The Premier Global Event in Power Electronics

APEC®

2★22

MARCH **20-24**

HOUSTON, TX

Sponsored by:

IAS IEEE INDUSTRY APPLICATIONS SOCIETY — Linking Research to Practice

pels IEEE POWER ELECTRONICS SOCIETY — Powering a Sustainable Future

PSMA

TABLE OF CONTENTS

APEC MOBILE APP

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

WI-FI

Network Name: APEC2022

Password: Houston22 *(case sensitive)*

apec@apec-conf.org

STAY CONNECTED WITH APEC

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

@APEC-CONF | #APEC2022

APEC: Applied Power Electronics Conference

APEC: Applied Power Electronics Conference

PROGRAM KEY

EDUCATIONAL PROGRAM

PROFESSIONAL EDUCATION SEMINARS

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

PLENARY SESSION

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

TECHNICAL SESSIONS

APEC professionals like you participated in a rigorous peer review process and have carefully picked hundreds of papers making up APEC's Technical Sessions. The review process highlights the most innovative technical solutions, and provides the highest quality possible. The technical program includes papers of broad appeal scheduled for **lecture presentation** from Tuesday morning through Thursday afternoon. Papers with a more specialized focus are available for discussion with authors at the **dialogue session** on Thursday from 11:30 a.m. – 1:30 p.m. The various technical venues cover all areas of technical interest to the practicing power electronics professional. The papers are sure to give you many new design ideas that you can apply to your work immediately.

INDUSTRY SESSIONS

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

EXHIBITOR SEMINARS

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

RAP SESSIONS

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

FOREWORD

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

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

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

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

Omer C. Onar
General Chair
2022 IEEE Applied Power Electronics Conference and Exposition

APEC HEALTH AND WELLNESS

Guidelines are subject to change.

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

LOCAL GUIDELINES

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

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

SOCIAL DISTANCING PINS

APEC recognizes individuals' preferences by promoting a safe environment and experiences.
Please respect each other by following this guide for those wearing colored pins.
Pins can be found at registration.

NOTES

SPONSORS AND PARTNERS

Thank you to our 2022 Sponsors and Partners

SPONSORS

APEC 2022 Sponsors provide financial backing (including liability)

IAS IEEE INDUSTRY APPLICATIONS SOCIETY Linking Research to Practice

pels IEEE POWER ELECTRONICS SOCIETY *Powering a Sustainable Future*

PSMA

PARTNERS

DIAMOND

MNC Mentech

PLATINUM

MOUSER ELECTRONICS

power integrations™

GOLD

life.augmented

WCM WEST COAST MAGNETICS

SILVER

transphorm

Texas Instruments

Wolfspeed

SUPPORTING PUBLICATIONS

Thank you to our 2022 Supporting Publications

APPLIANCE & HVAC REPORT Reaching Design Engineers at the OEM Level

Bodo's Power Systems®

CHARGED ELECTRIC VEHICLES MAGAZINE

Design World

EE POWER

EE Times

EEworld ONLINE

Electronic Design

ELECTRONICS sourcing NORTH AMERICA

Electronic PRODUCTS

everythingPE
Keep up to date with Power Electronics

HOW2POWER.COM
Answering Your Questions About Power Design

Houston Energy Industry News

IEEE GlobalSpec

it INTERFERENCE TECHNOLOGY

MAGNETICS BUSINESS & TECHNOLOGY
SUBSCRIBE TODAY
Print Magazine
Digital Magazine
eNewsletter
www.MagneticsMag.com

MANUFACTURING TECHNOLOGY INSIGHTS

i-MicroNews Turn knowledge into value

IEEE Power Electronics Magazine
For your engineering success

POWER ELECTRONICS EUROPE

POWER ELECTRONICS NEWS

Test & Measurement 2.0
Your Resource for Test, Measurement & Compliance Products

U.S. TECH
The Global Electronics Publication

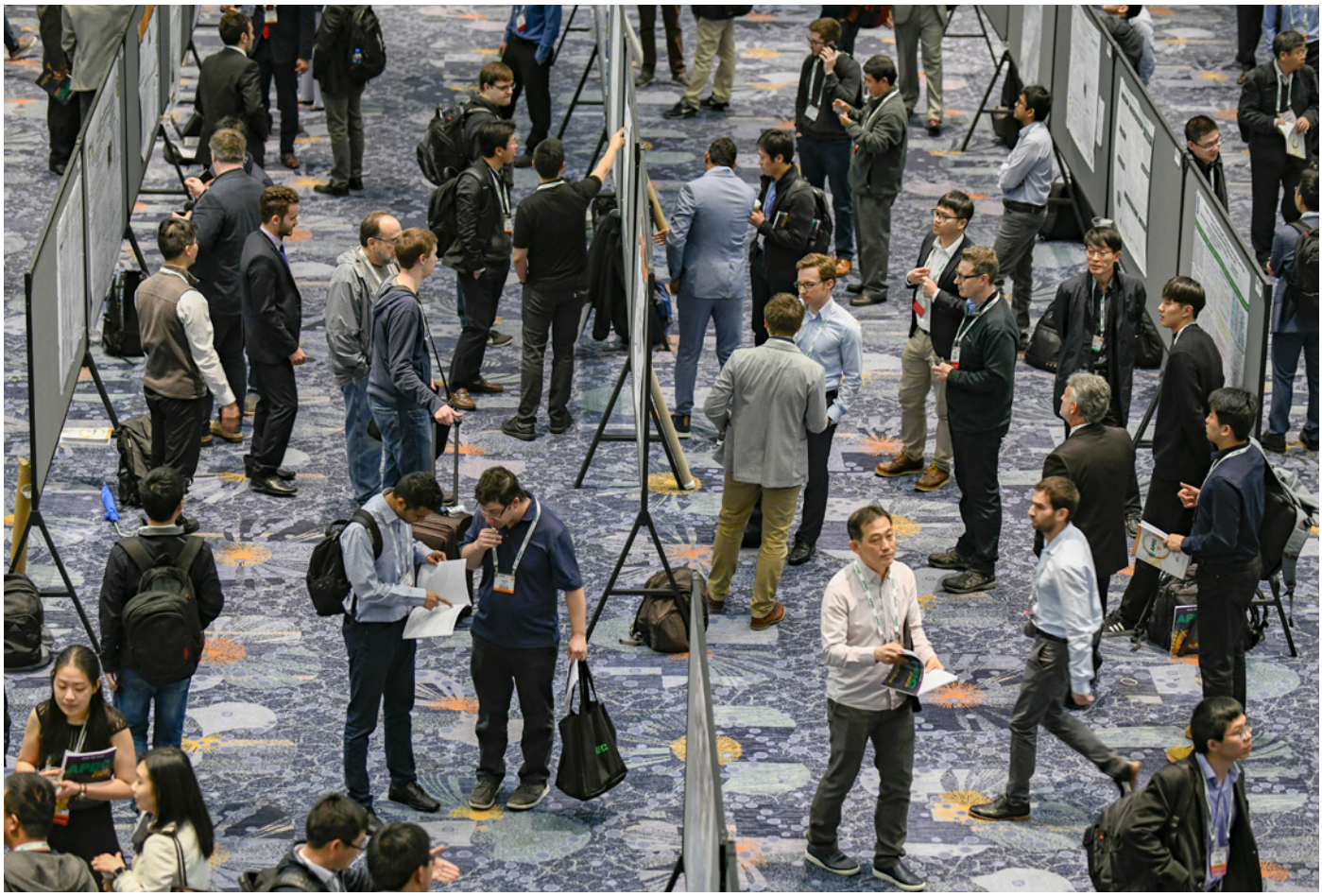
YOLE Développement

NOTES

CONFERENCE-AT-A-GLANCE

	Saturday March 19	Sunday March 20	Monday March 21	Tuesday March 22	Wednesday March 23	Thursday March 24
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 19

4:00 p.m. – 7:00 p.m.	**Registration is Open**	Hall DE Foyer

SUNDAY, MARCH 20

7:00 a.m. – 5:00 p.m.	**Registration is Open**	Hall DE Foyer
7:30 a.m. – 8:30 a.m.	**Speaker Breakfast**	Room 310
9:30 a.m. – 1:00 p.m.	**Professional Education Seminars** (concurrent sessions)	see page 19 for specific locations
2:30 p.m. – 6:00 p.m.	**Professional Education Seminars** (concurrent sessions)	see page 20 for specific locations

MONDAY, MARCH 21

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

TUESDAY, MARCH 22

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

SCHEDULE-AT-A-GLANCE

WEDNESDAY, MARCH 23

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

THURSDAY, MARCH 24

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

	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 19 . . . . . 4:00 p.m. – 7:00 p.m.
Sunday, March 20 . . . . . 7:00 a.m. – 5:00 p.m.
Monday, March 21. . . . . 7:00 a.m. – 6:00 p.m.
Tuesday, March 22 . . . . . 8:00 a.m. – 5:00 p.m.
Wednesday, March 23. . . . . 8:00 a.m. – 2:00 p.m.
Thursday, March 24. . . . . 8:00 a.m. – 12:00 p.m.

APEC EXPO HALL

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

Expo Hall Hours

Monday, March 21. . . . . 5:00 p.m. – 8:00 p.m.
Tuesday, March 22 . . . . . 9:00 a.m. – 5:00 p.m.
Wednesday, March 23. . . . . 9:00 a.m. – 2:30 p.m.

Expo Hall Admission

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

Lunch

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

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

Expo Hall Giveaway

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

Accessibility

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

MATERIALS PURCHASE

Purchase of Seminar Workbooks

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

Payment Policy

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

> **Seminar Workbook:** $125

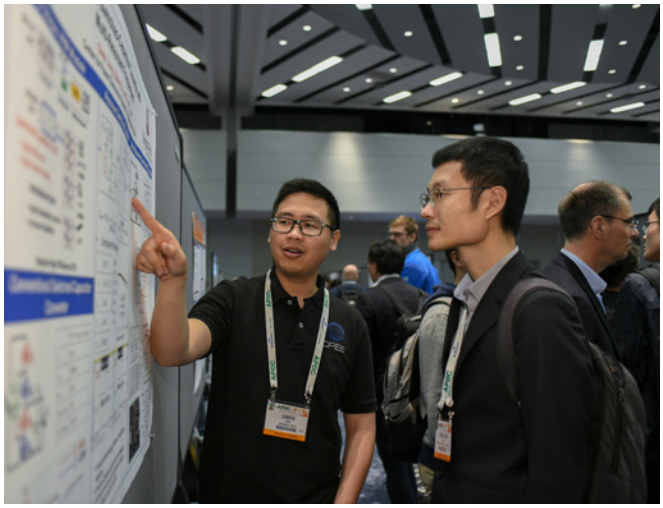
Purchased publications can be picked up at the registration desk.

Purchasing through the IEEE

Post conference APEC Proceedings may be purchased through the IEEE.

IEEE Single Copy Sales

445 Hoes Lane
Piscataway, New Jersey 08854, USA
P: (800) 678-4333 (USA & Canada)
or (732) 981-0060
Website: http://shop.ieee.org/ieeestore/



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 2022, 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.

Visit Houston

Recruitment Policy

IEEE Policy #10.1.24 prohibits recruiting at IEEE sponsored conferences. Consequently, recruiters and recruiting advertisements will not be permitted in the APEC 2022 hotel space, meeting facilities or Expo Hall.

Distribution of Commercial Material at APEC

Rules for Non-Exhibitors: Distribution of commercial material in the APEC 2022 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 2022 Exposition. In addition, APEC may use the information you provide to contact you with information about APEC 2022 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

PROFESSIONAL EDUCATION SEMINAR SPEAKERS

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

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

INDUSTRY SESSIONS AND LECTURE TECHNICAL SESSION SPEAKERS

You must attend a mandatory breakfast on the morning of your session. The Program Chair will host this breakfast at which you will be given your speaker ribbon and provided instructions. Immediately after breakfast you will be able to confer with your session chairs and/or review your previously uploaded presentation in the speaker ready room.

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

DIALOGUE TECHNICAL SESSION SPEAKERS

You must attend a mandatory breakfast on the morning of your session. During breakfast, you will receive brief instructions and will be able to mount your presentation on the poster boards in the Hall DE Foyer prefunction area after the breakfast. Thumb tacks will be provided.

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

SPEAKER READY ROOM

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

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

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 Houston

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

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

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

PELS AND IAS YOUNG PROFESSIONAL NETWORKING RECEPTION

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

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

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

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

Free breakfast will be included.

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

WEDNESDAY NIGHT SOCIAL

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

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

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

SPONSOR MEETINGS

PSMA MEETINGS

SATURDAY, MARCH 19

7:00 a.m. – 5:00 p.m.	**PSMA/PELS Workshop on High Frequency Magnetics**	352DEF
7:00 a.m. – 5:00 p.m.	**PSMA/PELS Workshop on Capacitors**	342

SUNDAY, MARCH 20

12:00 p.m. – 2:30 p.m.	**Friends of PSMA Reception – by invitation only**	

MONDAY, MARCH 21

7:30 a.m. – 1:00 p.m.	**PSMA Annual Meeting – followed by March BoD Meeting**	342EF

TUESDAY, MARCH 22

8:00 a.m. – 10:00 a.m.	**PSMA Semiconductor Committee Meeting**	332B
8:00 a.m. – 10:00 a.m.	**PSMA Transportation Electronics Committee Meeting**	332C
8:30 a.m. – 11:55 a.m.	**PSMA Sponsored Industry Session: Magnetics IS01**	360ABC
8:30 a.m. – 11:55 a.m.	**PSMA Sponsored Industry Session: PwrSoC IS05**	320C
10:00 a.m. – 12:00 p.m.	**PSMA Capacitor Committee Meeting**	332B
10:00 a.m. – 12:00 p.m.	**PSMA Marketing Committee Meeting**	332C
12:00 p.m. – 2:00 p.m.	**PSMA Packaging & Manufacturing Committee Meeting**	332B
12:00 p.m. – 2:00 p.m.	**PSMA Energy Management Committee Meeting**	332C
2:00 p.m. – 4:00 p.m.	**PSMA Magnetics Committee Meeting**	332B
2:00 p.m. – 4:00 p.m.	**PSMA Power Technology Roadmap Committee Meeting**	332C

WEDNESDAY, MARCH 23

8:00 a.m - 9:00 a.m.	**APEC Student Attendance Support Committee Meeting**	332C
8:00 a.m - 10:00 a.m.	**PSMA Energy Harvesting Committee Meeting**	332B
8:30 a.m. – 11:55 a.m.	**PSMA Sponsored Industry Session: Marketing IS06**	360ABC
8:30 a.m. – 11:55 a.m.	**PSMA Sponsored Industry Session: Semiconductor IS07**	360DEF
8:30 a.m. – 11:55 a.m.	**PSMA Sponsored Industry Session: Transportation Electronics IS09**	320B
8:30 a.m. – 11:55 a.m.	**PSMA Sponsored Industry Session: Packaging & Manufacturing IS10**	320C
10:00 a.m. – 12:00 p.m.	**PSMA Energy Storage Committee Meeting**	332B
10:00 a.m. – 12:00 p.m.	**PSMA Safety & Compliance Committee Meeting**	332C
12:00 p.m. - 2:00 p.m.	**PSMA Industry-Education Committee Meeting**	332B
2:00 p.m. - 4:00 p.m.	**PSMA Reliability Committee Meeting**	332B
2:30 p.m. – 5:45 p.m.	**PSMA Sponsored Industry Session: Semiconductor IS11**	360ABC
2:30 p.m. – 5:45 p.m.	**PSMA Sponsored Industry Session: Energy Storage IS15**	320C
3:00 p.m. - 5:00 p.m.	**PSMA/ IPC-2701 Committee Meeting**	332B

PSMA MEETINGS (continued)

THURSDAY, MARCH 24

8:30 a.m - 11:30 a.m.	**PSMA Sponsored Industry Session: Energy Management IS18**	320A
1:45 p.m - 3.25 p.m.	**PSMA Sponsored Industry Session: Semiconductor IS21**	360ABC
1:45 p.m - 3.25 p.m.	**PSMA Sponsored Industry Session: Capacitor IS22**	360DEF
1:45 p.m - 3.25 p.m.	**PSMA Sponsored Industry Session: Energy Harvesting IS24**	320B

IEEE PELS MEETINGS

MONDAY, MARCH 21

8:00 a.m. – 10:00 a.m.	**PELS Exec Team Strategy Meeting (PELS Officers Only)**	332E

TUESDAY, MARCH 22

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

WEDNESDAY, MARCH 23

7:30 a.m. – 8:30 a.m.	**WiE, YP, and You: How to become involved with IEEE PELS!**	332D
9:00 a.m. – 12:00 p.m.	**PELS Conferences Committee Meeting**	332E

FRIDAY, MARCH 25

7:30 a.m. – 8:30 a.m.	**PELS Administrative Committee Breakfast**	Brazoria Marriott, 2nd Level
8:30 a.m. – 1:00 p.m.	**PELS Administrative Committee Meeting**	Brazoria Marriott, 2nd Level

PROFESSIONAL EDUCATION SEMINARS

APEC strives to offer seminars with a practical mix of theory and application for the professional working in power electronics. APEC 2022 features 15 Professional Education Seminars with a broad range of topics.

SESSION 1

9:30 a.m. – 1:00 p.m.

S01: Insulation and Coordination Design Steps for Power Converters

ROOM 350DEF

TRACK: Control & Design

Ilknur Colak

Maschinenfabrik Reinhausen

Insulation and coordination design is one of the most important topics which needs to be considered at the beginning stage of a power electronics system design. This tutorial reviews the fundamentals of insulation and coordination and defines the relevant norms, requirements and standards for high power medium voltage power electronics systems. The tutorial is intended to address the design steps to provide required clearance and creepage distances through some examples. This guide covers also the electrical tests and measurements to fulfil the electrical withstand capability for a given medium voltage application example. Finally, the insulation and coordination regulations for medium voltage power electronics systems and the differences between the regulations are presented in the tutorial. The scope of the lecture would be very valuable to those power electronics engineers, mechanical engineers and students from university and industry who face with the design problems of implementing insulation and coordination requirements in their applications and who need a guide to the methods that can be used straight away without performing complex mathematics.

SESSION 2

9:30 a.m. – 1:00 p.m.

S02: PCB Layout Techniques for Optimizing Performance of Surface-Mounted Wide-Bandgap Power Electronic Circuits

ROOM 351ABC

TRACK: Design & EMI

Eric Persson

Infineon Technologies Americas Corp

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

SESSION 3

9:30 a.m. – 1:00 p.m.

S03: Topology & Control of MHz High Density DC-DC Power Converters

ROOM 361ABC

TRACK: Topologies

Xinke Wu

Zhejiang University

Dong Cao

University of Dayton

Numerous applications need high power density, high efficiency dc-dc power converters with kW/in3 level density. Such as server applications in near future, high voltage dc power distribution is required to feed the server motherboard. A board mount step-down isolated dc/dc converter with low output voltage is necessary, which bring the high density and high efficiency requirements for the step-down dc/dc converter, where the density of the dc-dc stage is almost 1kW/in3. A MHz level dc-dc converter is necessary for achieving such high power density applications. Different topologies and control strategies are investigated and presented in this seminar including the EMI issues, magnetic component design guidelines and optimizations, efficiency optimizations.

SESSION 4

9:30 a.m. – 1:00 p.m.

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

ROOM 352DEF

TRACK: Wide Bandgap

Fred Wang[1], Shiqi Ji[2], Haiguo Li[3], Ruirui Chen[3]
[1]University of Tennessee & ORNL, [2]Tsinghua University, [3]University of Tennessee

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

SESSION 5

9:30 a.m. – 1:00 p.m.

S05: VA Modelling of the Differential Power

ROOM 351DEF

TRACK: Wireless Power & Magnetics

Jose Cobos
Differential Power S.L.

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

SESSION 6

2:30 p.m. – 6:00 p.m.

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

ROOM 350DEF

TRACK: Control & Design

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

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

SESSION 7

2:30 p.m. – 6:00 p.m.

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

ROOM 351ABC

TRACK: Design & EMI

Aaron Brovont[1], Andrew Lemmon[2]
[1]Paul C. Krause and Associates, [2]University of Alabama

This seminar provides an intermediate-level treatment of techniques for estimation, analysis, and mitigation of conducted electromagnetic interference (EMI) in power electronic systems. The first section introduces foundational EMI concepts and terms. The second section demonstrates the development of equivalent circuit models for predicting common-mode (CM) behavior. The third section provides guidance for performing accurate measurements of conducted emissions, with emphasis on medium-voltage wide band-gap (WBG) converters. The fourth section provides examples of EMI suppression and mitigation through knowledge of system sensitivities and exploitation of CM voltage cancellation. Overall, this seminar will provide insight into underlying causes of emissions behavior and practical guidance for improving emissions performance.

SESSION 8

2:30 p.m. – 6:00 p.m.

S08: The GaNs Impact On The AC-DD Power Adapters

ROOM 332ABC

TRACK: Topologies

Ionel Jitaru

Rompower

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

SESSION 9

2:30 p.m. – 6:00 p.m.

S09: Wide-Bandgap Bidirectional Switches and Their Impact on Future AC Power Converters and Applications

ROOM 352DEF

TRACK: Wide Bandgap

Victor Veliadis[1], Johann Kolar[2], Bulent Sarlioglu[3], Thomas Jahns[4], Jonas Huber[2]

[1]North Carolina State University, [2]ETH Zurich, [3]WEMPEC University of Wisconsin-Madison, [4]University of Wisconsin-Madison

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

SESSION 10

2:30 p.m. – 6:00 p.m.

S10: Key Aspects of the Design and Control of Inductive Power Transfer Systems

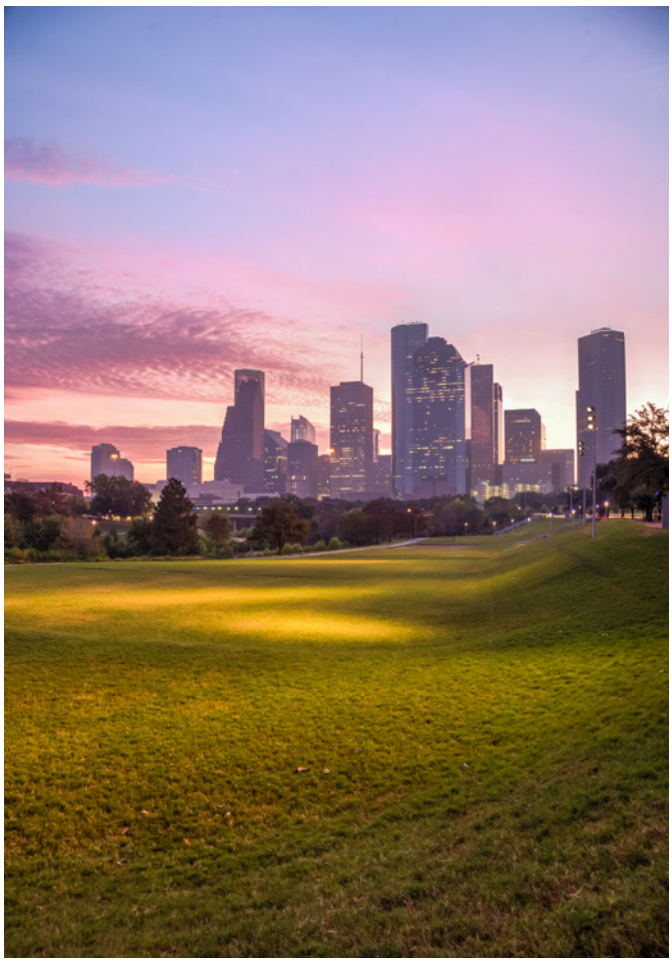
ROOM 351DEF

TRACK: Wireless Power & Magnetics

Alberto Delgado, Pedro Alou, Regina Ramos

Universidad Politecnica de Madrid

In this tutorial the complete process of the analysis and design of an inductive power transfer (IPT) system will be carry out including the topology and control stage. This tutorial aims to review the main solutions presented in the state of the art pointing out its mains advantages and drawbacks. A methodology to design inductive power systems will be presented taking as an example the design of an IPT system operating as a voltage source when having wide mutual inductance variation due to large gap variation.



SESSION 11

8:30 a.m. – 12:00 p.m.

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

ROOM 332ABC

TRACK: Control & Design

Ionut Vernica, Huai Wang, Frede Blaabjerg
Aalborg University

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

SESSION 12

8:30 a.m. – 12:00 p.m.

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

ROOM 352DEF

TRACK: Design & EMI

Shuo Wang
University of Florida

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

SESSION 13

8:30 a.m. – 12:00 p.m.

S13: A Primer on LLC Resonant Converter

ROOM 350DEF

TRACK: Topologies

Claudio Adragna, Francesco Gennaro

STMicroelectronics

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

SESSION 14

8:30 a.m. – 12:00 p.m.

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

ROOM 351ABC

TRACK: Wide Bandgap

Michael de Rooij, Marco Palma

Efficient Power Conversion Corporation

Gallium nitride (GaN) power semiconductors have seen increased adoption in many power-electronic applications. Recently GaN devices have made inroads into BLDC motor drives with surprising benefits that include ultra-low audible emissions, small size, high DC to mechanical efficiency, reduced component count, and improved precision control when compared to MOSFET based inverters. The goal of this tutorial is to provide engineers the tools and understanding needed to fully utilize the potential of GaN FETs and emerging GaN integrated circuits and be able to implement them in BLDC motor drive applications.

SESSION 15

8:30 a.m. – 12:00 p.m.

S15: Wireless Power Transfer: Technologies, Challenges and Opportunities

ROOM 351DEF

TRACK: Wireless Power & Magnetics

Francesco Carobolante

IoTissimo

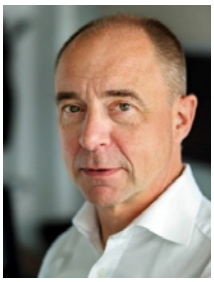
Wireless Power Transfer (WPT) challenges engineers to find solutions to “cut the cords.” Transferring power is easy, but developing robust implementations that can yield a viable product is much more complicated. Different solutions are required to address the most diverse applications, from well-known use cases like smartphones and wearables to industrial and robotic products as well as medical implants. This presentation will provide a broad analysis of the challenges and trade-offs, from frequency selection to transmitter design, to achieve short and long-distance power transfer, while addressing EMI, safety and interference issues.

PLENARY SESSION

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

Presentation 1
Space M: The Magnetics Universe and Challenges

1:30 p.m. – 2:00 p.m.



SPEAKER:

Alex Gerfer
CTO
Würth Elektronik eiSos Group

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

Presentation 2
On the Moon to Stay: Challenges Presented to Power Electronics Technology by Sustained Operations on the Lunar Surface

2:00 p.m. – 2:30 p.m.

SPEAKER:

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

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

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

Presentation 3
Energy Access: Challenges, Opportunities, and our Contributions

2:30 p.m. – 3:00 p.m.

SPEAKERS:

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

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

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

BREAK

3:00 p.m. – 3:30 p.m.

Presentation 4
Driving Plasma: Advancing Power Conversion in Critical Semi and Medical Applications

3:30 p.m. – 4:00 p.m.

SPEAKER:

Gideon (Don) van Zyl
Technical Fellow
Advanced Energy

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

Presentation 5
History of PSMA Power Technology Roadmap: from AAA TripTik® to Google Maps®

4:00 p.m. – 4:30 p.m.

SPEAKER:

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

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

Presentation 6
Inverters for the Future Grid – Challenges and Opportunities

4:30 p.m. – 5:00 p.m.

SPEAKER:

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

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

INDUSTRY SESSIONS

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: Magnetics: What It Takes to Commercialize Great Ideas

ROOM 360ABC

SESSION CHAIR

Edward Herbert, *PSMA*

8:30 a.m.

IS01.1 **Designing for Manufacturability — From the Magnetic Manufacturer's Point of View**
Adam Sullivan
Wurth Electronics Midcom

8:55 a.m.

IS01.2 **Planar Transformer Design: Options, Design Rules, and Tools**
Sudhakar Chakkirala
Power Integrations

9:20 a.m.

IS01.3 **Special Core Shapes, Machining, and Tooling**
Chuck Wild
Dexter Magnetic Technologies

9:45 a.m.

IS01.4 **Bobbins, Designing for High Volume Production**
Brian Hatley
Miles-Platts

10:40 a.m.

IS01.5 **Quantifying Leakage Inductance and Making it Producible**
Rodney Rodgers
All Star Magnetics

11:05 a.m.

IS01.6 **The Supply Chain for Magnetics**
Lucas Nicieza
Frenetic

11:30 a.m.

IS01.7 **Safety Requirements and Other Regulatory Pitfalls**
Landen Geerdes
Wurth Elektronik

8:30 a.m. – 11:55 a.m.

IS02: Wide-Bandgap Bidirectional Switches & Key Applications

ROOM 360DEF

SESSION CHAIR

Victor Veliadis, *North Carolina State University*

8:30 a.m.

IS02.1 **Overview of WBG BD Switch Devices and Applications**
Victor Veliadis[1], Thomas Jahns[2]
[1]North Carolina State University,
[2]University of Wisconsin-Madison

8:55 a.m.

IS02.2 **Efficacy of GaN-on-Si Technology for Realizing Commercially Viable Monolithic Bi-Directional Switches**
Mohamed Imam
Infineon

9:20 a.m.

IS02.3 **GaN Four Quadrant Switches: Ready for Prime Time?**
Rakesh Lal
Transphorm

9:45 a.m.

IS02.4 **Recent Advances on Bidirectional Switch Research for Emerging Applications**
Warren Chen
Raytheon Technologies Research Center

10:40 a.m.

IS02.5 **How Solid-State Circuit Breakers Enable the Energy Transition and the Critical Role of WBG Semiconductors**
Michael Harris
Atom Power

11:05 a.m.

IS02.6 **Solid-State Circuit Breaker: Opportunities and Challenges**
Xaioqing Song
ABB. Inc

11:30 a.m.

IS02.7 **Potential Applications of Bi-Directional Fets in Heavy-Duty Vehicle Electrification**
Brij Singh
John Deere

8:30 a.m. – 11:55 a.m.

IS03: Power Electronics for High Performance Computing: Opportunities & Challenges

ROOM 320A

SESSION CHAIR

Minjie Chen, *Princeton University*

8:30 a.m.

IS03.1 **Hybrid and Resonant Switched-Capacitor Converters for Efficient and Compact High Step-Down Dc-Dc Power Conversion**
Robert Pilawa-Podgurski
University of California-Berkeley

8:55 a.m.

IS03.2 **Microprocessor Power Delivery Challenges**
Kaladhar Radhakrishnan
Intel Corporation

9:20 a.m.

IS03.3 **Advanced Low-Voltage and Medium-Voltage AC/DC Grid Interfaces for High Performance Computing**
Johann Kolar
ETH Zurich

9:45 a.m.

IS03.4 **Power Conversion and Power Integrity Co-Design: a Holistic Approach for Future Processor Power Delivery**
Houle Gan
Google LLC

10:40 a.m.

IS03.5 **Overcoming Magnetics Limitations for Data Center Power**
Charles Sullivan
Dartmouth

11:05 a.m.

IS03.6 **Efficient and Compact Power, Packaging and Cooling for Future Datacenters**
Xin Zhang
IBM

11:30 a.m.

IS03.7 **Extreme Performance 48V-1V Power Delivery for Ultra High Current Microprocessors**
Minjie Chen
Princeton University

8:30 a.m. – 11:55 a.m.

IS04: AC-DC Converters & DataCenter

ROOM 320B

SESSION CHAIR

Alessandro Pevere, *Infineon Technologies*

8:30 a.m.

IS04.1 **Designing a step-Down Converter with a Space Grade Controller**
Daniel Hartung
Texas Instruments

8:55 a.m.

IS04.2 **Fan-Less Low-Profile High Efficiency AC/DC Converters for New 5G Telecom Environment**
Francesco Di Domenico, Alessandro Pevere
Infineon Technologies

9:20 a.m.

IS04.3 **New AC to DC Converter Technologies for Airborne Power Systems**
Travis Sitton
Crane Aerospace

9:45 a.m.

IS04.4 **Seamless Bidirectional Operation of a GaN Based Totem-Pole Active Front-End Rectifier for DC Microgrids and Robotics Applications**
Nour Elsayad, Yalcin Haksoz, Deepak Veereddy
Infineon Technologies

10:40 a.m.

IS04.5 **Addressing Power Delivery Challenges for FPGAs in data-Intensive Accelerator Applications**
Mukund Krishna
Empower Semiconductor

11:05 a.m.

IS04.6 **High Power Magnetics for Datacenter Applications: Alternate Constructions and Efficiency Analysis**
David Wiest, Yosef Zhou
Pulse Electronics

11:30 a.m.

IS04.7 **High Voltage 800-W Sepic Converter Reference Design for Server Battery Backup Charging**
Elisabetta Mahmutovic, Aidan Davidson
Texas Instruments

8:30 a.m. – 11:55 a.m.

IS05: PwrSoC for Next Generation Power Delivery & Management

ROOM 320C

SESSION CHAIRS

Matt Wilkowski, *EnaChip*

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

8:30 a.m.

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

8:55 a.m.

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

9:20 a.m.

IS05.3 **Thin Film Magnetics for PwrSoC and Hybrid Integration**
Martin Haug
Wurth Electronic

9:45 a.m.

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

10:40 a.m.

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

11:05 a.m.

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

11:30 a.m.

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

TECHNICAL LECTURES

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

8:30 a.m. – 12:00 p.m.

T01: Resonant DC-DC Converters

ROOM 352DEF

Resonant DC-DC Converters

SESSION CHAIRS

Yeonho Jeong, *University of Rhode Island*

Robert Pilawa-Podgurski, *University of California-Berkeley*

8:30 a.m.

T01.1 **Light Load Efficiency Improvement of Three Phase CLLC Resonant Converter for On-Board Charger Applications**
Feng Jin[1], Ahmed Nabih[2], Qiang Li[2]
[1]CPES, [2]Virginia Tech

8:50 a.m.

T01.2 **A High Efficiency and High Current LLC Resonant Converter with Improved Interleaving Winding Arrangements**
Mingxiao Li[1], Long Teng[2], Michael A.E. Andersen[1], Ziwei Ouyang[1], Chang Wang[1]
[1]Technical University of Denmark, [2]University of Cambridge

9:10 a.m.

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

9:30 a.m.

T01.4 **Automatic Resonant Frequency Tracking Scheme for LLC Resonant Converter Based on Adaptive Extended State Observer**
Runhui He, Haoyu Wang, Bo Xue
ShanghaiTech University

9:50 a.m.

T01.5 **Termination Design and Optimization for High-Frequency High-Current PCB-Winding Planar Transformers**
Pranav Raj Prakash[1], Qiang Li[2], Ahmed Nabih[2]
[1]CPES, [2]Virginia Tech

10:40 a.m.

T01.6 **High Density Hybrid Switched Capacitor Sigma Converter for DATA-Center Applications**
Mario Ursino[1], Roberto Rizzolatti[2], Gerald Deboy[3], Stefano Saggini[3]
[1]Infineon Technology AT, [2]Infineon Technologies Austria AG, [3]Università di Udine DPIA, [3]Infineon Technologies

11:00 a.m.

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

11:40 a.m.

T01.9 **Optimal Design of Transformer Winding of LLC Converter for Parasitic Capacitance Improvement**
Yifeng Wang[1], Bo Chen[1], Chen Chen[2], Ruilin Ji[3], Hongqing Zhu[4], Mingzhi Zhang[1]
[1]Tianjin University, [2]University of Texas at Dallas, [3]State Grid Tianjin Power Costumer Service Center, [4]State Grid Dongying Electric Power

8:30 a.m. – 12:00 p.m.

T02: Power Electronic Converters for Renewable Energy Systems

ROOM 351ABC

Power Electronic Converters for Renewable Energy

SESSION CHAIR

Fang Luo, *Stony Brook University*

Jingbo Liu

8:30 a.m.

T02.1 **Bidirectional Constant Current S2C Battery Equalizer Based on Fixed-Frequency L2C3 Resonant Converter**
Zhengqi Wei, Haoyu Wang, Yiqing Lu
ShanghaiTech University

8:50 a.m.

T02.2 **Comparative Study of the Phase Integrated Converter As Universal Power Converter**
Oleksandr Husev[1], Oleksandr Matiushkin[1], Dmitri Vinnikov[1], Naser Vosoughi[1], Samir Kouro[2]
[1]Tallinn University of Technology, [2]Universidad Técnica Federico Santa María

9:10 a.m.

T02.3 **Minimum Phase Hybrid Bipolar Converter for PV Integrated DC Microgrid Applications**
Pawan Kumar[1], Ranjit Mahanty[2], Rajeev Kumar Singh[1]
[1]Indian Institute of Technology (BHU), [2]IIT BHU Varanasi

9:30 a.m.

T02.4 **Triple Phase-Shift Optimization of SiC-Based Dual-Active Bridge Converter**
Adithyan Vetrivelan, Ruiyang Yu, Wei Xu, Alex Q.Q. Huang
University of Texas at Austin

9:50 a.m.

T02.5 **Performance Evaluation of Isolated Three-Phase Differential Flyback Inverter with Ripple-Free Input Current for Grid-Tied Applications**
Ahmed Ismail Mohamed Ali[1], Takaharu Takeshita[1], Mahmoud Sayed[2]
[1]Nagoya Institute of Technology, [2]South Valley University

10:40 a.m.

T02.6 **An Interleaved High Step-Up DC-DC Converter with Built-in Transformer-Based Voltage Multiplier for DC Microgrid Applications**
Ramin Rahimi, Saeed Habibi, Pourya Shamsi, Mehdi Ferdowsi
Missouri University of Science and Technology

11:00 a.m.

T02.7 **Modified Transformerless Boost Derived Hybrid Converter with No Right Half-Plane Zero and Reduced Leakage Current**
Simanta Samal[1], Rajeev Kumar Singh[2], Ranjit Mahanty[1]
[1]IIT BHU Varanasi, [2]Indian Institute of Technology (BHU)

11:20 a.m.

T02.8 **High Efficiency High Switching Frequency Single-Phase PV Inverter with Partial Soft-Switching Capability (AutoRecovered)**
Yunlei Jiang, Luke Shillaber, Yanfeng Shen, Teng Long
University of Cambridge

11:40 a.m.

T02.9 **Bidirectional Parallel Low-Voltage Series High-Voltage DAB-Based Converter Design Analysis**
Emanuel Serban[1], Martin Ordonez[2], Cosmin Pondiche[1], Juergen Wassmuth[1]
[1]UBC - EnerSys, [2]The University of British Columbia

8:30 a.m. – 12:00 p.m.

T03: Motor Drives

ROOM 351DEF

Motor Drives

SESSION CHAIRS

Rakibul Islam, *Nexteer Automotive*

Ziaur Rahman, *Booz Allen Hamilton*

8:30 a.m.

T03.1 **Variable Speed Induction Motor Drive Scheme with Very Dense 18-Sided Voltage Space Vector Structure**
Mohammed Imthias[1], Mriganka Ghosh Majumder[2], Umanand L[3], Rakesh R[1], Gopakumar K[3]
[1]Indian Institute of Science Bangalore, [2]University of Houston, [3]Indian Institute of Science

8:50 a.m.

T03.2 **High-Precision Parameter Identification Method for High Speed PMSM Based on High Frequency Impedance Model and Current Injection**
Zhihao Song[1], Kevin Lee[2], Wenxi Yao[1]
[1]Zhejiang University, [2]Eaton Corporation

9:10 a.m.

T03.3 **Dynamic Interleaving Method to Reduce Dc-Link Ripple for Asymmetric Dual Three-Phase Permanent Magnet Synchronous Machine Drives**
Yilmaz Sozer, Md Ehsanul Haque, Anik Chowdhury
University of Akron

9:30 a.m.

T03.4 **Comparison of Three-Phase and Six-Phase High-Power Ultra-High-Speed Machine for Portable Mechanical Antenna**
Md Khurshedul Islam, Seungdeog Choi, Kazi Nishat Tasnim
Mississippi State University

9:50 a.m.

T03.5 **One-Digital-Sampling Commutation Method for Low Inductance Brushless DC Motors**
Juwon Lee, Jung-Ik Ha, Gyu Cheol Lim
Seoul National University

10:40 a.m.

T03.6 **A Novel Speed Controller of 6-Phase Ultra-High-Speed PMSM for A-Mechanically-Based-Antenna (AMEBA)**
Kazi Nishat Tasnim[1], Moinul Shahidul Haque[2], Md Khurshedul Islam[1], Seungdeog Choi[1]
[1]Mississippi State University, [2]Nexteer Automotive

11:00 a.m.

T03.7 **UKF-Based offline Estimation of PMSM Magnet Flux Linkage Considering Inverter dead-Time Voltage Error**
Tao Li, Chaohui Liang, Duhuang Su
Spintrol Limited

11:20 a.m.

T03.8 **Self-Limiting Control of Induction Machines**
Veysel Tutku Buyukdegirmenci[1], Philip Krein[2]
[1]Elektra Elektronik San. Tic. A.S., [2]University of Illinois at Urbana-Champaign

11:40 a.m.

T03.9 **ANN Based On-Board Fault Diagnostic for Induction Motor Drive in Low-Cost Electric Vehicles**
Utkal Ranjan Muduli[1], Jamal Y. Alsawalhi[1], Ameena Saad Al-Sumaiti[1], Khaled Al Jaafari[1], Ranjan Kumar Behera[2], Khalifa Al Hosan[1]
[1]Khalifa University, [2]IIT Patna

8:30 a.m. – 12:00 p.m.

T04: GaN/Silicon/Passive Devices

ROOM 361ABC

GaN/Silicon/Passive Devices

SESSION CHAIRS

Justin Henspeter, *IBM*

Fei Yang, *Texas Instruments*

8:30 a.m.

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

8:50 a.m.

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

9:10 a.m.

T04.3 **Thermal Design Considerations for GaN-Based Power Adapters with Multi-Heat Sources**
Rahil Samani[1], Roy Hou[2], Jimmy Liu[2], Lucas Lu[2], Majid Pahlevani[3], Maryam Alizadeh[2]
[1]University of Calgary, [2]GaN Systems Inc., [3]Queen's University

9:30 a.m.

T04.4 **Characterization of GaN HEMT Under Short-Circuit Events**
Javier Galindos[1], Miroslav Vasic[2], Diego Serrano[2]
[1]CEI UPM, [2]Universidad Politecnica de Madrid

9:50 a.m.

T04.5 **Short Circuit Capability Design and Thermal Management for High Efficiency Solid-State Contactor**
Yuzhi Zhang[1], Taosha Jiang[1], Pietro Cairoli[2], Utkarsh Raheja[1]
[1]ABB Inc., [2]ABB Corporate Research

10:40 a.m.

T04.6 **Operation and Characterization of Low-Loss Bidirectional Bipolar Junction Transistor (B-TRANTM)**
Alireza Mojab, Jiankang Bu, Daniel Brdar, Jeffrey Knapp
Ideal Power Inc.

11:00 a.m.

T04.7 **K-TEM: KEMET Thermal Expectancy Model**
Dario Zuffi, Evangelista Boni, Walter Bruno, Massimo Totaro
KEMET

11:20 a.m.

T04.8 **Steady-State Heat Transfer in Class 1 MLCCs for Resonant Power Converter Applications**
Hunter Hayes, John Bultitude, Allen Templeton, Mark Laps, Axel Schmidt
KEMET Electronics Corporation

11:40 a.m.

T04.9 **Paralleled SiC MOSFETs DC Circuit Breaker with SiC MPS Diode As Avalanche Voltage Clamping**
Taro Takamori[1], Keiji Wada[1], Wataru Saito[2], Shin-Ichi Nishizawa[2]
[1]Tokyo Metropolitan University, [2]Kyushu University

8:30 a.m. – 12:00 p.m.

T05: Modeling & Simulation of Power Electronics Systems

ROOM 361DEF

Modeling & Simulation of Power Electronics Systems

SESSION CHAIRS

Sombuddha Chakraborty, *Texas Instruments*

Joseph Song-Manguelle, *Oak Ridge National Laboratory*

8:30 a.m.

T05.1 **Low Temperature Evaluation of Silicon Carbide (SiC) Based Resonant Converter**
Yuqi Wei, Maksudul Hossain, Alan Mantooth
University of Arkansas

8:50 a.m.

T05.2 **A New Discontinuous Conduction Mode in a Transformer Coupled High Gain DC-DC Converter**
Kartikeya Veeramraju[1], Jonathan Kimball[1], Joshua Rovey[2], Jacob Eisen[2]
[1]Missouri University of Science and Technology, [2]University of Illinois Urbana-Champaign

9:10 a.m.

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

9:30 a.m.

T05.4 **A Modular and Performance-Tunable Silicon Carbide Half-Bridge Building Block with Active Gate Driver**
Fei Diao[1], Yue Zhao[1], Yufei Li[1], Guangqi Zhu[2], Yuheng Wu[1]
[1]University of Arkansas, [2]Eaton

9:50 a.m.

T05.5 **Modeling and Design of High-Power Radio-Frequency Power Combiners Based on Transmission Lines**
Haoquan Zhang[1], Alexander Jurkov[2], Ky Luu[2], Grace Cassidy[1], Aaron Radomski[2], David Perreault[1]
[1]Massachusetts Institute of Technology, [2]MKS Instruments Inc.

10:40 a.m.

T05.6 **Discrete-Time Modeling Framework for Analysis of LLC Converters Over a Wide Frequency Range**
Gopi Chilukuri[1], Dipayan Chatterjee[1], Santanu Kapat[1], Ranajay Mallik[2]
[1]Indian Institute of Technology (IIT) Kharagpur, [2]ST Microelectronics Private Limited

11:00 a.m.

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

11:20 a.m.

T05.8 **Time-Effective Component Selection Automation in Electric Vehicles Using Openly-Available Data**
Gabriel Ferreira Da Silva[1], Ignacio Galiano Zurbriggen[2], Martin Ordonez[1], Francisco Paz[1]
[1]University of British Columbia, [2]University of Calgary

11:40 a.m.

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

8:30 a.m. – 12:00 p.m.

T06: Practical Design Considerations for Power Converters

ROOM 350DEF

Practical Design Considerations for Power Converters

SESSION CHAIRS

Eric Swenson, *IBM*

George Slama, *Würth Elektronik*

8:30 a.m.

T06.1 **Modeling and Reduction of Radiated EMI Due to Ground Impedance in a High-Density Active-Clamp Flyback Power Adapter**
Zhedong Ma[1], Srikanth Lakshmikanthan[2], Honggang Sheng[2], Shuo Wang[1]
[1]University of Florida, [2]Google LLC

8:50 a.m.

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

9:10 a.m.

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

9:30 a.m.

T06.4 **Miniature Liquid cold-Plate Enabled by Metal spraying: a Thermal Management Solution for a Modular 1 Kw bi-Directional GaN-Based dc-ac Converter**
Omri Tayyara, Sanjeev Chandra, Cristina Amon, Nameer Ahmed Khan, Olivier Trescases, Miad Nasr, Josh Palumbo, Carlos Da Silva Leal
University of Toronto

9:50 a.m.

T06.5 **Online Capacitance Estimation Method in Buck Converters with Characteristic Frequency Injection for Optimal Sensitivity**
Haoyu Wang[1], Kang Yue[1], Yu Liu[1], Xinguo Zhang[2]
[1]ShanghaiTech University, [2]School of Information Science and Technology ShanghaiTech University

10:40 a.m.

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

11:00 a.m.

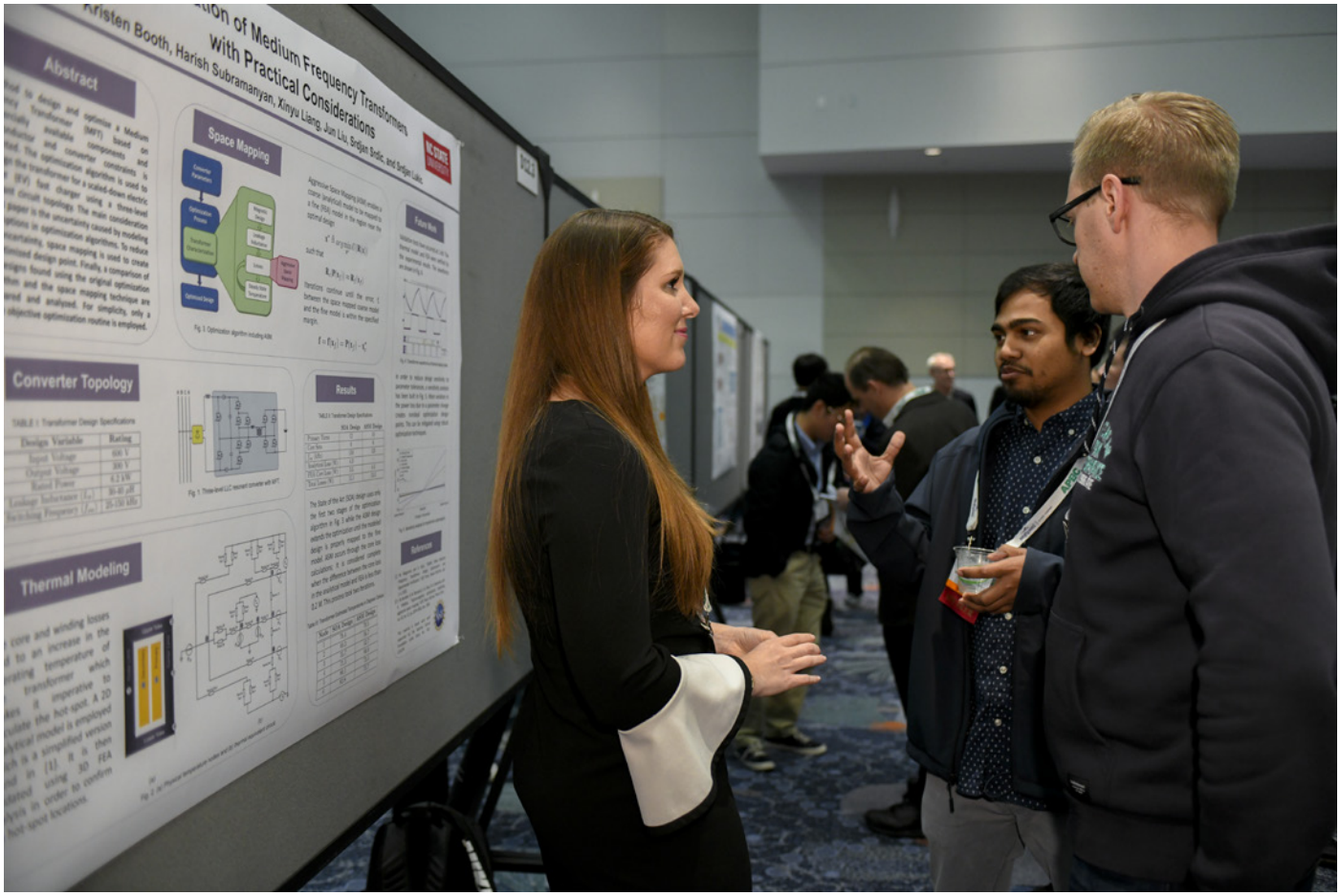
T06.7 **Analysis of Thermal Cycling Effects in Power Devices Under non-Constant Cumulative Stress**
Alessandro Vaccaro, Paolo Magnone
University of Padova

11:20 a.m.

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

11:40 a.m.

T06.9 **Modular Switching Cell Design for High-Performance Flying Capacitor Multilevel Converter**
Logan Horowitz, Robert Pilawa-Podgurski
University of California-Berkeley



RAP SESSIONS

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

5:00 p.m. – 6:30 p.m.

RAP SESSION #1: Switch Capacitor vs. Inductor Based Topologies

ROOM 320ABC

CHAIR:
Jonathan Kimball, *Missouri University*

PANELISTS:

- **Robert Pilawa,** *University of California Berkeley*
- **Loai Salem,** *University of California Santa Barbara*
- **Jose Cobos,** *Universidad Politécnica de Madrid*
- **Roger Chen,** *Texas Instruments*
- **Nicola Femia,** *University of Salerno*
- **Dr. Jinghai Zhou,** *Monolithic Power Systems*

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

5:00 p.m. – 6:30 p.m.

RAP SESSION #2: Challenges and Potential of "AI Based Design" vs. "Conventional Design"

ROOM 350DEF

CHAIR:
Alan Mantooth, *University of Arkansas*

PANELISTS:

- **Alfonso Martínez,** *Frenetic*
- **Minjie Chen,** *Princeton University*
- **Joao Pinto,** *Oakridge National Labs*
- **Alex Huang,** *University of Texas at Austin*
- **Dushan Broyevich,** *Virginia Tech*
- **Dragan Maksimovic,** *University of Colorado Boulder*

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

5:00 p.m. – 6:30 p.m.

RAP SESSION #3: Magnetics in IC vs. Magnetics in PCB

ROOM 310

CHAIR:
Kevin Parmenter, *Indumini Ranmuthu, Texas Instruments*

PANELISTS:

- **Matt Wilkowski,** *Enachip*
- **Francesco Carobolante,** *IoTissimo*
- **Alex Hanson,** *University of Texas at Austin*
- **P. Markondeya Raj,** *Florida International University*
- **Doug Hopkins,** *North Carolina State University*
- **Khurram Afridi,** *Cornell University*
- **Cian Ó Mathúna,** *Tyndall National Institute*

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

EXHIBITOR SEMINARS *as of February 21, 2022*

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

1:00 p.m. – 1:30 p.m.

Exhibitor Seminars – Session 1

Advanced Cooling Technologies, Inc.
ROOM 360ABC

Combatting Higher Power Densities within Power Electronics Cabinets Utilizing Advanced Thermal Management Technology

PRESENTED BY: **Seth Ryberg**

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

Ansys, Inc.
ROOM 360DEF

Conducted Emission Simulation for Power Electronics

PRESENTED BY: **Mark Christini**

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

DEWESoft LLC
ROOM 361DEF

DEWESoft Power Measurement Solutions

PRESENTED BY: **John Miller**

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

Power Integrations
ROOM THEATER 1 (Expo Hall)

Achieving Over 95% Efficiency by Combining GaN and Silicon Switches for 220 W Universal Input Power Supplies

PRESENTED BY: **Doug Bailey**

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

VisIC Technologies
ROOM 361ABC

D³GaN for Traction Inverter: Practical Guidelines

PRESENTED BY: **Dr. Daniel Sherman**

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

West Coast Magnetics
ROOM THEATER 2 (Expo Hall)

Ferrite Core Design for Power

PRESENTED BY: **Weyman Lundquist**

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

1:45 p.m. – 2:15 p.m.

Exhibitor Seminars – Session 2

Magnetics
ROOM 360ABC

Newest Powder Core Materials from Magnetics

PRESENTED BY: **Bill Glass**

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

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

Getting the Most from Your Gen 4 SiC FET Design

PRESENTED BY: **Dr. Anup Bhalla**

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

Navitas
ROOM 361DEF

GaNFast Power ICs: "Electrify Our World™"

PRESENTED BY: **Stephen Oliver**

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

Nichicon (America) Corp
ROOM 361ABC

Powering Tomorrow's Designs:
The Next Generation in Battery Technology

PRESENTED BY: **Mark Gebbia**

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

Simplis Technologies
ROOM 360DEF

AC analysis of PFC Circuits with Constant and Variable Frequency Control Schemes

PRESENTED BY: **Andrija Stupar**

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

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

STMicroelectronics
ROOM THEATER 1 (Expo Hall)

2kW Interleaved Totem Pole PFC Solution Featuring ZVS Digital Control

PRESENTED BY: **Gianni Vitale**

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

2:30 p.m. – 3:00 p.m.

Exhibitor Seminars – Session 3

DIOTEC Semiconductor Americas
ROOM 361ABC

Diotec Semiconductor

PRESENTED BY: **Andrew Dixon & Silviu Munteanu**

Company Introduction

New Product Roadmap

Focused Test, Inc.
ROOM 361DEF

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

PRESENTED BY: **Gordon Leak**

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

Frenetic
ROOM 360ABC

The Future of Magnetics Supply

PRESENTED BY: **Chema Molina**

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

Keysight Technologies
ROOM THEATER 2 (Expo Hall)

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

PRESENTED BY: **Nicola Femia & Casey Latham**

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

Mersen
ROOM THEATER 1 (Expo Hall)

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

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

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

SABIC
ROOM 360DEF

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

PRESENTED BY: **Adel Bastawros**

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

3:15 p.m. – 3:45 p.m.

Exhibitor Seminars – Session 4

Cambridge GaN Devices
ROOM 360ABC

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

PRESENTED BY: **Giorgia Longobardi & Florin Udrea**

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

Microchip Technology, Inc.
ROOM 360DEF

Secure Your Rugged Silicon Carbide Supply Today

PRESENTED BY: **Jason Chiang**

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

Murata
ROOM 361DEF

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

PRESENTED BY: **Gregory Szczeszynski**

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

Rohde & Schwarz USA, Inc.
ROOM 361ABC

Optimizing EMI Filter Design Using an Oscilloscope

PRESENTED BY: **Mike Schnecker**

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

ROHM Semiconductor
ROOM THEATER 1 (Expo Hall)

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

PRESENTED BY: **Ming Su**

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

TT Electronics
ROOM THEATER 2 (Expo Hall)

Practical Current Sensing With Resistors

PRESENTED BY: **Tom Morris**

This presentation will assist design engineers with information on the different types of current sense resistors and their proper selection for optimum accuracy, performance, and cost-effectiveness. Also covered is an overview of the various resistor technologies used in current sensing applications, 4 terminal vs 2 terminal board layouts, and new products suitable for this application.

8:30 a.m. – 11:55 a.m.

IS06: Market & Technology Trends

ROOM 360ABC

SESSION CHAIRS

Ada Cheng, *Adaclock*

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

8:30 a.m.

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

8:55 a.m.

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

9:20 a.m.

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

9:45 a.m.

IS06.4 **GaN Adoption, Market-by-Market**
Stephen Oliver, MBA
Navitas Semiconductor

10:40 a.m.

IS06.5 **Advances in Energy Storages Technologies**
Babu Chalamala
Sandia National Laboratories

11:05 a.m.

IS06.6 **Slaying Energy Vampires: A Regulatory Roadmap**
David Chen
Power Integrations

11:30 a.m.

IS06.7 **Energy Harvesting Powered Sensors/IoT Devices**
Lorandt Fölkel
Würth Elektronik eiSos GmbH

8:30 a.m. – 11:55 a.m.

IS07: Integration in WBG Semiconductors: Increased Power Density and Advanced Functionalities at Application Level

ROOM 360DEF

SESSION CHAIR

Andrea Bricconi, *Cambridge GaN Devices*

8:30 a.m.

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

8:55 a.m.

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

9:20 a.m.

IS07.3 **GaN Integration Enables Next Generation USB-C Chargers with Ultra-High Power Density and Wide Output Voltage Range**
Gerald Deboy[1], Matthias Kasper[2], Jon Azurza[2]
[1]Infineon Technologies, [2]Infineon Technologies Austria AG

9:45 a.m.

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

10:40 a.m.

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

11:05 a.m.

IS07.6 **Feature Integration in GaN FETs Leads to Compact and Intelligent System Designs**
Nathan Schemm, Fei Yang
Texas Instruments

11:30 a.m.

IS07.7 **Maximizing WBG Value: Smart Integration in Compact AC/DC Converters**
Mike Matthews
Power Integrations

8:30 a.m. – 12:00 p.m.

IS08: Addressing Gate Driver Design Challenges

ROOM 320A

SESSION CHAIR

Ajay Hari, *Onsemi*

8:30 a.m.

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

8:55 a.m.

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

9:20 a.m.

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

9:45 a.m.

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

10:30 a.m.

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

10:55 a.m.

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

11:20 a.m.

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

8:30 a.m. – 11:55 a.m.

IS09: Vehicle Electrification: Cheaper Lighter Faster

ROOM 320B

SESSION CHAIRS

Ralph Taylor, *PSMA*

Fred Weber, *Future Technologies Worldwide*

8:30 a.m.

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

8:55 a.m.

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

9:20 a.m.

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

9:45 a.m.

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

10:40 a.m.

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

11:05 a.m.

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

11:30 a.m.

IS09.7 **Static Charging with Focus on Passenger and Light Vehicles for Residential and Commercial Purposes, Using up to 11kW Solutions**
Pamposh Zutshi
Witricity

8:30 a.m. – 12:00 p.m.

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

ROOM 320C

SESSION CHAIRS

Brian Narveson, *Narveson Innovative Consulting*

John Bultitude, *KEMET Electronics*

8:30 a.m.

IS10.1 **Meet the New Aluminum...Busbars**
Mike Wingard
Amphenol Global Interconnect Systems

8:55 a.m.

IS10.2 **A Drop-in High-Temperature Lead-free Solder Solution that Outperforms High-Lead**
Hongwen Zhang
Indium Corporation

9:20 a.m.

IS10.3 **Application of Soft Magnetic Metal-Flake Composite Material to High Frequency Inductive Components**
Ken'Ichi Chata'ni
TOKIN, A KEMET Company

9:45 a.m.

IS10.4 **Addressing Solder Hierarchy Issues in Power Module Packaging with TLPS Pastes**
Catherine Shearer
EMD Electronics Inc

10:40 a.m.

IS10.5 **Micro-Magnetics based on Single-Litho Core Laminations**
Kamyar Admadi
EnaChip Inc.

11:05 a.m.

IS10.6 **Advanced Interconnection Technologies in Power Electronics for Improved Reliability and Performance**
Aarief Syed-Khaja
Heraeus Electronics.

11:30 a.m.

IS10.7 **Highly Thermally Conductive Epoxy Substrates as Ceramic Replacement with High Volume Manufacturing**
Douglas Hopkins
North Carolina State University

2:30 p.m. – 5:45 p.m.

IS11: Power Devices: Performance, Achievements & Road Ahead

ROOM 360ABC

SESSION CHAIRS

Reenu Garg, *Microchip*

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

2:30 p.m.

IS11.1 **A New Comparator-Less Miller Clamp Circuit for SiC MOSFET to Prevent Self-Turn-On**
Mitch Van Ochten, Shinya Tajima
ROHM Semiconductor U.S.A.,LLC

2:55 p.m.

IS11.2 **GaN-Based Lidar Pulse Generator Achieving 320 A in 6 ns: Design and System Integration Considerations**
Edward Jones[1], Marcus Hennecke
[1]*Infineon Technologies Austria AG*

3:20 p.m.

IS11.3 **1700V SiC MOSFETs: Enhancing Power Conversion from Watts to Megawatts**
Xuning Zhang, Kevin Speer
Microchip

3:45 p.m.

IS11.4 **Performance Parameters of SiC MOSFETs for Automotive Inverters**
Ranbir Singh
GeneSiC Semiconductor Inc.

4:30 p.m.

IS11.5 **WBG Devices Enable Mainstream Adoption of Totem Pole PFC**
Ajay Hari
Onsemi

4:55 p.m.

IS11.6 **Getting the Most Performance Out of SiC With the Latest Generation Cascode FETs**
Pete Losee
Qorvo

5:20 p.m.

IS11.7 **No Two Wide Bandgap Technologies are the Same: Switching Advantages of SuperGaN FETs**
Philip Zuk
Transphorm

2:30 p.m. – 5:45 p.m.

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

ROOM 360DEF

SESSION CHAIR

Dennis Stephens, *Continental Automotive*

2:30 p.m.

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

2:55 p.m.

IS12.2 **1.5kW - 2kW Bi-Directional Automotive 48V-12V DC-DC Converters Using eGaN Fets**
Yuanzhe Zhang, Michael de Rooij
Efficient Power Conversion Corporation

3:20 p.m.

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

3:45 p.m.

IS12.4 **Evaluation of Two-Level Slew-Rate Control in a 22 kW Drive Inverter**
Michael Ebli, Niclas Thon, Emanuel-Petre Eni, Wolfgang Frank
Infineon Technologies AG

4:30 p.m.

IS12.5 **Integrated Smart GaN Device for High Voltage Power Conversion in Automotive Applications**
Federica Cammarata, Francesco Gennaro, Filippo Scrimizzi, Giuseppe Longo
STMicroelectronics

4:55 p.m.

IS12.6 **GaN-Based 10 kW Three-Phase On-Board Charger with Ultra-High Power Density**
Gerald Deboy1, Johann Kolar[2], Matthias Kasper[3], Yunni Li, Jon Azurza[3]
[1]Infineon Technologies, [2]ETH Zurich, [3]Infineon Technologies Austria AG

5:20 p.m.

IS12.7 **Automotive Traction Module Attach by Silver Sintering — Process, Performance & Reliability**
Matthew Siebenhuhner, Gustavo Greca, Maurizio Fenech, Oscar Khaselev, Jeffrey Arouh, Julien Joguet, Gyan Dutt
MacDermid Alpha Electronics Solutions

2:30 p.m. – 5:45 p.m.

IS13: WBG Devices & Applications

ROOM 320A

SESSION CHAIR

Manish Shah, *Tagore Technology*

2:30 p.m.

IS13.1 **Robust Short Circuit Protection Technique for Silicon Carbide (SiC) MOSFET Modules**
Eric Motto, Michael Rogers
Mitsubishi Electric US Inc.

2:55 p.m.

IS13.2 **Challenges and Solutions for Dynamic Characterization on GaN Power Devices**
Mike Hawes[1], Ryo Takeda[2]
[1]Automotive Energy Solutions, [2]Keysight Technologies

3:20 p.m.

IS13.3 **Miller Turn-on and Threshold Voltage Correlation in SiC MOSFET Based high-Frequency Converters**
Angelo Sciacca, Luciano Salvo, Gionatan Montoro, Massimo Nania, Mario Pulvirenti
STMicroelectronics

3:45 p.m.

IS13.4 **Smart Cut™ SiC: Enabling a Larger Adoption of SiC Substrate for Power Devices**
Gonzalo Picun, Eric Guiot
SOITEC

4:30 p.m.

IS13.5 **High-density scalable GaN IBC for the new 48 V data center architecture**
Edward Jones, Kevin Tomas Mañez
Infineon Technologies Austria AG

4:55 p.m.

IS13.6 **Advancement on GaN Power IC System Integration**
Victor Sinow, Marco Giandalia
Navitas Semiconductors

5:20 p.m.

IS13.7 **Latest Generation SiC MOSFETs Allow High Efficiency in High Frequency Bidirectional Three-Phase PFC**
Francesco Gennaro, Giuseppe Aiello
STMicroelectronics

2:30 p.m. – 5:45 p.m.

IS14: Gate Driver Issues & USB Chargers

ROOM 320B

SESSION CHAIR

Deric Waters, *Texas Instruments Inc.*

2:30 p.m.

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

2:55 p.m.

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

3:20 p.m.

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

3:45 p.m.

IS14.4 **Gate Driver Considerations for Pulse Transformers**
Aaron Grgurich, Alex Mazany
Texas Instruments

4:30 p.m.

IS14.5 **Extended Power Range (EPR) USB Power Delivery**
Deric Waters
Texas Instruments Inc.

4:55 p.m.

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

5:20 p.m.

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

2:30 p.m. – 5:45 p.m.

IS15: The Ins & Outs of Energy Storage

ROOM 320C

SESSION CHAIRS

Edward Herbert, *PSMA*

Eric Schneider, *PSMA*

2:30 p.m.

IS15.1 **Thermal Management of Battery Systems**
Justin Farrelly
Vercet

2:55 p.m.

IS15.2 **How Lithium Battery Technology is Powering Sustainable Development**
Henrik Lundgren
Polarium

3:20 p.m.

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

3:45 p.m.

IS15.4 **Control of Distributed Energy Storage Systems for Energy Communities**
Shafi Khadem
The International Energy Research Center

4:30 p.m.

IS15.5 **Grid Systems Integration for Future Electric Charging Infrastructure**
Brian Rowden
Oak Ridge National Laboratory

4:55 p.m.

IS15.6 **Grid Energy Storage and Advanced Power Conversion Systems**
Stanley Atcitty
Sandia National Laboratories

8:30 a.m. – 12:00 p.m.

T07: Bi-directional DC-DC Converters

ROOM 352DEF

Bi-directional DC-DC Converters

SESSION CHAIRS

Sombuddha Chakraborty, *Texas Instruments*

Juan Manuel Rivas-Davila, *Stanford University*

8:30 a.m.

T07.1 **Transformer Current Spike Elimination for Dual Active Bridge Converter Considering Multiple-Phase-Shift Modulation**
Yu Yan[1], Liyan Zhu[1], Hua Bai[1], Ruirui Chen[2], Fred Wang[3], Yang Huang[1]
[1]University of Tennessee Knoxville, [2]University of Tennessee, [3]University of Tennessee & ORNL

8:50 a.m.

T07.2 **Multi-Variable Multi-Constraint Optimization of Triple Active Bridge DC-DC Converter with Conduction Loss Minimization**
Saikat Dey[1], Akin Akturk[2], Ayan Mallik[1]
[1]Arizona State University, [2]CoolCAD Electronics LLC

9:10 a.m.

T07.3 **Performance Evaluation of Two-Level to Three-Level Three-Phase Dual Active Bridge (2L-3L DAB3)**
Apoorv Agarwal, Sagar Rastogi, Subhashish Bhattacharya
North Carolina State University

9:30 a.m.

T07.4 **Voltage Balancing Feature and Output Regulation in a Multi-Mode Inverter/Rectifier Leg**
Reza Emamalipour, John Lam
York University

9:50 a.m.

T07.5 **An Isolated Bi-Directional Series Bridge DC Transformer Without Resonant Tank**
Yuliang Cao, Minh Ngo, Dong Dong, Rolando Burgos
[1]Virginia Tech

11:00 a.m.

T07.7 **Mitigation of Dead-Time Effects on Transient DC Bias Elimination in Dual Active Bridge Link Current**
Mk Kharabela Mohanta[1], Amlan Swain[1], Abinash Dash[1], Alberto Castellazzi[2], Amrit Gaurav Rath[1], Dipankar De[1]
[1]IIT Bhubaneswar, [2]Kyoto University of Advanced Science

11:40 a.m.

T07.9 **A High-Voltage-Gain ZVS IPOS Bidirectional Converter**
Mohammadreza Mohammadi[1], Afshin Amoorezaei[2], Sayed Ali Khajehoddin[2],Kambiz Moez[2]
[1]University of Alberta, [2]University of Alberta Elec. and Com. Eng.

8:30 a.m. – 12:00 p.m.

T08: Power Converters for Utility Applications

ROOM 351ABC

Power Converters for Utility Applications

SESSION CHAIRS

Maryam Saeedifard, *Georgia Institute of Technology*

Stanley Atcitty, *Sandia National Laboratories*

8:30 a.m.

T08.1 **A Hybrid Voltage Regulation Transformer Based on Interline Power Converters**
Yafeng Wang[1],
Tiefu Zhao[2]
[1]Monolithic Power Systems, [2]UNC Charlotte

8:50 a.m.

T08.2 **DC Bus Second Harmonic LC Filter with Solid-State Tuning Restorer**
Anwesha Mukhopadhyay, Vinod John
Indian Institute of Science

9:10 a.m.

T08.3 **A Single-Stage Converter for Integration of Induction Wind Energy Conversion Systems Into Multilevel Stand-Alone DC Nanogrids**
Javad Khodabakhsh[1], Adel Abosnina[1], Ebrahim Mohammadi[2],Gerry Moschopoulos[1]
[1]Western University, [2]Carleton University

9:30 a.m.

T08.4 **Medium Frequency SST Based Multiport Energy Routers for Subsea — Renewable Interconnection**
Arnur Karbozov, Kaushik Rajashekara, Harish Krishnamoorthy, Mriganka Ghosh Majumder
University of Houston

9:50 a.m.

T08.5 **High Power Density 10 kV SiC MOSFET-Based Modular, Scalable Converter for Medium Voltage Applications**
Slavko Mocevic[1], Boran Fan[1], Jianghui Yu[1], Rolando Burgos[1], Dushan Boroyevich[1], Igor Cvetkovic[1], Joshua Stewart[2],Jun Wang[3]
[1]Virginia Polytechnic Institute and State University, [2]Virginia Tech - Center for Power Electronics Systems (CPES), [3]University of Nebraska–Lincoln

10:40 a.m.

T08.6 **Switched Capacitor Based High Voltage DC Auxiliary Power Supply with Self Powering Capability**
Shengdao Ren[1], Chushan Li[2],Xiangning He[2], Wuhua Li[2],Huiqiang Yan[1], Wanyuan Qu[3]
[1]College of Electrical Engineering Zhejiang University, [2]Zhejiang University, [3]College of Micro-Nano Electronics Zhejiang University

11:00 a.m.

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

11:20 a.m.

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

11:40 a.m.

T08.9 **High Isolation, Low Coupling Gate Driver Power Supply for Medium Voltage Converters Using Large Air-Gapped Transformer**
Fei Teng[1], Srdjan Lukic[1], Hao Feng[2]
[1]North Carolina State University, [2]Chongqing University

8:30 a.m. – 12:00 p.m.

T09: Design of Wireless Power Transfer Systems

ROOM 351DEF

Design of Wireless Power Transfer Systems

SESSION CHAIRS

Khurram Afridi, *Cornell University*

Lingxiao Xue, *Oak Ridge National Laboratory*

8:30 a.m.

T09.1 **A 20-Kw Integrated AC/DC and DC/DC Oak Ridge Converter for Grid Services and Energy Storage Systems**
Erdem Asa
Oak Ridge National Labarotary

8:50 a.m.

T09.2 **A 50kW Bi-Directional Step-Up Step-Down DC DC Oak Ridge Converter for Wireless EV Chargers**
Erdem Asa
Oak Ridge National Labarotary

9:10 a.m.

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

9:30 a.m.

T09.4 **Thermal Design and Optimization of High-Power Wireless Charging System**
Mostak Mohammad[1], Omer Oner[1], Jonathan Wilkins[1], Gui-Jia Su[1], Veda Prakash Galigekere[2]
[1]Oak Ridge National Laboratory, [2]UT Battelle ORNL

9:50 a.m.

T09.5 **The Design of Coupler Integrating Infrared Detection and Power Transmission for Wireless Charging of Inspection Robot**
Jiacheng Li[1], Linlin Tan[2],Xueliang Huang[2]
[1]Nanjing Tech University, [2]Southeast University

10:40 a.m.

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

11:00 a.m.

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

11:20 a.m.

T09.8 **Multi-Megahertz Load Independent Synchronous Rectifier for Resonant Wireless Power Transfer Applications**
Amir Tahavorgar
Solace Power

11:40 a.m.

T09.9 **Advanced Design of Auxiliary Searching Coil for Autonomous Wireless EV Charging Robot Considering Various Shapes of Secondary**
Dong Hyeon Sim, Ju-A Lee, Sangjoon Ann, Won-Jin Son, Byoung Kuk Lee, Man-Jae Kwon
Sungkyunkwan University

8:30 a.m. – 12:00 p.m.

T10: Transportation Power Conversion 1

ROOM 361ABC

Transportation Power Conversion 1

SESSION CHAIRS

Dong Cao, *University of Dayton*

Rasoul Hosseini, *General Motors*

8:30 a.m.

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

8:50 a.m.

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

9:10 a.m.

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

9:30 a.m.

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

9:50 a.m.

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

10:40 a.m.

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

11:00 a.m.

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

11:20 a.m.

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

11:40 a.m.

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

8:30 a.m. – 12:00 p.m.

T11: High Frequency Magnetics

ROOM 361DEF

High Frequency Magnetics

SESSION CHAIRS

Matt Wilkowski, *EnaChip*

George Slama, *Würth Elektronik*

8:30 a.m.

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

8:50 a.m.

T11.2 **Design and Demonstration of a 100-Kw 50-Khz Matrix Core Transformer for High Power Dual Active Bridge Converters**
Zhe Zhao, Fei Diao, Yue Zhao, Nan Lin, Xinyuan Du, Yuheng Wu
University of Arkansas

9:10 a.m.

T11.3 **MagNet: an Open-Source Database for Data-Driven Magnetic Core Loss Modeling**
Haoran Li[1], Minjie Chen[1], Andrew Nadler[2], Charles Sullivan[2],Thomas Guillod[2],Evan Dogariu[1], Shukai Wang[1], Min Luo[3],Yuxin Chen[1], Vineet Bansal, Diego Serrano[4]
[1]Princeton University, [2]Dartmouth College, [3]Plexim GmbH, [4]Universidad Politécnica de Madrid

9:30 a.m.

T11.4 **A Resonant Approach to Transformer Characterization**
Michael Solomentsev, Alex Hanson, Odinaka Okeke
The University of Texas at Austin

9:50 a.m.

T11.5 **Modeling and Characterization of Natural-Convection Oil-Based Insulation for Medium Frequency Transformers**
Nikolina Djekanovic[1], Drazen Dujic[2]
[1]EPFL, [2]PEL EPFL

10:40 a.m.

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

11:00 a.m.

T11.7 **Application of Orthogonal Airgaps in High Frequency Coupled Inductors**
Satyaki Mukherjee[1], Dragan Maksimovic[2]
[1]Delta Electronics (Americas), [2]University of Colorado Boulder

11:20 a.m.

T11.8 **At What Frequencies Should Air Core Magnetics Be used?**
Michael Solomentsev, Alex Hanson
UT Austin

11:40 a.m.

T11.9 **Magnetic Core Losses Under Square-Wave Excitation and DC Bias in High Frequency Regime**
Bima Sanusi[1], Ziwei Ouyang[2]
[1]Danmarks Tekniske Universitet, [2]Technical University of Denmark

8:30 a.m. – 12:00 p.m.

T12: Control & Applications 1

ROOM 350DEF

Control & Applications 1

SESSION CHAIR

Martin Ordonez, *The University of British Columbia*

8:30 a.m.

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

8:50 a.m.

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

9:10 a.m.

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

9:30 a.m.

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

9:50 a.m.

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

10:40 a.m.

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

11:00 a.m.

T12.7 **A Highly Efficient Hybrid Devices-Based MMC with a Novel Modulation Scheme Using Hardware-in-the Loop System**
Rajat Shahane, Suryanarayana Doolla, Anshuman Shukla, Satish Belkhode
IIT Bombay

11:20 a.m.

T12.8 **A Bidirectional Three-Level Converter with Single Point Sensing Technique for Flying Capacitor Balance**
Yu-Yu Lin[1], Tsung-Wei Huang[2], Ching-Jan Chen[1], Yuan-Chih Li
[1]National Taiwan University, [2]Richtek Technology Corporation

11:40 a.m.

T12.9 **A Lienar Active Disturbance Rejection Control Based Sensorless Control for PMSMs Considering Harmonic Current Suppression**
Lizhi Qu
magniX USA Inc.

2:30 p.m. – 5:50 p.m.

T13: DC-DC Converter Applications

ROOM 352DEF

DC-DC Converter Applications

SESSION CHAIRS

Jeff Niles, *Alpha & Omega Semiconductor*

Olivier Trescases, *University of Toronto*

2:30 p.m.

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

2:50 p.m.

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

3:10 p.m.

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

3:30 p.m.

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

3:50 p.m.

T13.5 **Low Cost and Small Component Count Hybrid Converter with Energy Management Control for Unmanned Aerial Vehicle Applications**
Xueshen Zhang[1], Yeonho Jeong[1], Keon-Woo Kim[2]
[1]University of Rhode Island, [2]Samsung Electronics

4:30 p.m.

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

4:50 p.m.

T13.7 **Analysis of Mathematical Modeling of Soft Switching in Synchronous Rectification Boost Converter**
Yifeng Wang[1], Zhongjie Wang[1], Hao Wang[2],Bo Chen[1]
[1]Tianjin University, [2]Tiangong University

5:10 p.m.

T13.8 **RMS Current Based Automated Optimal Design Tool for LLC Resonant Converters**
Yuqi Wei, Alan Mantooth
University of Arkansas

5:30 p.m.

T13.9 **Novel Realization of ZVS and Efficient Energy Transfer for Double-Clamped ZVS Buck-Boost Converter Without Current Sampling**
Song Ding[1], Qinsong Qian[1], Qi Liu[2]
[1]Southeast University, [2]Southeast University Nanjing

2:30 p.m. – 5:50 p.m.

T14: Analysis & Control of Power Electronics for Grid Integration

ROOM 351ABC

Analysis & Control of Power Electronics for Grid

SESSION CHAIRS

Behrooz Mirafzal, *Kansas State University*

Yilmaz Sozer, *University of Akron*

2:30 p.m.

T14.1 **Microgrid Structure for Testing a Real-Time Energy Management System Model**
Enrique Sanabria-Torres[1], Fabio Andrade-Rengifo[1], Cesar Trujillo[2],Nelson Diaz[2],David Rosero-Bernal[2]
[1]University of Puerto Rico, [2]Universidad Distrital Francisco Jose de Caldas

2:50 p.m.

T14.2 **Identification of "Trouble Maker(s)" Caused by the PLL in Multi-Paralleled Inverters Systems**
Yanqi Cheng[1], Frede Blaabjerg[2], Henry Chung[3], Weimin Wu[1], Lixun Zhu[1], Koutroulis Eftychios[4]
[1]Shanghai Maritime University, [2]Aalborg University, [3]CityU of Hongkong, [4]Technical University of Crete

3:10 p.m.

T14.3 **A Medium Voltage Testbed for the Performance and Function Tests of a 13.8 kV Power Conditioning System Converter**
Haiguo Li[1], Zhe Yang[1], Fred Wang[2],Zihan Gao[1], Cheng Nie[1]
[1]University of Tennessee, [2]University of Tennessee & ORNL

3:30 p.m.

T14.4 **Load Current Feedforward Control for the Inverter with Output Transformer Based on Frequency Compensation of Resonant Controller**
Bowei Lin, Li Peng
School of Electrical and Electronic Engineering, Huazhong University of Science and Technology

3:50 p.m.

T14.5 **Partial Fluctuating Power Control of Resonant Converter for Solid-State Transformer**
Zheqing Li[1], Chunyang Zhao[1], Yi-Hsun Hsieh[1], Qiang Li[2]
[1]CPES Virginia Tech, [2]Virginia Polytechnic Institute and State University

4:30 p.m.

T14.6 **Comparison of Controllers with Current Droop Capability for Series-Connected Autonomous Distributed Modular Power Converter**
Koki Yamanokuchi, Jun-Ichi Itoh, Hiroki Watanabe
Nagaoka University of Technology

4:50 p.m.

T14.7 **Feedforward-Enhanced Feedback Control of Output Voltage of a GaN-Based High-Power-Density Single-Phase Transformer-Less Online Ups**
Maida Farooq, Khurram Afridi, Danish Shahzad
Cornell University

5:10 p.m.

T14.8 **Analysis and Experimental Verification for Overvoltage Suppression in a Hybrid DC Circuit Breaker**
Zhi Jin Zhang, Maryam Saeedifard
Georgia Institute of Technology

5:30 p.m.

T14.9 **Equivalent Modeling Method for Real-Time Simulation of Multi-Active Bridge Based Solid-State Transformer**
Xuekun Meng, Wei Li
OPAL-RT TECHNOLOGIES

2:30 p.m. – 5:50 p.m.

T15: Inverters

ROOM 351DEF

Inverters

SESSION CHAIRS

Ziaur Rahman, *Booz Allen Hamilton*

Woongkul Lee, *Michigan State University*

2:30 p.m.

T15.1 **A Galvanically Isolated Single-Phase Inverter Topology with Flux-Rate Control Based Harmonic Filtering Scheme**
Ruman Kalyan Mahapatra, Gopakumar K, Umanand L
Indian Institute of Science

2:50 p.m.

T15.2 **Active Reflected Wave Canceller with Partial Discharge Suppression for MV SiC Motor Drive**
Yu Zhang, Hui Li, Rachit Agarwal
Florida State University

3:10 p.m.

T15.3 **A Power Decoupling Technique for High Power-Density Single-Phase Inverters**
Mohammad Ebrahimi, S. Ali Khajehoddin
University of Alberta

3:30 p.m.

T15.4 **A MHz LCLCL Resonant Converter Based Single-Stage Soft-Switching Isolated Inverter with Variable Frequency Modulation**
Hao Wen[1], Johan Strydom[2], Bing Lu[2], Jih-Sheng Lai[3], Dong Jiao[3]
[1]Monolithic Power Systems, [2]Texas Instrument, [3]Virginia Polytechnic Institute and State University

3:50 p.m.

T15.5 **A High-Frequency Compact Zero-Voltage-Transition GaN-Based Single-Phase Inverter**
Mohammadreza Hazrati Karkaragh, Mohammadreza Mohammadi, Morteza Esteki, Ali Khajehoddin
University of Alberta

4:30 p.m.

T15.6 **A Hybrid MMC with SiC-Based Full-Bridge and Si-Based Half-Bridge Sub-Modules with Novel Voltage Sorting Scheme**
Rajat Shahane, Satish Belkhode, Anshuman Shukla
IIT Bombay

4:50 p.m.

T15.7 **Single-Phase Cascaded Half-Bridge Multilevel Inverter Fed by Single Inductive DC-Link**
Manxin Chen, Poh Chiang Loh
The Chinese University of Hong Kong

5:10 p.m.

T15.8 **250 W GaN Hybrid BCM Micro-Inverter Design for Avionic Applications**
Alper Cimendag[1], Murat Yilmaz[2], Tuncay Duman[3]
[1]Aselsan, [2]Istanbul Technical University, [3]AVL List GmbH

5:30 p.m.

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

2:30 p.m. – 5:50 p.m.

T16: AC-DC Converters 1

ROOM 361ABC

AC-DC Converters 1

SESSION CHAIRS

Ayan Mallik, *Arizona State University*

John Lam, *York University*

2:30 p.m.

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

2:50 p.m.

T16.2 **GaN-Based Series-Stacked Energy Decoupling Buffer for Selective DC Ripple Cancellation**
Thibaut Runser[1], Anatolii Tcai[1], Thiwanka Wijekoon[2]
[1]Huawei Technologies, [2]Hua

3:10 p.m.

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

3:50 p.m.

T16.5 **Integrated Grid Inductors-Transformer Structure with Reduced Core Loss and Volume in Totem-Pole Single-Stage EV Charger**
Ramadhan Muhammad Hakim[1], Junyeong Park[1], Sewan Choi[2], Huu-Phuc Kieu[1]
[1]Seoul National University of Science and Technology, [2]Seoultech

4:30 p.m.

T16.6 **Modulation Scheme Optimization of an Active Soft-Switching Cell for 1-ph/3-Ph Universal Voltage Input PFC for On-Board Charger Applications**
Tomas Sadilek[1], Peter Barbosa[1], Iqbal Husain[2]
[1]Delta Electronics, [2]North Carolina State University

4:50 p.m.

T16.7 **A Novel Soft-Switched Three-Phase Three-Wire Isolated AC-DC Converter**
Abirami Kalathy, Mojtaba Forouzesh, Yan-Fei Liu, Paresh C. Sen
Queen's University

5:10 p.m.

T16.8 **A Novel Integrated Bidirectional AC to DC Resonant Converter**
Sunil Dube[1], Ramu Nair[1], Kalyan Yenduri[1], Pritam Das[2]
[1]SUNY Binghamton, [2]Binghampton University

5:30 p.m.

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

2:30 p.m. – 5:50 p.m.

T17: Modeling & Characterization of Power Electronics Components

ROOM 361DEF

Modeling & Characterization of Power Electronics

SESSION CHAIRS

Ziaur Rahman, *Booz Allen Hamilton*

Cahit Gezgin, *Infineon Technologies AG*

2:30 p.m.

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

2:50 p.m.

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

3:10 p.m.

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

3:30 p.m.

T17.4 **Characterization and Modeling of a 1.3 kV Vertical GaN P-N Diode**
Prakash Pandey, Raghav Khanna, William Collings, Tolen Nelson, Andrew Koehler, Travis Anderson, Karl Hobart, Daniel Georgiev, Michael Hontz, James Gallagher, Geoffrey Foster, Alan Jacobs, Mona Ebrish, Sadab Mahmud
University of Toledo

4:30 p.m.

T17.6 **Predicting Wireless Charging Coils Performance with Permanent Magnets**
Tianze Kan[1], Shaohua Lin[2], Mark Solveson[1]
[1]ANSYS Inc., [2]N/A

4:50 p.m.

T17.7 **Analysis of Current Resonances Due to Winding Parasitic Capacitances in Medium-Voltage Medium-Frequency Transformers**
Roderick Gomez[1], Juan Balda[1], German Oggier[2]
[1]Unviersity of Arkansas, [2]Universidad de Rio Cuarto

5:10 p.m.

T17.8 **An Extendable and Accurate High-Frequency Modelling of Three-Phase Cable for Prediction of Reflected Wave Phenomenon**
Yuxuan Wu, Fang Luo, Mustafeez Ul Hassan, Kushan Choksi
Stony Brook University

5:30 p.m.

T17.9 **FEA-Tool Estimation of Triple Loop Antenna Measurement Levels of a Double Induction Heater Fed by Independent Inverters**
Claudio Carretero[1], Jesus Acero[1], Antonio Munoz[2], Ignacio Lope[2], Marta Ribas[1]
[1]University of Zaragoza, [2]BSH Home Appliances Group

2:30 p.m. – 5:50 p.m.

T18: Design Techniques for Wide Bandgap Power Modules

ROOM 350DEF

Design Techniques for Wide Bandgap Power Modules

SESSION CHAIRS

Qing Ye

Ali Safayet, *Halla Mechatronics*

2:30 p.m.

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

2:50 p.m.

T18.2 **Feasibility Design of Tight Integration of Low Inductance SiC Power Module with Microchannel Cooler**
Hao Chen[1], Xiaoling Li[1], Mehdi Asheghi[2], Yongfeng Lu[3],Kenneth Goodson[2], Alan Mantooth[1], Yue Zhao[1], Yuxiang Chen[1], Tiwei Wei[2], Nan Li[3], Man Prakash Gupta[4], Qiuchi Zhu[3], Sougata Hazra[2]
[1]University of Arkansas, [2]Stanford University, [3]University of Nebraska-Lincoln, [4]Ford Motor Company

3:30 p.m.

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

3:50 p.m.

T18.5 **In-Package Common-Mode Filter for GaN Power Module with Improved Radiated EMI Performance**
Niu Jia[1], Lingxiao Xue[2], Han Cui[1], Xingyue Tian[1]
[1]University of Tennessee Knoxville, [2]Oak Ridge National Laboratory

4:30 p.m.

T18.6 **DC SST Mf Transformer Partial Discharge Characteristics Study with High dV/dT PWM Switching Transients of SiC Devices**
Rachit Agarwal[1], Hui Li[1], Peter Cheetham[1], Zhehui Guo[2]
[1]Florida State University, [2]Center for Advanced Power Systems, Florida State University

4:50 p.m.

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

5:10 p.m.

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

5:30 p.m.

T18.9 **High Voltage SiC Power Module Optimized for Low Parasitics and Compatible System Interface**
Xiaoling Li[1], Yuxiang Chen[1], Yuheng Wu[1], William Weber[2], Robert Cuzner[2], Adel Nasiri[3], Alan Mantooth[1], Hao Chen[1], Yue Zhao[1]
[1]Univerity of Arkansas, [2]University of Wisconsin-Milwaukee, [3]University of South Carolina

as of February 21, 2022

12:15 p.m. – 12:45 p.m.

Exhibitor Seminars – Session 5

Murata
ROOM THEATER 2 (Expo Hall)

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

PRESENTED BY: **Laurence McGarry**

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

Nexperia
ROOM 360DEF

Not All MOSFETs Are The Same

PRESENTED BY: **Tom Wolf**

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

PMBus
ROOM THEATER 1 (Expo Hall)

SMBus Revision 3.2 and PMBus 1.4 Have Been Released

PRESENTED BY: **Peter Miller**

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

Wolfspeed, Inc.
ROOM 361ABC

Wolfspeed Silicon Carbide Facilitating Industrial and Energy End Systems

PRESENTED BY: **Guy Moxey**

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

1:00 p.m. – 1:30 p.m.

Exhibitor Seminars – Session 6

Apex Microtechnology
ROOM 360ABC

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

PRESENTED BY: **HelenAnn Brown & Gina Rotermund**

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

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

Magnetics Technologies Now Ready for Prime Time

PRESENTED BY: **Roger Gabriel**

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

ROHM Semiconductor
ROOM THEATER 2 (Expo Hall)

150V Rohm GaN HEMT Featuring Superior High Switching Frequency

PRESENTED BY: **Brandon Becker**

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

Nexperia
ROOM 360DEF

Nexperia Introduces Power GaN FETs

PRESENTED BY: **Jim Honea**

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

1:45 p.m. – 2:15 p.m.

Exhibitor Seminars – Session 7

Nexperia
ROOM 360DEF

Nexperia Introduces SiC Schottky Diodes

PRESENTED BY: **Upal Sengupta**

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

Teledyne LeCroy
ROOM THEATER 1 (Expo Hall)

Power Electronics Probing – What to Use and Why

PRESENTED BY: **Kenneth Johnson**

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

Visit Houston

NOTES

8:30 a.m. – 11:30 a.m.

IS16: High Power & Resonant Converters

ROOM 360ABC

SESSION CHAIR

Bill Peterson, *E&M Power*

8:30 a.m.

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

8:55 a.m.

IS16.2 **High Efficiency 3-Phase Power Inverter Using SiC MOSFET and Trans-Linked Neutral-Point-Clamped Topology**
Ming Su[1], Tatsuya Miyazaki[2], Yuta Okawauchi[2], Ken Nakahara[2], Mamoru Tsuruya[3]
[1]ROHM Semiconductor USA, LLC, [2]Rohm Co., Ltd., [3]Power Assist Technology Ltd.

9:20 a.m.

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

9.45 a.m.

IS16.4 **GaN HEMT Power Losses Modeling and Evaluation in Resonant LLC Converters**
Santi Agatino Rizzo[1],
[1]UniCT, [2]STMicroelectronics
Simone Buonomo[2], Alfio Scuto[2], Domenico Nardo[2], Massimiliano Chiantello[2]

10:35 a.m.

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

11:00 a.m.

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

8:30 a.m. – 11:30 a.m.

IS17: Thermal Issues in Devices & Magnetics

ROOM 360DEF

SESSION CHAIR

Devin Pellicone, *Advanced Cooling Technologies Inc.*

8:30 a.m.

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

8:55 a.m.

IS17.2 **Meeting the Growing Thermal Requirements with Advanced Magnetics Design and GaN Transistors**
Rongyong Tang[1],Jeff Chou[2], Juncheng Lu[2]
[1]Magwii, [2]GaN Systems

9:20 a.m.

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

9.45 a.m.

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

10:35 a.m.

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

11:00 a.m.

IS17.6 **Thermal Tool for Quick Estimation of Thermal Performance of eGaN® Fets**
Michael de Rooij, Assaad El Helou
Efficient Power Conversion Corporation

8:30 a.m. – 11:30 a.m.

IS18: Are You Throwing Energy Away? Don't, or Recover it!

ROOM 320A

SESSION CHAIRS

David Chen, *Power Integrations*

Edward Herbert, *PSMA*

8:30 a.m.

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

8:55 a.m.

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

9:20 a.m.

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

9.45 a.m.

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

10:40 a.m.

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

11:05 a.m.

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

8:30 a.m. – 11:30 a.m.

IS19: Novel Devices & Applications

ROOM 320B

SESSION CHAIR

Davide Giacomini, *Infineon Technologies AG*

8:30 a.m.

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

8:55 a.m.

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

9:20 a.m.

IS19.3 **A New Class of Power MOSFETs with Low On-Resistance, near-Zero Reverse Recovery Losses, 2x Lower Qoss, and sub-30um Substrate**
Leo Mathew[1], Jerry Fossum[2], Rajesh Rao[1], Vishal Trivedi[1], Bradley Richardson[3], Daniel Fine[1], Myles Golden[3]
[1]Applied Novel Devices Inc, [2]University of Florida, [3]SkyWater Technologies

9.45 a.m.

IS19.4 **Printed Wiring Board Effects in High Efficiency Switching Power Supplies**
Alan Palevsky[1], Adam Anders[2], Steven Lee[3],
[1]Alan Palevsky LLC, [2]Wolfspeed, [3]Keysight Technologies

10:35 a.m.

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

11:00 a.m.

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

8:30 a.m. – 11:30 a.m.

IS20: EMC Issues & Motor Drives

ROOM 320C

SESSION CHAIR

Lei Han, *Infineon Technologies*

8:30 a.m.

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

8:55 a.m.

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

9:20 a.m.

IS20.3 **EMC Virtual Lab for Power Electronics**
Zheng Luo
Monolithic Power Systems

9:45 a.m.

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

10:35 a.m.

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

11:00 a.m.

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

1:45 p.m. – 3:25 p.m.

IS21: SiC and GaN Product and Technology reliability, Robustness and Qualification

ROOM 360ABC

SESSION CHAIRS

Tim McDonald, *Infineon Technologies AG*

Darshan Gandhi, *Navitas Semiconductor*

1:45 p.m.

IS21.1 **Transient Voltage Specification and Reliability for GaN Power Devices**
Sandeep Bahl[1], Stephanie Butler[2], Tod Wootton, Jungwoo Joh
[1]Texas Instruments, [2]Independent Consultant

2:10 p.m.

IS21.2 **Wide Bandgap Quality and Reliability Standards: JEDEC Delivers!**
Tim McDonald[1], Stephanie Butler[2]
[1]Infineon Technologies AG, [2]Independent Consultant

2:35 p.m.

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

3:00 p.m.

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

1:45 p.m. – 3:25 p.m.

IS22: The Latest and Greatest Capacitor Technology Improvements for Wide Bandgap Applications

ROOM 360DEF

SESSION CHAIRS

Fred Weber, *Future Technologies Worldwide*

Andrew Mikulski, *KEMET Electronics*

1:45 p.m.

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

2:10 p.m.

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

2:35 p.m.

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

3:00 p.m.

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

1:45 p.m. – 3:25 p.m.

IS23: New Developments in the SiC & GaN Technology Ecosystem

SESSION CHAIR

Victor Veliadis, *North Carolina State University*

1:45 p.m.

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

2:10 p.m.

IS23.2 **Tame the SiC Beast - Unlock the Full Capability of Silicon Carbide with Digital Gate Drivers**
Perry Schugart
Microchip

2:35 p.m.

IS23.3 **Packaging Considerations to Get the Most Benefit from SiC in Traction Applications**
Ole Muehlfeld
Danfoss Silicon Power

3:00 p.m.

IS23.4 **Reliable and Efficient Silicon Carbide MOSFETs in High Volume Production**
Sauvik Chowdhury, Hong Kim
onsemi

1:45 p.m. – 3:25 p.m.

IS24: Energy Harvesting State-of-the-Art with Functional Demos

ROOM 320B

SESSION CHAIRS

Mike Hayes, *Tyndall National Institute*

Brian Zahnstecher, *PowerRox LLC*

1:45 p.m.

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

2:10 p.m.

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

2:35 p.m.

IS24.3 **How to turbo charge the Internet of Things with Ultra Capacitors and Energy Harvesting**
Ronald de Graaf
NAWA Technologies

3:00 p.m.

IS24.4 **Interactive Energy Harvesting Demo Session**
Brian Zahnstecher
PowerRox LLC

1:45 p.m. – 3:25 p.m.

IS25: Passive Components

ROOM 320C

SESSION CHAIR

John Gallagher, 1:45 p.m. *Pulse Electronics, Inc*

1:45 p.m.

IS25.1 **High Performance Pulse Load SURFACE-Mount Resistors**
Breno Albuquerque
Vishay Intertechnology, Inc

2:10 p.m.

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

2:35 p.m.

IS25.3 **Trans-Inductor Voltage Regulator (TLVR): Circuit Operation, Power Magnetic Construction, Efficiency and Cost Trade-Offs**
David Wiest, Yosef Zhou
Pulse Electronics

8:30 a.m. – 11:15 a.m.

T19: PoL & Multi-phase DC-DC Converters

ROOM 352DEF

PoL & Multi-phase DC-DC Converters

SESSION CHAIRS

Cahit Gezgin, *Infineon Technologies AG*

Luke Jenkins, *IBM*

8:30 a.m.

T19.1 **300A Single-Stage 48V Voltage Regulator with Multiphase Current Doubler Rectifier and Integrated Transformer**
Xin Lou, Qiang Li
Virginia Tech

8:50 a.m.

T19.2 **Dual-Path Hybrid Synchronous Rectifier in Active Clamp Forward Converter for Inductor Current Reduction**
Katsuhiro Hata[1], Sadanori Suzuki[2], Makoto Takamiya[1]
[1]The University of Tokyo, [2]Toyota Industries Corporation

9:10 a.m.

T19.3 **Direct Power Converter -DPx- for High Gain & High Current Applications**
Jose Cobos, Juan Cruz, Oscar Garcia, Alvaro Cobos, Alejandro Castro
Differential Power S.L.

9:30 a.m.

T19.4 **Modelling of Quasi-Parallel Sigma DC-DC Converter for High Efficiency Single-Stage Voltage Regulator**
Lingyun Li, Shen Xu, Weifeng Sun, Yijie Qian, Limin Yu
Southeast University

9:50 a.m.

T19.5 **Per-Core Configurable Power Supply for Multi-Core Processors with Ultra-Fast DVS Voltage Transitions**
Inder Kumar[1], Santanu Kapat[2]
[1]University of Colorado Boulder, [2]Indian Institute of Technology (IIT) Kharagpur

10:35 a.m.

T19.6 **MC-SEPIC: Matrix Coupled Sepic Converter with Planar Integrated Magnetics**
Ping Wang, Youssef Elasser, Minjie Chen
Princeton University

10:55 a.m.

T19.7 **A 3D Integrated Nonlinear Coupled Inductor for Improving Light Load Efficiency of Voltage Regulator Modules**
Longyang Yu
xjtu

8:30 a.m. – 11:15 a.m.

T20: Energy Storage Systems & Grids

ROOM 351ABC

Energy Storage Systems & Grids

SESSION CHAIRS

Rajeev Kumar Singh, *Indian Institute of Technology (BHU)*

Hanyu Wang, *Huazhong University of Science and Technology*

8:30 a.m.

T20.1 **High Gain Non-Isolated Interleaved Current-Fed 3-Phase Partial Series Resonance Pulse Based ZCS Voltage Quadrupler**
Koyelia Khatun[1], Regan Zane[1], Akshay Rathore[2]
[1]Utah State University, [2]Concordia University

8:50 a.m.

T20.2 **In-Situ EV Battery Electrochemical Impedance Spectroscopy with Pack-Level Current Perturbation from a 400V-to-12V Triple-Active-Bridge**
Seyed Amir Assadi, Zhe Gong, Cheng Feng Wang, James Xu, Joshua Piruzza, Diana Jokic, Olivier Trescases
University of Toronto

9:10 a.m.

T20.3 **The Partial Power Processing Converter System with Robust DC-Link Voltage for Islanded DC Microgrid**
Nie Hou[1], Yunwei Li[2], Pasan Gunawardena[2], Yue Zhang[2]
[1]Department of Electrical and Computer Engineering University of Alberta, [2]University of Alberta

9:30 a.m.

T20.4 **"A Novel Method for Least Differential Power Processing in Photovoltaic Systems"**
Ali Alenezi, Hussain Hussain
Kuwait University

9:50 a.m.

T20.5 **A Low Communication Dependency Control Strategy for Hybrid Series-Parallel Microgrid**
Xiaohai Ge, Xin Zhang, Bin Guo
Zhejiang University

10:35 a.m.

T20.6 **Internal Resistance Measurement of Lithium-Ion Batteries Using LC Resonant Tank**
Abdulraouf Benshatti, M Rakiul Islam, Thomas Link, Sung-Yeul Park, Desmon Simatupang
University of Connecticut

10:55 a.m.

T20.7 **Power Oscillation Characterization and Component Sizing for Asymmetrical Fault Ride Through of Grid Forming Converters**
Md Rifat Kaisar Rachi[1], Iqbal Husain[1], M A Awal[2]
[1]North Carolina State University, [2]Danfoss

8:30 a.m. – 11:15 a.m.

T21: Control of Wireless Power Transfer Systems

ROOM 351DEF

Control of Wireless Power Transfer Systems

SESSION CHAIRS

Emre Gurpinar, *Oak Ridge National Laboratory*

Jungwon Choi, *University of Minnesota Twin Cities*

8:30 a.m.

T21.1 **Design and Validation of a High-Power Dynamic Wireless Charging for Electric Vehicles**
Lingxiao Xue[1], Omer Oner[1], Rong Zeng[1], Veda Prakash Galigekere[2], Mostak Mohammad[1], Gui-Jia Su[1]
[1]Oak Ridge National Laboratory, [2]UT Battelle ORNL

8:50 a.m.

T21.2 **A High Misalignment-Tolerant IPT System Based on Dual Decoupled Receiver Coils with Voltage Doubler Rectifier**
Yihao Wu[1], Shunpan Liu[2], Lingyun Zhou[2], Ruikun Mai[2], Jiaqi Yu[2], Yong Li[2]
[1]Imperial College London, [2]Southwest Jiaotong University

9:30 a.m.

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

9:50 a.m.

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

10:35 a.m.

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

10:55 a.m.

T21.7 **Identifying Complete Set of Parameters Using Transmitter Side Information for two-TX-one-RX Wireless Power Transfer Systems**
Kang Yue[1], Yu Liu[1], Minfan Fu[1], Rong He[1], Xinguo Zhang[2]
[1]ShanghaiTech University, [2]School of Information Science and Technology ShanghaiTech University

8:30 a.m. – 11:15 a.m.

T22: Transportation Power Conversion 2

ROOM 361ABC

Transportation Power Conversion 2

SESSION CHAIRS

Lingxiao Xue, *Oak Ridge National Laboratory*

Harish Krishnamoorthy, *University of Houston*

8:30 a.m.

T22.1 **An Isolated Step-Down Multi-Port DC-DC Power Converter for Electric Refrigerated Vehicles Auxiliary Power Unit System**
Sina Vahid, Ayman El-Refaie, Pouya Zolfi
Marquette University

8:50 a.m.

T22.2 **Analysis and Performance Evaluation of a Two-Stage Resonant Converter for Wide Voltage Range Operation**
Nicola Zanatta[1], Tommaso Caldognetto[2], Paolo Mattavelli[2], Giorgio Spiazzi[2]
[1]Dept. of Management and Engineering University of Padova Vicenza, [2]University of Padova

9:10 a.m.

T22.3 **Maximum Fast-Charging Current Estimation Algorithm Considering Temperature of Lithium-Ion Batteries in Electrical Vehicles**
Dong Hwan Kim, Tae-Won Noh, Byoung Kuk Lee, Seung Hyun Kang
SungKyunKwan University

9:30 a.m.

T22.4 **Multiport LLC DC-DC Converter Using Actively-Controlled Inductors for Multi-Source Integration**
Jun-Hyung Jung[1], Thiago Pereira[2], Alan Mantooth[3], Yuqi Wei[3], Marco Liserre[2], Yoann Pascal[4]
[1]Kiel University, [2]Christian-Albrechts-Universität zu Kiel, [3]University of Arkansas, [4]Fraunhofer Institute for Silicon Technology ISIT

9:50 a.m.

T22.5 **An Integrated On-Board Charger and Auxiliary Power Module for Electric Vehicles**
Ioannis Kougioulis, Rishad Ahmed, Patrick Wheeler
University of Nottingham

10:35 a.m.

T22.6 **Quantification and Active Filtering-Based Mitigation Approach for Third Harmonic Component Attenuation in Totem-Pole PFC for Onboard Charging Systems**
Ashwin Chandwani, Ayan Mallik, Abed Kazemtarghi
Arizona State University

10:55 a.m.

T22.7 **11-Kw High-Frequency High-Density Bidirectional OBC with PCB Winding Magnetic Design**
Nabih Ahmed, Phu Hieu Pham, Wang Shuo, Li Qiang
Center for Power Electronics Systems Virginia Tech

8:30 a.m. – 11:15 a.m.

T23: Power Applications: LED, Heating, USB, Magnetics

ROOM 361DEF

Power Applications: LED, Heating, USB, Magnetics

SESSION CHAIRS

Yingyi Yan, *Analog Devices*

Khorshed Alam, *General Motors*

8:30 a.m.

T23.1 **Precise Luminous Flux and Color Temperature Control of Dimmable Bi-Color White Light-Emitting Diode Systems**
Yuchen He[1], Siew-Chong Tan[2], Albert Ting Leung Lee[2], Germaine Cheuk Ping Wong[2], Ron Shu Yuen Hui[3]
[1]Florida State University, [2]The University of Hong Kong, [3]Nanyang Technological University

8:50 a.m.

T23.2 **Discrete-Time Trajectory Based Control of DC-DC Converters and Applications to Led Driving**
Raktim Roy, K Hariharan, Santanu Kapat
Indian Institute of Technology (IIT) Kharagpur

9:10 a.m.

T23.3 **A Boost Converter with Lossless Passive Snubber for Powering the 5G Small Cell Station**
Yeu-Torng Yau[1], Tsung-Liang Hung[2], Kuo-Ing Hwu[3]
[1]National Chin-Yi University of Technology, [2]Asian Power Device Inc., [3]National Taipei University of Technology

9:30 a.m.

T23.4 **Low-Noise, 24 V, 1 A, 2.1 MHz GaN DC/DC Converter for Variable Power Supply of a GaN-Based Solid-State Power Amplifier**
Dominik Koch, Ingmar Kallfass, Benjamin Schoch
University of Stuttgart

10:35 a.m.

T23.6 **High-Performance class-E quasi-Resonant Inverter for Domestic Induction Heating Applications**
Hector Sarnago, Jose M. Burdio, Oscar Lucia
University of Zaragoza

8:30 a.m. – 11:15 a.m.

T24: Control of DC-DC Converters

ROOM 350DEF

Control of DC-DC Converters

SESSION CHAIR

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

8:30 a.m.

T24.1 **Constant Switch Stress Control of Hybrid Switched Capacitor DC-DC Converters**
Ziyu Xia, Jason Stauth
Dartmouth College

8:50 a.m.

T24.2 **Deadbeat Control with Parameter Identification Under Single-Phase Shift Modulation for Dual Active Bridge Converters**
Tan-Quoc Duong, Sung-Jin Choi
University of Ulsan

9:10 a.m.

T24.3 **A Novel Multi-Mode Control Method for Double-Clamped ZVS Converter with Reduced Loss**
Song Ding[1], Qi Liu[2], Qinsong Qian[1]
[1]Southeast University, [2]Southeast University Nanjing

9:30 a.m.

T24.4 **DC Voltage Balancing Control Based on Second Order Harmonic Current Injection of Hysteresis Controlled 3-Level AC/DC Converter**
Yuguo Li, Xin Jiang, Hao Yi, Fang Zhuo
Xi'an Jiaotong University

9:50 a.m.

T24.5 **Transient Suppression Scheme for Mitigation of High-Performance VRM Intricate Load Profiles**
Bar Halivni, Tom Urkin, Mor Peretz
Ben-Gurion University of the Negev - PEMIC

10:35 a.m.

T24.6 **Chattering-Free Event-Trigger Fast Recovery Stable Digital Sliding Mode Control in DC-DC Converters**
Santanu Kapat
Indian Institute of Technology (IIT) Kharagpur

10:55 a.m.

T24.7 **Real-Time Reconfiguration in Digital Current Mode Control for Fast Transient with Robust Stability**
Santanu Kapat
Indian Institute of Technology (IIT) Kharagpur

1:45 p.m. – 3:25 p.m.

T25: Hybrid DC-DC Converters

ROOM 352DEF

Hybrid DC-DC Converters

SESSION CHAIR

Xin Zhang, *IBM*

1:45 p.m.

T25.1 **Vertical Stacked LEGO-PoI CPU VRM with 1 A/mm2 Current Density**
Youssef Elasser[1], Harish Krishnamurthy[2], Houle Gan[3], Kaladhar Radhakrishnan[2], Jonathan Douglas[2], Xin Li[3], Shuai Jiang[3], Jaeil Baek[1], Charles Sullivan[4], Minjie Chen[1]
[1]Princeton University, [2]Intel, [3] Google LLC, [4]Dartmouth

2:05 p.m.

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

2:25 p.m.

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

2:45 p.m.

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

3:05 p.m.

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

1:45 p.m. – 3:25 p.m.

T26: Renewable Energy System Control

ROOM 351ABC

Renewable Energy System Control

SESSION CHAIRS

Jingbo Liu

Seunghoon Baek, *Virginia Tech*

1:45 p.m.

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

2:05 p.m.

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

2:25 p.m.

T26.3 **MPPT Based Performance Analysis of Minimum Phase Multi-Output Hybrid Bipolar Converter**
Pawan Kumar[1], Rajeev Kumar Singh[1], Ranjit Mahanty[2]
[1]Indian Institute of Technology (BHU), [2]IIT BHU Varanasi

2:45 p.m.

T26.4 **Optimization of Self-Adaptive INR-MPPT for R-Mode Red Stacks**
Zhihong Yan[1], Yuchen He[2], Li Wang[1], Ron Shu Yuen Hui[3], Siew-ChongTan[1], Ying Huang[1], Chuyang Tang[1]
[1]The University of Hong Kong, [2]Florida State University, [3]Nanyang Technological University

3:05 p.m.

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

1:45 p.m. – 3:25 p.m.

T27: Inverters & Others

ROOM 351DEF

Inverters & Others

SESSION CHAIRS

Ali Safayet, *Halla Mechatronics*

Dinesh Kumar, *Global Research & Development Center, Danfoss Drives A/S*

1:45 p.m.

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

2:05 p.m.

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

2:25 p.m.

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

2:45 p.m.

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

3:05 p.m.

T27.5 **Equivalent Circuit and Modified Unipolar Pulse Width Modulation Technique for High Efficiency SiC Based Class-D Power Amplifiers in Underwater Acoustic Applications**
Muhammed Yusuf Candan[1], Hüseyin Meşe[2], Murat Hacıosmanoşlu[1]
[1]Aselsan, [2]Togg

1:45 p.m. – 3:25 p.m.

T28: SiC Devices

ROOM 361ABC

SiC Devices

SESSION CHAIRS

Zheyu Zhang, *Clemson University*

Jingbo Liu

1:45 p.m.

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

2:05 p.m.

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

2:25 p.m.

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

2:45 p.m.

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

3:05 p.m.

T28.5 **A Four-Level Active Gate Driver with Continuously Adjustable Intermediate Gate Voltages**
Xia Du, Yuqi Wei, Liyang Du, Alan Mantooth, Venkata Samhitha Machireddy
University of Arkansas

1:45 p.m. – 3:25 p.m.

T29: Gate Drive Circuits

ROOM 361DEF

Gate Drive Circuits

SESSION CHAIR

Seungdeog Choi, *Mississippi State University*

1:45 p.m.

T29.1 **Gate Driver Development and Stray Inductance Extraction of 10 kV SiC MOSFET Module for Switched-Capacitor MMC Application**
Zhehui Guo[1], Hui Li[2], Fang Peng[2]
[1]Center for Advanced Power Systems, Florida State University, [2]Florida State University

2:05 p.m.

T29.2 **A Very-High-Frequency Isolated Gate Driver Power Supply Using Solid Dielectrics for Medium Voltage SiC MOSFETs**
Zhehui Guo[1], Hui Li[2]
[1]Center for Advanced Power Systems, Florida State University, [2]Florida State University

2:25 p.m.

T29.3 **Transient Overvoltage Detection Technique for GaN HEMTs Integrated in a 200-V GaN-on-SOI Process**
Samantha Murray[1], Peter Moens[2], Jaume Roig[2], Olivier Trescases[1], Herbert De Vleeschouwer[2], Mohammed Shawkat Zaman[1], Wanlin Jiang[1]
[1]University of Toronto, [2]ON Semiconductor

2:45 p.m.

T29.4 **Equalization of DC and Surge Components of Drain Current of Two Parallel-Connected SiC MOSFETs Using Single-Input Dual-Output Digital Gate Driver IC**
Kohei Horii[1], Makoto Takamiya[1], Ryuzo Morikawa[1], Ryunosuke Katada[1], Shin-Ichiro Hayashi[2], Takayasu Sakurai[1], Katsuhiro Hata[1], Keiji Wada[2], Ichiro Omura[3]
[1]The University of Tokyo, [2]Tokyo Metropolitan University, [3]Kyushu Institute of Technology

3:05 p.m.

T29.5 **An Integrated Active Gate Driver for Half-Bridge SiC MOSFET Power Modules**
Dongwoo Han[1], Sanghun Kim[2], Yuan Li[1], Jinyeong Moon[1], Xiaofeng Dong[2], Zhehui Guo[2], Hui Li[1], Fang Peng[1]
[1]Florida State University, [2]Center for Advanced Power Systems/ Florida state university

1:45 p.m. – 3:25 p.m.

T30: Control & Applications 2

ROOM 350DEF

Control & Applications 2

SESSION CHAIR

Xiaonan Lu, *Temple University*

1:45 p.m.

T30.1 **Grid Forming Control in Switching Frequency Constrained Medium Voltage Multi-Megawatt Voltage Source Converters**
M A Awal, Stefan Schroeder
Danfoss

2:05 p.m.

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

2:25 p.m.

T30.3 **Control Technique for Transformerless Regenerative Testing of Grid-Connected Power Converters**
Partha Pratim Das, Debanjan Chatterjee
ABB

2:45 p.m.

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

3:05 p.m.

T30.5 **Multi-Sampling with Real-Time Update PWM for Time-Delay Minimization of FPGA-Based Voltage-Controlled Converters**
Zejie Li[1], Fangzhou Zhao[1], Xiongfei Wang[2], Shan He[1], Munk-Nielsen Stig[1]
[1]Department of Energy Aalborg University, [2]Aalborg University

TECHNICAL DIALOGUE SESSIONS

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

11:30 AM – 1:30 PM

D01: AC-DC Converters 2

POSTER AREA

AC-DC Converters 2

SESSION CHAIRS

Edward Herbert, *PSMA*

George Slama, *Würth Elektronik*

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

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

D01.3 **Practical Switching Frequency Control for Improved Efficiency in Hard-Switched CCM Boost PFC Converters at Light Load**
Rytis Beinarys, Trong Tue Vu[1]
[1]ICERGi Ltd.

11:30 AM – 1:30 PM

D02: High Frequency Inductors

POSTER AREA

High Frequency Inductors

SESSION CHAIRS

Edward Herbert, *PSMA*

George Slama, *Würth Elektronik*

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

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

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

D02.4 **Physics-Based-Magnetic Modeling of a Three-Port Transformer in a Triple-Active-Bridge Converter with Decoupling Power Flow Regulation**
Fei Diao[1], Guangqi Zhu[2], Yue Zhao[1], Yuheng Wu[1], Hui Cao[1], Andrew Rockhill[2]
[1]University of Arkansas, [2]Eaton Research Labs

D02.5 **Core Size Scaling Law of Two-Phase Coupled Inductors — Demonstration in a 48-to-1.8 V MLB-PoI Converter**
Ting Ge, Robert Pilawa-Podgurski, Zichao Ye, Rose Abramson
University of California – Berkeley

D02.6 **Convolutional Neural Network (CNN) Based Planar Inductor Evaluation and Optimization**
Xiaoyan Liu[1], Yanchao Li[2], Maohang Qiu[1], Shuai Yang[1], Dong Cao[1], Mengxuan Wei[1], Xiaofeng Lyu[3]
[1]University of Dayton, [2]Google,[3]Navitas Semiconductor Inc.

11:30 AM – 1:30 PM

D03: Design & Control of Power Converters for Utility Applications

POSTER AREA

Design & Control of Power Converters for Utility Applications

SESSION CHAIRS

Madhav Manjrekar, *UNC Charlotte*

Jacob Mueller, *Sandia National Laboratories*

D03.1 **Var Control Capability Analysis for a Hybrid Voltage Regulation Transformer**
Yafeng Wang[1], Tiefu Zhao[2]
[1]Monolithic Power Systems, [2]UNC Charlotte

D03.2 **Control Strategy of Delta-Connected Solid State Transformer Under Unbalanced Grid Voltage**
Shaodi Ouyang
Xi'an Jiaotong University

D03.4 **SiC-Based Intelligent Power Stage with Device Prognostics/Diagnostics and ZVRT Capability for Smart Universal Power Electronic Regulators (SUPER) Application**
Xiaofeng Dong[1], Dongwoo Han[2], Yuan Li[2], Hui Li[2], Madhu Sudhan Chinthavali[3], Jinyeong Moon[2], Radha Krishna Moorthy[3], Sandro P. Martin[2], Sanghun Kim[1], Fang Peng[2]
[1]Center for Advanced Power Systems, Florida State University, [2]Florida State University, [3]Oak Ridge National Laboratory

D03.5 **A Zero Current Switching Hybrid DC Circuit Breaker for DC Grid Applications**
Satish Naik Banavath[1], Nandakumar Saminathan[1], Kaushik Rajashekara[2], Muhammed Ajmal Cn[1]
[1]Indian Institute of Technology Dharwad, [2]University of Houston

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

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

D03.9 **A Bidirectional Three Phase Solid-State Transformer for Utility Interface of Energy Storage Devices**
Shaozhe Wang, Prasad Enjeti, Erick Ivan Pool Mazun
Texas A&M University

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

11:30 AM – 1:30 PM

D04: Drives & Inverter

POSTER AREA

Drives & Inverter

SESSION CHAIRS

Ali Safayet, *Halla Mechatronics*

Woongkul Lee, *Michigan State University*

D04.1 **Quantitative Harmonics Performance Evaluation of High Speed Permanent Magnet Synchronous Machine Under Various Synchronous SVPWM Strategies**
Kevin Lee[1], Wenxi Yao[2], Zhihao Song[2]
[1]Eaton Corporation, [2]Zhejiang University

D04.3 **Real Time dq0 Analysis of FOC Systems**
Jonathan Tucker[1], Bharghavi Vempati[2], Niranjan Hegde[2], Srikrishna N H[2]
[1]Tektronix, [2]Tektronix India Pvt. Ltd.

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

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

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

D04.7 **Auxiliary Resonant Commutated Pole Inverter (ARCPI) Operation Using online Voltage Measurements**
Markus Zocher[1], Norbert Grass[2], Ralph Kennel[3]
[1]Institute ELSYS, Nuremberg University of Applied Sciences, [2]Technische Hochschule Nuernberg, [3]Technische Universität München

D04.9 **Sensorless Control Method for Single-Phase BLDC Motors Based on Phase Current Information**
John Henry Puente, Mark Calderon, John Emmanuel Tan
Power Integrations

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

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

11:30 AM – 1:30 PM

D05: Devices & Components

POSTER AREA

Devices & Components

SESSION CHAIRS

Jason Neely, *Sandia National Laboratories*

Hengzhao Yang, *New Mexico Institute of Mining and Technology*

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

D05.2 **An Adaptive Driving Signals Delay Control for Voltage Balancing of Multiple Series-Connected SiC MOSFETs**
Min Zhao, Tao Wang, Hua Lin
Huazhong University of Science and Technology

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

D05.4 **Silicon Application Extension Versus WBG Due to Partial Power Processing**
Jon Anzola[1], Shrivatsal Sharma[2], Iosu Aizpuru[1], Subhashish Bhattacharya[2]
[1]Mondragon Unibertsitatea, [2]North Carolina State University

D05.5 **GaN HEMT Power Losses Modeling and Evaluation in Resonant LLC Converters**
Domenico Nardo[1],Alfio Scuto[1], Simone Buonomo[1], Santi Agatino Rizzo[2], Massimiliano Chiantello[1]
[1]STMicroelectronics, [2]UniCT

D05.6 **Experimental Validation of a Chip Area Optimized 3.3 kV SiC Half Bridge for HVDC Converters**
Lukas Bergmann[1], Marcus Wahle[2], Mark-M. Bakran[1]
[1]University of Bayreuth, [2]Siemens Energy

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

D05.9 **An Improved Turn-on Switching Transient Model of 10-kV SiC MOSFET**
Ruirui Chen[1], Min Lin[1], Leon Tolbert[2], Fred Wang[3], Xingxuan Huang[4]
[1]University of Tennessee, [2]University of Tennessee & NASA Glenn Research Center, [3]University of Tennessee & ORNL, [4]University of Tennessee Knoxville

11:30 AM – 1:30 PM

D06: Power Converter Packaging, Integration, & EMI Considerations

POSTER AREA

Power Converter Packaging, Integration, & EMI Considerations

SESSION CHAIR

Emre Gurpinar, *Oak Ridge National Laboratory*

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

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

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

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

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

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

D06.7 **Adaptive Outlier Detection for Power MOSFETs Based on Gaussian Process Regression**
Kyohei Shimozato[1], Michihiro Shintani[2], Takashi Sato[1]
[1]Kyoto University, [2]Nara Institute of Science and Technology

D06.8 **A Practical Application of Commercial 3.3KV, 750A SiC Modules**
Eric Motto[1], Jeff Reichard[2]
[1]Mitsubishi Electric US Inc., [2] Abstract Power Electronics

D06.9 **Packaging and Characterization of a Novel 7.2kV85A SiC Austin SuperMOS Half-Bridge Intelligent Power Module (IPM)**
Junhong Tong
University of Texas at Austin

D06.10 **Digital Twin Approach for Degradation Parameters Identification of a Single-Phase DC-AC Inverter**
Qunfang Wu, Wanquan Wang, Hang Shi, Qin Wang, Lan Xiao
Nanjing University of Aeronautics and Astronautics

11:30 AM – 1:30 PM

D07: Modeling & Simulation of Power Electronics

POSTER AREA

Modeling & Simulation of Power Electronics

SESSION CHAIRS

Matt Wilkowski, *EnaChip*

Shajjad Chowdhury

D07.1 **Modeling Substrate Voltage Effects on GaN I-V Characteristics with ASM-HEMT Model**
Sourabh Khandelwal[1], Gordon Stecklein[2], Tom Herman[2]
[1]Macquarie University, [2]EPC

D07.2 **Simple, Low Cost, Method for Measuring Single Phase Line Impedance**
Mark Didat[1], Seungdeog Choi[2]
[1]GE Appliances, [2]Mississippi State University

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

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

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

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

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

D07.8 **Online Model-Parameter Identification for Battery Cells Utilizing Switched-Capacitor Equalizers**
Ngoc-Thao Pham, Phuong-Ha La, Sung-Jin Choi
University of Ulsan

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

11:30 AM – 1:30 PM

D08: Control 1

POSTER AREA

Control 1

SESSION CHAIRS

Jaber Abu Qahouq,

The University of Alabama

Xiaonan Lu,

Temple University

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

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

D08.4 **Start-Up Method for Hybrid Switched Capacitor Converter**
Roberto Rizzolatti[1], Stefano Saggini[2], Christian Rainer[1], Mario Ursino[3], Venugopal Reddy Chintala Cheruvu[4]
[1]Infineon Technologies Austria AG, [2]Università di Udine DPIA, [3]Infineon Technology AT, [4]Infineon Technologies Americas Corp.

D08.5 **A Single-Sensor-Based Circulating Current Controller for a Modified Three-Level Modular Multilevel Converter**
Paolo Mattavelli[1], Igino Toigo[2], Michele Corradin[2], Tarek Younis[1]
[1]University of Padova, [2]Socomec

D08.6 **Reliability of DC-Link Capacitors in Three-Level NPC Inverters Under Different PWM Methods**
Ariya Sangwongwanich[1], Frede Blaabjerg[1], Mateja Novak[1], Somboon Sangwongwanich[2]
[1]Aalborg University, [2]Chulalongkorn University

D08.7 **HSS Modeling and Stability Analysis of Single-Phase PFC Converters**
Guoqing Gao, Xiongfei Wang, Tianhua Zhu, Yicheng Liao
Aalborg University

11:30 AM – 1:30 PM

D09: Control 2

POSTER AREA

Control 2

SESSION CHAIR

Emanuel Serban, *UBC – EnerSys*

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

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

D09.3 **Novel Power Decoupling Methods for Three-Port Triple-Active-Bridge Converters**
Hui Cao[1], Fei Diao[1], Guangqi Zhu[2], Yue Zhao[1]
[1]University of Arkansas, [2]Eaton

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

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

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

D09.7 **Decentralized Interleaving of Cascaded H-Bridge Multi-Level Converters**
Oscar Andres Montes[1], Wensong Yu[1], Iqbal Husain[1], M A Awal[2], Srdjan Lukic[1]
[1]North Carolina State University, [2]Danfoss

11:30 AM – 1:30 PM

D10: Wireless Power Transfer Systems

POSTER AREA

Wireless Power Transfer Systems

SESSION CHAIRS

Joseph Song-Manguelle, *Oak Ridge National Laboratory*

Shajjad Chowdhury

D10.1 **Non-Isolated Buck-Boost Hybrid Converter with AC to AC or DC Power Conversion for Simultaneous Wired and Wireless Power Transfer**
Yuchen He[1], Jiayang Wu[2], Ron Shu Yuen Hui[3], Siew-Chong Tan[2], Albert Ting Leung Lee[2]
[1]Florida State University, [2]The University of Hong Kong, [3]Nanyang Technological University

D10.5 **A Novel Power Combining Strategy for Rectenna Array of Microwave Power Transmission System**
Zehao Zhai, Ke Jin, Weiyang Zhou, Xue Wang
Nanjing University of Aeronautics and Astronautics

D10.6 **Simultaneous Wireless Power and Data Transmission for Laser Power Transfer System Based on Frequency-Shift Keying Modulation Method**
Han Zhang, Weiyang Zhou, Ke Jin
Nanjing University of Aeronautics and Astronautics

D10.7 **Design of Multi-Receiver IPT System for Electric Vehicles Considering Transfer Efficiency and Different Power Requirements**
Zhi Feng, Baokun Zhang, Lantian Li, Zhenpo Wang, Deng Junjun
Beijing Institute of Technology

D10.8 **Modeling and Analysis of a Polyphase Wireless Power Transfer System for EV Charging**
Rong Zeng[1], Gui-Jia Su[1], Mostak Mohammad[1], Veda Prakash Galigekere[2], Erdem Asa[1], Omer Oner[1]
[1]Oak Ridge National Laboratory, [2]UT Battelle ORNL

D10.9 **Frequency Domain Analysis of a Wireless Power Transfer System Operating in a Wide Load and Coupling Range Using Frequency Modulation of Inverter for Voltage Regulation**
Abirami Kalathy, Arpan Laha, Praveen Jain
Queen's University

11:30 AM – 1:30 PM

D11: Renewable Energy Systems

POSTER AREA

Renewable Energy Systems

SESSION CHAIRS

Rajeev Kumar Singh, *Indian Institute of Technology (BHU)*

Luocheng Wang, *University of North Carolina at Charlotte*

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

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

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

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

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

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

D11.7 **Model-Based cyber-Attack Detection for ANPC PV Converter Using Kalman Filter**
Jinan Zhang, Jin Ye
University of Georgia

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

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

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

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

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

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

11:30 AM – 1:30 PM

D12: Transportation Power Conversion 3

POSTER AREA

Transportation Power Conversion 3

SESSION CHAIRS

Rasoul Hosseini, *General Motors*

Woongkul Lee, *Michigan State University*

D12.1 **A non-Cascading step-up/Down DC-DC Converter with non-Pulsating Input Current for Lithium-Ion batteries: Analysis and Design**
Jesus Leyva-Ramos[1], Juan Antonio Villanueva-Loredo[1], Ma Guadalupe Ortiz-Lopez[2], Luis Humberto Diaz-Saldierna[1]
[1]IPICYT, [2]UPSLP

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

D12.4 **Isolated Three-Port Bidirectional DC-DC Converter for Electric Vehicle Applications**
Misha Kumar[1], Juan Ruiz[1], Peter Barbosa[2], Sun Hao[3], Jia Minli[3]
[1]Delta Electronics (Americas) Ltd., [2]Delta Electronics, [3]Delta Electronics (Shanghai) Co. Ltd.

D12.5 **Three-Loop Multi-Variable Control of Triple Active Bridge Converter with Power Flow Optimization**
Ashwin Chandwani, Ayan Mallik
Arizona State University

D12.6 **Performance Comparison and Modelling of Instantaneous Current Sharing Amongst GaN-HEMT Switch Configurations for Current Source Inverters (CSI)**
Mustafeez Ul Hassan[1], Fang Luo[1], Asif Imran Emon[1], Zhao Yuan[2], Hongwu Peng[3]
[1]Stony Brook University, [2]University of Arkansas, [3]University of Connecticut

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

11:30 AM – 1:30 PM

D13: Power Applications

POSTER AREA

Power Applications

SESSION CHAIRS

Khorshed Alam,

General Motors

Jeff Niles,

Alpha & Omega Semiconductor

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

D13.2 **Temperature Dependent Characterization-Based Design Optimization of a DC-DC Converter for High-Temperature Space Applications**
Saikat Dey[1], Neil Goldsman[2], Zeynep Dilli[2], Ayan Mallik[1]
[1]Arizona State University, [2]CoolCAD Electronics LLC

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

11:30 AM – 1:30 PM

D14: DC-DC Converters 1

POSTER AREA

DC-DC Converters 1

SESSION CHAIR

Cahit Gezgin, *Infineon*

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

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

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

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

D14.5 **Charge Sharing LAU Switched-Capacitor Converter with Reducing Power Loss**
Jaesoon Choi[1], Seokmun Choi[1], Inkuk Baek[1], Kin Keung Lau[2]
[1]Silicon Mitus, [2]Empower Semiconductor

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

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

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

D14.9 **A Novel Five-Level Hybrid Dual Active Bridge Converter with Optimized Switching Scheme**
Gautam Ratanpuri, Satish Belkhode, Anshuman Shukla
IIT Bombay

11:30 AM – 1:30 PM

D15: DC-DC Converters 2

POSTER AREA

DC-DC Converters 2

SESSION CHAIRS

Olivier Trescases, *University of Toronto*

D15.2 **High-Frequency LLC Converter with Narrow Frequency Variations for Aircraft Applications**
Aurora de Juan[1], Diego Serrano[2], Miroslav Vasic[2], Pedro Alou[2], Jean-Nöel Mamousse[3], Romain Deniéport[3]
[1]Centro de Electrónica Industrial (CEI), [2]Universidad Politécnica de Madrid, [3]Gaia Converter

D15.3 **Analytical Modelling of single-Phase and three-Phase DC/DC LLC Converters**
Aurora de Juan[1], Romain Deniéport[2], Jean-Nöel Mamousse[2], Pedro Alou[3], Miroslav Vasic[3], Diego Serrano[3]
[1]Centro de Electrónica Industrial (CEI), [2]Gaia Converter, [3]Universidad Politecnica de Madrid

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

D15.5 **High Efficiency Dual-Output LLC Resonant Converter with Synchronous Rectifier Control**
Keon-Woo Kim[1], Yeonho Jeong[2], Moon-Young Kim[1], Jeong-Il Kang[1]
[1]Samsung Electronics, [2]University of Rhode Island

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

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

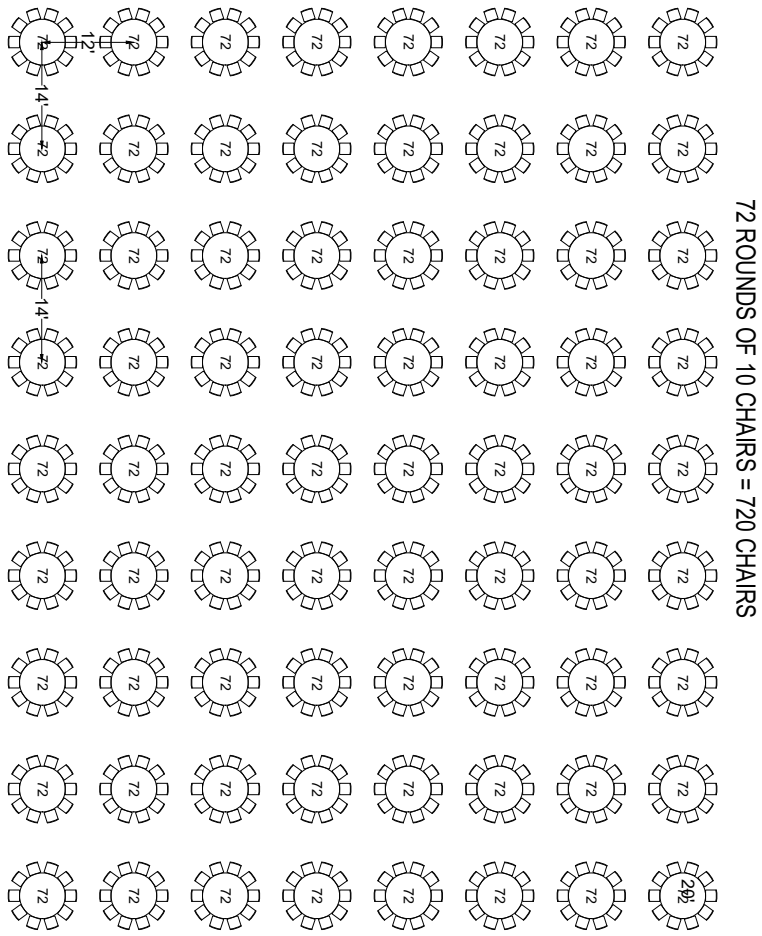
D15.8 **Design and Magnetic Optimization of a Dual Active Bridge for Energy Storage Application**
Amin Khakparvaryazdi, Morteza Mahdavifard, Neda Mazloum, S. Ali Khajehoddin
University of Alberta

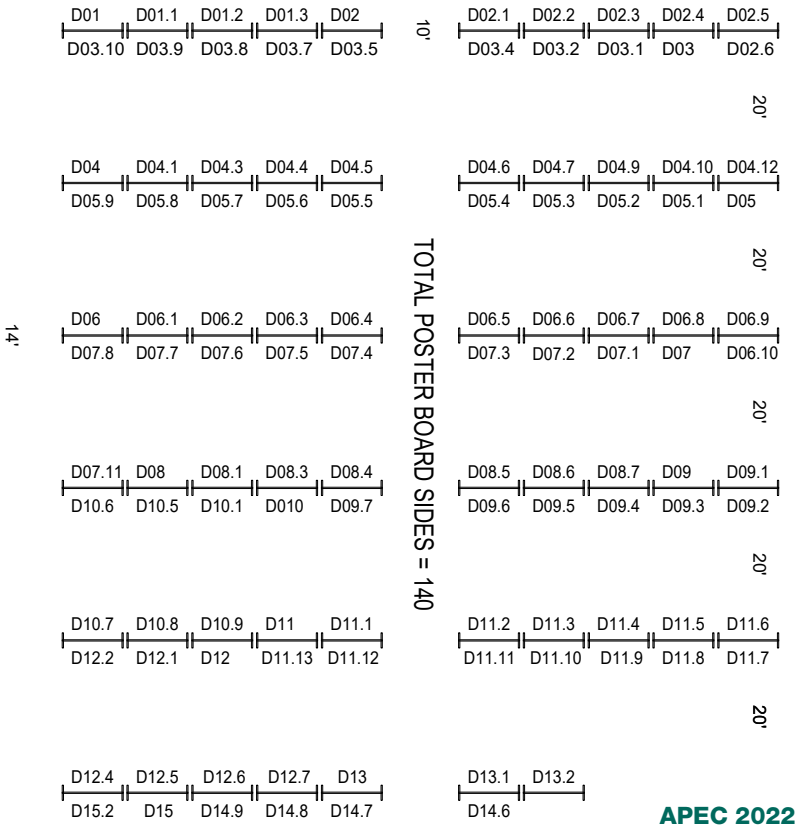
D15.9 **A Monolithic 200V GaN Half Bridge IC with Integrated Gate Drivers and Level-Shifters Achieving 98.3% Peak Efficiency**
Mike Wens[1], Deniz Aygün[1], Marc Fossion[2], Stefaan Decoutere[3], Andrew Barnes[3], Christophe Delepaut[4], Jef Thoné[5]
[1]MinDCet NV, [2]Thales Alenia Space Belgium, [3]imec, [4]European Space Agency, [5]MinDCet NV

D15.11 **A Novel Three Phase LCL Dual Active Bridge Converter to Reduce RMS Phase Current**
Hui Chen, Xianzao Li, Sixing Du, Jinjun Liu, Shaodi Ouyang
Xi'an Jiaotong University

NOTES

DIALOGUE SESSIONS FLOOR PLAN

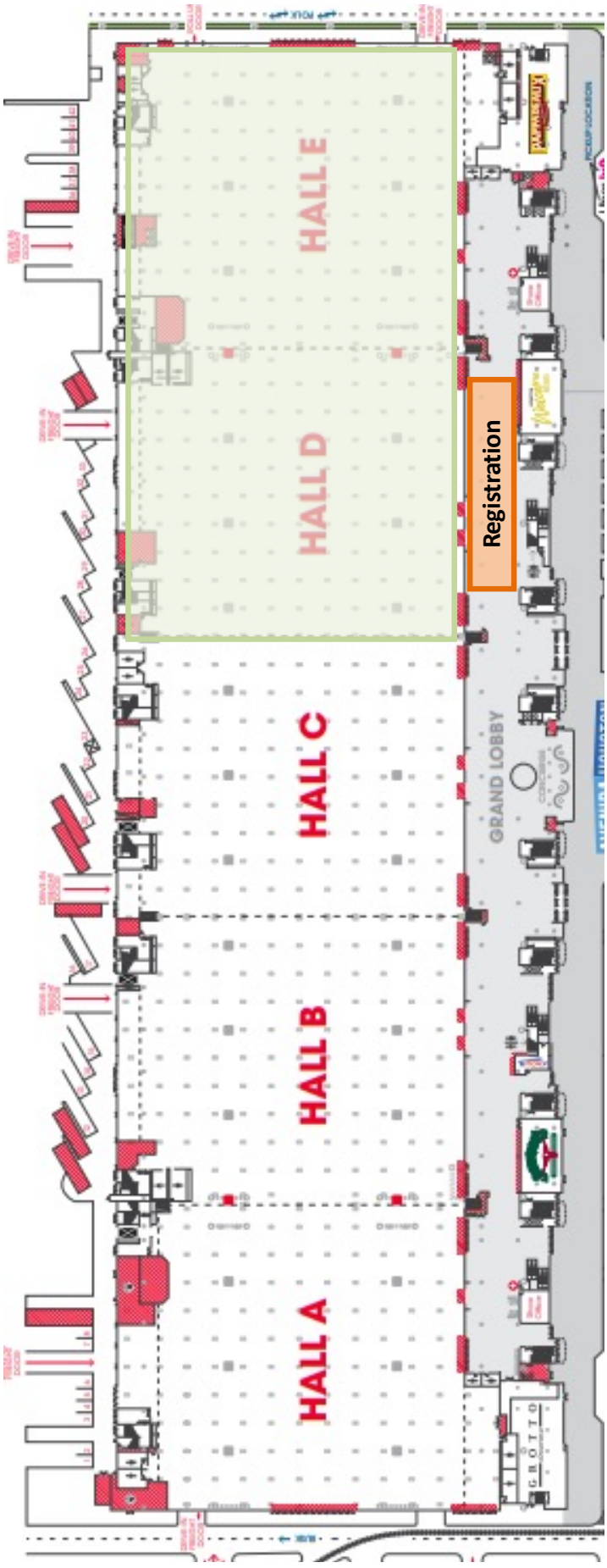




CONVENTION CENTER FLOOR PLAN

LEVEL 100

Exhibit Hall
Halls D – E



CONVENTION CENTER FLOOR PLAN

LEVEL 300

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

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

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

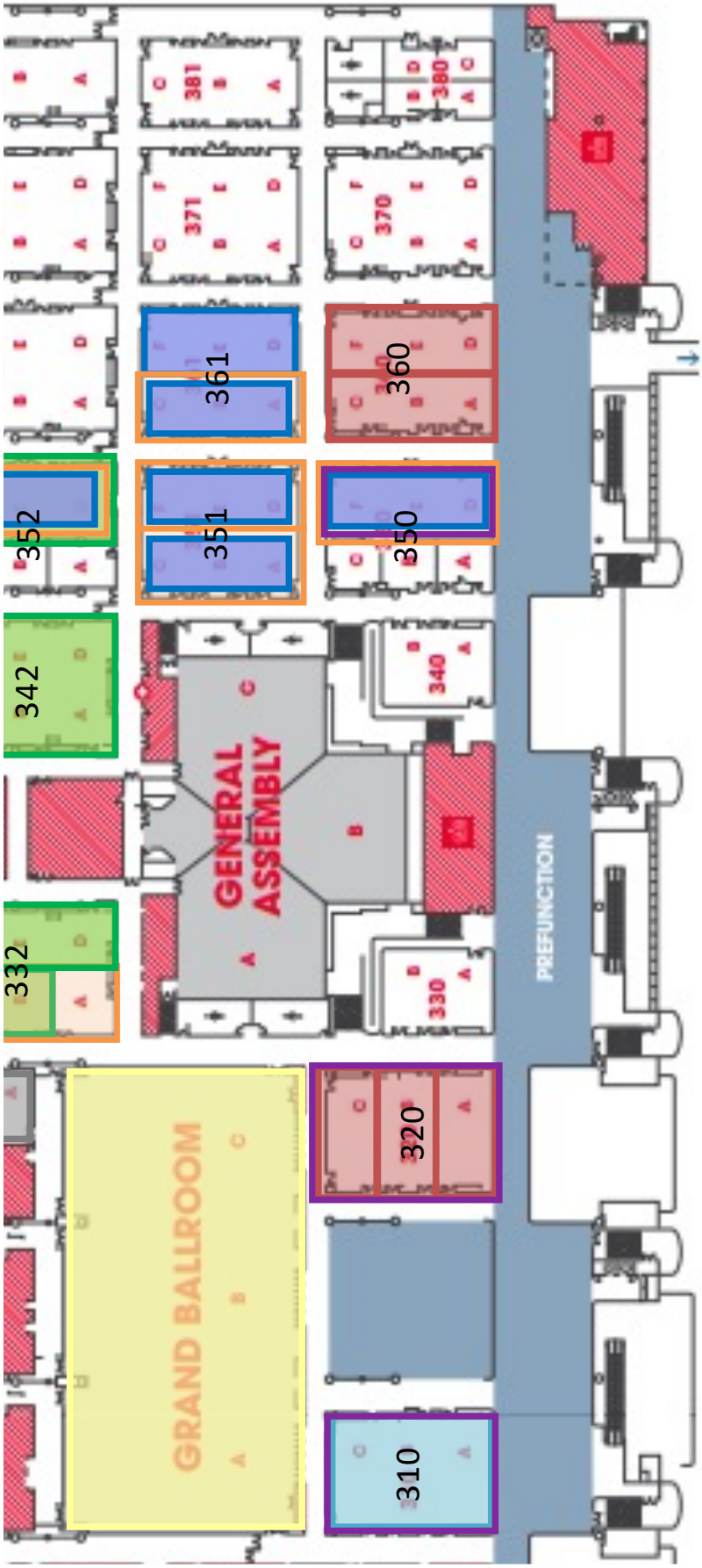
Professional Education Seminars
332 ABC | 350 DEF | 351 ABC
351 DEF | 352 DEF | 361 ABC

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

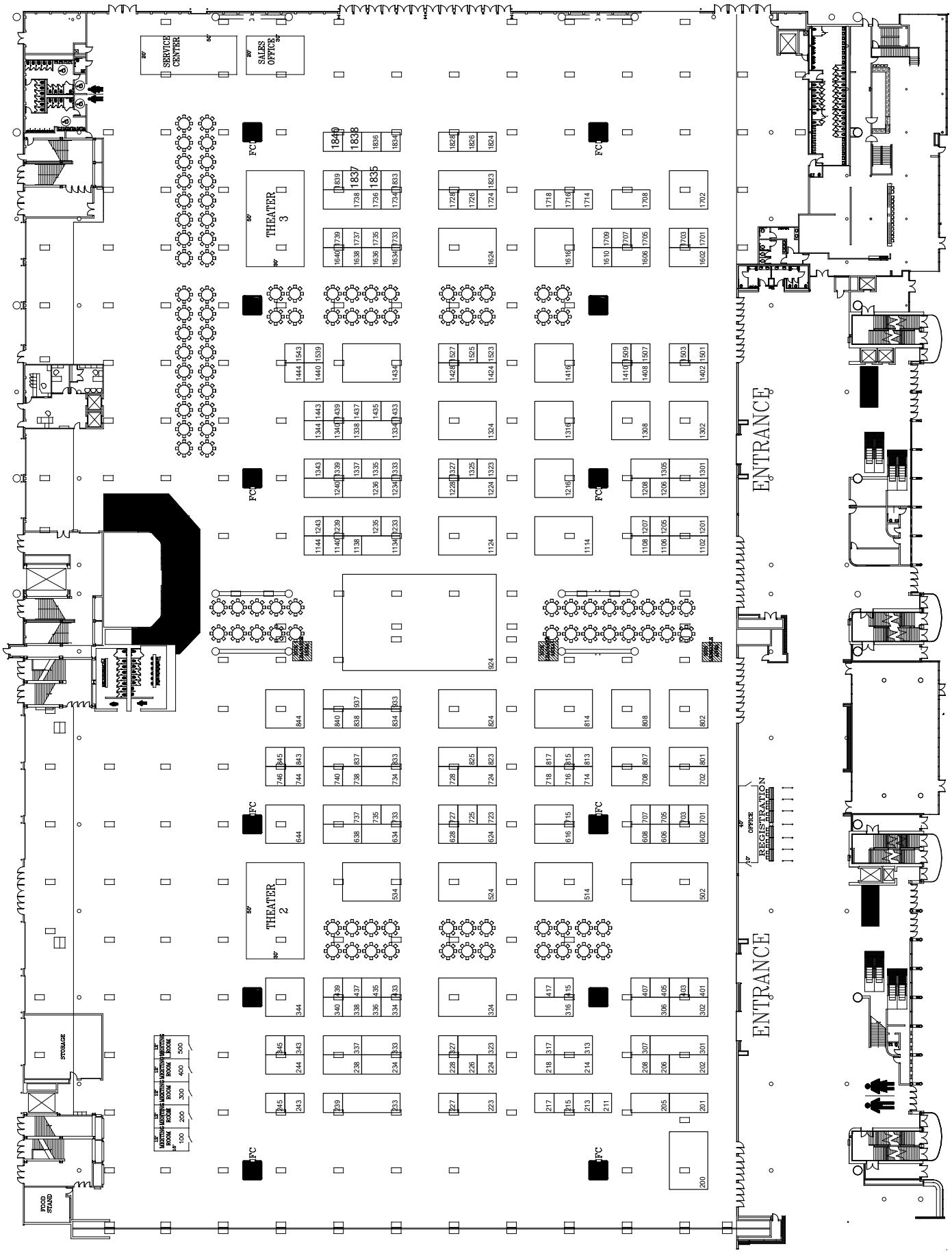
Plenary & Dialogue Sessions

Speaker Breakfast

Speaker Ready Room



EXPOSITION FLOOR PLAN



EXHIBITOR LISTING

as of February 21, 2022

EXHIBITOR	BOOTH #
AC POWER CORP. (Preen)	834
ACME Electronics Corporation	1634
Acopian Power Supplies	833
Advanced Conversion	843
Advanced Cooling Technologies, Inc.	840
Advanced Test Equipment Corp.	243
Aehr Test	345
AEM	1737
AIR-VAC Automation	1344
Aishi Capacitors	815
All Flex Flexible Circuits and Heaters	1709
Alpha & Omega Semiconductor	616
AmePower - Contract Manufacturing	1703
AMETHERM, INC	307
AMX Automatrix	337
Analog Devices	233
ANSYS, Inc.	845
APEC HUB	924
Apex Microtechnology	1610
Axiom Test Equipment	1701
B&K Precision	1705
BH Electronics	1636
Boschman-Advanced Packaging Technology	628
Bourns, Inc.	1402
Broadcom Inc.	707
BROXING SA	1440
CAEN Technologies	1335
CalRamic Technologies, LLC	1239
Cambridge GaN Devices	1733
Captor Corporation	1338
CEJN North America	1734
Central Semiconductor Corp.	733
Centrotherm International AG	1339
Chroma Systems Solutions, Inc.	844
Clas-SiC Wafer Fab Ltd.	1838
Coil Winding Specialist, Inc.	218
Cornell Dubilier Electronics	1602
Cramer Magnetics	1106

EXHIBITOR	BOOTH #
Danfoss Silicon Power GmbH	1424
Datatronics	1835
Dean Technology, Inc.	608
DEWESoft LLC	202
Dexter Magnetic Technologies	1144
Digi-Key Electronics	602
Digilant.net	1525
DIOTEC Semiconductor America	227
DMEGC Magnetics Co., LTD	714
Dongguan Mentech Optical & Magnetic Co., Ltd.	1216
dSPACE Inc.	817
Ducati Energia Power Capacitors	740
EA Elektro-Automatik	1702
EBG Resistors	606
ECI	1527
EFC/Wesco	725
Efficient Power Conversion Corporation (EPC)	1302
Eggtronic	1823
EGSTON Power Electronics Gmbh	1325
Electrocube, Inc.	403
Electronic Concepts, Inc.	1102
Elektrisola Inc.	727
Elna Magnetics	1228
Epoxies, Etc.	1323
EXATRON, INC.	1515
EXXELIA SAS	213
Fair-Rite Products	1507
Ferroxcube	1517
Focused Test, Inc.	813
Frenetic	234
Fuji Electric Corp. of America	1308
GaNPower International Inc.	1839
GaN Systems	1324
GE	340
GeneSiC Semiconductor	1428
GLOBALFOUNDRIES	1138
GMW Associates	718
Goldenbamboo Electronics (zhuhai) Co., Ltd	701

EXHIBITOR LISTING

EXHIBITOR	BOOTH #
Good-Ark Semiconductor	401
Halo Microelectronics	1828
Heraeus Electronics	715
Hesse Mechatronics	702
Hioki USA Corp.	205
Hitachi Metals America, LTD.	1235
Hoi Luen Electrical Manufacturer Co., Ltd.	1327
Holy Stone International	1435
Hotland International Corp	703
HVM Technology	746
HVR Advanced Power Components	327
IAS (IEEE Industry Applications Society)	924
ICE Components, Inc.	1207
Ideal Power	336
IMEC	1340
Indium Corporation	1234
Infineon Technologies Americas Corp	1114
Innoscience Technology Co., Ltd.	200
iNRCORE, LLC	1708
Inter Outstanding Electronics Inc (IOE)	738
Ion Beam Services	1444
ITELCOND SRL	1439
ITG Electronics, Inc.	211
IVWorks Co., Ltd	308
IWATSU ELECTRIC CO., LTD.	1834
Jianghai America Inc	728
Johanson Dielectrics, Inc	1714
Jovil Universal LLC	208
KDM Zhejiang NBTM Keda Magnetoelectricity Co. Ltd.	838
KEPCO, Inc.	417
Keysight Technologies	1738
Kikusui America, Inc.	708
KYOCERA AVX	1305
LEM USA, Inc.	1334
Lodestone Pacific	1523
Magna-Power Electronics	1202
Magnetics	823
Malico Inc.	239
Max Echo Technology Corp	735
MaxLinear Corporation	1606
Menlo Microsystems, Inc.	215
Mersen	1316
Methode Electronics	407
MH&W International Corp	744
Microchip Technology, Inc.	344
Micrometals, Inc.	1108
Minntronix, Inc.	338
Mitsubishi Electric US, Inc	824
Mouser Electronics, Inc.	937
Murata	1624
NAC Semi	238
NAMICS Technologies Inc.	1724
National Magnetics Group/ Ceramic Magnetics, Inc.	1437
Navitas	1616
New England Wire Technologies	638
Newtons4th Ltd.	217
NexGen Power Systems	301
Nexperia	534
NH Research, Inc.	313
NIC Components Corp.	1205
Nichicon (America) Corp	1301
Nisshinbo Micro Devices, Inc.	1739
Noratel/Plitron	1408
NXP Semiconductors	223
Ohmite Manufacturing	1224
Omicron Lab	433
ON Semiconductor	1124
OPAL-RT TECHNOLOGIES	1236
Pacific Sowa Corporation; C/O Epson Atmix Corporat	1509
Payton America Inc.	933
PCIM Europe	1736
PELS (IEEE Power Electronics Society)	924
PEM Ltd	716

EXHIBITOR LISTING

EXHIBITOR	BOOTH #
Performance Controls	1826
PINK North America Corp.	1726
Plexim	228
PMBus	405
PMK	1833
Power Integrations	324
PowerAmerica	1343
PowerELab Ltd.	435
Powersim, Inc	415
PPST Solutions	1640
Premier Magnetics	634
Prodrive Technologies	244
Protavic America	1840
PSMA (Power Sources Manufacturers Association)	924
Quantic Capacitors Group	1134
ReliaPE	206
REMTEC, Inc.	334
Rohde & Schwarz USA, Inc.	807
ROHM Semiconductor	524
Rubadue Wire Company, Inc.	837
SABIC	1718
Samwha USA Inc.	333
SanRex Corporation	302
Schunk Carbon Technology GmbH	1728
Semikron, Inc.	624
SemiQ	323
Sentec E&E Co., Ltd.	1707
Shenzhen Codaca Electronic Co., Ltd	1206
Shin-Etsu Silicones of America	1539
Simplis Technologies	724
Skyworks Solutions	1240
Speedgoat	437
Standex Electronics	802
Stellar Industries Corp.	1208
STMicroelectronics	502
Storm Power Components	1501

EXHIBITOR	BOOTH #
StratEdge Corporation	1638
Sumida America Components Inc.	801
Tagore Technology	317
Taiwan Semiconductor	1337
TAIYO YUDEN USA INC.	734
Tamura Corp. of America,Tamura Japan	1543
TCLAD Inc.	1837
TDG Holding Co., LTD	705
TDK Corporation	814
Teledyne LeCroy	201
Tesec, Inc.	439
Texas Instruments	514
Tower Semiconductor	316
Transcat, Inc	1410
Transphorm	825
Tran-Tec	226
Trigon Components	224
TSC International	1836
TT Electronics	737
Tyndall National Institute	1140
Typhoon HIL, Inc.	1433
United Chemi-Con	1201
United Silicon Carbide	808
uPI Semiconductor Corp.	1716
Versatile Power	1443
Vincotech GmbH	214
Vishay Intertechnology	1434
VisIC Technologies	1416
Vitrek-High Voltage Test & Measurement	1503
Voltage Multipliers, Inc.	1243
WEMS ELECTRONICS	343
West Coast Magnetics	1333
WIMA Capacitors GmbH & Co.KG	1735
Wurth Electronics	644
X-FAB Semiconductor Foundries	723
Yole Developpement	1233

NOTES

Save the Date

MARCH 19-23, 2023

APEC®

2023

Orlando,

FLORIDA

APEC 2022

330 N. Wabash Avenue, Suite 2000
Chicago, IL 60611
P: +1-202-973-8664
E-mail: apec@apec-conf.org
www.apec-conf.org