interconnects for Power Semiconductors**

Zhongchao Sun, *Aalborg University*

Power Electronics Packaging

AUTHORS: Zhongchao Sun, Asger Bjørn Jørgensen, Nick Baker, Szymon Beczkowski, Wendi Guo, Stig Munk-Nielsen, Francesco Iannuzzo

2:10 p.m.

T21.3 **Electrothermal Modeling Based Digital Twin Method for Degradation Parameters Identification of DC-DC Converter**

Chuangchuang Lu, *Nanjing University of Aeronautics and Astronautics*

Quality and System Reliability

AUTHORS: Chuangchuang Lu, Weiyang Zhou, Ke Jin

2:30 p.m.

T21.4 **Sliding Window-Based Thermal Topography Determining Thermal Impedance and Thermal Coupling**

Shamar Christian, *University of Arkansas*

Thermal and EMC Management

AUTHORS: Shamar Christian, Brett Sparkman, Jonathan Hayes, Austin Curbow, Ty McNutt, Juan Carlos Balda

2:50 p.m.

T21.5 **Thermal Stress Reliability Comparison of WB and POL-kW Structure by Power Cycling and Simulation**

Youichi Nishihara, *Shinko Electric Industries Co.,Ltd.*

Power Electronics Packaging

AUTHORS: Youichi Nishihara, Koji Bando, Shingo Hayashibe, Takumi Yumoto, Tatsuro Yoshida, Hiroko Ota

3:30 p.m.

T21.6 **A Comprehensive Comparison of EFT, RF, and Lightning Susceptibility Tests in DO-160G and MIL-STD-461G**

Han Wu, *University of Florida*

Thermal and EMC Management

AUTHORS: Han Wu, Shuo Wang

3:50 p.m.

T21.7 **Study on Thermal Stress Behavior of Mold Type POL Tile**

Kei Murayama, *Shinko Electric Industries Co. Ltd.*

Power Electronics Packaging

AUTHORS: Kei Murayama, Kiyoko Tajima, Mikiko Kobayashi, Junichi Mizushima, Shingo Hayashibe, Kiyoshi Oi

4:10 p.m.

T21.8 **Gradient-Based End-of-Life Criterion of Power Semiconductor Modules**

Yichi Zhang, *Aalborg University*

Quality and System Reliability

AUTHORS: Yichi Zhang, Yi Zhang, Bo Yao, Shuai Zhao, Huai Wang

4:30 p.m.

T21.9 **Lifetime Prediction in Power Semiconductor Devices: A Comparative Study Between Analytical Modeling and Artificial Neural Network**

Alessandro Vaccaro, *University of Padova*

Quality and System Reliability

AUTHORS: Alessandro Vaccaro, Andrea Zilio, Paolo Magnone

1:30 p.m. – 4:50 p.m.

T22: Digital Controllers & Control ICs

ROOM W105

SESSION CHAIRS

Kang Wei, *Texas Instruments*

Seungdeog Choi, *Mississippi State University*

1:30 p.m.

T22.1 **Integrated Delay-Line Based High-Resolution PFM-PWM Modulator**

Tom Urkin, *PEMIC center - Ben Gurion University of the Negev*

MCUs, DSPs, FPGAs, ASICs

AUTHORS: Tom Urkin, Mor Mordechai Peretz

1:50 p.m.

T22.2 **Digital Sliding-Mode-Based xy-Current Suppression in Dual Three-Phase PMSM Drives**

Fengyang Sun, *McMaster University*

Digital Control

AUTHORS: Fengyang Sun, Williem Agnihotri, Sumedh Dhale, Subarni Pradhan, Wesam Taha, Babak Nahid-Mobarakeh

2:10 p.m.

T22.3 **Estimator-Based Step-Load Transient Improvements in a Digitally Controlled Synchronous Buck Converter**

Chandan Suthar, *University of Colorado Boulder*

Digital Control

AUTHORS: Chandan Suthar, Vedula Inder Kumar, Dragan Maksimović

2:30 p.m.

T22.4 **An Improvement of Surge Voltage and Efficiency in Three-Phase Inverter by Using Fully Digital Active Gate Control**

Van-Long Pham, *Yokohama National University*

Gate Drive Circuits

AUTHORS: Van-Long Pham, Hidemine Obara, Katsuhiro Hata

2:50 p.m.

T22.5 **Closed-Loop Stabtility Analysis of Digitally Current Mode Controlled Three-Level Buck Converter Using a Simplified Discrete-Time Modeling Framework**

Gopi Reddy, *IIT Kharagpur*

Digital Control

AUTHORS: Gopi Reddy Chilukuri, Prantik Majumder, Santanu Kapat

3:30 p.m.

T22.6 **A 155W –95.6 dB THD+N GaN-Based Class-D Audio Amplifier with LC Filter Nonlinearity Compensation**

Qinwen Fan, *Delft University*

Control ICs

AUTHORS: Minggang Chen, Huajun Zhang, Qinwen Fan

3:50 p.m.

T22.7 **A Monolithic 30uA – 1.5A > 85%-Efficiency, Passive-Ramp-Extended-Ton Controlled Buck Converter for Mobile SoC Fast DVS**

Hsaio-Hsuan Chen, *National Taiwan University*

Control ICs

AUTHORS: Hsaio-Hsuan Chen, Chieh-Ju Tsai, Ching-Jan Chen

4:10 p.m.

T22.8 **Autotuning of Resonant Switched-Capacitor Converters for Zero Current Switching and Terminal Capacitance Reduction**

Haifah Boureima, *University of California Berkeley*

Control of Power Electronic Converters

AUTHORS: Haifah Boureima H Sambo, Yicheng Zhu, Ting Ge, Nathan Ellis, Robert Pilawa-Podgurski

4:30 p.m.

T22.9 **Digital Gate Driver IC with Fully Integrated Automatic Timing Control Function in Stop-and-Go Gate Drive for IGBTs**

Dibo Zhang, *The University of Tokyo*

Gate Drive Circuits

AUTHORS: Dibo Zhang, Kohei Horii, Katsuhiro Hata, Makoto Takamiya

1:30 p.m. – 4:50 p.m.

T23: Single-Phase AC-DC Converters

ROOM W109B

SESSION CHAIRS

John Lam, *York University*

Jin Moon, *Florida State*

1:30 p.m.

T23.1 **Hybrid Fixed/Variable Frequency TCM Average Current Control Method Enabling ZVS MHz Operation of GaN HEMTs in PFC Stages**

Matthias Joachim, *Infineon Technologies Austria AG*

Power Factor Correction, CCM, DCM, CRM/BCM Control, Bridgeless

AUTHORS: Matthias Joachim Kasper, Jon Azurza Anderson, Sven Weihe, Gerald Deboy

1:50 p.m.

T23.2 **Active Ripple Energy Storage Circuit with Extended Hold-Up Time Capability and Minimum Capacitance for High Power Dense Rectifiers**

Alessandro Pevere, *Infineon Technologies*

Power Factor Correction, CCM, DCM, CRM/BCM Control, Bridgeless

AUTHORS: Alessandro Pevere, Alex Rossi, Roberto Petrella

2:10 p.m.

T23.3 **The Design Methodology of High-Power-Density Adapter Based on Flying Capacitor Converter and Series Power Decoupling Topology for PD3.1 Application**

Yu Qi, *silergy*

External AC-DC Adapters

AUTHORS: Yu Qi, Gao Fan, Wei Chen, Chen Zhao, Kaiwei Yao

2:30 p.m.

T23.4 **An Ultra-High Efficiency High Power Density 140W PD3.1 AC-DC Adapter Using GaN Power ICs**

Xiucheng Huang, *Navitas Semiconductor*

External AC-DC Adapters

AUTHORS: Xiucheng Huang, Yingchuan Lei, Yun Zhou, Weijing Du, Jason Zhang

2:50 p.m.

T23.5 **Hybrid-Flyback and GaN Enable Ultra-High Power Density 240W USB-PD EPR Adaptor**

Alfredo Medina-Garcia, *Infineon Technologies AG*

Embedded AC-DC Power Supplies

AUTHORS: Alfredo Medina-Garcia, Markus Schmid, Martin Krueger, Josef Daimer, Manfred Schlenk

3:30 p.m.

T23.6 **Control Strategies of Active Power Decoupling Integrated Active Clamp Flyback Converter**

Lei Wang, *The University of Sydney*

Single-Phase and Three-Phase Input

AUTHORS: Lei Wang, Huan Li, Sinan Li

3:50 p.m.

T23.7 **A Novel Transformer Leakage Energy Recovery Active Clamp Control Technique for High Power AC/DC Flyback Converters**

Raj Kumar, *North Carolina State University*

Single-Phase and Three-Phase Input

AUTHORS: Raj Kumar Kokkonda, Richard Beddingfield, Subhashish Bhattacharya, Bruce Carsten, Bo Varga

4:10 p.m.

T23.8 **An Auxiliary Circuit with a Flexible LC Resonant Tank for High-Efficiency and Low-Cost Totem-Pole Boost Bridgeless Power-Factor Correction Converter**

Shaun Thurber, *University of Rhode Island*

Power Factor Correction, CCM, DCM, CRM/BCM Control, Bridgeless

AUTHORS: Shaun Thurber, Xueshen Zhang, Jaeil Baek, Yeonho Jeong

4:30 p.m.

T23.9 **Ultra-Functional Novel Circuit for Electric Vehicle Charging Solutions Based on a Floating Active Filter Connected to the High-Frequency Link**

Itziar Alzuguren, *Ikerlan Technology Research Centre*

Bidirectional AC/DC converters

AUTHORS: Itziar Alzuguren, Asier Garcia-Bediaga, Ander Avila, Alejandro Rujas, Miroslav Vasić

1:30 p.m. – 4:50 p.m.

T24: Power Converter Control & Stabtility Analysis

ROOM W108

SESSION CHAIRS

Justin Henspeter, *IBM*

Joseph Song-Manguelle, *Oak Ridge National Laboratory*

1:30 p.m.

T24.1 **Loop Gain Modeling of a Single-Phase PFC for Online Small-Signal Stabtility Monitoring**

Qing Lin, *CPES Virginia Tech*

Circuits and Systems

AUTHORS: Qing Lin, Bo Wen, Rolando Burgos, Xiong Li, Qiong Wang

1:50 p.m.

T24.2 **Average and Small-Signal Model of the Four-Switch Buck-Boost Converter Under Both Duty-Cycle and Phase-Shift Modulation**

Ezio Gallo, *Università degli Studi di Padova*

Circuits and Systems

AUTHORS: Ezio Gallo, Filip Cvejić, Giorgio Spiazzi, Davide Biadene, Tommaso Caldognetto

2:10 p.m.

T24.3 **Analysis and Modeling of a Four-Switch Buck-Boost Converter with PWM Plus Phase-Shift Control**

Lingxuan Xiao, *Nanjing University of Aeronautics and Astronautics*

Circuits and Systems

AUTHORS: Lingxuan Xiao, Xinbo Ruan, Renxi Dong, Yuyang Jiang, Tao Fu

2:30 p.m.

T24.4 **Analytical Modelling and Optimization of DC-Link Voltage Harmonic Spectra of Full-Bridge Modular Multilevel Converters for Buck and Boost Operation**

Thabet Alzahrani, *University of Sheffield*

Circuits and Systems

AUTHORS: Thabet Alzahrani, Milijana Odavic, Sumeet Thakur, Kais Atallah

2:50 p.m.

T24.5 **Auxiliary Power Supply Startup Evaluation and Improvement of the Input-Series System with Small Submodule Capacitances**

Rui Wang, *Aalborg University*

Circuits and Systems

AUTHORS: Rui Wang, Asger Bjørn Jørgensen, Wentao Liu, Hongbo Zhao, Zhixing Yan, Dipen Narendra Dalal, Stig Munk-Nielsen

3:30 p.m.

T24.6 **Equivalent DQ Sequence-Domain Model of Unbalanced Three-Phase Passive Elements for Power Converter Controllers**

Airan Francés, *CEI, Universidad Politécnica de Madrid*

Circuits and Systems

AUTHORS: Airan Francés Roger, Luis Saz, Rafael Castillo, Dionisio Ramírez, Javier Uceda

3:50 p.m.

T24.7 **Impact of Machine-Side Converter Dynamics on AC Impedance of Grid-Forming PMSG Wind Turbines**

Shiyi Liu, *Aalborg University and DNV*

Circuits and Systems

AUTHORS: Shiyi Liu, Heng Wu, Liang Zhao, Xiongfei Wang, Theo Bosma, Jos van der Burgt, Ganesh Sauba

4:10 p.m.

T24.8 **FPGA Model of Multi-Active-Bridge-Based Cascaded Solid-State Transformer for Real-Time HIL Tests**

Hossein Chalangar, *OPAL-RTOPAL-RT TECHNOLOGIES*

Rapid Prototyping

AUTHORS: Hossein Chalangar, Kevin-Rafael Sorto-Ventura, Xuekun Meng, Wei Li

4:30 p.m.

T24.9 **Demagnetization Modeling and Analysis for MTPA-Driven Permanent Magnet Motors with Distributed Lap Windings**

Jinqiu Gao, *Central South University*

Device and Component Modeling

AUTHORS: Jinqiu Gao, Weihua Gui, Chao Yang, Tao Peng, Junze Luo, Chunhua Yang

NOTES

12:00 p.m. – 12:30 p.m.

Exhibitor Seminars – Session 5

Coilcraft, Inc.
EXPO HALL THEATER #2

MAGPro™ – The World's Most Comprehensive Inductor Characterization Tools

PRESENTED BY: **Len Crane**

Coilcraft introduces the newest features in MAGPro™, the world's most comprehensive set of inductor analysis tools and demonstrates new ways to optimize dc-dc converter performance.

Dean Technology, Inc.
ROOM W206A

UMR Collection of High Voltage Power Supplies

PRESENTED BY: **Jawanza Hall**

DTI is excited to introduce our line of UMR Collection of high voltage power supplies, which are form-fit-function replacements for industry standard products. Voltages range from 125V to 30kV at up to 125W of power.

Diotec Semiconductor America
ROOM W103A

MOSFETS in DIOTEC: Packaged and Solutions

PRESENTED BY: **Andrew Dixon**

DIOTEC Semiconductor's solutions of MOSFET's for an increasingly difficult sector of discrete semiconductors.

EA Elektro-Automatik, Inc.
ROOM W202B

Advancements in Programmable DC Power Supplies

PRESENTED BY: **Eric Turner**

The world around us is electrifying at a rapid pace. While the planet focuses on revolutionizing energy conservation, we are consuming more electrical power than ever before. The electrification of automobiles, airplanes and transport vehicles reliance on energy are stretching the limits of power consumption across the globe as the world continues to drive renewable energy solutions. It creates a unique challenge for testing these high-powered devices.

Efficient Power Conversion Corporation (EPC)
ROOM W203A

GaN Roadmap Update

PRESENTED BY: **Alex Lidow**

GaN power devices have been in volume production for over 13 years with hundreds of millions of transistors and ICs in use in a wide variety of applications. However, GaN technology still has a long way to go before it reaches a state of maturity similar to silicon power devices. In this talk we will discuss the state-of-the-art in GaN-on-Si devices with ratings below 400 V including key applications, and we will show a roadmap for the next 5 years.

Focused Test, Inc.
ROOM W204A

Testing SCSOA in SiC FETs: The Challenge of Delivering 1000A Safely at High Voltage

PRESENTED BY: **Gordon Leak**

In principle, Short Circuit Safe Operating Area (SCSOA) seems like a simple test. Connect the DUT to a high voltage power source. Pulse the gate fully on for a few microseconds so the device draws as much current as possible and see if the device survives. The issue is that this has to be done at the rated operating voltage (1KV and higher) and with low enough inductance and resistance that the DUT is the current limiter. Next you have to make it safe when the DUT dies, without invalidating the test. This presentation discusses the challenges and some solutions.

Frenetic
ROOM W205A

How To Design an LLC Transformer

PRESENTED BY: **Jonathan Brown**

One of the most common topologies in the industry is the LLC converter. During this webinar, we will present to you how to design the transformer for this topology.

Heraeus Electronics
ROOM W102B

Please check the mobile app for more information.

Mouser Electronics
EXPO HALL THEATER #1

Optimizing Your Battery Management System

PRESENTED BY: **Jorge Lugo**

Battery Management System (BMS) is an important electronic control unit for single or multi-cell battery pack operated systems from both a safety and performance perspective. The main objectives of the BMS are to protect the battery cells from abuse and damage, prevent overheating, provide vital information of the battery pack, and extend the battery life.

attery packs are made-up of individual battery cells and no two battery cells are identical, they vary in cell capacity, self-discharge, impedance, temperature performance and cell aging. These differences in general increase over time and can damage the batteries if not optimized. Within the battery pack it is critical during charging and discharging the BMS accurately monitors current, voltage and temperature of the individual battery cells and the overall battery pack. Not only does the BMS need to monitor and balance the individual cells, but it also must monitor the overall system. Key functions include control, state of health of the system, state of charge and energy management during use.

Vishay has a broad portfolio of discrete semiconductors and passive electronic components to help optimize design and ensure long-term operation and reliability of the battery management system.

ROHM Semiconductor
ROOM W205B

Challenges and Solutions for Packaging State-of-the-Art SiC Power Devices

PRESENTED BY: **Ming Su**

Recent advances in SiC have led to commercial availability of efficient and cost-effective power switches for automotive and industrial power systems. Meanwhile, power electronics applications increasingly demand for package solutions to maximize the performance of SiC technologies, driven primarily by compact form factor, high thermal conductivity, low parasitic inductance, increased current rating, convenient device integration and superior reliability. These technology directions are defining new standards for power converters. In this presentation, ROHM will introduce the latest power module options for EV and other applications to support these trending industry requirements.

12:45 p.m. – 1:15 p.m.

Exhibitor Seminars – Session 6

Apex Microtechnology
ROOM W102B

Reducing Oscillation in Analog Designs

PRESENTED BY: **HelenAnn Brown**

Apex Microtechnology will explore the technical topic of op-amp stability. This presentation will present an overview of Apex Microtechnology, types of instability, techniques for assessing stability, and tools for reducing oscillation.

GeneSiC Semiconductor
ROOM W206A

GeneSiC High-speed, High-voltage SiC Drives High-power Innovation

PRESENTED BY: **Sumit Jadav**

For high-power applications, from solar string inverters, to EVs and industrial automation, high-speed (high-frequency) switching continues to reduce the size, weight and cost of passive components, and so improve the power density and efficiency of the power systems themselves. At 150 kHz, Navitas' GeneSiC power MOSFETs with trench-assisted planar gate technology, run 25 degC cooler than standard SiC devices - reducing hotspots, and extending device lifetime by 3x.

Hioki USA Corp.
ROOM W103A

Please check the mobile app for more information.

Indium Corporation
ROOM W202B

A Novel Material Technology that Reduces Tooling Dependency and Process Complexity in Power Module Soldering and Sintering Applications

PRESENTED BY: **Joe Hertline**

Reliance on complex, costly alignment fixturing is growing as power module designers seek repeatable manufacturing and to achieve high-reliability performance. A novel material technology, applied during assembly, provides robust tacking strength to reduce the dependency on customized fixturing. The technology reduces process time, energy input, and tooling complexity while minimizing up-front thermal stress applied to the device components, yielding an overall manufacturing cost of ownership reduction for high-reliability power modules.

Infineon Technologies
ROOM W204A

Predictive Maintenance In Systems Using a Gate Driver

PRESENTED BY: **Riley Beck**

With the increase of edge node processing and data analysis to allow for predictive maintenance of systems, there is a growing need for circuits that measure and communicate information. In applications where energy efficiency is key such as solar, EV charging, and energy storage, it's critical to predict when failures will occur to maximize their energy output. The EiceDRIVER X3 Digital (1ED38xx) is an I2C-connected isolated gate driver that enables data measurement, fault indication, and configuration of these systems in a safe and reliable manner.

iNRCORE, LLC
EXPO HALL THEATER #2

High Temperature & High Reliability Design Considerations for Power Inductors and Transformers

PRESENTED BY: **Keith Blendowski**

Planned discussion points:

- Acceptable insulation materials and methods

- Applicable core materials

- Perform brief design examples

IWATSU ELECTRIC CO.,LTD.
ROOM W203A

Issues In Measuring Switching Losses of SiC & GaN Devices In an Inductor (Magnetic Device) Load

PRESENTED BY: **Ryu Nagahama**

In switching loss measurements using inductors and magnetic devices, differences due to errors in probing and measurement systems appear. These differences are explained here on the basis of actual measurement results in an GaN device switching circuits.

Nexperia
ROOM W205B

Combining Proven MOSFET Expertise and Broad Application Understanding to Develop Market-Leading Application Specific MOSFETs for Hotswap Applications

PRESENTED BY: **Dwayne Mott**

Whether it is in the cloud or at the edge, we truly live in a 24/7 world. So much of our daily lives depend on rack-based computers, communications and storage systems that are always-on. Ensuring these systems do not experience any power disruption and to protect the components on replacement boards when they are inserted into a live system, it is essential that in-rush current is carefully controlled. In normal MOSFETs, strong SOA and low RDS(on) are mutually exclusive. Offering both capabilities in a single device, Nexperia's specific MOSFETs for Hotswap and Soft Start are optimized for a non-stop world.

Qorvo
ROOM W205A

Qorvo Brings Unprecedented Low RDS(on) 750V SiC FETs to the Industry Workhorse Surface Mount Package

PRESENTED BY: **Pete Losee**

Demanding power applications such as EVs, datacenter/servers, telecoms and circuit protection that use 750V power FETs were able to leverage the continually improved RDS(on) performance for minimizing conduction losses in their end system but were limited to having only through-hole package options. At APEC, Qorvo will present a new 750V SiC FET solution that delivers both unprecedented low RDS(on) and the compactness of a small surface mount package.

Texas Instruments
EXPO HALL THEATER #1

The Benefits of GaN In Consumer AC/DC Power Delivery

PRESENTED BY: **David Snook**

Increasingly, consumers seek smaller, lighter electronics while also wanting to reduce their energy footprint. In the laptop power adapter market, this has challenged engineers to find new ways to pack more power in smaller spaces while minimizing power loss to deliver more efficient adapters – and many are looking to gallium nitride (GaN) semiconductors to help them achieve those goals. In this session you will learn how to use TI's integrated GaN technology to reduce the size of your consumer power adapters by 50% (down to 49 cm3) and improve their efficiency by up to 94%, resulting in an easy-to-use, high-efficiency and high power-density solution for AC/DC designs under 75 W. We'll also touch on the benefits GaN delivers in other applications.

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8:30 a.m. – 11:20 a.m.

IS19: WBG Applications

ROOM W206

SESSION CHAIRS

Peter Di, *GaN Systems*

Reza Sharifi, *Texas Instruments*

8:30 a.m.

IS19.1 **A SiC Based 60kW Three Phases LLC Converter with Wide Voltage Range**
Chen Wei, *Wolfspeed*

8:55 a.m.

IS19.2 **Maximize Performance of Silicon Carbide MOSFETs for High Power Conversions**
Yuequan Hu, *Wolfspeed*

9:20 a.m.

IS19.3 **2.4kW All-GaN 48V-12V Bidirectional Converter with Bi-GaN Load Switch for Mild Hybrid Electrical Vehicle (MHEV)**
Shuilin Tian, *Innoscience America INC*

9:45 a.m.

IS19.4 **New GaNSense Half-Bridge IC Enables Next Gen High-Frequency, High-Efficiency, High-Density Topologies**
Tom Ribarich, *Navitas Semiconductor*

10:30 a.m.

IS19.5 **Hybrid SiC and GaN Implementation of a Totem Pole PFC**
Sam Abdel-Rahman, *Infineon Technologies*

10:55 a.m.

IS19.6 **High Efficiency and High-Power Density GaN-Based 11kW/800V Onboard Charger**
Mahdi Jedari, *GaN systems*

8:30 a.m. – 11:20 a.m.

IS20: Packaging and Thermal Management

ROOM W203ABC

SESSION CHAIRS

Hanh-Phuc Le, *University of California-San Diego*

Douglas Hopkins, *North Carolina State University*

8:30 a.m.

IS20.1 **Assessment of MOSFET Switching Losses Based on Junction Temperature: Comparison in an LLC Converter Between TO-247 and ACEPACK™ SMIT Using MDmesh™ DM6 Technology**
Alfio Scuto, *STMicroelectronics*

8:55 a.m.

IS20.2 **Maximize Performances and Power Density in AC-DC Power Conversion by Using SMD Packages with Top-Side Cooling**
Ludovica Longo, *STMicroelectronics*

9:20 a.m.

IS20.3 **Robust, Flexible Copper Interconnections to Enhance Performance and Reliability of SiC Power Modules for Traction Inverters**
Brandon Passmore, *Wolfspeed*

9:45 a.m.

IS20.4 **Thermal Management for Bottom-Side Cooled Surface-Mount SiC Devices**
Tamanna Bhatia, *Wolfspeed*

10:30 a.m.

IS20.5 **Inverter/Converter Power Density and Flexibility Improvements Through Modularity and Novel Thermal Management Architecture**
Ian Byers, *Marel Power Solutions*

10:55 a.m.

IS20.6 **GaN Transistor for Next Generation Power Supply Units**
Bo Sheng, *GaN Systems Inc.*

8:30 a.m. – 11:20 a.m.

IS21: PMBus and Security in Power Supplies with Digital Communication

ROOM W202BC

SESSION CHAIRS

Richard Nowakowski, *Texas Instruments*

Peter Miller, *Texas Instruments*

8:30 a.m.

IS21.1 **What is new in PMBus™ 1.4 Part I & Part II**
Bob White, *Embedded Power Labs*

8:55 a.m.

IS21.2 **AVSBus™ Serial Interface for Dynamic Voltage Scaling – Evolution**
Juan Arango, *Texas Instruments*

9:20 a.m.

IS21.3 **Secure PMBus Controller to Add Security Protection to PMBus-based Devices**
Clay Greene, *Analog Devices Inc*

9:45 a.m.

IS21.4 **Firmware Authentication Techniques for Front-End Power supplies and Environment Monitors**
Srini Kothapally, *Cisco Systems*

10:30 a.m.

IS21.5 **Implementing Digital Power Supply Security with PMBus 1.5**
Robert Santucci, *Intel Corporation*

10:55 a.m.

IS21.6 **Looking Forward – PMBus™ 2.0**
Peter Miller, *System Management Interface Forum*

8:30 a.m. – 11:20 a.m.

IS22: Flyback Converters for Low Power Applications

ROOM W204ABC

SESSION CHAIRS

Armando Mesa, *onsemi*

Elisabetta Mahmutovic, *Texas Instruments*

8:30 a.m.

IS22.1 **How to Achieve Low Standby Power for an Isolated offline Flyback**
Roberto Scibilia, *Texas Instruments*

8:55 a.m.

IS22.2 **Under the Hood of an Isolated Flyback Compensation with TL431 Voltage Reference**
Elisabetta Mahmutovic, *Texas Instruments*

9:20 a.m.

IS22.3 **High Efficiency and High-Power Density 35W USB-PD Adapter Using Asymmetrical Half-Bridge Flyback and GaN Device**
Allan Saliva, *Infineon Technologies*

9:45 a.m.

IS22.4 **Accurate Multiple-Output Flyback Converter with Single Secondary Winding**
Yi Li, *Power Integrations*

10:30 a.m.

IS22.5 **Peak Power Optimization Using ZVS, Active-Clamp Flyback Converters**
Donnie Saturno, *Power Integrations*

10:55 a.m.

IS22.6 **Achieving Zero Input Power for No-Load Operation in a 5 W to 10 W Flyback Power Supply**
John Mardy, *Power Integrations*

8:30 a.m. – 11:20 a.m.

IS23: Measurement Techniques and Other Topics

ROOM W205A

SESSION CHAIRS

Davide Giacomini, *Infineon Technologies AG*

Raj Pulugurtha, *Florida International University*

8:30 a.m.

IS23.1 **Measurement of In-Circuit Magnetic Properties of Core Using Oscilloscope for Efficient Automotive Designs**
Srikrishna N, *Tektronix India Pvt. Ltd.*

8:55 a.m.

IS23.2 **Using a High Bandwidth Loss Probe to Measure SiC and GAN Fets Losses with a Lower Bandwidth Oscilloscope**
Ken Henderson, *Cleverscope*

9:20 a.m.

IS23.3 **The Secrets to an Accurate and Useful Double Pulse Test**
Julius Rice, *Wolfspeed*

9:45 a.m.

IS23.4 **Recirculating Load Testbed for High Power Inverter Validation**
Jonathan Hayes, *Wolfspeed*

10:30 a.m.

IS23.5 **Small Form-Factor Tunable Wavelength Horticultural Led Driver**
Fred Song, *Infineon Technologies Americas Corp.*

10:55 a.m.

IS23.6 **Designing an Input EMI Filter for an Automotive Multiphase Buck Converter**
Eric Lee, *Texas Instruments*

8:30 a.m. – 11:20 a.m.

IS24: Energy Storage Systems and Their Relevant Aspects

ROOM W205BC

SESSION CHAIRS

Victor Boyadzhyan, *IBM*

Eric Swenson, *IBM*

8:30 a.m.

IS24.1 **Fitness for Purpose – Choosing the Right Storage Device for IoT Applications**
Mike Hayes, *Tyndall National Institute*

8:55 a.m.

IS24.2 **V2G Storage with School Bus Fleets**
Aaron Nutt, *Dynapower*

9:20 a.m.

IS24.3 **Grid Tied Storage**
Babu Chalamala, *Sandia National Laboratories*

9:45 a.m.

IS24.4 **SuperCapacitor Applications**
Nihal Kularatna, *The University of Waikato*

10:30 a.m.

IS24.5 **High Power and Dynamic Wireless Charging of Electric Vehicles**
Veda Prakash, *UT Battelle ORNL*

10:55 a.m.

IS24.6 **Panel Discussion on Energy Storage Technologies**
Victor Boyadzhyan, *Arseco Laboratories*

1:45 p.m. – 3:25 p.m.

IS25: WBG Devices

ROOM W206

SESSION CHAIRS

Peter Comiskey, *Wolfspeed*

Anuj Narain, *Wolfspeed*

1:45 p.m.

IS25.1 **An Experimental Study on Parasitic Turn-On (PTO) Due to Crosstalk in Fast Switching Silicon Carbide (SiC) Power MOSFETs**
Shashank Mathur, *Wolfspeed*

2:10 p.m.

IS25.2 **Improving Switching Performance in SiC Power Modules by Better Balancing Gate Threshold Voltage Differences**
Antonia Lanzafame, *STMicroelectronics*

2:35 p.m.

IS25.3 **On-Chip and Inline Characterization of SiC-MOSFET Physical Parameters for Optimized Gate Drive Control**
Thoralf Rosahl, *Robert Bosch GmbH*

3:00 p.m.

IS25.4 **A GaN HEMT with Exceptional Gate Overvoltage Robustness**
Bixuan Wang, *CPES Virginia Tech*

1:45 p.m. – 3:25 p.m.

IS26: Magnetics

ROOM W203ABC

SESSION CHAIRS

George Slama, *Würth Elektronik*

Ed Herbert, *PSMA*

1:45 p.m.

IS26.1 **Overview for Specifying a Common Mode Choke for Improved Circuit Performance**
Paul Oppelt, *Minntronix Inc.*

2:10 p.m.

IS26.2 **Considerations for Integrating Inductor Within Transformer**
Victor Quinn, *Exxelia*

2:35 p.m.

IS26.3 **New LLC Transformer Design Methodology**
Lucas Nicieza, *Frenetic*

3:00 p.m.

IS26.4 **Planar Magnetics: A Case Study Showcasing Software Design Tools That Provide Real-Time Relative Performance Analysis**
Vladimir Alexiev, *Power Integrations*

1:45 p.m. – 3:25 p.m.

IS27: Renewable Energy As Primary Power Generation Sources – Topologies and Control

ROOM W202BC

SESSION CHAIRS

Juan Carlos, *University of Arkansas*

Ke Ma, *GaN Systems*

1:45 p.m.

IS27.1 **Grid-forming Inverters, an Enabling Technology to Realize the Power System Paradigm Shift, from Machines to Electronics**
Gab-Su Seo, *National Renewable Energy Laboratory*

2:10 p.m.

IS27.2 **Comparison of Goldwind's Grid Following and Grid Forming Control based WTGs – Designing & Engineering Application Experience**
Rui Sun, *Goldwind*

2:35 p.m.

IS27.3 **High-Voltage SiC Device Technology for Renewable Energy Applications**
Victor Veliadis, *North Carolina State University*

3:00 p.m.

IS27.4 **Universal Grid-Forming Control Paradigms and Their Applications to Renewable Generation**
Dominic Gross, *University of Wisconsin-Madison*

1:45 p.m. – 3:25 p.m.

IS28: Open-Source Design Automation Tools for Power Electronics

ROOM W204ABC

SESSION CHAIRS

Alan Mantooth, *University of Arkansas*

Kevin Hermanns, *PE-Systems GmbH*

1:45 p.m.

IS28.1 **Using OpenSource Technology and Tools in Power Electronics To Drive Innovation, Boost Productivity and Create Value**
Peter Wilson, *University of Bath*

2:10 p.m.

IS28.2 **Open Source Solutions for Power Magnetics Modeling and Design**
Minjie Chen, *Princeton University*

2:35 p.m.

IS28.3 **Layout Design Automation in Power Electronics**
Alan Mantooth, *University of Arkansas*

3:00 p.m.

IS28.4 **From Machine-readable Data Sheets for Power Semiconductors to Optimized Llc Converters Utilizing Reinforcement Learning Strategies**
Kevin Hermanns, *PE-Systems GmbH*

1:45 p.m. – 3:25 p.m.

IS30: Effective, Reliable and Stable Operation of 100% Renewable Powered Grid

ROOM W205BC

SESSION CHAIRS

Grain Philip, *NEOM Energy and Water*

Ricardo Orfei, *Siemens Energy*

1:45 p.m.

IS30.1 **Dynamic Stabtility in 100% RES System – Technologies and Operation Challenges**
Ricardo Orfei, *Siemens Energy*

2:10 p.m.

IS30.2 **Types of System Study and Methodologies for Modular Static Synchronous Series Compensators (mSSSC) in Renewable Grids Installation**
Nuwan Perera, *Stantec*

2:35 p.m.

IS30.3 **Planning 100% Renewable Powered Grid: Challenges and Opportunities**
Nand Singh, *NEOM Energy and Water (ENOWA)*

3:00 p.m.

IS30.4 **Power Electronic Dominated Grids: Part–I Enhancing Synchronous Condenser Capabilities by Interfacing with a Back-to-back Converter, and Part–II Integration Challenges of Large Electrolyzers**
Mojtaba Mohaddes, *TransGrid Solutions*

NOTES

8:30 a.m. – 11:20 a.m.

T25: Bi-directional DC-DC Converters

ROOM W101

SESSION CHAIRS

Justin Henspeter, *IBM*

Cahit Gezgin, *Infineon Technologies AG*

8:30 a.m.

T25.1 **Asymmetric Resonant Tank Design for a Bidirectional CLLC Resonant Converter in G2V and V2G Operation**

Stefan Ditze, *Fraunhofer IISB*

Bidirectional dc/dc Converters

AUTHORS: Stefan Ditze, Stefan Ehrlich, Dominik Happel, Andreas Rosskopf

8:50 a.m.

T25.2 **Sensor-Reduction Control for SPS-Modulated DAB Converter Using Ultra-Local Model**

Tan-Quoc Duong, *University of Ulsan*

Bidirectional dc/dc Converters

AUTHORS: Tan-Quoc Duong, Sung-Jin Choi

9:10 a.m.

T25.3 **Operation and Comparison of a Novel Modular Asymmetric Buck-Boost DC-DC Converter for High-Power Applications**

Soumya Nag, *Indian Institute of Technology*

Bidirectional dc/dc Converters

AUTHORS: Mohammad Saleh Khan, Jyoti Jyoti, Soumya Shubhra Nag, Anandarup Das

9:30 a.m.

T25.4 **Data-Driven Modeling of Zero Voltage Switching of Non-Resonant DAB Converters Under TPS Modulation**

Xinze Li, *Nanyang Technological University*

Bidirectional dc/dc Converters

AUTHORS: Xinze Li, Fanfan Lin, Josep Pou, Suvajit Mukherjee, Jiaxin Dong

9:50 a.m.

T25.5 **Stacked-Bridge-Based Three-Level DAB Converter in 800V DC Micro-Grids**

Haoyu Zhang, *ShanghaiTech University*

Bidirectional dc/dc Converters

AUTHORS: Haoyu Zhang, Liang Wang, Haoyu Wang

10:40 a.m.

T25.6 **A Communication-Integrated Battery Equalization Strategy Based on Bidirectional Flyback Converters**

Lingyu Li, *College of Electrical Engineering Zhejiang University*

Bidirectional dc/dc Converters

AUTHORS: Lingyu Li, Long Qin, Keming Liu, Jiande Wu, Xiangning He

11:00 a.m.

T25.7 **Single Current Measurement Based Bidirectional Frequency Tracking for Unregulated Series Resonant DAB Converters**

Liyang Du, *University of Arkansas*

Bidirectional dc/dc Converters

AUTHORS: Liyang Du, Hui Cao, Xia Du, Xiaoling Li, Yue Zhao, H. Alan Mantooth

8:30 a.m. – 11:20 a.m.

T26: Motors Drives

ROOM W102

SESSION CHAIRS

Woongkul Lee, *Michigan State University*

Rakib Islam, *American Axle & Manufacturing*

8:30 a.m.

T26.1 **Saliency-Based Sensorless IPMSM Drives Using Derivatives of Phase Currents with Single DC-Link Current Sensor**

Byung Ryang, *Seoul national university*

AC, DC, BLDC Motor Drives

AUTHORS: Byung Ryang Park, Gyu Cheol Lim, Yongsu Han, Juwon Lee, Jung-Ik Ha

8:50 a.m.

T26.2 **Design of High-Efficiency Ultra-High-Speed Motor for Fuel-Cell Air Compressor Using an Amorphous Stator with Multiphase Winding**

Khurshedul Islam, *Mississippi State University*

AC, DC, BLDC Motor Drives

AUTHORS: Khurshedul Islam, Kazi Nishat Tasnim, Han-Gyu Kim, Seungdeog Choi

9:10 a.m.

T26.3 **Evaluation and Efficiency Comparison of Soft-Switching ARCP SiC-Based Traction Inverters in Electric Vehicles**

Che-Wei Chang, *Virginia Polytechnic Institute and State University*

AC, DC, BLDC Motor Drives

AUTHORS: Che-Wei Chang, Matthias Spieler, Dong Dong, Rolando Burgos

9:30 a.m.

T26.4 **Design and Optimization of a Modular Multiphase Drive for Multiphase Machines**
Yuxuan Wu, *Stony Brook University*
Single- and Multi-Phase Inverters
AUTHORS: Yuxuan Wu, Mustafeez Ul-Hassan, Fang Luo

9:50 a.m.

T26.5 **Smart Coils for Mitigation of Motor Reflected Overvoltage Fed by SiC Drives**
Majid Tahmasbi, *University of Kentucky*
High Performance Drives
AUTHORS: Majid Tahmasbi Fard, Jiangbiao He, Milad Sadoughi, Behrooz Mirafzal, Fariba Fateh

10:40 a.m.

T26.6 **Self-Calibration Technique for Junction Temperature Estimation of SiC MOSFET Inverters Loaded with Synchronous Reluctance Motors**
Paolo Pescetto, *Politecnico di Torino*
Sensor Integration
AUTHORS: Paolo Pescetto, Fausto Stella, Gianmario Pellegrino

11:00 a.m.

T26.7 **A Multi-Kilowatt Low-Profile GaN Inverter for Light Electric Vehicles and High-Power Tools**
Martin Wattenberg, *Infineon Technologies Austria AG*
AC, DC, BLDC Motor Drives
AUTHORS: Martin Wattenberg, Oscar G. Lorenz, Juan Sanchez

8:30 a.m. – 11:20 a.m.

T27: Power Converter Modulation & Control

ROOM W103

SESSION CHAIRS

Qingxuan Ma, *Eaton*

Jingbo Liu, *Eaton*

8:30 a.m.

T27.1 **A Robust Voltage Sensor-Less Control for SiC Grid-Tied Inverter with Zero-Voltage Ride-Through**
Xiaofeng Dong, *Florida State University*
Grid-Tied Systems
AUTHORS: Xiaofeng Dong, Hui Li, Olugbenga Moses Anubi

8:50 a.m.

T27.2 **Non-Isolated High Voltage Conversion Ratio Soft-Switched Interleaved Bidirectional DC-DC Converter with Low Voltage Stress on Switches**
Zahra Saadatizadeh, *University of Arkansas*
Bi-directional Power Converters
AUTHORS: Zahra Saadatizadeh, H. Alan Mantooth

9:10 a.m.

T27.3 **Design and Control of Three-Phase Smart Inverter Using Gate-Drive Integrated Gallium Nitride (GaN) Devices for Solar Energy Integration**
Tucker Skinner, *Utah State University*
Photovoltaic (PV) Inverters and Micro Inverters
AUTHORS: Tucker Skinner, Dakota Goodrich, Conner Sabin, McKay Waite, Aditya Zade, Hongjie Wang

9:30 a.m.

T27.4 **A Comprehensive Control Scheme for CM Resonance Suppression and Current Quality Improvement with DPWM Method in ILCL-Filtered Grid-Connected Inverter**
Zicheng Zhang, *Shandong University*
Photovoltaic (PV) Inverters and Micro Inverters
AUTHORS: Zicheng Zhang, Xiaoyan Li, Hongliang Zhang, Chenghui Zhang

9:50 a.m.

T27.5 **Autonomous Control Schemes for Grid-Interfaced Series-Connected Low-Voltage Isolated PV Microinverter**
Subhrasish Pal, *Indian Institute of Technology Kharagpur*
Photovoltaic (PV) Inverters and Micro Inverters
AUTHORS: Subhrasish Pal, Souvik Chattopadhyay

10:40 a.m.

T27.6 **Optimal Modulation and DM Filter Design for a High Switching Frequency Single-Stage Microinverter**
Arafat Hasnain, *University of Maryland*
Photovoltaic (PV) Inverters and Micro Inverters
AUTHORS: Arafat Hasnain, Michael D'Antonio, Chanaka Singhabahu, Yidi Shen, Daniel Zakzewski, Alireza Khaligh

11:00 a.m.

T27.7 **On the Fault-Ride-Through Dynamics of Grid-Forming Converters — a Multi-Dimensional Adaptive Inertia Approach**
Pranjal Gajare, *Georgia Tech*
Grid-Tied Systems
AUTHORS: Pranjal Gajare, Mohammadreza Miranbeigi, Joseph Benzaquen, Deepak Divan

8:30 a.m. – 11:20 a.m.

T28: Solid-State Transformers

ROOM W104

SESSION CHAIRS

Maja Harfman, *Menlo Microsystems*

Mohammed Agamy, *University at Albany*

8:30 a.m.

T28.1 **Second Harmonic Ripple Voltage Suppression for Single-Phase ISOP Solid-State Transformer by Active Power Decoupling**

Tianyu Wei, *Power Electronics Laboratory EPFL*

Solid-State Transformers

AUTHORS: Tianyu Wei, Andrea Cervone, Drazen Dujić

8:50 a.m.

T28.2 **A Single-Stage Three-Phase Isolated AC-DC Converter for Medium Voltage Solid State Transformer Applications**

Chi Zhang, *Delta Electronics (Americas) Ltd.*

Solid-State Transformers

AUTHORS: Chi Zhang, Ruxi Rudy Wang, Zhiyu Shen, Tomas Sadilek, Anup Anurag, Peter Barbosa

9:10 a.m.

T28.3 **Square-Wave Source with Adjus le dv/dt for Insulation Testing Under Mixed-Frequency Stresses**

Hajime Takayama, *Kyoto University*

Solid-State Transformers

AUTHORS: Hajime Takayama, Chengmin Li, Jennifer Abou-Najm, Takashi Hikihara, Drazen Dujić

9:30 a.m.

T28.4 **7.2kV/100kVA Solid State Transformer Based on Half Bridge LLC Resonant Converter and 15kV SiC AC Switch**

Wei Xu, *The University of Texas at Austin*

Solid-State Transformers

AUTHORS: Wei Xu, Sanjay Rajendran, Zhicheng Guo, Adithyan Vetrivelan, Alex Q. Huang

9:50 a.m.

T28.5 **Magnetic Design of a 4.16 kV/1 MW Medium Voltage PV Plus Storage Solid State Transformer (PVS-SST)**

Zhicheng Guo, *UT Austin*

Solid-State Transformers

AUTHORS: Zhicheng Guo, Wei Xu, Adithyan Vetrivelan, Alex Q. Huang

10:40 a.m.

T28.6 **Medium Voltage Solid State Transformer for Extreme Fast Charging Applications**

M A, *Danfoss*

Solid-State Transformers

AUTHORS: M A Awal, Oscar Andres Montes, Fei Teng, Dakai Wang, Md Rashed Hasan Bipu, Wensong Yu, Srdjan Lukic, Iqbal Husain

11:00 a.m.

T28.7 **A High-Frequency PCB-Winding Transformer Design with Medium Voltage Insulation for Solid-State Transformer**

Zheqing Li, *CPES, Virginia Polytechnic Institute and State University*

Solid-State Transformers

AUTHORS: Zheqing Li, Feng Jin, Yi-Hsun Hsieh, Qiang Li

8:30 a.m. – 11:20 a.m.

T29: Magnetics Modeling & Simulation

ROOM W105

SESSION CHAIRS

Matt Wilkowski, *EnaChip*

George Slama, *Würth Elektronik*

8:30 a.m.

T29.1 **Predicting the B-H Loops of Power Magnetics with Transformer-Based Encoder-Projector-Decoder Neural Network Architecture**

Haoran Li, *Princeton University*

Magnetics modeling and simulations

AUTHORS: Haoran Li, Diego Serrano, Shukai Wang, Thomas Guillod, Min Luo, Minjie Chen

8:50 a.m.

T29.2 **Current Sharing Analysis of a High Power Transformer with Parallel Windings**

Tianlong Yuan, *CPEC Virginia Tech*

Magnetics modeling and simulations

AUTHORS: Tianlong Yuan, Feng Jin, Zheqing Li, Qiang Li

9:10 a.m.

T29.3 **An Alternative Method to Accurately Model Magnetic Components Using Ansys HFSS 3D**

Amin Khakparvaryazdi, *University of Alberta*

Magnetics modeling and simulations

AUTHORS: Amin KhakparvarYazdi, Mona Mostafavi, Alireza Safaee, Sayed Ali Khajehoddin

9:30 a.m.

T29.4 **A Simplified DC-Bias Injection Method with Mirror Transformer for Magnetic Material Characterization**

Shukai Wang, *Princeton University*

Magnetics modeling and simulations

AUTHORS: Shukai Wang, Diego Serrano, Haoran Li, Annie Lin, Thomas Guillod, Min Luo, Charles R. Sullivan, Minjie Chen

9:50 a.m.

T29.5 **Transformer Leakage Inductance Design Methodology**

Angshuman Sharma, *Missouri University of Science and Technology*

Magnetics modeling and simulations

AUTHORS: Angshuman Sharma, Jonathan W. Kimball

10:40 a.m.

T29.6 **Design Guidelines to Reduce Parasitic Capacitance in Planar Inductors**

Shaokang Luan, *Aalborg University*

Magnetics modeling and simulations

AUTHORS: Shaokang Luan, Stig Munk-Nielsen, Zhixing Yan, Jan Schupp, Bruce Wakelin, Magnus Hortans, Hongbo Zhao

11:00 a.m.

T29.7 **Calculation of Ferrite Core Losses with Arbitrary Waveforms Using the Composite Waveform Hypothesis**

Thomas Guillod, *Dartmouth College*

Magnetics modeling and simulations

AUTHORS: Thomas Guillod, Jenna S. Lee, Haoran Li, Shukai Wang, Minjie Chen, Charles R. Sullivan

8:30 a.m. – 11:20 a.m.

T30: Practical Design Considerations for Power Modules

ROOM W108

SESSION CHAIRS

Ran Mo, *Eaton*

Ran Mo, *Shell*

8:30 a.m.

T30.1 **Layout-Dominated Electro-Thermal Optimization for Multichip Power Modules with Response Surface and Fourier Series Model**

Yu Chen, *Zhejiang University*

Power Electronics Packaging

AUTHORS: Yu Chen, Ankang Zhu, Hongbin Yu, Benben Zhang, Yi Zhao, Haoze Luo, Wuhua Li, Xiangning He

8:50 a.m.

T30.2 **Experimental Evaluation of Liquid Immersed Electronics for High Density Power Converters**

Jamie Turnbull, *UW-Madison*

Power Electronics Packaging

AUTHORS: Jamie Turnbull, Giri Venkataramanan, Daniel Ludois

9:10 a.m.

T30.3 **Modular Scalable Power Electronics Building Block Based MVDC Solid State Circuit Breakers**

Shuyan Zhao, *Drexel University*

Quality and System Reliability

AUTHORS: Shuyan Zhao, Yao Wang, Reza Kheirollahi, Yashraj Shanker, Jeremy Wartenberg, Dana Murphy, Hua Zhang, Fei Lu

9:30 a.m.

T30.4 **Proactive Thyristor-Based DC Solid-State Circuit Breaker**

Reza Kheirollahi, *Drexel University*

Quality and System Reliability

AUTHORS: Reza Kheirollahi, Shuyan Zhao, Yao Wang, Hua Zhang, Fei Lu

9:50 a.m.

T30.5 **Package Design of a Double-Side Cooled 20-kV Gallium Nitride Diode Module with Improved Insulation by Nonlinear Resistive Polymer-Nanoparticle Coating**

Zichen Zhang, *Virginia Tech*

Power Modules / High Density Design

AUTHORS: Zichen Zhang, Carl Nicholas, Khai Ngo, Guo-Quan Lu

10:40 a.m.

T30.6 **A 2x2 Paralleling GaN Half-Bridge Power Module for High-Density 500kHz 3.3kW CLLC Converter**

Satoshi Otsu, *Panasonic Industry Co Ltd*

Power Modules / High Density Design

AUTHORS: Satoshi Otsu, Shinji Ujita, Kenichiro Tanaka, Masato Maede, Hideki Niimi, Shozo Ochi

11:00 a.m.

T30.7 **A Simple and Non-Destructive Method to Measure Per-Terminal Baseplate Coupling of Power Modules**

Brian Deboi, *Wolfspeed*

Thermal and EMC Management

AUTHORS: Brian DeBoi, Andrew Lemmon, Austin Curbow

8:30 a.m. – 11:20 a.m.

T31: Wireless Power Transfer II

ROOM W109A

SESSION CHAIRS

Shajjad Chowdhury, *Oak Ridge National Lab*

Khurram Afridi, *Cornell University*

8:30 a.m.

T31.1 **Current Controlled Transmitter for High Frequency WPT Utilizing Non-Invasive PCB Integrated Rogowski Current Sensor**

Bar Halivni, *Ben-Gurion University of the Negev - PEMIC*

Wireless charging

AUTHORS: Bar Halivni, Mor Mordechai Peretz

8:50 a.m.

T31.2 **State Estimation Based Foreign Object Detection in Wireless Power Transfer Systems**

Kang Yue, *ShanghaiTech University*

Wireless charging

AUTHORS: Kang Yue, Yu Liu, Xinguo Zhang, Haoyu Wang

9:10 a.m.

T31.3 **A Fast-Speed Phase Adaptation Algorithm Based on Power Feedback for Microwave Power Transmission**

Doumin Zhou, *Nanjing University of Aeronautics and Astronautics*

Wireless charging

AUTHORS: Doumin Zhou, Ke Jin, Weiyang Zhou, Shuchen Cheng

9:30 a.m.

T31.4 **A Planar Omnidirectional Wireless Power Transfer Platform for Por le Devices**

Xipei Yu, *Center for Power Electronics Systems*

Wireless charging

AUTHORS: Xipei Yu, Junjie Feng, Qiang Li

9:50 a.m.

T31.5 **Ultra-Wideband Unidirectional Reset-Less Rogowski Coil Switch Current Sensor Topology for High-Frequency DC-DC Power Converters**

Ali Parsa, *University of North Carolina at Charlotte*

Non-contact Sensors for Power Electronics

AUTHORS: Ali Parsa Sirat, Hossein Niakan, Daniel Evans, James Gafford, Babak Parkhideh

10:40 a.m.

T31.6 **A Compact Anisotropic Magnetoresistance Based Contactless Current Sensor for Medium Voltage Power Electronics Applications**

Lakshmi Ravi, *Virginia Polytechnic Institute and State University*

Non-contact Sensors for Power Electronics

AUTHORS: Lakshmi Ravi, Jian Liu, Steven Schmalz, Andy Schroedermeier, Rolando Burgos, Dong Dong

11:00 a.m.

T31.7 **A Novel Metal Object Detection System Using Asymmetric Triangular Gradiometers for High-Power Inductive Power Transfer Applications**

Jin S., *Samsung Electronics*

Non-contact Sensors for Power Electronics

AUTHORS: Jin S. Choi, Bohwan Choi, Youngho Ryu

8:30 a.m. – 11:20 a.m.

T32: Fast Charging Applications

ROOM W109B

SESSION CHAIRS

Dong Cao, *University of Dayton*

Dong Cao, *University of Dayton*

8:30 a.m.

T32.1 **Active Power Decoupling Strategy for Single Phase AC Charging Using a Dual Inverter Drive**

Chatumal Perera, *University of Toronto*

Charging Systems

AUTHORS: Chatumal Perera, Mehanathan Pathmanathan, Caniggia Viana, Peter Lehn

8:50 a.m.

T32.2 **Scalable GaN-Based EV Charging Station with Energy Storage**

Mohamed Tamasas, *University of Central Florida*

Charging Systems

AUTHORS: Mohamed Tamasas Elrais, Reza Rezaii, Issa Batarseh

9:10 a.m.

T32.3 **A 3.3 kV Silicon Carbide MOSFET Based Building Block for Medium-Voltage Ultra-Fast DC Chargers**

Ahmed Ismail, *University of Arkansas*

Charging Systems

AUTHORS: Ahmed Ismail, Hui Cao, Ahmad Al-Hmoud, Zhuxuan Ma, Xinyuan Du, Yue Zhao

9:30 a.m.

T32.4 **Event-Based Spread Spectrum Voltage and Current Mode Digital PFM Controllers in LLC Converters**

Santanu Kapat, *Indian Institute of Technology (IIT) Kharagpur*

Vehicular Power Electronic Circuits and Systems

AUTHORS: Santanu Kapat, Faraz Ahmad, Gopi Reddy Chilukuri, Ranajay Mallik, Akshat Jain

9:50 a.m.

T32.5 **High Power Factor Correction of a Single Stage Bidirectional Wireless Battery Charger for EV**

Asier Garcia-Bediaga, *IKERLAN*

Charging Systems

AUTHORS: Asier Garcia-Bediaga, Itziar Alzuguren, Ander Avila, Alejandro Rujas, Miroslav Vasić

10:40 a.m.

T32.6 **An 18 kW Battery Charger Module for Extreme Fast Charging Applications Using an Unfolding-Based AC-DC Topology**

Shubhangi Gurudiwan, *Utah State University*

Charging Systems

AUTHORS: Shubhangi Gurudiwan, Rees Hatch, Mahmoud Mansour, Hongjie Wang, Regan Zane

11:00 a.m.

T32.7 **Individual Module Power Transmission Control for Extreme Fast Charging Stations Configured with Solid-State Transformer**

Dong-Ho Choi, *Dankook University*

Charging Systems

AUTHORS: Dong-Ho Choi, Jin-Hyuk Park, June-Seok Lee

1:45 p.m. – 3:25 p.m.

T33: LLC Converters

ROOM W109B

SESSION CHAIRS

Mladen Ivankovic, *Stanford University*

Juan Rivas, *Stanford University*

1:45 p.m.

T33.1 **High Power Density Three-Phase LLC DC/DC Converter with Coupled Resonant Inductor and Wye-Delta Transformer for Aircraft Applications**

Daniel Ríos, *ETSII / Universidad Politécnica de Madrid*

Resonant Converters

AUTHORS: Daniel Ríos Linares, Miroslav Vasić

2:05 p.m.

T33.2 **Em Noise Mitigation Using Partial Power Regulated LLC Resonant Converter**

Kyung-Wook Heo, *UNIST*

Resonant Converters

AUTHORS: Kyung-Wook Heo, Hwa-Pyeong Park, Jee-Hoon Jung

2:25 p.m.

T33.3 **Design Consideration for CLLC Converter with High Power and Wide Gain Range**

Chunyang Zhao, *Virginia Tech*

Resonant Converters

AUTHORS: Chunyang Zhao, Feng Jin, Zheqing Li, Yi-Hsun Hsieh, Fred C. Lee, Qiang Li

2:45 p.m.

T33.4 **Three-Phase LLC DC/DC Converter in Stack Configuration: A Topology for High-Voltage Conversion Ratio Applications**

Daniel Ríos, *ETSII / Universidad Politécnica de Madrid*

Resonant Converters

AUTHORS: Daniel Ríos Linares, Miroslav Vasić, Pedro Alou Cervera

3:05 p.m.

T33.5 **Shielding Technique of Planar Transformers to Suppress Common-Mode EMI Noise for LLC Converter with Full Bridge Rectifier**

Feng Jin, *CPES*

Resonant Converters

AUTHORS: Feng Jin, Ahmed Nabih, Qiang Li

1:45 p.m. – 3:25 p.m.

T34: Design Techniques for Noise & EMI Reduction

ROOM W101

SESSION CHAIRS

Liming Liu, *ON Semiconductor*

Yusi Liu, *Eaton*

1:45 p.m.

T34.1 **Reduction of CM Noise by Minimizing Near-Field Effects in a DC/DC Converter**

Tyler McGrew, *Center for Power Electronics Systems Virginia Tech*

Thermal and EMC Management

AUTHORS: Tyler McGrew, Shuo Wang, Qiang Li

2:05 p.m.

T34.2 **Impact Assessment of Common-Mode Interference on Communication Cable in a Motor Drive System: Modified Bulk Current Injection Approach**

Kushan Choksi, *Stony Brook University*

Thermal and EMC Management

AUTHORS: Kushan Choksi, Yuxuan Wu, Deepi Singh, Fang Luo

2:25 p.m.

T34.3 **Review of Radiated EMI Modeling and Mitigation Techniques in Power Electronics Systems**

Zhedong Ma, *University of Florida*

Power Modules / High Density Design

AUTHORS: Zhedong Ma, Yanwen Lai, Yirui Yang, Qinghui Huang, Shuo Wang

2:45 p.m.

T34.4 **Low Conducted-EMI Single-Phase Boost PFC with Sliding Frequency Modulation**

Zhansen Akhmetov, *North Carolina State University*

Thermal and EMC Management

AUTHORS: Zhansen Akhmetov, Muhammad Abdelraziq, Zeljko Pantic

3:05 p.m.

T34.5 **Modeling and Analysis of Differential-Mode Noise in a USB-C Charger**

Pinhe Wang, *Technical University of Denmark*

Thermal and EMC Management

AUTHORS: Pinhe Wang, Jiasheng Huang, Ziwei Ouyang, Tiberiu Gabriel Zsurzsan, Michael A. E. Andersen

1:45 p.m. – 3:25 p.m.

T35: Battery System Management & Control

ROOM W102

SESSION CHAIRS

Adam Skorek, *ABB*

Weiqiang Chen, *ABB*

1:45 p.m.

T35.1 **Hyperparameter Optimization in Bagging-Based Elm Algorithm for Lithium-Ion Battery State of Health Estimation**

Xin Sui, *Aalborg University*

Energy Storage Systems

AUTHORS: Xin Sui, Shan He, Søren Byg Vilsen, Remus Teodorescu, Daniel-Ioan Stroe

2:05 p.m.

T35.2 **Hybrid Physics and Machine Learning Models of Desktop-Scale Naval Power Systems**

Matthew Overlin, *PacMar Technologies*

Microgrid Systems

AUTHORS: Matthew Overlin, Alexander McBain, Justin Quattlebaum, Joshua Roper, Eric Thornton, Steven Iannucci, Eric Hultgren

2:25 p.m.

T35.3 **Electro-Thermal Co-Design of a High-Density Power-Stage for a Reconfigurable-Battery Assisted Electric-Vehicle Fast-Charger Using Multi-Physics Co-Simulation and Topology Optimization**

Seyed Amir, *University of Toronto*

Energy Storage Systems

AUTHORS: Seyed Amir Assadi, Omri Tayyara, Josh Palumbo, Andrew Chen, Mohammad Shawkat Zaman, Carlos Da Silva, Sanjeev Chandra, Cristina H. Amon, Olivier Trescases

2:45 p.m.

T35.4 **How to Identify Mechanism Consistency for Lfp/C Batteries During Accelerated Calendar and Cycling Aging Using the Lognormal Distribution**

Wendi Guo, *Aalborg University*

Energy Storage Systems

AUTHORS: Wendi Guo, Zhongchao Sun, Yaqi Li, Søren Byg Vilsen, Daniel-Ioan Stroe

3:05 p.m.

T35.5 **Soft-Switching Analysis of Beat Frequency Modulated Microinverters**

Dheeraj Etta, *Cornell University*

Photovoltaic (PV) Inverters and Micro Inverters

AUTHORS: Dheeraj Etta, Milad Heidari Khouzani, Mohammad Ebrahimi, Sayed Ali Khajehoddin, Khurram Khan Afridi

1:45 p.m. – 3:25 p.m.

T36: Power Components

ROOM W109A

SESSION CHAIRS

Lincoln Xue, *Oak Ridge National Lab*

Mike Ranjram, *Arizona State University*

1:45 p.m.

T36.1 **iFuse — A Controllable Overcurrent Protection Device for Multi-Inverter Microgrids with High IBR Penetration**

Kartavya Agarwal, *Georgia Institute of Technology*

Interconnects and Fuses

AUTHORS: Kartavya Agarwal, Joseph Benzaquen, Deepak Divan

2:05 p.m.

T36.2 **B-Tran™ Optimization and Performance Characterization**

Mouzhi Dong, *Ideal Power Inc.*

Power Silicon MOSFETs, BJTs, IGBTs

AUTHORS: Mouzhi Dong, Ruiyang Yu, Yifan Jiang, Jiankang Bu, Jeff Knapp, Dan Brdar

2:25 p.m.

T36.3 **Supercapacitor Assisted Extra Low Frequency Power Converters and Surge Protectors: Applying Supercapacitor Assisted Loss Management Concept in Practical Applications**

Thilanga Ariyarathna, *Waikato Institute of Technology*

Capacitors, Supercapacitors

AUTHORS: Thilanga Ariyarathna, Nihal Kularatna, Kosala Gunawardane

2:45 p.m.

T36.4 **Accelerated Degradation Testing and Failure Phenomenon of Metalized Film Capacitors for AC Filtering**

Bo Yao, *Aalborg university*

Capacitors, Supercapacitors

AUTHORS: Bo Yao, Yichi Zhang, Pedro Correia, Rui Wu, Sungyoung Song, Ionut Trintis, Haoran Wang, Huai Wang

3:05 p.m.

T36.5 **Modeling and Experimental Verification of a Hybrid DC Breaker During Fault Interruption**

Waqas Ali, *Friedrich-Alexander-Universität Erlangen-Nürnberg*

Interconnects and Fuses

AUTHORS: Waqas Ali, Ara Bissal, Martin März

1:45 p.m. – 3:25 p.m.

T37: Power Electronics Applications I

ROOM W103

SESSION CHAIRS

Jeffery Nilles, *Independent*

Jeffery Nilles, *Alpha&Omega Semiconductor*

1:45 p.m.

T37.1 **Adjus le 4-Level Hybrid Converter for Symbol Power Tracking in 5G New Radio**

Hieu Pham, *University of California San Diego*

Network and Telecommunication Power Electronics

AUTHORS: Hieu Pham, Ratul Das, Casey Hardy, Donald Kimball, Peter Asbeck, Hanh-Phuc Le

2:05 p.m.

T37.2 **Design Techniques in Constant On/Off-Time Peak Current Controlled Boost LED Drivers for Fast Start-Up and Dimming Transient Performance**

Dipayan Chatterjee, *Indian Institute of Technology (IIT) Kharagpur*

Lamp Ballasts and LED Lighting

AUTHORS: Dipayan Chatterjee, Santanu Kapat, Reddi Kiran Poola, Ravikumar Setty A., Sucheendran Sridharan

2:25 p.m.

T37.3 **Serving Constant and Pulsed Loads in Naval Power and Energy Systems**

Jack Hannum, *University of South Carolina*

Defense and Military Power Electronics

AUTHORS: Jack Hannum, Herbert Ginn, Kristen Booth

2:45 p.m.

T37.4 **xTMS: A Pulse Generator for Exploring Transcranial Magnetic Stimulation Therapies**

Kawsar Ali, *University of Oxford*

AC-DC-AC Applications and Matrix Converters

AUTHORS: Kawsar Ali, Karen Wendt, Majid Memarian Sorkhabi, Moaad Benjaber, Timothy Denison, Daniel J. Rogers

3:05 p.m.

T37.5 **Flexible PCB Connection Methods for Wearable Energy Harvesting Applications**

Katherine Kim, *National Taiwan University*

Energy Harvesting

AUTHORS: F. Selin Bagci, Richard Angsetya, Sean Logi, Katherine A. Kim

1:45 p.m. – 3:25 p.m.

T38: On Board Charger

ROOM W104

SESSION CHAIRS

Rasoul Hosseini, *General Motors*

1:45 p.m.

T38.1 **Evaluation of Split-Phase Inverter Mode for 1-ph/3-ph Combo Soft-Switching PFC for On-Board Charger Applications**

Tomas Sadilek, *Delta Electronics*

Power Electronics for Hybrid and Electric Cars

AUTHORS: Tomas Sadilek, Laszlo Huber, Peter Barbosa, Iqbal Husain

2:05 p.m.

T38.2 **An Accurate Loss Model of Single-Stage Single-Phase Isolated PFC Converter for Bidirectional Plug-In EV Charger**

Nil Patel, *Concordia University*

Charging Systems

AUTHORS: Nil Patel, Luiz Lopes, Akshay Kumar Rathore

2:25 p.m.

T38.3 **Self-Balanced Two-Output Battery Charger**

Christian Branas, *Universidad de Cantabria*

Charging Systems

AUTHORS: Christian Branas, Francisco J. Azcondo, Alberto Pigazo, Rosario Casanueva, Francisco J. Díaz, Paula Lamo

2:45 p.m.

T38.4 **A Two-Stage Twin-Bus Buck Converter for Battery Charging Applications**

Nicola Zanatta, *Dept. of Management and Engineering University of Padova Vicenza*

Charging Systems

AUTHORS: Nicola Zanatta, Tommaso Caldognetto, Davide Biadene, Giorgio Spiazzi, Paolo Mattavelli

3:05 p.m.

T38.5 **Light-Load and Cross-Load Control of Integrated OBC and APM for Electric Vehicle Applications**

Misha Kumar, *Delta Electronics (Americas) Ltd.*

Power Electronics for Hybrid and Electric Cars

AUTHORS: Misha Kumar, Peter Barbosa, Juan Ruiz

1:45 p.m. – 3:25 p.m.

T39: Three-Phase AC-DC Converters

ROOM W105

SESSION CHAIRS

John Lam, *University of Minnesota Twin Cities*

Jungwon Choi, *Mississippi State University*

1:45 p.m.

T39.1 **Direct Three-Phase AC-DC Rectifier with High-Frequency Open-Delta Transformer and Closed Loop Output Voltage Regulation**

Erick I., *Texas A&M University*

Single-Phase and Three-Phase Input

AUTHORS: Erick I. Pool-Mazun, Kevin Kim, Prasad Enjeti

2:05 p.m.

T39.2 **Investigation of Non-Unity Power Factor Operation of 3-ph ZVS PFC Rectifier for On-Board Charging of Electric Vehicles**

Tomas Sadilek, *Delta Electronics*

Single-Phase and Three-Phase Input

AUTHORS: Tomas Sadilek, Laszlo Huber, Peter Barbosa, Iqbal Husain

2:25 p.m.

T39.3 **Novel Bidirectional Single-Stage Isolated Three-Phase Buck-Boost PFC Rectifier System**

David Menzi, *ETH Zurich*

Bidirectional AC/DC converters

AUTHORS: David Menzi, Florian Krismer, Takanobu Ohno, Jonas Huber, Johann W. Kolar, Jordi Everts

2:45 p.m.

T39.4 **Analysis and Mitigation of Sector Transition Distortions for Unfolding-Based Grid-Tied AC-DC Converters**

Aditya Zade, *Utah State University*

Single-Phase and Three-Phase Input

AUTHORS: Aditya Zade, Chakridhar Reddy Teeneti, Shubhangi Gurudiwan, Sanat Poddar, Mahmoud Mansour, Regan Zane

3:05 p.m.

T39.5 **Novel DPWM Method with Suppression of the Voltage Unbalance in the Neutral-Point for Vienna Rectifier**

Young-Min Go, *Dankook University*

Single-Phase and Three-Phase Input

AUTHORS: Young-Min Go, June-Seok Lee

1:45 p.m. – 3:25 p.m.

T40: 48V-1V DC-DC Converters

ROOM W108

SESSION CHAIRS

Cahit Gezgin, *Infineon Technologies AG*

1:45 p.m.

T40.1 **Mini-LEGO: A 1.5-MHz 240-A 48-V-to-1-V CPU VRM with 8.4-mm Height for Vertical Power Delivery**

Youssef Elasser, *Princeton University*

Point-of-Load (PoL) and Multi-Phase Converters

AUTHORS: Youssef Elasser, Jaeil Baek, Kaladhar Radhakrishnan, Houle Gan, Jonathan Douglas, Vivek De, Shuai Jiang, Harish Krishnamurthy, Xin Li, Charles R. Sullivan, Minjie Chen

2:05 p.m.

T40.2 **MSC-PoL: An Ultra-Thin 220-A/48-to-1-V Hybrid GaN-Si CPU VRM with Multistack Switched Capacitor Architecture and Coupled Magnetics**

Ping Wang, *Princeton University*

Point-of-Load (PoL) and Multi-Phase Converters

AUTHORS: Ping Wang, David Giuliano, Stephen Allen, Minjie Chen

2:25 p.m.

T40.3 **Multiphase Half-Bridge Current-Doubler Rectifier: A 93.1%-Efficiency Single-Stage 48V Voltage Regulator with 1.04 kW/in³ Power Density**

Xin Lou, *Virginia Tech*

Voltage Regulator Modules (VRM)

AUTHORS: Xin Lou, Qiang Li

2:45 p.m.

T40.4 **A Regulated Cascaded Hybrid Switched-Capacitor Converter with Soft-Charging and Zero Voltage Switching for 48-to-12-V Applications**

Ting Ge, *University of California - Berkeley*

Hard- and Soft-Switched

AUTHORS: Ting Ge, Yicheng Zhu, Robert Pilawa-Podgurski

3:05 p.m.

T40.5 **A 500-A/48-to-1-V Switching Bus Converter: A Hybrid Switched-Capacitor Voltage Regulator with 94.7% Peak Efficiency and 464-W/in³ Power Density**

Yicheng Zhu, *University of California Berkeley*

Point-of-Load (PoL) and Multi-Phase Converters

AUTHORS: Yicheng Zhu, Ting Ge, Nathan Ellis, Logan Horowitz, Robert Pilawa-Podgurski

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 a.m. – 1:30 p.m.

D01: AC-DC Converters

HALL WA3

SESSION CHAIR

Mike Ranjram, *Arizona State University*

Mike Ranjram, *Arizona State University*

D01.1 Precise Gate Timing Control Based on State Trajectory Analysis for 3.3kW Bidirectional AC/DC Converter
Ryusuke Kanomata, *Panasonic Industry Co., Ltd.*
Bidirectional AC/DC Converters
AUTHORS: Ryusuke Kanomata, Sho Hiura, Satoshi Otsu, Shinji Ujita, Kenichiro Tanaka

D01.2 Evaluation of a Single-Phase Soft Switched AC/DC Active Front End Converter for Solid-State Transformer Applications
Anup Anurag, *Delta Electronics Americas*
Power Factor Correction, CCM, DCM, CRM/BCM Control, Bridgeless
AUTHORS: Anup Anurag, Peter Barbosa

D01.3 A ZVD Control Based 5kW iTCM Totem Pole PFC for Server Power
Brent McDonald, *Texas Instruments*
Power Factor Correction, CCM, DCM, CRM/BCM Control, Bridgeless
AUTHORS: Brent McDonald, Johan Strydom, Branko Majmunović, John Kim, Sheng-Yang Yu

D01.4 Design Methodology for Power-Dense and Cost-Effective Series-Stacked Active Power Decoupling Circuit
Sandeep Anand, *Indian Institute of Technology*
Single-Phase and Three-Phase Input
AUTHORS: Nachiketa Deshmukh, Arnab Sarkar, Abhishek Chanekar, Sandeep Anand, Soumya Sahoo

D01.5 Weight Optimization of a Flying Capacitor Multilevel Converter
Sami Pettersson, *ABB*
Bidirectional AC/DC Converters
AUTHORS: Hemant Bishnoi, Mario Schweizer, Sami Pettersson, Francisco Canales

D01.6 Cascaded Half-Bridge Multi-Level Multi-Outputs Bridgeless PFC
Jun Min, *The University of British Columbia*
Power Factor Correction, CCM, DCM, CRM/BCM Control, Bridgeless
AUTHORS: Jun Min, Martin Ordonez

D01.7 AC Dropout Algorithm for Digitally Controlled Totem-Pole Bridgeless PFC
Jongwan Kim, *META*
Power Factor Correction, CCM, DCM, CRM/BCM Control, Bridgeless
AUTHORS: Jongwan Kim, Brent McDonald, Sheng-Yang Yu

D01.10 A Single-Stage AC/DC Bridge-Less Converter with an Adaptive Control Scheme and Reduced DC-Link and Output Capacitances for High Voltage EV Systems
Siamak Derakhshan, *York University*
Power Factor Correction, CCM, DCM, CRM/BCM Control, Bridgeless
AUTHORS: Siamak Derakhshan, John Lam

D01.11 PCB-Based Magnetics Integration and Common-Mode Noise Suppression for a High-Frequency PFC
Shuo Wang, *Virginia Tech*
Power Factor Correction, CCM, DCM, CRM/BCM Control, Bridgeless
AUTHORS: Shuo Wang, Phu Hieu Pham, Qiang Li, Xingyu Chen

D01.12 A Modular DC to Three-Phase AC Converter Topology with Minimized Intermediate Energy Storage Requirements
Wiwin Hartini, *Portland State University*
Bidirectional AC/DC Converters
AUTHORS: Wiwin Hartini, Mahima Gupta

D01.13 A Two-Step Commutation Scheme with Analysis of Zero-Voltage Switching for Bidirectional Isolated Matrix Converter
Bing Gong, *Toronto Metropolitan University*
Single-Phase and Three-Phase Input
AUTHORS: Bing Gong, Jahangir Afsharian, Dewei Xu, Zhihua Yang

D01.14 An Active EMI Filter for High-Power Off-Line Applications
Ashish Kumar, *Texas Instruments*
Single-Phase and Three-Phase Input
AUTHORS: Ashish Kumar, Yuetao Hou, Yogesh Ramadass, Tim Merkin, Timothy Hegarty, Abdallah Obidat

D01.15 Flying Capacitor Voltage Imbalance Protection in Multilevel Bidirectional Inverters During Surge
Rytis Beinarys, *ICERGi*
Power Factor Correction, CCM, DCM, CRM/BCM Control, Bridgeless
AUTHORS: Rytis Beinarys, Séamus O'Driscoll, Trong Tue Vu

11:30 a.m. – 1:30 p.m.

D02: DC-DC Converters I

HALL WA3

SESSION CHAIR

Mark DeMarie, *IBM*

D02.2 A Low-Ripple High-Frequency High-Voltage Power Supply for Ion Pumps
Zhechi Ye, *Stanford University*
Resonant Converters
AUTHORS: Zhechi Ye, Kawin Surakitbovorn, Sanghyeon Park, Juan Rivas-Davila

D02.3 A Novel Non-Isolated Bidirectional 48V-12V DCX Converter
Song Ding, *Southeast University*
Resonant Converters
AUTHORS: Song Ding, Chunyan Nie, Qinsong Qian

D02.4 Decoupling Power Sharing Control Scheme with the Fast Dynamic Response for a Dual-Input Dual-Active-Bridge DC-DC Converter Topology
Pasan Gunawardena, *University of Alberta*
Bidirectional dc/dc Converters
AUTHORS: Pasan Gunawardena, Nie Hou, Yunwei Li

D02.5 Trans-Inductors Versus Discrete Inductors in Multiphase Voltage Regulators: An Analytical and Experimental Comparative Study
Amin Y., *Intel Corporation*
Point-of-Load (PoL) and Multi-Phase Converters
AUTHORS: Amin Y. Fard, Satya Sai Deepak Naidu, Horthense D Tamdem, Behzad Vafakhah

D02.6 5-Level E-Type Dual Active Bridge Converter for Photovoltaic Applications
Stefano Menicanti, *Roma Tre University*
Bidirectional dc/dc Converters
AUTHORS: Stefano Menicanti, Marco Di Benedetto, Fabio Crescimbini

D02.7 Asymmetrically Driven HB-LLC Resonant Converter Integrated in Low-Power IoT Devices
Tom Urkin, *PEMIC center - Ben Gurion University of the Negev*
Resonant Converters
AUTHORS: Tom Urkin, Mor Mordechai Peretz

D02.8 A Two-Phase Hybrid Switched Capacitors Converter with Interleaving Control Scheme for Flying Capacitors Self-Balancing
Weidong Xue, *Fudan University*
Point-of-Load (PoL) and Multi-Phase Converters
AUTHORS: Weidong Xue, Yisen Zhang, Yang Lu, Jian Fang, Junyan Ren

D02.9 Magnetics Analysis and Optimization Techniques for a 2 MHz GaN-Based Active-Clamped Isolated SEPIC Converter
Stefano Cabizza, *University of Padova*
Resonant Converters
AUTHORS: Stefano Cabizza, Giorgio Spiazzi

D02.10 Virtually Isolated Class E Converter with Coupled Capacitors
Geon-Hong Min, *Seoul National University*
Resonant Converters
AUTHORS: Geon-Hong Min, Hyukjae Kwon, Junhyeong Lee, Jung-Ik Ha

D02.11 Comparison of Three Buck Topologies for Wide Output Voltage Applications
Oisín Anderson, *University of Galway*
Point-of-Load (PoL) and Multi-Phase Converters
AUTHORS: Oisín Anderson, Brendan Barry, Diarmuid Hogan, Maeve Duffy

D02.12 Design and Analysis of A Novel Current-Fed Three Level Three Limb Converter with Auxilary Inductor for DC Micro-Grid Application
Subhasish Pal, *Indian Institute of Technology*
Bidirectional dc/dc Converters
AUTHORS: Srushti Sengarap, Debaprasad Kastha, Prabodh Bajpai

D02.13 Design and Implementation of a Five-Port LLC Converter for PV Applications
Reza Rezaii, *University of Central Florida*
Resonant Converters
AUTHORS: Reza Rezaii, Sumana Ghosh, Md Safayatullah, Issa Batarseh

D02.14 Non-Dissipative Regenerative Snubber for Isolated DC-DC Ćuk Converter
David Arturo, *University of Arkansas*
Hard- and Soft-Switched
AUTHORS: David Arturo Porras Fernandez, Roberto Armin Fantino, Roderick A. Gomez Jimenez, Juan Carlos Balda

D02.15 Multi-Frequency Trans-Inductor Voltage Regulator
Stefano Saggini, *Università di Udine DPIA*
Voltage Regulator Modules (VRM)
AUTHORS: Stefano Saggini, Federico Iob, Giulia Segatti, Chehao Nan, Qiong Wang

11:30 a.m. – 1:30 p.m.

D03: DC-DC Converters II

HALL WA3

SESSION CHAIR

Juan Rivas, *Stanford University*

D03.1 Controller Design and Phase Current Balancing for Fast Dynamic Performance in Voltage Mode Controlled Multiphase Buck Converters
Teja Golla, *IIT Kharagpur*
Point-of-Load (PoL) and Multi-Phase Converters
AUTHORS: Teja Golla, Santanu Kapat, Nagabhushana Chittaragi, Ravikumar Setty A., Sucheendran Sridharan

D03.2 Analysis of Resonant PWM Active-Clamp Ćuk DC/DC Converter
Shantanu Gupta, *UIC*
Resonant Converters
AUTHORS: Shantanu Gupta, Sudip Mazumder

D03.3 400V-to-48V Transformer-Isolated Stacked Active Bridge Converter with Integrated Magnetics
Branko Majmunović, *University of Colorado Boulder, Texas Instruments*
Hard- and Soft-Switched
AUTHORS: Branko Majmunović, Yucheng Gao, Inder Kumar Vedula, Subodh Khandelwal, Dragan Maksimović

D03.4 Improvement Technique for Power Efficiency of Dab DC-DC Converters by Reducing Hard Switching and Copper Losses in Light Loads
Masahiro Tajiri, *Nagasaki University*
Bidirectional dc/dc Converters
AUTHORS: Masahiro Tajiri, Syusei Nakashima, Yuichi Ishihama, Toshiro Hirose, Yoichi Ishizuka

D03.5 A Practical and Cost Effective Wide Range 6kW LLC Converter for EV Charging Infrastructure
Alfio Scuto, *STMicroelectronics*
Resonant Converters
AUTHORS: Ranajay Mallik, Akshat Jain, Santanu Kapat

D03.6 Active Clamp Push-Pull Full-Bridge Bidirectional DC-DC Converter with Wide Load Range
Heng Xi, *Nanjing University of Aeronautics and Astronautics*
Bidirectional dc/dc Converters
AUTHORS: Heng Xi, Qunfang Wu, Qin Wang, Lan Xiao, Weiyang Zhou, Jiagang Li

D03.7 Study on Improving Line Frequency Ripple of Bidirectional DC-DC CLLC Resonant Converter
Yu-Meng Lin, *National Cheng Kung University*
Bidirectional dc/dc Converters
AUTHORS: Yu-Meng Lin, Tsorng-Juu Liang, Kai-Hui Chen, Kuo-Fu Liao

D03.8 A Multi-Phase Series Capacitor Trans-Inductor Voltage Regulator with High Switching Frequency and Fast Dynamic Response
Liang Wang, *ShanghaiTech University*
Point-of-Load (PoL) and Multi-Phase Converters
AUTHORS: Liang Wang, Chenxi Li, Jiawei Liang, Haoyu Wang

D03.9 High-Frequency Fully-ZVS Isolated Current-Fed Bidirectional DC-DC Converter
Zahra Saadatizadeh, *University of Arkansas*
Bidirectional dc/dc Converters
AUTHORS: Zahra Saadatizadeh, H. Alan Mantooth

D03.10 Open Circuit Switch Fault Management Method of a Multi-Phase Synchronous Buck Converter for EV Charging Application
Md Rashed, *NC State University*
Bidirectional dc/dc Converters
AUTHORS: Md Rashed Hassan Bipu, David Dadzie, Srdjan Lukic, Iqbal Husain

D03.11 A 400W, 99.3% Efficient GaN Buck-Boost Converter
Mojtaba Heydari, *University of Texas at Austin*
Hard- and Soft-Switched
AUTHORS: Mojtaba Heydari, Qingyun Huang, Alex Q. Huang

D03.12 A Reconfigurable Modular Switched Capacitor Structure for High Efficiency Over a Wide Input Voltage Range
PENG FANG, *University of Minnesota Duluth*
Hard- and Soft-Switched
AUTHORS: Peng Fang, Rudy Rice

D03.13 Bootstrap Operation in eGaN-Based Full-Wave ZCS Quasi-Resonant Synchronous Buck Converter for Server Application
Nagaraju Mandru, *Indian Institute of Science*
Point-of-Load (PoL) and Multi-Phase Converters
AUTHORS: Nagaraju Mandru, Nithyadas P V, Utsab Kundu, Vinod John

D03.14 Deep-Learning-Based Fault Detection and Location Method Applied on Isolated DC-DC Converter
Amin Ashraf, *University of California Santa Cruz*
Hard- and Soft-Switched
AUTHORS: Amin Ashraf Gandomi, Maryam Kargar, Saeed Kargar, Leila Parsa, Keith Corzine

D03.15 Superimposed Quadratic Buck Converter for High-Efficiency Direct 48V/1V Applications
Jin Woong, *The University of Texas at Dallas*
Point-of-Load (PoL) and Multi-Phase Converters
AUTHORS: Jin Woong Kwak, D. Brian Ma

11:30 a.m. – 1:30 p.m.

D04: Utility Interface

HALL WA3

SESSION CHAIR

Jaber Abu, *Missouri University of Science and Technology*

Jonathan Kimball, *Missouri University of Science and Technology*

D04.1 Improvement of Motor Side Converter Voltage Using Common Mode Filter at the Grid Side Converter in a Grid Connected Motor Drive System
Gopal Mondal, *Siemens AG*
Power Quality, UPS, Filters
AUTHORS: Gopal Mondal, Hauke Nannen, Michae Finkenzeller

D04.3 Conduction Performance Evaluation of Power Semiconductor Device Technologies for Solid-State DC Breakers
Andreas Giannakis, *Norwegian University of Science and Technology*
Power Quality, UPS, Filters
AUTHORS: Andreas Giannakis, Dimosthenis Peftitsis

D04.4 Droop Control Strategy for Series-Connected Current-Source Inverter Based Offshore Wind Energy Conversion System
Hang Gao, *Washington State University Vancouver*
Power Generation, Transmission and Distribution
AUTHORS: Hang Gao, Tahmin Mahmud

D04.5 A Hybrid Solid State Transformer (HSST) Based on a Two Stage Isolated Solid State Transformer (SST) : Control and Modulation
Sanjay Rajendran, *University of Texas at Austin*
Solid-State Transformers
AUTHORS: Sanjay Rajendran, Wei Xu, Zhicheng Guo, Alex Q. Huang

D04.6 Mode Switching of H-Bridge Time-Sharing Multiplexing
Chongbin Zhao, *Tsinghua University*
Solid-State Transformers
AUTHORS: Chongbin Zhao, Chunpeng Zhang, Qirong Jiang

D04.7 PV Inverter Control Algorithm Using Reinforcement Learning to Mitigate the Duck Curve Problem
Yu-Quan Chen, *National Taiwan University*
SmartGrid
AUTHORS: Yu-Quan Chen, Iris Hui-Ru Jiang, Katherine A. Kim

D04.8 A High Power Density 75kVA Air-Cooled SiC Intelligent Power Stage (IPS) as a Universal Building Block for Grid Applications
Zibo Chen, *The University of Texas at Austin*
Bidirectional Grid Interface Converters
AUTHORS: Zibo Chen, Chen Chen, Houshang Salimian Rizi, Alex Q. Huang

D04.9 SiC Bidirectional Solid-State Circuit Breaker with Soft-Start Function for Motor Control Center
Jiale Zhou, *University of North Carolina at Charlotte*
Power Generation, Transmission and Distribution
AUTHORS: Jiale Zhou, Haichen Liu, Tiefu Zhao, Xiwen Xu, Yao Wang

D04.10 Development of a High Frequency/Power Three-Port SST Sui le for Solar PV/Battery Interface
Saban Ozdemir, *Gazi University*
Solid-State Transformers
AUTHORS: Saban Ozdemir, Necmi Altin, Ahmad El Shafei, Adel Nasiri

D04.11 A Virtual Impedance Method Based on Power Adaptive Compensator for Cascaded DC System
Xinyang Su, *Xi'an Jiaotong University*
Power Quality, UPS, Filters
AUTHORS: Xinyang Su, Yue Wang, Bi'an Zhao, Yunqing Pei, Tonglu Wang

D04.12 Three Phase Dual Active Bridges with Integrated Series Inductance Using 10-kV SiC MOSFETs for Medium-Voltage Grid Applications
Roderick A., *University of Arkansas*
Solid-State Transformers
AUTHORS: Roderick A. Gomez, David Arturo Porras Fernandez, German Oggier, Juan Carlos Balda, Yue Zhao

D04.13 Scalable Auxiliary Power Supply System for SiC-Based Modular Medium Voltage Converters
Ning Yan, *Virginia Polytechnic Institute and State University*
Distributed Energy Systems
AUTHORS: Ning Yan, Keyao Sun, Boran Fan, Dong Dong, Rolando Burgos, Dushan Boroyevich

D04.14 Design Challenges of the 22 kV Solid-State Switch for Capacitor Discharge Application Based on 3.3 kV SiC MOSFET Super-Cascode
Ning Yan, *Virginia Polytechnic Institute and State University*
Power Generation, Transmission and Distribution
AUTHORS: Ning Yan, Xiang Lin, Dong Dong, Rolando Burgos

D04.15 Optimal Ratio of Grid-Forming to Grid-Following Inverters Towards Resilient Power Electronics Dominated Grids
Alireza Zare, *University of Illinois Chicago*
SmartGrid
AUTHORS: Alireza Zare, Silvanus D'Silva, Mohammad B. Shadmand

D04.17 Switching Loss Analysis of Three-Phase Three-Level Neutral Point Clamped Converter Pole Enabled by Series-Connected 10 kV SiC MOSFETs
Nithin Kolli, *North Carolina State University*
Bidirectional Grid Interface Converters
AUTHORS: Nithin Kolli, Sanket Parashar, Raj Kumar Kokkonda, Subhashish Bhattacharya, Victor Veliadis

11:30 a.m. – 1:30 p.m.

D05: Motor Drives & Inverter

HALL WA3

SESSION CHAIR

Rakib Islam, *American Axle & Manufacturing*

Ali Safayet, *Halla Mechatronics*

D05.1 Improved Q-MRAS Based Online Rotor Time Constant Compensation for IFOC Induction Motor Drives
Heonyoung Kim, *Renesas Electronics America*
AC, DC, BLDC Motor Drives
AUTHORS: Heonyoung Kim, Yongsu Han, Kibok Lee

D05.2 Damping Controller Integrated Into Output Current Control Loop and Design for Multiple Servo Drive Systems Connected to Common DC-Bus Line
Katsuki Miura, *Nagaoka University of Technology*
AC, DC, BLDC Motor Drives
AUTHORS: Katsuki Miura, Hiroki Watanabe, Jun-Ichi Itoh, Takeshi Kiribuchi, Hiroyuki Tokusaki

D05.3 Carrier Based Pulse Width Modulation for Low Distortion Sinewave Generation Using Hybrid Harmonics Elimination Method
Ron Vaizman, *Ben Gurion University*
High Performance Drives
AUTHORS: Ron Vaizman, Bar Halivni, Mor Mordechai Peretz

D05.4 Dead Time Reduction Strategy for GaN-Based Low-Voltage Inverter in Motor Drive System
Vincenzo Barba, *Politecnico di Torino*
AC, DC, BLDC Motor Drives
AUTHORS: Vincenzo Barba, Salvatore Musumeci, Marco Palma, Radu Bojoi

D05.5 Optimal Low Switching Frequency PWM Pattern for a Three-Level Neutral Point Clamped (NPC) Inverter
Aathira Karuvaril, *McMaster University*
Single- and Multi-Phase Inverters
AUTHORS: Aathira Karuvaril Vijayan, Battur Batkhishig, Mehdi Narimani, Ali Emadi

D05.6 Temperature Estimation in Induction Motors Using Machine Learning
Panagiotis Kakosimos, *ABB AB Corporate Research*
AC, DC, BLDC Motor Drives
AUTHORS: Dinan Li, Panagiotis Kakosimos

D05.7 Encoderless Predictive Control of PMSM Drives Combining Sliding-Mode and Luenberger Observers
Panagiotis Kakosimos, *ABB AB Corporate Research*
High Performance Drives
AUTHORS: Dinan Li, Panagiotis Kakosimos

D05.9 Compensating the Performance of PMSM Based Electrified Powertrain Through Sliding Mode Control
Ahmad Hussain, *The ohio state university*
AC, DC, BLDC Motor Drives
AUTHORS: Ahmad Hussain Safder, Athar Hanif, Muhammad Asghar Saqib, Fahad Tanveer

D05.10 Maximum Torque Per Ampere Control Algorithm for an Interior Permanent Magnet Synchronous Motor Drive Reflecting the PM Flux Linkage Variations
Sungmin Choi, *Chonbuk national university*
AC, DC, BLDC Motor Drives
AUTHORS: Sungmin Choi, Jeasuk Lee

D05.11 The Duality Droop Control for Grid-Tied Cascaded Microinverter
Maohang Qiu, *University of Dayton*
Single- and Multi-Phase Inverters
AUTHORS: Maohang Qiu, Mengxuan Wei, Xiaoyan Liu, Dong Cao

D05.12 Switching Loss Reduction of Dual Inverters Using Isolated Voltage Sources Fed an Open-End Winding Interior Permanent Magnet Synchronous Motor
Hyung-Woo Lee, *Ajou University*
AC, DC, BLDC Motor Drives
AUTHORS: Hyung-Woo Lee, Kyo-Beum Lee

D05.14 Dynamic Level Shift Control Scheme for Power Loss Reduction in T-Type Traction
Shivam Chaturvedi, *University of Michigan Dearborn*
Single- and Multi-Phase Inverters
AUTHORS: Shivam Chaturvedi, Mengqi Wang, Guanliang Liu, Shahid Aziz Khan, Wencong Su

D05.17 Gallium-Nitride (GaN) Transistor Design for Transient-Overload Power Applications
Jinshui Zhang, *Duke University*
Single- and Multi-Phase Inverters
AUTHORS: Jinshui Zhang, Stefan Goetz, Boshuo Wang

11:30 a.m. – 1:30 p.m.

D06: Devices & Components

HALL WA3

SESSION CHAIR

Zheyu Zhang, *Halla Mechatronics*

Ali Safayet, *Halla Mechatronics*

D06.1 DC Series ARC Fault Detection and Extinguishing Method Using Input Capacitor Design
Hwa-Pyeong Park, *Kumoh National Institute of Technology*
Interconnects and Fuses
AUTHORS: Hwa-Pyeong Park, Mina Kim, Suyong Chae

D06.2 Investigation of the Parasitic Inductance Influence on the Short-Circuit Behaviour of High Voltage IGBTs
He Du, *Kyushu Institute of Technology*
Power Silicon MOSFETs, BJTs, IGBTs
AUTHORS: He Du, Ichiro Omura, Shuhei Matsumoto, Takuro Arai

D06.3 Assessment of MOSFET Switching Losses in an LLC Converter by a Calorimetric Method
Alfio Scuto, *STMicroelectronics*
Power Silicon MOSFETs, BJTs, IGBTs
AUTHORS: Alfio Scuto, Giuseppe Sorrentino, Marco Ventimiglia, Gaetano Belverde, Domenico Nardo, Gianpaolo Vitale, Giuseppe Lullo

D06.4 Physics-Based Modeling of Packaging-Related Degradation of IGBT Modules
Yichi Zhang, *Aalborg University*
Power Silicon MOSFETs, BJTs, IGBTs
AUTHORS: Yichi Zhang, Yi Zhang, Shuai Zhao, Bo Yao, Huai Wang

D06.5 A Method to De-Skew Probes and Estimate Power Loop Inductance of WBG-DPT Circuits
Vivek Shivaram, *Tektronix India Private Limited*
SiC MOSFETs and BJTs
AUTHORS: Vivek Shivaram, Srikrishna Nh, Niranjan Hegde, Shubha B, Yogesh Pai, Venkatraj M

D06.7 Design and Implementation of Interleaved Flyback Converter with GaN E-HEMT
Jui-Wen Cheng, *National Cheng Kung University*
GaN HEMTs
AUTHORS: Jui-Wen Cheng, Tsorng-Juu Liang, Kuo-Fu Liao, Kai-Hui Chen

D06.8 Accuracy Analysis of the LCR Meter-Based Method for C-V Characterization of a Capacitor
Zhansen Akhmetov, *North Carolina State University*
Capacitors, Supercapacitors
AUTHORS: Zhansen Akhmetov, Ujjwal Pratik, Zeljko Pantic

D06.9 A GaN Based LCC Converter for Lithium-Ion Battery Chargers
Harsha Ademane, *ST Microelectronics*
GaN HEMTs
AUTHORS: Rosario Attanasio, Jon Hyslop, Harsha Ademane, Gianni Vitale

D06.10 Design, Packaging, and Empirical Characterization of 1 kV Vertical GaN P-N Diode
Sadab Mahmud, *University of Toledo*
Fast Recovery Diodes
AUTHORS: Sadab Mahmud, Prakash Pandey, Samuel Atwimah, Tolen Nelson, Daniel Georgiev, Andrew Koehler, Travis Anderson, James Gallagher, Karl Hobart, Raghav Khanna

D06.11 A GaN DC-DC Converter with In-Situ Detection of Aging-Induced Coss Changes for Device State-of-Health Determination
Samantha Murray, *University of Toronto*
GaN HEMTs
AUTHORS: Samantha Murray, Tudor Sigmund, Olivier Trescases

D06.12 A Self-Powered Two-Terminal MEMS Based Relay with Advanced Control Functions
Pallab Midya, *Menlo Microsystems Inc.*
Interconnects and Fuses
AUTHORS: Pallab Midya, Mohammed Agamy, Ahmed Khamis, Raul Vera

D06.13 Switching Performance Evaluation of 650 V Vertical GaN Fin JFET
Ruizhe Zhang, *Virginia Polytechnic Institute and State University*
GaN HEMTs
AUTHORS: Ruizhe Zhang, Qiuzhe Yang, Vianey Padilla, Tiziano Pastore, Wolfgang Meier, Subhash Pidaparthi, Qiang Li, Yuhao Zhang, Cliff Drowley

D06.14 Paralleling 650 V/150 a GaN HEMTs for Cryogenically Cooled Solid-State Circuit Breaker Applications
Ching-Hsiang Yang, *University of Tennessee*
GaN HEMTs
AUTHORS: Ching-Hsiang Yang, Zhou Dong, Shimul K. Dam, Dehao Qin, Ruirui Chen, Fei Fred Wang, Hua Kevin Bai, Zheyu Zhang

D06.15 Design of a Medium Voltage PCB-Based Power Bus Considering Current Carrying Capacity for Insulation Integrity in a 6 kV 500 kW Converter
Joshua Stewart, *Virginia Polytechnic Institute and State University*
Interconnects and Fuses
AUTHORS: Joshua Stewart, Rolando Burgos

D06.16 Impact of Conduction Current on Output Capacitance Loss in GaN HEMTs
Qihao Song, *Virginia Tech*
GaN HEMTs
AUTHORS: Qihao Song, Ruizhe Zhang, Qiang Li, Yuhao Zhang

11:30 a.m. – 1:30 p.m.

D07: Power Converter Design, Packaging, & Integration

HALL WA3

SESSION CHAIR

Adam Skorek, *University of Québec at Trois-Rivières*

Zhehui Guo, *Center for Advanced Power Systems Florida State University*

D07.1 A Gallium Nitride Intelligent Power Module Based on Bonding Wire Interconnection
Yilong Yao, *State Key Laboratory of Electrical Insulation and Power Equipment*
Power Modules / High Density Design
AUTHORS: Yilong Yao, Hong Zhang, Fengtao Yang, Hang Kong, Yan Wang, Xiaobo Dong, Laili Wang, Kangping Wang

D07.2 A Compact Hybrid Sensor for Chip-Level Online Current Sensing in Press-Pack Power Module
Weili Guo, *Xi'an Jiaotong University*
Quality and System Reliability
AUTHORS: Weili Guo, Guochun Xiao, Kai Gao, Laili Wang

D07.3 A Double-Sided Cooling 6.5kV SiC MOSFET Power Module with Insulation Enhancement Design
Liangjun Ma, *School of Electrical Engineering Xi'an Jiaotong University*
Power Modules / High Density Design
AUTHORS: Liangjun Ma, Hong Zhang, Tianshu Yuan, Dingkun Ma, Yan Nie, Lei Li, Yilong Yao, Laili Wang

D07.4 Analysis of a Transistor-Based On-State Voltage Measurement Circuit for Condition Monitoring of Power Transistors
Kevin Muñoz, *University of Stuttgart*
Quality and System Reliability
AUTHORS: Kevin Muñoz Barón, Mathias Weiser, Kanuj Sharma, Ingmar Kallfass

D07.5 Reliability Monitoring and Predictive Maintenance of Power Electronics with Physics and Data Driven Approach Based on Machine Learning
Yujia Cui, *ROCKWELL AUTOMATION INC*
Quality and System Reliability
AUTHORS: Yujia Cui, Jiangang Hu, Ranga Tallam, Rob Miklosovic, Navid Zargari

D07.6 Transient Thermal Modeling of Power Semiconductors for Long-Term Load Profiles
Xinyue Zhang, *Northwestern Polytechnical University*
Thermal and EMC Management
AUTHORS: Xinyue Zhang, Yi Zhang, Dao Zhou, Huai Wang, Xiaohua Wu

D07.7 Highly Reliable Silver Sintering Joints for Power Module Application
Sihai Chen, *Indium Corporation*
Power Electronics Packaging
AUTHORS: Sihai Chen, Jacob Wells, Tim Raner, Thomas Moore, Liam Stuart, Christine Labarbera, Yaling Zheng, Khedup Lodoe, Brandon Boncella, Tarun Muraharasetty, Jeffrey Skojec

D07.8 A Capacitive Impedance Control Method for Active Capacitor with Adaptive Parameter Capability
Zhihao Lin, *Aalborg University*
Quality and System Reliability
AUTHORS: Zhihao Lin, Bo Yao, Huizhong Sun, Haoran Wang, Huai Wang

D07.10 High-Temperature (250°C) SiC Power Module Integrated with LTCC-Based Isolated Gate Driver
Salahaldein Ahmed, *UA*
Power Electronics Packaging
AUTHORS: Salahaldein Ahmed, Pengyu Lai, Sudharsan Chinnaiyan, Alan Mantooth, Zhong Chen

D07.12 Advanced GaN IPM for High-Frequency Converter Applications Enabled with Thin-Substrates
Sourish S, *FREEDM Systems Center North Carolina State University*
Power Modules / High Density Design
AUTHORS: Sourish S Sinha, Tzu-Hsuan Cheng, Keval Parmar, Douglas C. Hopkins

D07.13 Packaging and Characterization of an Ultra Compact 1200V PCB SiC MOSFET Half-Bridge Module
Wei-Jung Hsu, *University of Texas at Austin*
Power Modules / High Density Design
AUTHORS: Wei-Jung Hsu, Junhong Tong, Qingyun Huang, Alex Q. Huang

D07.14 Hybrid Power Module: Silicon and SiC Combination – Technical Win or Pain
Ondrej Picha, *onsemi*
Power Modules / High Density Design
AUTHOR: Ondrej Picha

D07.15 Alternating Sequence and Zero Vector Modulation with Reduced Switching Losses and Common-Mode Voltage in Current Source Inverters
Sangwhee Lee, *University of Wisconsin-Madison*
Thermal and EMC Management
AUTHORS: Sangwhee Lee, Feida Chen, Thomas Jahns, Bulent Sarlioglu

D07.16 Decoupling Device for Small Commutation Loop and Improved Switching Performance with Large Power Transistors
Logan Horowitz, *UC Berkeley*
Power Modules / High Density Design
AUTHORS: Logan Horowitz, Nathan Ellis, Robert Pilawa-Podgurski

D07.17 A Mechanically Ultra-Thin Flying Capacitor Multilevel Converter with Embedded Passive Components
Nicole Stokowski, *University of California Berkeley*
Embedding Technologies, 3D Packaging, and Additive Manufacturing
AUTHORS: Nicole Stokowski, Samantha Coday, Logan Horowitz, Robert Pilawa-Podgurski

D07.18 Thermal Mapping of Power Modules Using Optical Fibers During AC Power Cycling Tests
Francesco Iannuzzo, *Aalborg University*
Thermal and EMC Management
AUTHORS: Kaichen Zhang, Francesco Iannuzzo

D07.19 3.3 kV Low-Inductance Full SiC Power Module
Yuxiang Chen, *Univerity of Arkansas*
Power Modules / High Density Design
AUTHORS: Yuxiang Chen, Xinyuan Du, Liyang Du, Xia Du, Abu Shahir Md Khalid Hasan, Xiaoling Li, Hao Chen, Riya Paul, Sudharsan Chinnaiyan, Yue Zhao, H. Alan Mantooth

11:30 a.m. – 1:30 p.m.

D08: Modeling & Simulation

HALL WA3

SESSION CHAIR

Shajjad Chowdhury, *Oak Ridge National Lab*

Dinesh Kumar, *Global Research & Development Center, Danfoss Drives A/S*

D08.1 Analysis of Switching Voltage Regulator Noise Coupling to Signal via Using a Novel Simulation Approach
Soumya Singh, *DELL Technologies*
Device and Component Modeling
AUTHORS: Soumya Singh, Seema P K, Feng-Yu Wu, Chu-Yang Lai, Lei Wang

D08.2 Power Hardware-in-the-Loop Simulation to Verify Protection Coordination for DC Microgrid
Kazuki Watanabe, *Mitsubishi Heavy Industries Ltd.*
Rapid Prototyping
AUTHORS: Kazuki Watanabe, James Langston, John Hauer, Michael Coleman, Mark Stanovich, Yuki Izumida, Michael Steurer

D08.3 Performance Comparison of Miniaturized Isolation Transformer Topologies
Yue Wu, *Dartmouth*
Device and Component Modeling
AUTHORS: Yue Wu, Charles R. Sullivan

D08.4 Comprehensive Analysis and Design Optimization of the Dual Active Bridge DC-DC Converter with Finite Magnetizing Inductance
Harsha Vardhan, *University of Sheffield*
Circuits and Systems
AUTHORS: Harsha Vardhan, Milijana Odavic, Kais Atallah

D08.5 Heat Cycle Failure Point Prediction by 3D Thermal Stress Analysis for Medium Voltage Power Module
Masaki Takahashi, *Aalborg University*
Device and Component Modeling
AUTHORS: Masaki Takahashi, Jannick Kjær Jørgensen, Asger Bjørn Jørgensen, Stig Munk-Nielsen, Christian Uhrenfeldt

D08.6 A Virtual Prototyping System for Silicon-Carbide Power Modules
James Victory, *onsemi*
Rapid Prototyping
AUTHORS: Klaus Neumaier, Vaclav Valenta, Jonathan Chu, Yunpeng Xiao, Stan Benczkowski, Bob Marquis, Sameer Yadav, Jonathan Harper, Ondrej Picha, Rajani Thirukoluri, Roveendra Paul, Leon Zhang, Levan Bidzishvili, Thierry Bordignon, James Victory

D08.7 An Implementation of Dowell Model with Neural Network to Foil Winding Transformer
Yu Hsin, *Nagoya University*
Device and Component Modeling
AUTHORS: Yu Hsin Wu, Koichi Shigematsu, Yasumichi Omoto, Yoshihiro Ikushima, Jun Imaoka, Masayoshi Yamamoto

D08.8 Development of Simulation Prediction Techniques for Low Frequency Emissions
Yanwen Lai, *University of Florida*
Software Tools
AUTHORS: Yanwen Lai, Yirui Yang, Zhedong Ma, Qinghui Huang, Shuo Wang, Zheng Luo

D08.9 Switching Converter Circuits Representation in CCM & DCM Using Graph Neural Network
Ahmed Khamis, *University at Albany SUNY*
Circuits and Systems
AUTHORS: Ahmed Khamis, Mohammed Agamy

D08.10 Circuit Structure Dependent Multi-Variable Regression Model Based Predictions for DC-DC Converters
Ahmed Khamis, *University at Albany SUNY*
Circuits and Systems
AUTHORS: Ahmed Khamis, Mohammed Agamy

D08.11 A Systematic Parasitic Capacitance Extraction Procedure for Three Level Neutral Point Clamped Inverter Modules
Shin-Yu Chen, *Center for Power Electronics Systems Virginia Tech*
Parasitics
AUTHORS: Shin-Yu Chen, Ripun Phukan, Rolando Burgos, Dong Dong, Gopal Mondal, Henrik Krupp, Sebastian Nielebock

11:30 a.m. – 1:30 p.m.

D09: Control I

HALL WA3

SESSION CHAIR

Jaber Abu, *The University of Alabama*

D09.1 Time Domain Analysis of Series-Resonant Converter in Auxiliary Power Supply for Medium-Voltage Converter
Zhixing Yan, *Aalbory University*
Gate Drive Circuits
AUTHORS: Zhixing Yan, Dipen Narendra Dalal, Shaokang Luan, Guihua Mao, Rui Wang, Bjørn Rannestad, Stig Munk-Nielsen, Hongbo Zhao

D09.2 Dynamic Modeling of Peak Current Mode Controlled Two-Phase PWM Converters with Coupled Inductors
Arvind Sivakumar, *University of Colorado-Boulder*
Current-Mode and Voltage-Mode Control
AUTHORS: Arvind Sivakumar, Kaushik Raam A.G, Dragan Maksimović

D09.3 Enhanced Model Predictive Nearest Level Control for 5-Level Flying Capacitor Multilevel Converter, Hardware Implementation and Comparison
Armin Ebrahimian, *Marquette University*
Control of Power Electronic Converters
AUTHORS: Armin Ebrahimian, Seyed Iman Hosseini Sabzevari, Waqar A. Khan, Nathan Weise

D09.4 Stability Impact of Hybrid Synchronization Strategy on Virtual-Admittance-Based Grid-Forming Inverters
Liang Zhao, *Aalborg University*
Control of Power Electronic Converters
AUTHORS: Liang Zhao, Xiongfei Wang, Hong Gong, Zheming Jin

D09.5 Issues of Impedance Emulation of Converter-Based Grid Emulator for LVRT Test
Zejie Li, *Department of Energy Aalborg University*
Control of Power Electronic Converters
AUTHORS: Zejie Li, Fangzhou Zhao, Xingxing Chen, Stig Munk-Nielsen, Xiongfei Wang

D09.6 Surge Current Reduction in LLC Resonant Converter with a Hybrid Control Strategy of PFM and PSM for Expansion of Output Voltage Range
Ryo Moriyasu, *Kyushu University*
Control of Power Electronic Converters
AUTHORS: Ryo Moriyasu, Yuichi Noge, Masahito Shoyama, M. S. Hassan

D09.7 Grid-Forming Nature Retaining Fault Ride-Through Control
M A, *Danfoss*
Control of Power Electronic Converters
AUTHORS: M A Awal, Md Rifat Kaisar Rachi, Stefan Schröder, Hui Yu, Jorg Dannehl, Iqbal Husain

D09.8 Small-Signal Model of Multiphase Constant On-Time Control with Phase Overlapping
Sundaramoorthy Sridhar, *Virginia Polytechnic Institute and State University*
Current-Mode and Voltage-Mode Control
AUTHORS: Sundaramoorthy Sridhar, Qiang Li

D09.9 Performance Enhancement of a Dual Active Bridge by a Genetic Algorithm Based Routine for Optimal Parameters of a Cascade Control
Thomas Eberle, *Universität Erlangen-Nürnberg*
Control of Power Electronic Converters
AUTHORS: Thomas Eberle, Arash Jalilian, Nikolai Weitz, Martin März

D09.10 Improved Control for Three-Phase Rectifiers with Constant Power Loads
Franco Degioanni, *The University of British Columbia*
Control of Power Electronic Converters
AUTHORS: Franco Degioanni, Ignacio Galiano Zurbriggen, Martin Ordonez

D09.11 Sensorless Speed and Vector Control of Induction Motor Based on Rotor Slot Harmonics
Aleksandar Milic, *School of Electrical Eengineering University of Belgrade*
Sensor and Sensor-less Control
AUTHORS: Aleksandar Milic, Slobodan Vukosavic

D09.12 Pre-Charge/Start-Up Strategy for Flying-Capacitor Modular Multilevel Converter (FC-MMC) with Damping of L-C Oscillations
Riccardo Breda, *University of Udine*
Control of Power Electronic Converters
AUTHORS: Riccardo Breda, Stefano Breda, Sandro Calligaro, Roberto Petrella

D09.13 Design-Oriented Dissipativity Robustness Enhancement for Current Control of LCL-Filtered Grid-Following VSCs
Shan He, *Department of Energy Aalborg University*
Control of Power Electronic Converters
AUTHORS: Shan He, Frede Blaabjerg

D09.14 Data-Driven Controllability of Power Electronics Under Boundary Conditions – A Physics-Informed Neural Network Based Approach
Subham Sahoo, *Aalborg University*
Control of Power Electronic Converters
AUTHORS: Subham Sahoo, Frede Blaabjerg

D09.15 Coupled Inductor Analysis and Design for Flying-Capacitor Passive Cross-Connected Arms Modular Multilevel Converter (FC-MMC) for PMSM Drive Application
Riccardo Breda, *University of Udine*
Control of Power Electronic Converters
AUTHORS: Riccardo Breda, Stefano Breda, Sandro Calligaro, Roberto Petrella

11:30 a.m. – 1:30 p.m.

D10: Control II

HALL WA3

SESSION CHAIR

Dorin Neacsu, *Technical University of Iasi*

D10.1 Small Signal Model of Modular Multilevel Converter with Power Synchronization Control
Wentao Liu, *Aalborg University*
Control of Power Electronic Converters
AUTHORS: Wentao Liu, Rui Wang, Tamas Kerekes, Tomislav Dragicevic, Remus Teodorescu

D10.2 Passivity-Based Admittance Shaping of LCL-Type Grid-Connected Inverters Using Capacitor Voltage Feedforward Active Damping
Linguo Liu, *Huazhong University of Science and Technology*
Control of Power Electronic Converters
AUTHORS: Linguo Liu, Jie Ye, Baojin Li, Songtao Huang, Jinbang Xu, Anwen Shen

D10.3 Increasing the Utilization of DC-Link Voltage of a Five-Leg VSI Based on Rotor Angle Control of Dual Induction Motors
Dmytro Kondratenko, *Gdańsk University of Technology*
Control of Power Electronic Converters
AUTHORS: Dmytro Kondratenko, Arkadiusz Lewicki, Charles Odeh

D10.4 Feasibility Study on a Novel Robust Current-Mode Method
Fabio Cacciotto, *ST Microelectronics*
Control of Power Electronic Converters
AUTHORS: Fabio Cacciotto, Claudio Adragna

D10.5 Staircase Matrix Modulation for the Switched-Capacitor Modular Multilevel Converter with Sensor-Less Voltage Balancing
Rami Yehia, *Florida State University*
Control of Power Electronic Converters
AUTHORS: Rami Yehia, Fangzheng Peng

D10.6 Hybrid Lithium Capacitor Voltage Balancing with Planar Power Inductor for Electric Vehicles and Other Applications
Mohammad Al-Smadi, *University of Alabama*
Control of Power Electronic Converters
AUTHORS: Mohammad Al-Smadi, Jaber Abu Qahouq

D10.7 Interpre le AI for Power Conversion Control
Benjamin Schwabe, *Infineon Technologies AG*
Digital Control
AUTHORS: Benjamin Schwabe, Tarek Senjab, Amandus Bach

D10.9 Multi-Sampling Asymmetric Dual-Edge Digital Pulse-Width Modulator
Giovanni Bonanno, *University of Padova*
Digital Control
AUTHORS: Giovanni Bonanno, Andrea Comacchio, Paolo Mattavelli

D10.10 Digital Implementation of a Current Observer with On-Line Current Sample Correction for PFC Rectifiers
Mohsin Ejaz, *University Paderborn*
Sensor and Sensor-less Control
AUTHORS: Mohsin Ejaz Ahmad, Frank Schafmeister, Joachim Böcker

D10.11 An Ultra-Fast Inrush-Current-Free Startup Method for Grid-Tie Inverter Without Voltage Sensors
Yuchen He, *Florida State University*
Digital Control
AUTHORS: Yuchen He, Bokang Zhou, Yuntao Zou, Yuan Li, Fangzheng Peng

D10.12 Improved Delta-Sigma Modulator for Direct Switch Control of a DC-DC Converter
Bart Bokmans, *Eindhoven University of Technology*
Control of Power Electronic Converters
AUTHORS: Bart Bokmans, Bas Vermulst, Jan Schellekens

D10.13 Performance of Predictive Control Applied to Active Power Filter
Juan Silva, *UFPB*
Control of Power Electronic Converters
AUTHORS: Juan Silva, Jefferson Assis, Darlan Fernandes, Nady Rocha, Alfeu Sguarezi Filho

D10.15 Closed-Loop Current Control of a Buck Converter via Sensing of Optical Emission from a GaN PN Freewheeling Diode
Justin Johnston, *Naval Postgraduate School*
Sensor and Sensor-less Control
AUTHORS: Justin Johnston, Matthew Porter, Keith Corzine, Todd Weatherford

11:30 a.m. – 1:30 p.m.

D11: Wireless Power Transfer III

HALL WA3

SESSION CHAIR

Veda Prakash, *UT Battelle ORNL*

Joseph Song-Manguelle, *Oak Ridge National Laboratory*

D11.1 Advanced Front-End Monitoring Scheme for Inductive Power Transfer Systems Based on Random Forest Regression
Kaiyuan Wang, *Hong Kong Polytechnic University*
Wireless charging
AUTHORS: Kaiyuan Wang, Yun Yang, Xun Zhang

D11.8 **Robust Unity-Gain Transmitter-Side Operation Mode in IPT Systems for Low Power Applications**
Alexis Adrian, *Universidad de Zaragoza I3A*
Wireless charging
AUTHORS: Alexis Adrian Narvaez Acaro, Claudio Carretero Chamarro, Jesús Acero, José Miguel Burdío

D11.9 **Exploring Switching Limit of SiC Inverter for Multi-kW Multi-MHz Wireless Power Transfer System**
Yao Wang, *Drexel University*
Wireless charging
AUTHORS: Yao Wang, Reza Kheirollahi, Fei Lu, Hua Zhang

D11.10 **Practical Receiver Coil Design to Improve Coil Selection in a Multi-Coil Wireless Charging System**
Li Wang, *Google LLC*
Wireless charging
AUTHORS: Li Wang, Liyu Yang, Liang Jia, Srikanth Lakshmikanthan

D11.11 **Design of Different Symmetrical Bidirectional WPT Topologies Based on CC and CV Operating Modes for V2G Applications**
Ritesh Gupta, *IIT Kanpur*
Wireless charging
AUTHORS: Ritesh Gupta, Jalaj Kumar, Suvendu Samanta

D11.2 **Equilibrating Winding Currents in a DC Transformer for Future Electric Transport Application Based on Inductive Power Transfer**
Miguel Ángel, *Centro de Electrónica Industrial ETSII UPM*
Wireless charging
AUTHORS: Miguel Ángel Moya Garrido, Alberto Delgado Expósito, Miroslav Vasić

D11.3 **Design of Four Plate Capacitive Coupler with Enhanced Safe Operating Region for Electric Vehicle Wireless Charging Applications**
Deepak Ronanki, *University of Ontario Institute of Technology*
Wireless charging
AUTHORS: Deepak Ronanki, Harish Karneddi, Pramod Patidar

D11.4 **Dynamic Improvement of Direct Inductive Power Transfer Systems Using Adaptive Model Predictive-Based Phase Shift Control**
Huiwen Xiao, *Hong Kong Polytechnic University*
Wireless charging
AUTHORS: Huiwen Xiao, Yun Yang, Kaiyuan Wang

D11.5 **Optimization of Core Size and Harvested Power for Magnetic Energy Harvesters Based on Cascaded Magnetics**
Min Gao, *Florida State University*
Energy harvesting
AUTHORS: Min Gao, Hebert Lopez Herrera, Jinyeong Moon

D11.6 **Impedance-Sensing Technique Using a Dual Harmonic/Negative Peak-Detector in Class EF2 Inverters for LCC-Based WPTs**
Beom Woo, *Samsung Electronics*
Wireless charging
AUTHORS: Beom Woo Gu, Jae-Hyun Park, Sung-Ku Yeo

D11.7 **A Single-Inductor Multiple-Output (SIMO) Buck-Boost Hybrid Converter for Multi-Device Wired and Wireless Charging System**
Albert Ting, *The University of Hong Kong*
Wireless charging
AUTHORS: Albert Ting Leung Lee, Kai Ting Wong, Siew-Chong Tan, Shu Yuen Ron Hui

11:30 a.m. – 1:30 p.m.

D12: Renewable Energy Systems

HALL WA3

SESSION CHAIR
Jingbo Liu, *Eaton*

D12.1 **An Integrated Charging Equalizer Based on LLC Resonant DC-DC Converter for Series-Connected Battery String in Plug-In Hybrid Electric Vehicle**
Yiqing Lu, *ShanghaiTech University*
Energy Storage Systems
AUTHORS: Yiqing Lu, Zhengqi Wei, Lizhou Liu, Haoyu Wang, Yilin Wang, Yuchong Peng

D12.2 **A Computationally Efficient Model for Large-Scale Energy Storage Systems with Active Voltage Balancing in Modular Multilevel Converters**
Mohsen Asoodar, *KTH Royal Institute of Technology*
Energy Storage Systems
AUTHORS: Mohsen Asoodar, Mehrdad Nahalparvari, Panagiotis Bakas, Jean-Philippe Hasler, Lexuan Meng, Hans-Peter Nee

D12.3 **Battery Aging Behavior Evaluation Under Variable and Constant Temperatures with Real Loading Profiles**
Yunhong Che, *Aalborg University*
Energy Storage Systems
AUTHORS: Yunhong Che, Daniel-Ioan Stroe, Xin Sui, Søren Byg Vilsen, Xiaosong Hu, Remus Teodorescu

D12.4 Bidirectional Power Flow Controllability of Inverter-Dominated Radial Microgrids Incorporating Harmonic Mitigation Capabilities
Augusto Matheus, *University of Sao Paulo*
Microgrid Systems
AUTHORS: Augusto Matheus Dos Santos Alonso

D12.5 Dynamic Power Allocation Control for Frequency Regulation Using Hybrid Electrolyzer Systems
Manuel Agredano-Torres, *KTH Royal Institute of Technology*
Grid-Tied Systems
AUTHORS: Manuel Agredano-Torres, Qianwen Xu, Mengfan Zhang, Lennart Söder, Ann Cornell

D12.6 Passivity-Based Stability Design of LCL-Filtered Converters: An Overview
Jiacheng Sun, *Northwestern Polytechnical University*
Grid-Tied Systems
AUTHORS: Jiacheng Sun, Dao Zhou, Tamas Kerekes, Wenli Yao, Xiaobin Zhang

D12.7 4.8 kW Low Profile Compact Single-Phase PV Converter with GaN-HEMT
Huizhong Sun, *Aalborg University*
Photovoltaic (PV) Inverters and Micro Inverters
AUTHORS: Huizhong Sun, Jing Yuan, Chen Chen, Takeo Nishikawa, Huai Wang

D12.8 Intelligent Control Approach Applied for Grid-Forming Power Converters
Arman Oshnoei, *Aalborg University*
Grid-Tied Systems
AUTHORS: Arman Oshnoei, Saeed Peyghami, Frede Blaabjerg

D12.9 System Integration for Grid-Scale Hybrid Battery Technologies
Oindrilla Dutta, *Sandia National Labs*
Energy Storage Systems
AUTHORS: Oindrilla Dutta, Jacob Mueller, Robert Wauneka, Valerio De Angelis

D12.10 Overview of Machine Learning-Enabled Battery State Estimation Methods
Yingjian Zhuge, *ShanghaiTech University*
Energy Storage Systems
AUTHORS: Yingjian Zhuge, Hengzhao Yang, Haoyu Wang

D12.11 Cell Equalizers Modeling and Analysis Based on Energy Conservation Method
Nasim Hasanpour, *University of Alberta*
Energy Storage Systems
AUTHORS: Nasim Hasanpour, Sayed Ali Khajehoddin

D12.12 Design of a Multi-Chemistry Battery Pack System for Behind-the-Meter Storage Applications
Anik Chowdhury, *University of Akron*
Energy Storage Systems
AUTHORS: Anik Chowdhury, Ashraf Siddiquee, Partha Mishra, Md Ehsanul Haque, Mithat J. Kisacikoglu, Alastair Thurlbeck, Edward Watt, Mohammad Arifur Rahman, Yilmaz Sozer, Jeff Holt

D12.14 A Single-Phase Switched-Capacitor Five-Level Boost Inverter with Boost Factor Improvement
Vinh-Thanh Tran, *Ho Chi Minh City University of Technology and Education*
Photovoltaic (PV) Inverters and Micro Inverters
AUTHORS: Vinh-Thanh Tran, Duc-Tri Do, Minh-Khai Nguyen

D12.15 Design and Analysis of a Grid-Tied Non-Isolated Three-Phase Unfolder for Energy Storage Systems
Soumya Nag, *Indian Institute of Technology*
Bi-directional Power Converters
AUTHORS: Sudeshna Bit, Mohammad Saleh Khan, Soumya Shubhra Nag

D12.16 Comparative Study of 100kW Three-Level Bidirectional DC-DC Converters for Battery Storage Integration with 1500V PV Inverter
Chen Chen, *The University of Texas at Austin*
Bi-directional Power Converters
AUTHORS: Chen Chen, Zibo Chen, Houshang Salimian Rizi, Alex Q. Huang

D12.17 A High-Robust Control Scheme for the DAB-Based PPP Energy Storage System
Nie Hou, *Department of Electrical and Computer Engineering University of Alberta*
Energy Storage Systems
AUTHORS: Nie Hou, Rui Liu, Ruizhi Wei, Yue Zhang, Yunwei Li

D12.18 Comparison of String Inverter and Microinverters: A Case Study Concerning Energy Yield and Accuracy of MPPT Algorithms
Rodolfo Godoi, *Universidade Federal de Uberlândia*
Maximum power point tracking (MPPT)
AUTHORS: Rodolfo Godoi, Thiago Felipe, Fernando Melo, Luiz Carlos Gomes Freitas

D12.19 Projection of Safe Operation for Inverters Using Artificial Intelligence-Based Stability Criterion
Tareq Hossen, *Kansas State University*
Grid-Tied Systems
AUTHORS: Tareq Hossen, Fahmid Sadeque, Fariba Fateh, Behrooz Mirafzal

D12.20 SOH Prediction and Abnormality Detection of High Power Lithium-Ion Battery Using Incremental Capacity-Based Health Indicator
Pyeong-Yeon Lee, *Chungnam National University*
Energy Storage Systems
AUTHORS: Pyeong-Yeon Lee, Deokhun Kang, Seunghwa Shin, Sangwoo Cho, Dongjae Lee, Jonghoon Kim

D12.21 Embedded Linux Based SOH Prediction Using LSTM Network Considering EV Load Condition
Dongho Han, *Chungnam National University*
Energy Storage Systems
AUTHORS: Dongho Han, Miyoung Lee, Taesuk Mun, Eunjin Kang, SangRyuk Lee, Jonghoon Kim

D12.22 Operation and Control of a PV Converter with Enhanced Stability Based on Virtual Impedance Emulation in a Pseudo Resistive Grid
Vikram Roy, *National Renewable Energy Laboratory*
Photovoltaic (PV) Inverters and Micro Inverters
AUTHORS: Vikram Roy Chowdhury, Akanksha Singh

11:30 a.m. – 1:30 p.m.

D13: Transportation Applications

HALL WA3

SESSION CHAIR

Dong Cao, *University of Dayton*

Rasoul Hosseini, *General Motors*

D13.1 Universal Bridgeless Reconfigurable Battery Charger with Wide Output Voltage Range for Next-Generation EV Compatibility
Harish Karneddi, *Indian Institute of Technology Roorkee*
Charging Systems
AUTHORS: Harish Karneddi, Deepak Ronanki

D13.2 A New Medium-Voltage Architecture for Ultra-Fast Electric Vehicle (EV) Charging Stations
Ahoora Bahrami, *McMaster University*
Charging Systems
AUTHORS: Ahoora Bahrami, Mehdi Narimani

D13.3 A Comparative Study of Single- and Multi-Cell Three-Level ANPC Inverters for Electric Aircraft Applications
Linke Zhou, *Mcmaster University*
Power Electronics for Aerospace
AUTHORS: Linke Zhou, Di Wang, Yuhang Yang, Chang Liu, Giorgio Pietrini, Ali Emadi

D13.4 Series DC Arc Fault in More Electric Aircraft
Alperen Çalıkoğlu, *ASELSAN INC.*
Power Electronics for Aerospace
AUTHORS: Alperen Çalıkoğlu, Bünyamin Tamyürek

D13.5 Practical Design Consideration and Experimental Validation of SiC MOSFET-Based 50kW Three-Phase PWM Rectifier for EV Charging Station
Ju-A Lee, *Sungkyunkwan University*
Charging Systems
AUTHORS: Ju-A Lee, Hun Heo, Dong-Hyun Sim, Hyeon-Woo Jo, Won-Jin Son, Byoung Kuk Lee

D13.6 Performance of a 500A, Unidirectional IGCT-Based Solid-State DC Circuit Breaker for Electric Vehicle Charging Applications
Govind Chavan, *ABB Inc.*
Power Electronics for Hybrid and Electric Cars
AUTHORS: Govind Chavan, Abhinav Patni, Chunmeng Xu, Steven Englebretson, Pietro Cairoli

D13.7 A High-Density 200-kW All Silicon Carbide Three-Phase Inverter for Traction Applications
Ahmad Al-Hmoud, *University of Arkansas*
Vehicular Power Electronic Circuits and Systems
AUTHORS: Ahmad Al-Hmoud, Ahmed Ismail, Yue Zhao

D13.8 Control of a Dual-Active-Bridge DC-DC Converter in a MV Grid-Compliant Solid-State Transformer Based DC Fast Charger
Shrivatsal Sharma, *North Carolina State University*
Charging Systems
AUTHORS: Shrivatsal Sharma, Yos Prabowo, Subhashish Bhattacharya

D13.9 Design and Implementation of a GaN-Based Capacitively-Isolated Hybrid Dickson Switched-Capacitor DC-DC Converter for Space Applications
Samantha Coday, *University of California, Berkeley*
Power Electronics for Aerospace
AUTHORS: Samantha Coday, Elisa Krause, Margaret Blackwell, Nathan Ellis, Ansel Barchowsky, Robert Pilawa-Podgurski

D13.10 Solar PV Powered PMSM Driven Encoder-Less Electric Vehicle
Shadab Murshid, *Nanyang Technological University*
Vehicular Power Electronic Circuits and Systems
AUTHORS: Shadab Murshid, Bhim Singh, Ahmed Al-Durra, Mohd. Kashif

D13.11 A Wide Input Voltage High-Frequency Current-Fed Resonant Inverter for HFAC Electric Vehicle Auxiliary Electrical System
Jiagang Li, *Nanjing University of Aeronautics and Astronautics*
Power Electronics for Hybrid and Electric Cars
AUTHORS: Jiagang Li, Qunfang Wu, Qin Wang, Lan Xiao, Weiyang Zhou, Zhifeng Sun

D13.12 FPGA-Based Forced Air-Cooled SiC High-Power-Density Inverter for Electrical Aircraft Applications
Xiaoyan Liu, *University of Dayton*
Power Electronics for Aerospace
AUTHORS: Xiaoyan Liu, Mengxuan Wei, Maohang Qiu, Kevin Hobbs, Shuai Yang, Ahmed Dahneem, Dong Cao

D13.13 Multi-Objective Parametric Analysis of EV Traction Inverter Between Reliability and Efficiency
Lee Gill, *Sandia National Laboratories*
Vehicular Power Electronic Circuits and Systems
AUTHORS: Lee Gill, Lee Rashkin, Luke Yates, Jason Neely, Robert Kaplar

D13.14 A High Power Density SiC Motor Drive for a 6-Phase PMSM
Oscar Lopez, *Florida State University*
Power Electronics for Aerospace
AUTHORS: Oscar Lopez, Zhehui Guo, Juan Ordonez, Hui Li, Philippe Masson, Thirumalai Ananthanpillai

D13.16 Multiport Resonant GaN-Based DC/DC Converter for Automotive On-Board Low-Voltage Bus
Dario Metschies, *Reese Techware GmbH*
Power Electronics for Hybrid and Electric Cars
AUTHORS: Dario Metschies, Thiago Pereira, Fabian Groon, Sergej Schikowski, J. Maximilian Placzek, Marco Liserre

D13.17 Experimental Evaluation of Cryogenic Performances of Electronic Components for Signal Isolation in Medium Voltage Power Converters
Shimul K., *University of Tennessee, Knoxville*
Power Electronics for Aerospace
AUTHORS: Shimul K. Dam, Ching-Hsiang Yang, Zhou Dong, Dehao Qin, Ruirui Chen, Fei Fred Wang, Hua Kevin Bai, Zheyu Zhang

D13.18 GaN-Based 400V/48V DC-DC Converter with 97% Efficiency and PCB Magnetics for Automotive Applications
Pranav Raj, *CPES, Virginia Tech*
Power Electronics for Hybrid and Electric Cars
AUTHORS: Pranav Raj Prakash, Ahmed Nabih, Shuo Wang, Pham Phu Hieu, Yizhi Ruan, Qiang Li

11:30 a.m. – 1:30 p.m.

D14: Power Electronics Applications II

HALL WA3

SESSION CHAIR

Jeffery Nilles, *Independent*

Jim Spangler, *Independent*

D14.1 Bus Voltage Frequency and Phase Estimation Method for Induction Heating Appliances
Oscar Lucia, *University of Zaragoza*
AC-DC-AC Applications and Matrix Converters
AUTHORS: Luis Angel Barragán, Jorge Villa, Jose Ignacio Artigas, Alberto Domínguez, Denis Navarro, Jose Miguel Gil-Narvion, Oscar Lucía

D14.2 Control Strategy for Restarting Procedure of Sensorless PMSM Drives Using Indirect Matrix Converter
Yeongsu Bak, *Keimyung University*
AC-DC-AC Applications and Matrix Converters
AUTHOR: Yeongsu Bak

D14.3 A Batteryless Full Energy Harvesting System for Inside-Engine Temperature Sensors
Andreas Schorer, *Wuerth Elektronik eiSos Group*
Energy Harvesting
AUTHORS: Andreas Schorer, Mahmoud Shousha, Sebastian Pfennig, Martin Haug, Lorandt Fölkel, Michael Brooks, Jonas Groten, Oliver Werzer

D14.4 Avalanche Transistor-Based Nanosecond Pulse Generator in Plasma-Jet-Driven Magneto-Inertial Fusion Systems
Yingjian Zhuge, *ShanghaiTech University*
Defense and Military Power Electronics
AUTHORS: Yingjian Zhuge, Yong Chia Francis Thio, Haoyu Wang

D14.5 A Soft-Switching Zeta-Based AC-Link Universal Converter
Mojtaba Salehi, *Northeastern University*
AC-DC-AC Applications and Matrix Converters
AUTHORS: Mojtaba Salehi, Mahshid Amirabadi

11:30 a.m. – 1:30 p.m.

D15: Magnetic Applications

HALL WA3

SESSION CHAIR

Matt Wilkowski, *Würth Elektronik*

George Slama, *Würth Elektronik*

D15.1 Design Comparison of Different Coupled Inductor Concepts for Voltage Regulators
Feiyang Zhu, *Virginia Tech*
Magnetics applications
AUTHORS: Feiyang Zhu, Xin Lou, Qiang Li

D15.2 Controllable Built-In Leakage Inductance for a Novel Matrix Integrated Transformer
Feng Jin, *CPES*
Magnetics applications
AUTHORS: Feng Jin, Zheqing Li, Ahmed Nabih, Qiang Li

D15.3 Exploiting the Depth: Design, Analysis, and Implementation of High-Power-Density High-Frequency Transformers for One Rack Unit CLLC DCX Converters
Giacomo Andrioli, *University of Udine*
Magnetics applications
AUTHORS: Giacomo Andrioli, Milan Pajnić, Sandro Calligaro, Roberto Petrella

D15.4 **Investigating UU Powder Core Inductor Winding Configurations Influence on DC Bias Inductance**
Dorai Yelaverthi, *ABB INC.*
Magnetics applications
AUTHORS: Dorai Yelaverthi, Harish Suryanarayana, Arun Kadavelugu

11:30 a.m. – 1:30 p.m.

D16: High Frequency Magnetics

HALL WA3

SESSION CHAIR

George Slama, *Würth Elektronik*

Edward Herbert, *PSMA*

D16.1 **High-Density Planar Integrated Magnetics with Common Mode Noise Immunity**
Junyun Deng, *University of Twente*
High-frequency magnetics
AUTHORS: Junyun Deng, Wenbo Wang, Prasanth Venugopal, Jelena Popovic, Gert Rietveld

D16.2 **A High Frequency Coupled Inductor Design for High Power Density DC-DC Converters**
Ahmed Ismail, *University of Arkansas*
High-frequency magnetics
AUTHORS: Ahmed Ismail, Zhuxuan Ma, Ahmad Al-Hmoud, Yue Zhao

D16.3 **Design and Fabrication of Low-Loss High-Permeability Soft Magnetic Mouldable Composites for High-Frequency Power Inductor Applications**
Hasan Ahmadian, *Tyndall National Institute*
High-frequency magnetics
AUTHORS: Hasan Ahmadian Baghbaderani, Sumit Sukhbashi Lal, Liang Ye, Guannan Wei, Ranajit Sai, Michael Morris, Paul McCloskey

D16.4 **Load Test Method Using Two Small-Capacity Power Supplies for High-Frequency Transformers in Single-Phase Dual Active Bridge Converters**
Koji Orikawa, *Hokkaido University*
High-frequency magnetics
AUTHORS: Koji Orikawa, Satoshi Ogasawara

11:30 a.m. – 1:30 p.m.

D17: Magnetic Modeling & Simulation

HALL WA3

SESSION CHAIR

Matt Wilkowski, *PSMA*

Edward Herbert, *PSMA*

D17.2 **Comparative Evaluation of Different Cables for Magnetic Couplers in Inductive Power Transfer Systems**
Jesús Acero, *Universidad de Zaragoza*
Magnetics modeling and simulations
AUTHORS: Jesús Acero, Claudio Carretero Chamarro, Ignacio Lope, José Miguel Burdío, Héctor Sarnago

D17.3 **Modeling and Analysis of Coupling Effect in Four Legged Core for Multi-Phase Buck Converter**
Yanda Lyu, *Technical University of Denmark*
Magnetics modeling and simulations
AUTHORS: Yanda Lyu, Bima Nugraha Sanusi, Ziwei Ouyang

D17.4 **3D Thermal Modeling of Inductive Power Transfer Coils Based on Basic Thermal Network for Optimization Analysis**
Alberto Delgado, *CEI, ETSII, Universidad Politécnica de Madrid*
Magnetics modeling and simulations
AUTHORS: Alberto Delgado Expósito, Lucia Clavero, Pedro Alou, Miroslav Vasić, Miroljub Bakic, Thiwanka Wijekoon

SAMWHA CAPACITOR GROUP

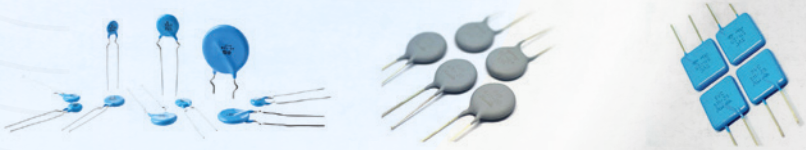
POWER CAPACITORS
DC LINK Capacitors
AC Filter Capacitors
Snubber Capacitors
High/Low Voltage Power Capacitors
Power Factor Correction Capacitors Bank

MLCC (MULTILAYER CERAMIC CAPACITORS)
MLCC for Automotive
MLCC High Voltage
MLCC Metal Frame Type

AL-CAP (ALUMINUM ELECTROLYTIC CAPACITORS)
Conductive Polymer Hybrid AL-CAP
Surface Mount AL-CAP
Large / Miniature AL-CAP

GREEN-CAP(EDLC) & BATTERY CAPACITORS
Electric Double Layer Capacitors Cell & Module
Battery Capacitors

DISC CERAMIC CAP & VARISTORS
Disc Ceramic Capacitors High Voltage
Disc Varistors (Metal Oxide Varistors)



EMI SOLUTIONS
Ferrite Cores & Absorbers (Tiles)
MPC (Magnetic Powder Cores)
SMD Power Inductors
Inductors for Class D
SMD Transformers & EMI Filter Coils

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Etched Cathode Foils
Formed Cathode Foils
Electrode for EDLC

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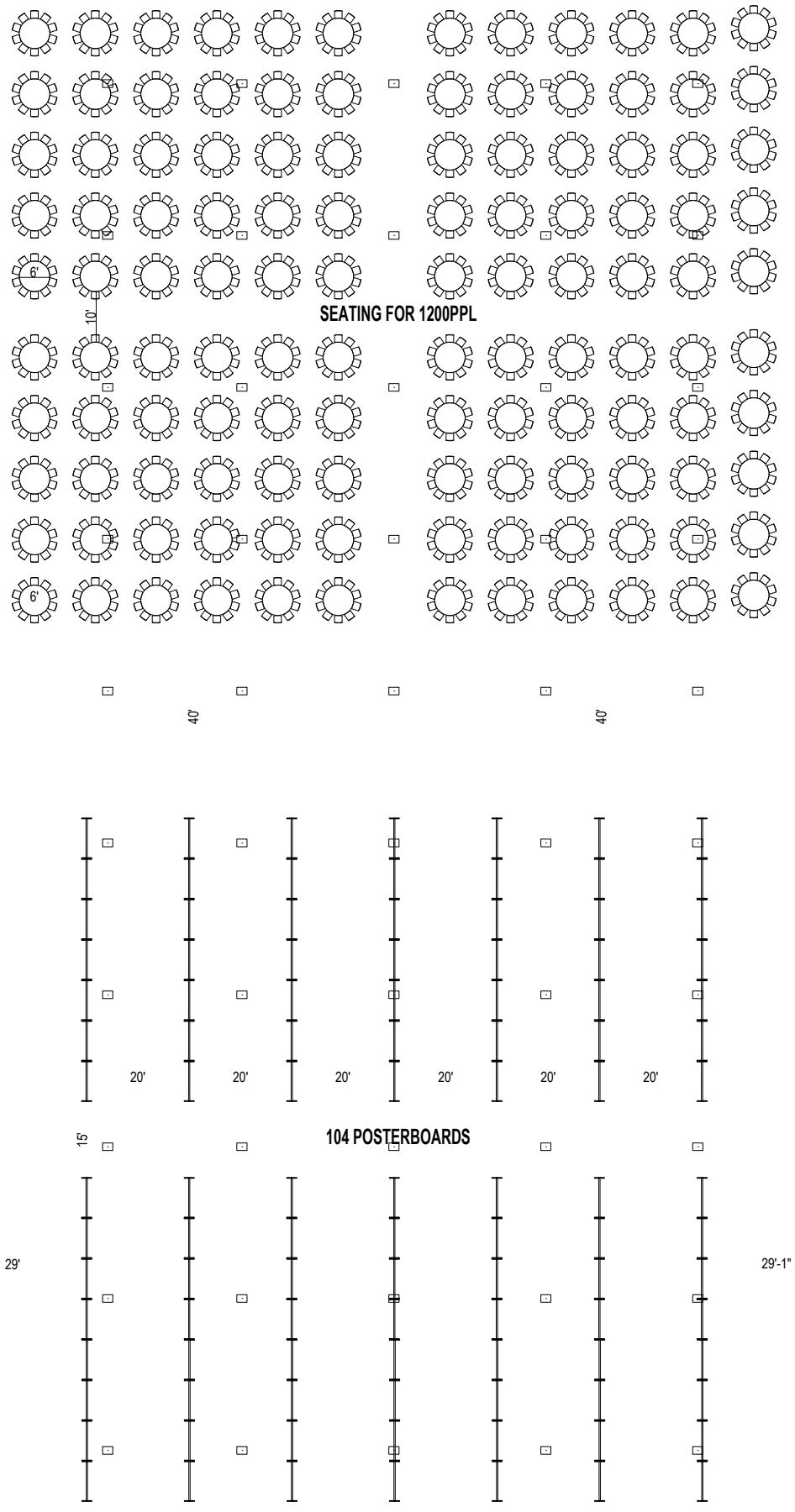
DIALOGUE SESSIONS FLOOR PLAN

Please see the APEC mobile app for your poster location.



CONVENTION CENTER FLOOR PLAN

OCCC: LEVEL 1 OVERVIEW

Registration

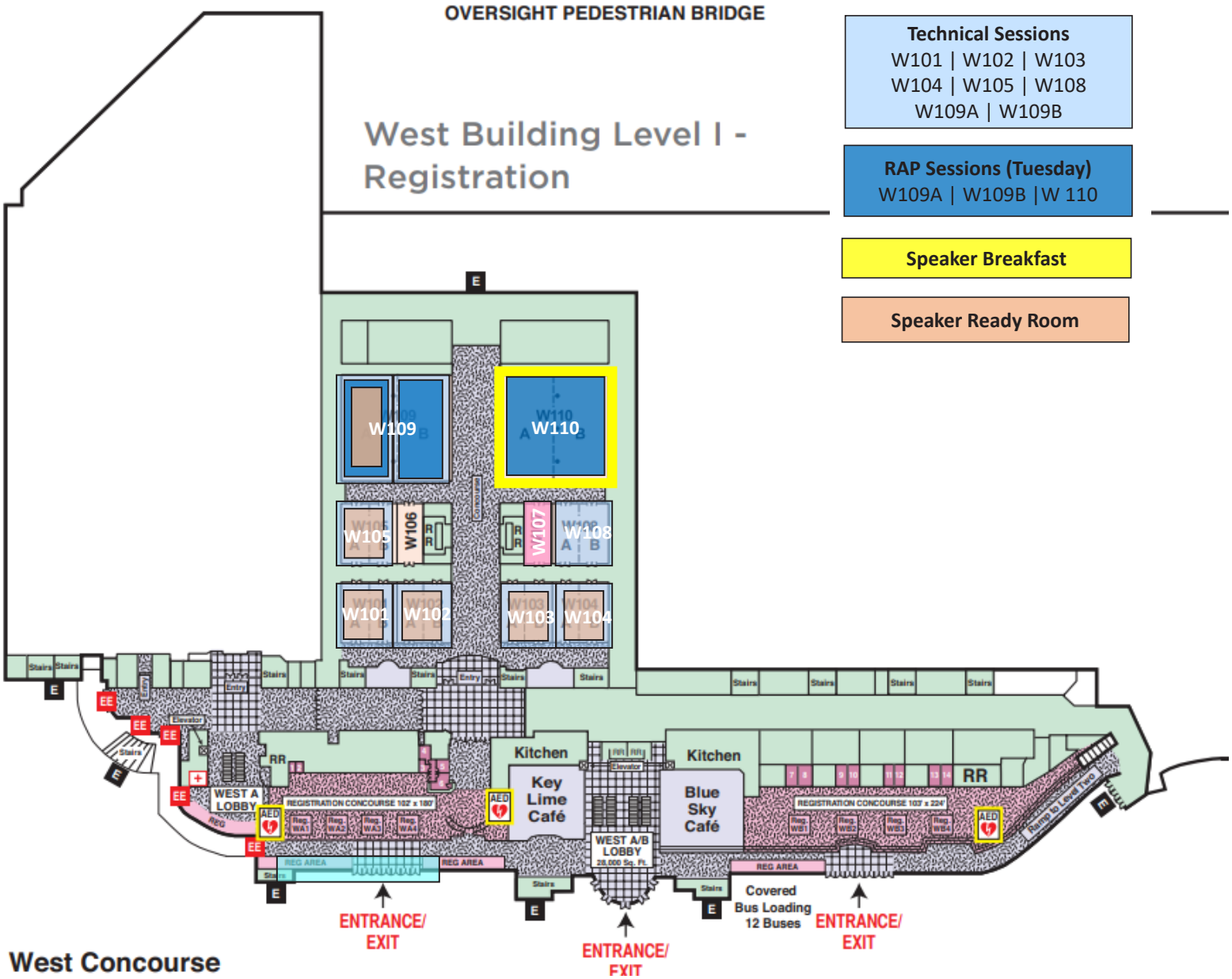
Professional Education Seminars
W101 | W102 | W103
W104| W105 | W109B

Technical Sessions
W101 | W102 | W103
W104 | W105 | W108
W109A | W109B

RAP Sessions (Tuesday)
W109A | W109B |W 110

Speaker Breakfast

Speaker Ready Room



CONVENTION CENTER FLOOR PLAN

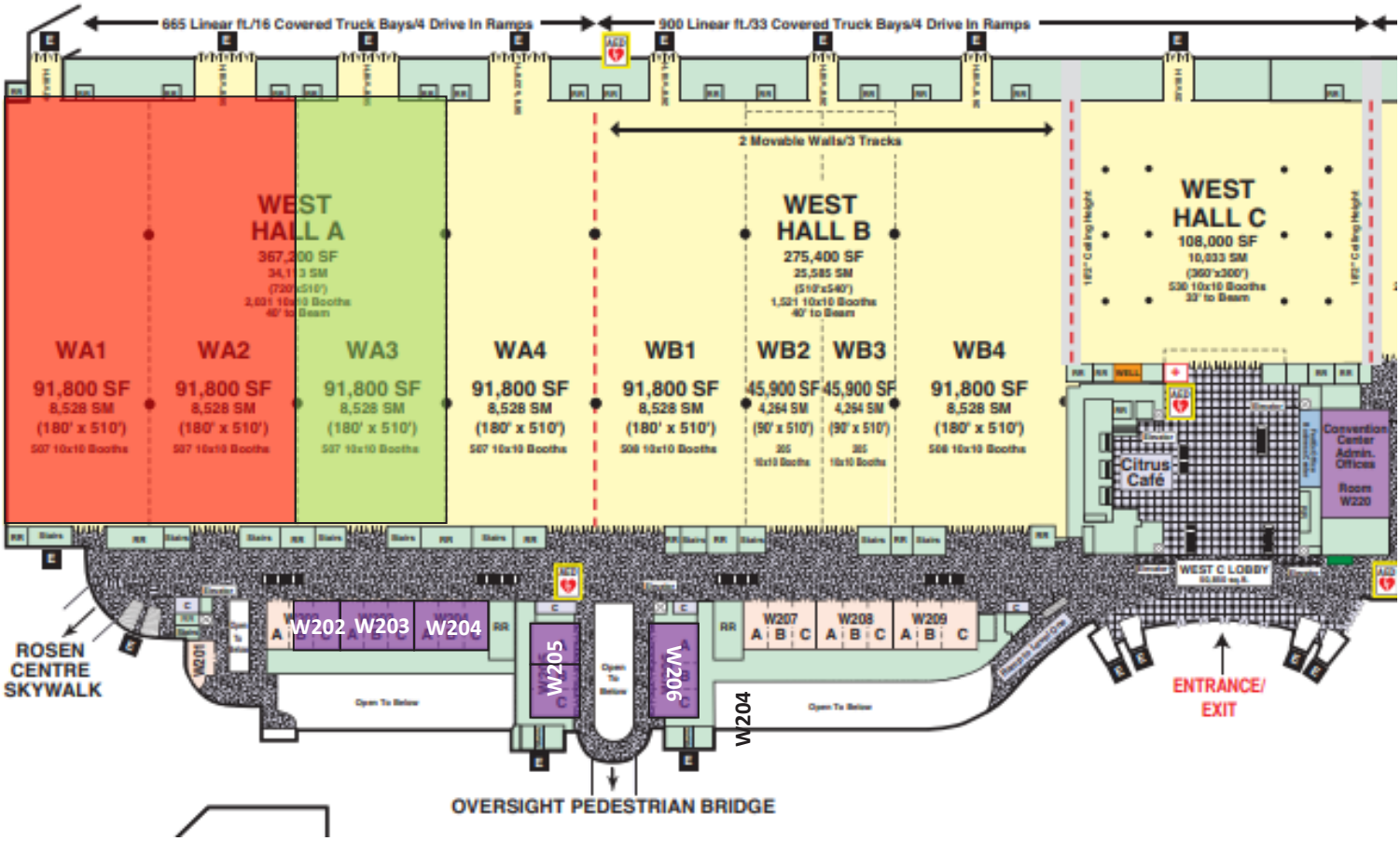
OCCC: LEVEL 2 OVERVIEW

Expo Hall
Hall WA1 & WA2

Plenary Session
Student Job Fair
Dialogue Sessions
Hall WA3

Industry Sessions
202B | 203A | 204A
205A | 205B | 206A

West Building Level II - Exhibit Halls/Meeting Rooms



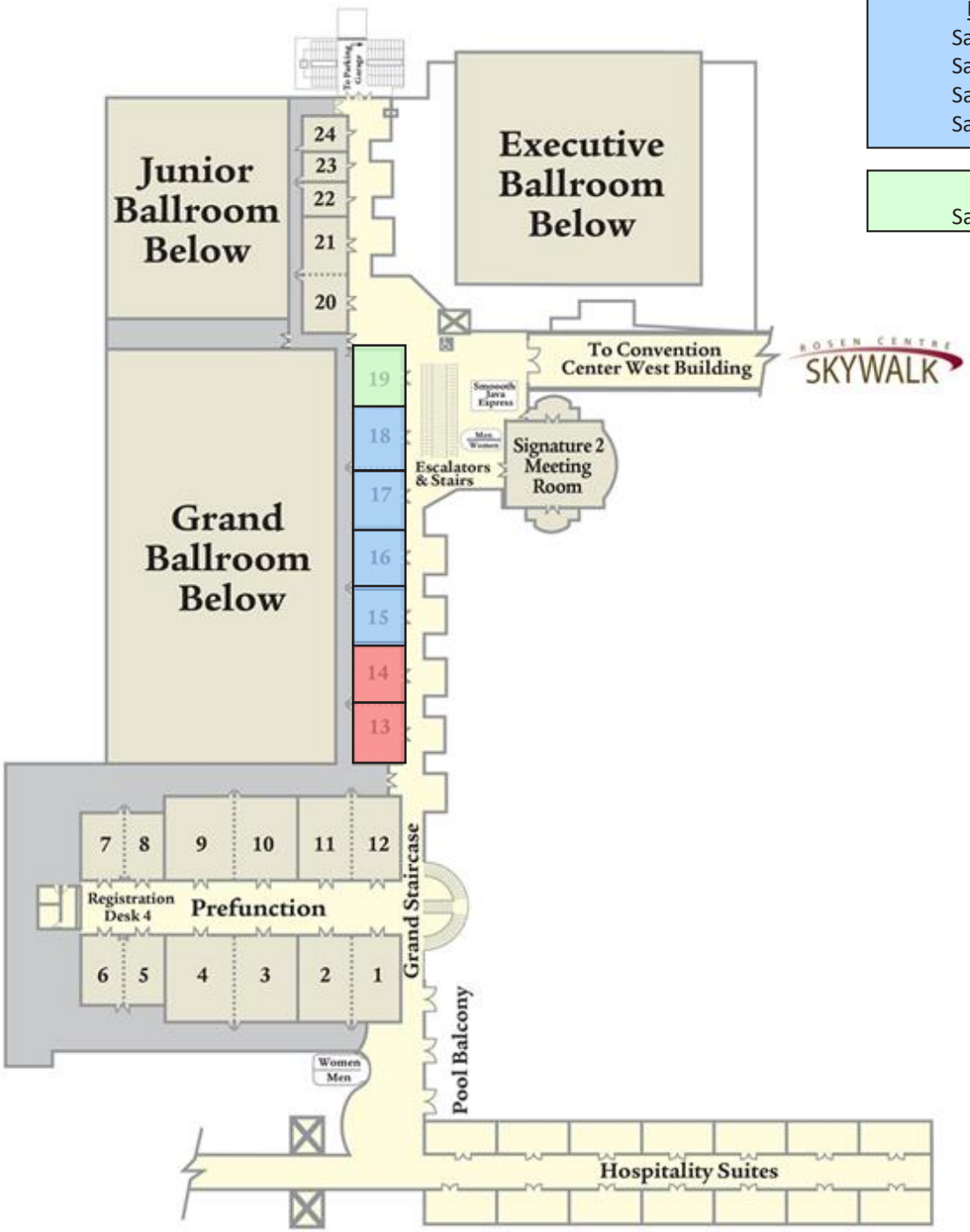
CONVENTION CENTER FLOOR PLAN

ROSEN CENTRE OVERVIEW

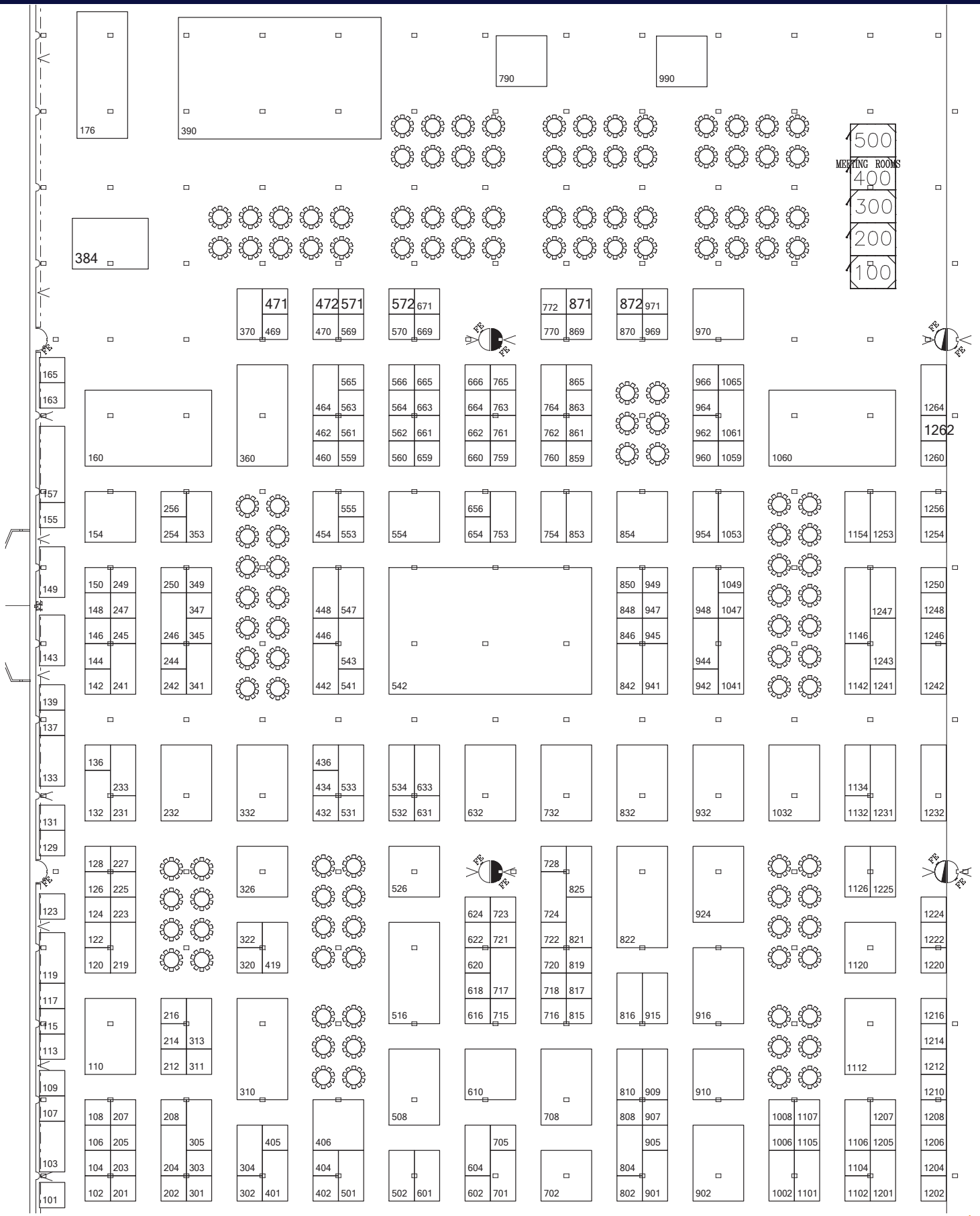
PSMA :
Salon 13
Salon 14

PELS:
Salon 15
Salon 16
Salon 17
Salon 18

IAS:
Salon 19



EXPOSITION FLOOR PLAN



EXHIBITOR LISTING

as of February 17, 2023

EXHIBITOR	BOOTH #
ABC Taiwan Electronics Corp	123
AC Power Corp. (Preen)	941
Aceinna Inc	863
ACME Electronics Corporation	566
Acopian Power Supplies	945
Advance Pro Tech	971
Advanced Cooling Technologies, Inc.	949
Advanced Energy	555
Advanced Test Equipment Corp.	705
Advantech Corporation	1248
AE Techron, Inc.	1212
Aehr Test	631
AEM	150
Aishi Capacitors	724
Aismalibar North America	136
Alberko HeatsinkOnline	1246
Alpha & Omega Semiconductor	810
Altair	1254
AmberSemi	131
AmePower- Contract Manufacturing	572
American - Made Challenges	871
AMETHERM, Inc	432
AMOGREENTECH Co., Ltd.	122
Analog Devices	360
Anbon Semi	163
ANHUI Tiger Co.,Ltd.	249
AOI Electronics Co.,Ltd.	165
APEC HUB	542
Apex Microtechnology	1049
ASC American Sun Components	872
Astro Space, LLC	472
Aurora Circuits	763
Axiom Test Equipment	602
B&K Precision	313
Barker Microfarads	137
Batten & Allen	570
BH Electronics	225
BJA Magnetics	203
Boschman-Advanced Packaging Technology	659

EXHIBITOR	BOOTH #
Bose Research Pvt. Ltd.	1250
Bourns, Inc.	154
Brightworks Technology, Inc.	108
BROXING SA	470
CAEN Technologies	819
CalRamic Technologies, LLC	563
Cambridge GaN Devices	305
CapXon	907
Central Semiconductor Corp.	1101
Centrotherm International AG	564
Chimicron Semiconductor	815
Cincinnati Sub-Zero	618
Cleverscope	1256
Coil Winding Specialist, Inc.	304
Coilcraft, Inc.	370
Conquer Electronics Co., Ltd.	462
Core Electronics	129
Cornell Dubilier Electronics	1142
Cramer Magnetics	1006
Custom Electronics Inc. - Celektronix	665
CVD Equipment Corporation	765
Datatronics	446
Dean Technology, Inc.	402
Delta Electronics (Americas) Ltd.	1065
DEWESoft LLC	944
Dexter Magnetic Technologies	960
Digi-Key Electronics	1120
DIOTEC Semiconductor America	1132
Dongguan Mentech Optical & Magnetic Co., Ltd.	526
dSPACE Inc.	1107
E&B Technology	865
EA Elektro-Automatik	326
EBG Resistors	404
Efab International Technology Co., Ltd.	772
EFC/Wesco	722
Efficient Power Conversion Corporation (EPC)	732
EGSTON Power Electronics	761
ELANTAS PDG, Inc.	671
Electro Technik	469

EXHIBITOR LISTING

EXHIBITOR	BOOTH #
Electrocube, Inc.	1104
Electronic Concepts, Inc.	901
Electronicon Kondensatoren GmbH.	119
Elektrisola Inc.	553
Elna Magnetics	728
Empower a Billion Lives Global Competition.	990
Empower Semiconductor	454
EMWORKS	303
EXATRON, Inc.	909
EXXELIA	120
Fair-Rite Products	654
Faratronic Co. LTD	146
Ferroxcube	1008
FIRST Robotics	790
Focused Test, Inc.	620
Fraunhofer ISIT	870
Frenetic.	1106
Fuji Electric Corp. of America.	610
GaN Systems	822
GaNPower International Inc.	256
GE.	715
Geehy Semiconductor USA	139
GeneSiC Semiconductor	532
GMW Associates	624
Good-Ark Semiconductor	242
Gwanak Analog	1206
Halo Microelectronics.	353
Hengdian Group DMEGC Magnetics Co., Ltd.	101
Heraeus Electronics	534
Hesse Mechatronics	701
Hioki USA Corp.	1201
Hitachi America Ltd.	212
Hoi Luen Electrical Manufacturer Co., Ltd.	760
Holy Stone International.	1214
Hotland International Corp	905
HVM Technology	231
HVR Advanced Power Components.	861
IBS Electronics, Inc.	1225
ICE Components, Inc.	660

EXHIBITOR	BOOTH #
Ideal Power.	1205
IFEC (International Future Energy Challenge)	1190
imec	616
imperix	1208
Indium Corporation	859
Infineon Technologies Americas Corp	932
Innoscience Technology Co., Ltd.	310
iNRCORE, LLC	246
Intepro Systems	770
Inter Outstanding Electronics Inc (IOE)	311
Invicta Electronics Inc	250
ITECH Electronics.	1224
ITELCOND SRL.	247
ITG Electronics, Inc.	349
IVWorks Co., Ltd.	1207
IWATSU Electric Co.,Ltd.	208
Jianghai America Inc	850
Johanson Dielectrics, Inc	531
Jovil Universal LLC	802
Kawaso Texcel co., Ltd	966
Kendeil Srl	1220
KEPCO POWER	148
Keysight Technologies	854
Kikusui America, Inc.	1134
Knick Interface LLC.	104
Knowles Precision Devices	126
KOKI Solder America Inc.	663
KYOCERA AVX	816
LEM USA Inc.	103
LiSAT.	817
Lodestone Pacific	442
Mag Layers USA	102
Magna-Power Electronics.	804
Magnetics	942
Mainstream Engineering Corporation	964
Malico Inc.	1204
Max Echo Technology Corp	561
MaxLinear Corporation.	448
MCB Electronics	1262

EXHIBITOR LISTING

EXHIBITOR	BOOTH #
Menlo Microsystems, Inc.	219
Mersen	554
Methode Electronics	543
MH&W International Corp.	205
Microchip Technology, Inc.	910
Micrometals, Inc.	541
Micromouse	390
Micross Components	1242
Minntronix, Inc.	322
Mitsubishi Electric US, Inc	924
Mitsui Kinzoku	662
Molex	204
Moov Technologies	124
Mouser Electronics, Inc.	1126
Murata	508
NAC Semi	821
National Magnetics Group/ Ceramic Magnetics, Inc.	223
Navitas	516
New England Wire Technologies	754
Newtons4th Ltd.	241
NexGen Power Systems	1231
NexGen Power Systems	1232
Nexperia	110
Nichicon (America) Corp	501
Ningguo Yuhua Electrical Products Co.,Ltd	669
Noratel	302
NXP Semiconductors	341
Ohmite Manufacturing	233
Omicron Lab	1154
onsemi	1032
OPAL-RT Technologies	633
Oxford Instruments Plasma Technology	117
Pacific Sowa Corporation; C/O Epson Atmix Corporat	1102
Payton America Inc.	533
PCIM Europe	721
Peak Nano Films	115
PEM Ltd	622

EXHIBITOR	BOOTH #
PFARR Stanztechnik GmbH	962
PIN SHINE INDUSTRIAL CO., LTD	661
PINK, ipTEST and Tresky Automation	718
Plexim	723
PMBus	1210
PMK	207
PolyCharge America, Inc.	245
Power Integrations	708
Power Management Integration Center (PMIC)	1222
PowerAmerica	656
Powercast Corporation	471
PowerELab Ltd.	345
PPST Solutions	848
Premier Magnetics	604
Protavic America	759
Proterial America, Ltd.	717
Quantic Capacitors and Magnetics	842
Reed Semiconductor Inc.	202
REGATRON	107
REMTEC, Inc.	227
Robert Bosch	764
Rohde & Schwarz USA, Inc.	601
ROHM Semiconductor	832
Rubadue Wire	954
SABIC	559
Samwha USA Inc.	1041
SanRex Corporation	825
Schunk Carbon and Sonosystems	716
Semikron Danfoss	970
SemiQ	133
Sentec E&E Co., Ltd.	1241
Shenzhen Click Technology Co., Ltd.	155
Shenzhen Microgate Technology Co.,Ltd	666
Shenzhen Sunlord Electronics Co.,Ltd.	1264
Shin-Etsu Silicones of America	405
Shinko Electric Industries Co., Ltd.	216
Sichuan Zhongxing Electronic Co., Ltd.	254
Simplis Technologies	915
Skyworks Solutions	1146

EXHIBITOR LISTING

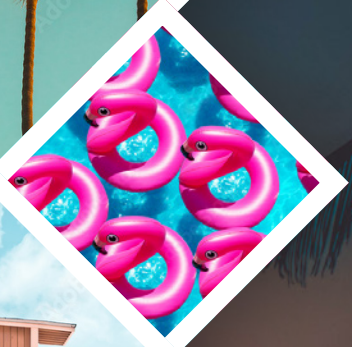
EXHIBITOR	BOOTH #
Soitec	214
Speedgoat	1047
Standex Electronics	702
Stellar Industries Corp.	560
STMicroelectronics	902
Storm Power Components	1202
StratEdge Corporation	347
Stratus Vision GmbH	664
Sumida America Inc.	753
Sumitomo Chemical Co., Ltd.	969
Tagore Technology	301
Taiwan Semiconductor	762
TAIYO YUDEN USA Inc.	464
Talema Group LLC	142
Tamura Corporation - Novel Crystal Technology, Inc	157
TCLAD Inc.	201
TDK Corporation	1112
Tektronix Inc.	1253
Teledyne LeCroy	401
TenXer Labs Inc	569
Tesec, Inc.	1059
Texas Instruments	916
Tianchang Fuan Electronics Co., LTD	128
TME US, LLC.	149
Tower Semiconductor	132
Transcat, Inc	720
Transphorm	853
TransSiP, Inc.	869
Tran-Tec	808
TSC International	1105

EXHIBITOR	BOOTH #
TT Electronics	502
Tyndall National Institute	846
Typhoon HIL, Inc.	434
United Chemi-Con	1002
UnitedSiC, now Qorvo	632
UNITES Systems	113
Vacuumschmelze GmbH & Co., KG	1216
Verivolt	1260
Vincotech GmbH	948
Vishay Intertechnology	332
VisIC Technologies	547
Vitrek-High Voltage Test & Measurement	320
Voltage Multipliers, Inc.	565
Wakefield Thermal	143
West Coast Magnetics	1053
WIMA Capacitors GmbH & Co.KG	244
WIN Source Electronics	1243
Wolfspeed, Inc.	1247
World Micro	571
Würth Elektronik	232
Wuxi CRE New Energy Technology Co., Ltd	1061
Wuxi Leapers Semiconductor Co., Ltd.	460
X-FAB Semiconductor Foundries	436
YAGEO Group	419
Yokogawa Corporation of America	106
YOLE Group	947
ZES ZIMMER Electronic Systems GmbH	109
Zhongshan Competent Automation Equipment Co.,Ltd	144
Zhuhai Weihan Wire Co., Ltd	562

NOTES

APEC 2024

LONG BEACH CALIFORNIA





February 25th - 29th

SAVE THE DATE

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