



*The Multinational Power Electronics Association*

# PSMA Magnetics Committee Meeting

March 27<sup>TH</sup> 2024

**Ed Herbert, George Slama, Matt Wilkowski**  
**Committee Chairs**

*PSMA is a not-for-profit organization and a CO-SPONSOR OF APEC*



# ***PSMA Magnetics Committee Meeting Agenda***

## ***March 27, 2024***

- Introductions
- 2024 Workshop Overview
- 2025 Workshop Planning
- 2025 Industry Session Planning
- Power Technology Roadmap
- Special Projects
  - Electrical parameters of magnetic materials
  - Core Loss Database
- Magnetics Forum on PSMA Website
- Next Meeting



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# Power Magnetics at High Frequency Workshop

## Logistics – Agenda - Scope

- Logistics

- Venue:

- APEC 2024
    - Long Beach CA

- Attendance

- 132
    - 27% Research 73% Industry
    - 68% NA, 22% Europe,
    - 9% Asia Pacific, 1% SA
    - 18 Countries

- Scope

- This day-long event continued the workshop series' focus on identifying the latest improvements in magnetic materials, coil (winding) design, construction and fabrication, evaluation and characterization techniques and modelling and simulation tools to target the technical expectations and requirements of higher application frequencies while addressing two specific issues of interest: measurement and reporting of data to improve modelling of ac power loss measurements and the impacts of fringing effects on power magnetics performance. The target audience for this workshop is anyone working to achieve higher power densities, low profile aspect ratio, higher efficiencies and improved thermal performance.

- Agenda

Time	Event
7:00 AM - 8:00 AM	Breakfast
8:00 AM - 8:05 AM	Opening Remarks
8:05 AM - 8:45 AM	Keynote Presentation: Opportunities for New Magnetics Designs to Address Market-Driven Technology Trends in Automotive Applications
8:45 AM - 9:40 AM	Technical Session - Design and Optimization of Magnetics for Different Applications Part I
9:40 AM - 10:00 AM	Break
10:00 AM - 12:00 Noon	Technical Session - Design and Optimization of Magnetics for Different Applications Part II
12:00 Noon - 2:00 PM	Technology Demonstration and Posters Session
2:00 PM - 2:50 PM	Keynote Presentation: Thermal, Scaling and Dielectric Issues in Magnetics Design
2:50 PM - 3:40 PM	Technical Session - Thermal Design and Other Special Issues: Partial Discharge, Insulation, etc. - Part I
3:40 PM - 4:00 PM	Break
4:00 PM - 4:45 PM	Technical Session - Thermal Design and Other Special Issues: Partial Discharge, Insulation, etc. - Part II
4:45 PM - 5:00 PM	Closing Remarks - Best of the Best
5:00 PM - 6:00 PM	Networking Session

- Financials

- 31.7% Surplus on ~ \$50K income

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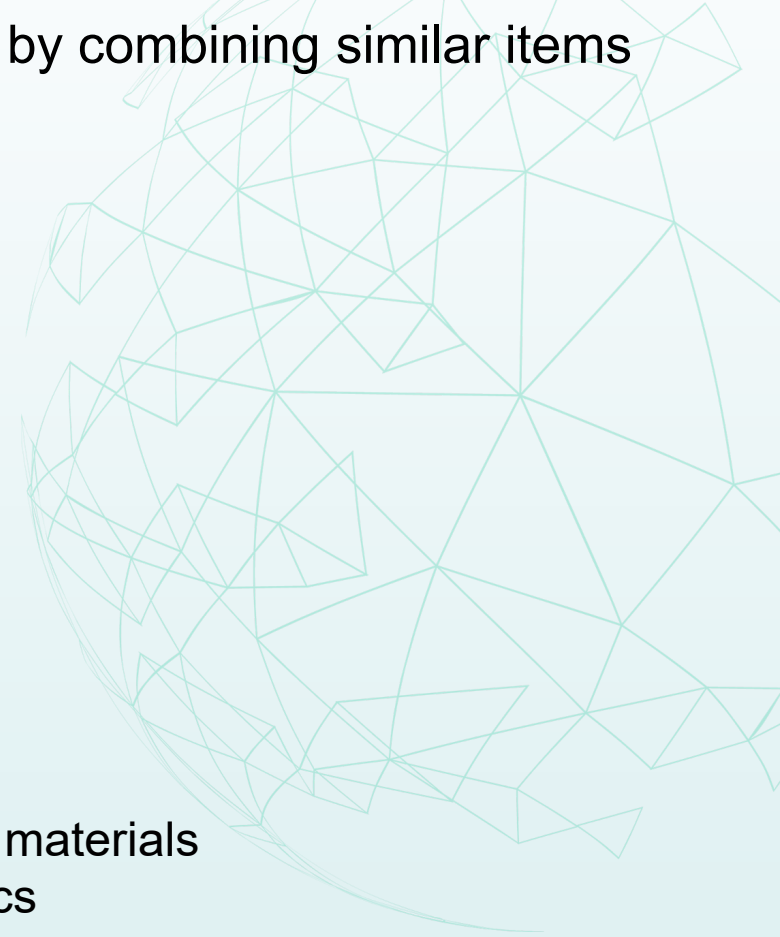


Question 9: Please suggest topics for the magnetics workshop to concentrate on next year.

Pre-sort

Pare down original list of 65 items to 15 items by combining similar items

1. Magnetic integration
2. Best practices on testing
3. AC winding loss modeling
4. Core testing
5. Database sharing
6. Core modeling
7. AI for modeling and design
8. Manufacturing of magnetics, DFM
9. Planar magnetics
10. Insulation materials and failures
11. Medium voltage magnetics
12. New magnetic materials
13. Electroplated, thin film, 3D printed magnetic materials
14. Wireless, EV, coupled, multi phase magnetics
15. Cooling concepts



Sponsored by:



# PSMA Magnetics Committee Meeting Agenda Workshop Planning Notes

## March 27, 2024

- Integrated Magnetics

- Physical Integration Types

- Heterogeneous Integration
  - 2.5D Vs 3D
  - Lateral Vs Vertical
- Embedded magnetics
  - PCB windings about a magnetic core

- Power System in Package

- Silicon + Discrete Magnetics in semiconductor packaging

- Wafer level (on silicon) magnetics

- Sputtered
- Electroplated

- Issues

- Thermal Limitations
- Assembly methods

Afternoon  
Session

Agreement of  
highlighted topics

- Integrated Magnetics

- Electrical Characteristic Integration

- LLC
- Coupled Inductors
- TLVR
- VERT

Morning  
Session

Integration  
has different meaning  
for different audiences  
Need definition for  
workshop audience

# ***PSMA Magnetics Committee Meeting Agenda Workshop Planning Notes***

## ***March 27, 2024***

- Additional discussions
  - Start to finish to manufacture a magnetic components
    - Materials
      - Conductors
      - Insulation
      - Core Materials
    - Assembly
    - Testing
    - Qualification
    - Reliability
    - Application/Environment Considerations
      - Cooling
        - » Conduction
        - » Forced Air
      - Special Consideration
        - » Aerospace
        - » Automotive
  - Other

Could be industry session  
Reference SST discussion  
on industry session slide



# ***PSMA Magnetics Committee Meeting Agenda Workshop Planning Notes***

## ***March 27, 2024***

- Additional discussions
  - Core Loss Testing & Modelling can be one session
    - Impact of machine learning to predict core loss
  - AI for overall design?
- Tech Demos
  - Core Loss Database project
    - Demonstration of the website database
      - Visualization of core loss data
  - Our other project – core permittivity and permeability characteristics
  - Zimmer wattmeter
  - Fair-Rite – dimensional resonance



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# ***PSMA Magnetics Committee Meeting Agenda - Industry Session Planning Notes***

## ***March 27, 2024***

- All aspects of fabricating a Solid-State Transformer (SST)
  - Conductor design
  - Insulation/Isolation Issues
  - AC Power Loss
  - Magnetic Core materials
  - Thermal Design
  - Environmental Design
  - Capacitance
  - Coupling and Leakage Inductance
  - Other? SMART transformer?
    - *Are there seven specific topics to fill an industry session*
    - *Or should we consider four topics to fill the afternoon of the magnetics workshop*
- **Focus on the transformer of Solid-State Transformer**
  - Too many APEC and ECCE session on SST focus on topology rather than the transformer

What is definition of SST?  
Per Kolar (1kHz to 20 kHz)

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# 2022/2023/2024 PSMA PTR Webinar Series

## Potential Contributions from the Magnetics Committee

- Tyndall – Ranajit Sai
  - Core Loss Mechanisms
  - Presentation delivered November 30 ✓
- Utah State University – Reebal Nimri
  - High Power (1 MW) Charging
  - 2024 Q2/Q3
  - Confirmed 8/16/23
- Fraunhofer – Florian Ziegler
  - PowderMEMS – a novel technology for fabrication of functionalized MEMS structures
  - Spring 2024
  - Confirmed 1/16/24 – e-mail of introduction sent March 5, 2024
- CBMM - Bharadwaj Reddy Andapally
  - Technology Roadmap for Nanocrystalline Cores
  - Spring 2024
  - Confirmed: 9/1/23 – reconfirmed during the 2024 workshop



Potential Source of Additional Presentations  
Intermag Japan  
Presentations  
Measurement Techniques  
New Materials

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# ***PSMA Magnetics Committee Meeting Agenda – Special project***

## ***March 27, 2024***

- Special Projects
  - In Process
    - Core Loss Database
    - Electrical parameters of magnetic materials
  - Pending
    - Steinmetz Like Approximation
    - Electrical parameters of magnetic materials
    - Propagation in magnetic materials
    - Current driven core loss testing
    - Spice model



# ***PSMA Magnetics Committee Meeting Agenda – Special Projects***

***March 27, 2024***

- Electrical parameters of magnetic materials
  - Proposal approved during PSMA BOD meeting on November 17
  - Preliminary results shared with PSMA Magnetics Committee during December 18 meeting
  - Draft report distributed by e-mail to attendees of January 24 PSMA Magnetics committee meeting
  - Final report approved for placement on a tab on the Magnetics Forum during meeting on Feb 28

## **Discussion Decisions**

- Draft dated January 22, 2024 is ready to placed in the Special projects Tab on Magnetics Forum
  - Confirmed by Ed Herbert and Jonas Muhlethaler
  - This report should be behind a members only firewall
  - Reference Ed Herbert e-mail of February 25, 2024
- Maintain Core Loss Studies as a Separate Tab
- Create a new Special Projects tab for all this and all future special projects
- In the future Core Loss Data Base may be a separate tab from Core Loss Studies

**Need to follow up on  
creating the  
Special Projects Tab**

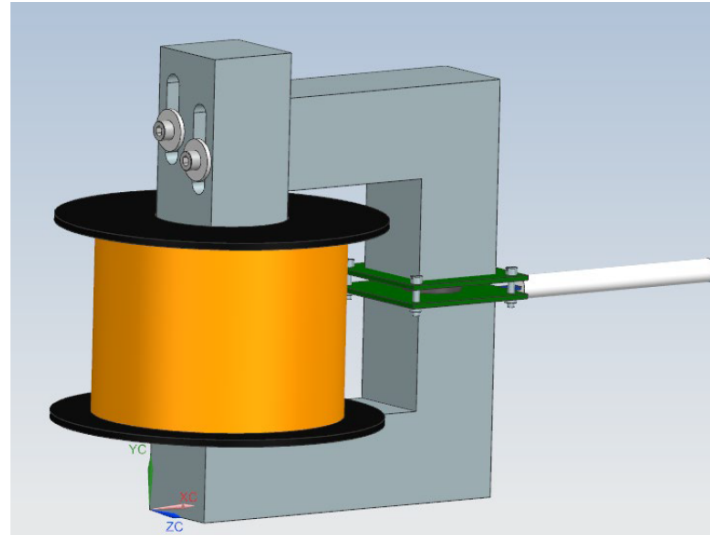


# PSMA Magnetics Committee Meeting Agenda – Special Projects

March 27, 2024

Lucerne University of Applied Sciences and Arts

Lucerne School of Engineering and Architecture



JC Sun will provide existing standards that can be used to test material as well for comparison

Lukas Mueller will contact a university that is about to publish a paper on the same topic to try get an early copy

## Characterization of Core Material

Author: Frédéric Mathieu

Supervisor: Prof. Dr. Jonas Mühlethaler

Expert: Dr. Severin Nowak

Industrial partner: Power Sources Manufactures Association (PSMA)

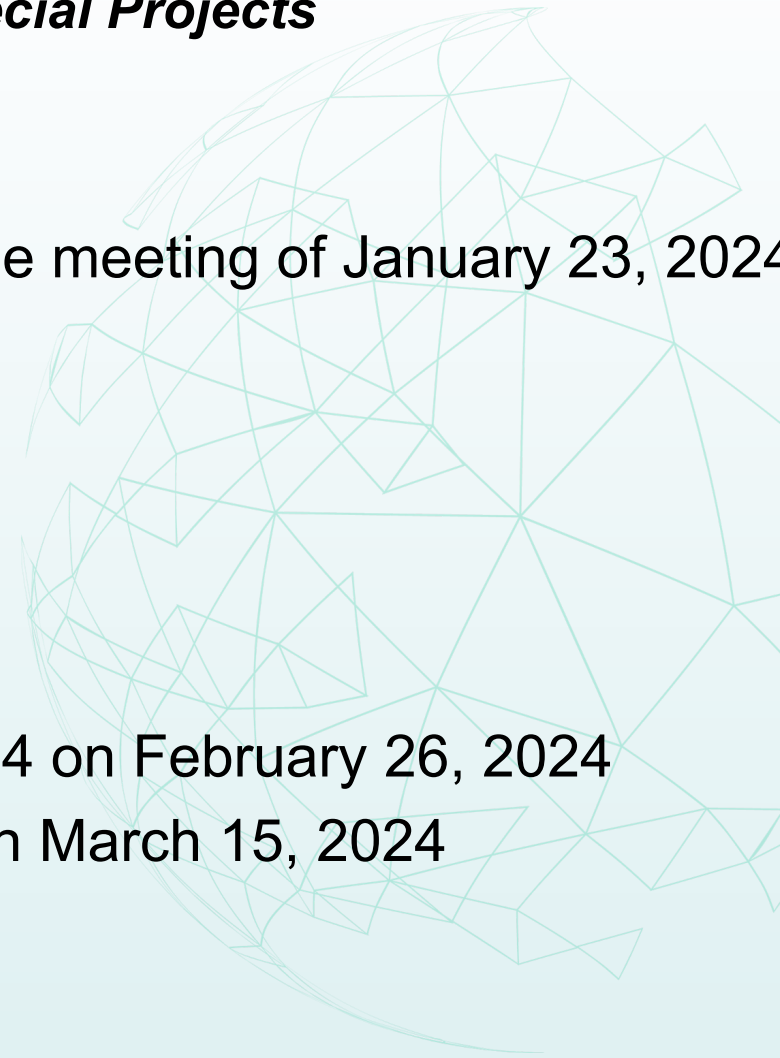
January 22, 2024

Confidentiality level: Public

# ***PSMA Magnetics Committee Meeting Agenda – Special Projects***

## ***March 27, 2024***

- Core Loss Database
  - E-mail ballot after PSMA Magnetics Committee meeting of January 23, 2024
    - Ballots sent:13
    - Ballots Returned:11
    - Return Rate: 85%
    - Approve Ballots: 11
    - Disapprove Ballots: 0
    - Approval Rate: 100%
  - Special project proposal to BOD at APEC 2024 on February 26, 2024
  - BOD approved project during BOD meeting on March 15, 2024
    - Ongoing support for three additional years



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# ***PSMA Magnetics Committee –Magnetics Committee Forum on PSMA Website March 27, 2024***

- Ongoing discussion to create a Short Videos Tab on Magnetics Forum to address specific topics of general interest
  - This could be the home of a “Magnetics Are Everywhere” introductory video
  - These can be simple redirects to URLs already established by PSMA members
    - Helps traffic to magnetics forum
    - Increases audience access for PSMA member companies
- **Action item for members to review HF task force page for whether to keep, it update it, add to it – could be used to organize information**

<https://www.pdma.com/technical-forums/magnetics/hf-task-force>

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# ***PSMA Magnetics Committee Meeting***

## ***March 27, 2024***

- Attendance (14)
  - John Horzepa
  - Joe Horzepa
  - Mike Arasim
  - Alan Cooper
  - Doug Eaton
  - Ed Herbert
  - Alfonso Martinez
  - Lukas Mueller
  - Marek Rylko
  - Ranajit Sai
  - George Slama
  - JC Sun
  - Mark Swihart
  - Hongbo Zhao



**PSMA Magnetics Committee**  
**March 27, 2024**

**Thank You**

