The Multinational Power Electronics Association

PSMA Magnetics Committee Meeting

July 10TH 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
July 10, 2024

- Introductions
- 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

PSMA Magnetics Committee Meeting Agenda
July 10, 2024

- Introductions
- 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

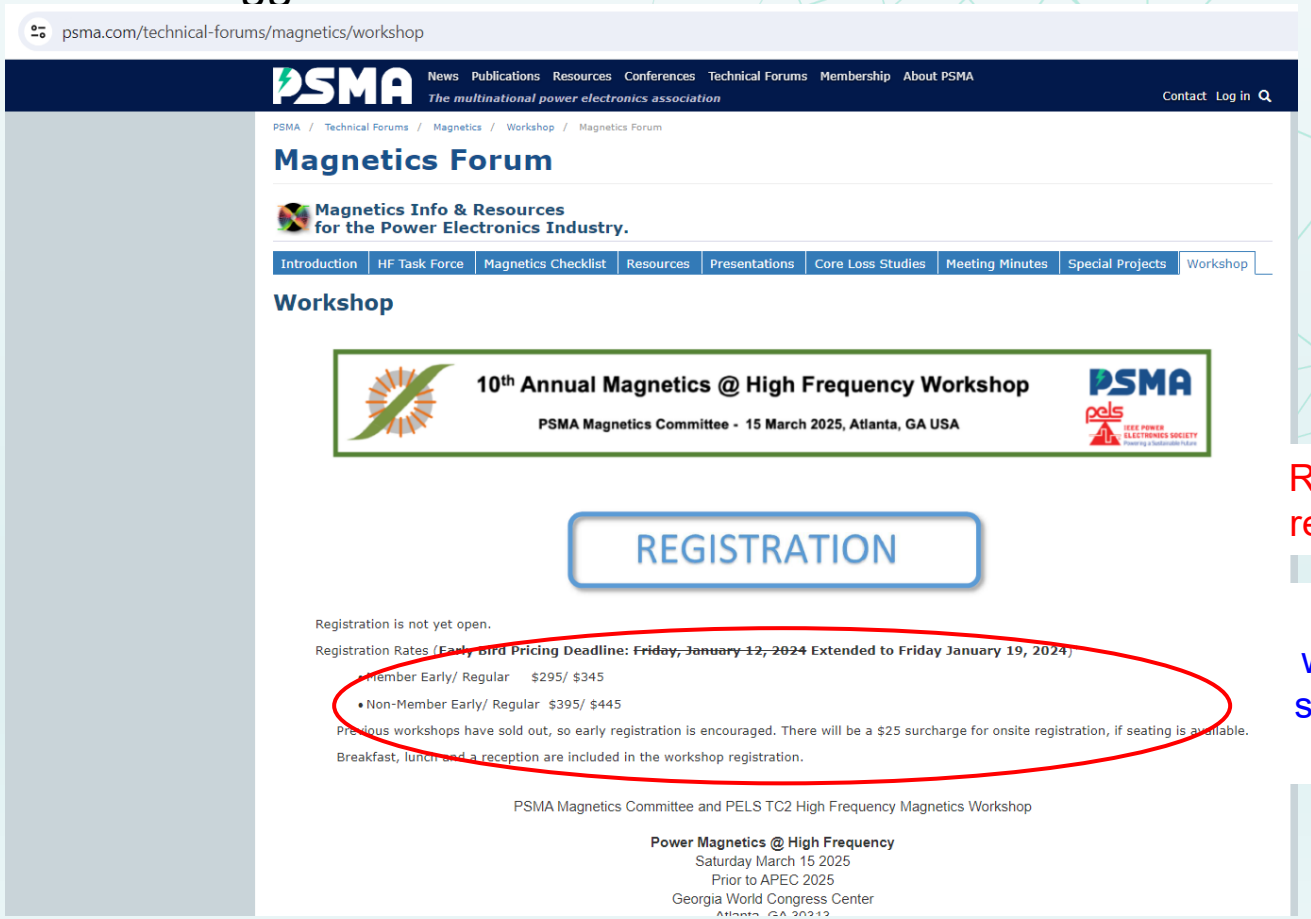
PSMA Magnetics Committee Meeting Agenda Workshop Planning Notes July 10, 2024

- Workshop Tab
  - Needs to be updated to reflect date for 2025 workshop –complete
    - Note comment on next slide regarding workshop partners
  - Workshop presentations available to 2024 attendees
    - Available on Presentations tab if logged in

Discussion:
Preserve partners for specific workshop years
Either by

1. Part of the running text on the workshop home page
2. Presentation pages for each workshop year

Matt W to work with John H for the most practical approach



Remove fees until registration opens

Fees for 2025 workshop will be the same as for the 2024 workshop

PSMA Magnetics Committee Meeting Agenda Workshop Planning Notes July 10, 2024

- Workshop Tab
  - Workshop partners
    - 2024 Workshop partners removed
    - 2023 Workshop partners still listed

Add photos to 2024 workshop text.

Example of preserving workshop partners for 2023 workshop

PSMA Magnetics Committee Meeting Agenda Workshop Planning Notes July 10, 2024

- Special Project Nomination Form For 2025 Magnetics Workshop

PSMA Special Project Nomination Form

Date: June 12, 2024

Committee sponsoring the project: PSMA Magnetics Committee
Project Champion
Individual sponsoring the project: Matt Wilkowski, Co-Chairman; Ed Herbert, Co-Chairman

Team Members identified: George Slama,
Potential Team Members: Rodney Rogers Mike Arasim, Lukas Mueller, Paul Ohodnicki, Mike Ranjram
Project Description and Scope: "10TH Annual Power Magnetics @ High Frequency Workshop 2025"
A workshop on High Frequency Magnetics.

PSMA Mission

To enhance the stature of member companies and their products and to improve their knowledge of industry developments.

How will this Project support the mission of PSMA?
This project will bring together experts from aspects of power magnetics design ranging from magnetic and conductor materials thru fabricators of transformers and inductors, designers of power magnetic components and users of power magnetic components to establish common terminology, identify mature, state of the art and roadmap materials and techniques for power magnetics design and manufacture.

Who will benefit from this project? What will be the benefits?
Designers of power magnetics for electronics power applications will benefit since they will have an opportunity to voice their needs to their supply chain (magnetic materials and cores, transformer and inductor manufacturers, test equipment suppliers and providers of modelling and simulation tools).
The supply chain for power magnetics will benefit as they will have access to the concerns and needs of their ultimate customers so as to identify areas of improvement that can address in both the short term and in the long term.

What will be the output of the project? (report, workshop, award, etc.)
The tangible output of the workshop will be the presentation slides and recordings of the presentations themselves.

What is the budget for this project? Not to exceed $30,000. We expect to recover all or most of this expense though attendance charge, tentatively $295 for PSMA members and $395 for nonmembers (early registration) increasing by $50 for late registration and $100 for walk-ins. And Partnership income.

Breakdown of expected income.

Description	Estimated Income
Estimated registrations	100
Estimated average fee	$300
Estimated registration income	$30,000
Estimated partnership income	$2,500
Total	$32,500

Please provide a breakdown for the expected expenses.

Description	Estimated Cost
Administration	$2,500
Credit card expense	$1,000
Breakfast	$1,500
Lunch	$3,500
Breaks	$1,200
Network Hour	$4,000
Audio Visual	$5000
Recording Fees	$1500
Registration expenses	$300
Travel Expenses, Co-Chairmen	$2,000
Miscellaneous	$1,000
Total	23,500
Requested budget	Not to exceed $30,000

Based on the 2024 workshop.

We expect to recover all of the expenses and make a profit, as we have every year in the past.

Project Milestone Targets

Milestone	Target Date
Workshop	Saturday March 15, 2025
Workshop slides and recordings	Saturday April 19, 2025

Measure of success for this project:

- Past Workshops o The workshops of 2016 through 2024 were very successful growing each year in attendance. A summary of a survey done at the 2024 workshop is attached.

Decision:
5-0 to submit special project nomination form for 2025 Magnetics Workshop for consideration at the PSMA BOD meeting on June 21 2024

Approved by BOD on June 21 2024

PSMA Magnetics Committee Meeting Agenda Workshop Planning Notes July 10, 2024

- Special Project Nomination Form For 2025 Magnetics Workshop

Magnetics workshop:

Survey notes for 2024 workshop.

- Attendance
  - Total: 132
    - By Sector
      - 73% Industry, 27% Research
    - By Global Region
      - 68% NA, 22% Europe, 9% Asia Pacific, 1% SA
    - 18 Countries
- Survey Results (82 responses)
  - Response Rate: 62%
  - Overall Rating:
    - 35% Excellent, 46% Very Good, 17% Good
  - Value
    - 49% Excellent, 40% Good, 11% Average
  - Skill of the presenters
    - 58% Superior, 33% Above Average 9% Average
  - Recommend workshop to a colleague
    - 83% Yes, 15% maybe, 2% No
  - First Time attendees 60%
  - Plan to attend next year 63% Yes 35% Maybe
  - General topics for next workshop based on survey
    - Thermal Design - Power Loss Density Thermal Aging
    - Core Loss testing, modelling & specification
    - Integrated Magnetics

- Survey Results – General topics for 2025

Topic	Score
Thermal Aging Thermal Design and power loss density	301
Core Loss testing, modelling and specifications	299
Integration of Magnetic Functions	277
Temperature testing and temperature coefficients	264
Specific Testing of Magnetics	256
Artificial Intelligence for simulation and design	256
Verification Vs Qualification Vs Manufacturing Test Procedures	250
Specific Topologies	244
Specific Applications	235

PSMA Magnetics Committee Meeting Agenda Workshop Planning Notes
July 10, 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

- Integrated Magnetics
  - Electrical Characteristic Integration
    - LLC
    - Coupled Inductors
    - TLVR
    - VERT

Morning Session

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

Agreement of highlighted topics

- Wurth – Martin Sittner
- Tyndall
- Frenetic
- Bryce – Utah State
- Jose Cobos –
- Roshen, Waseem
- Rico, TriDelta

Lukas – LLC design
Open magnetics – simulation, design
Cuk – LLC, circuit concept
Virginia Tech – Understanding core Ae/Le
Dan Jitaru
Premo Power – 3D magnetics

PSMA Magnetics Committee Meeting Agenda Workshop Planning Notes
July 10, 2024

- Morning Session – Physical Integration
  - Plenary – David Perreault?
  - Magnetics integration for 2.5D Vs 3D Packaging – Ranajit Sai (Tyndall) ✓
  - Wafer Level Magnetics Sputtered – Martin Haug/Martin Sittner (Wurth)?
  - Single Device Multi Function SDMF – Premo Power?
  - Planar Magnetics – Payton Magnetics?
  - Assembly methods – Sandia? – Additives combining core/winding
  - Power System in Package
    - Silicon + Discrete Magnetics in semiconductor packaging - ???
  - Thermal Limitations – Heat sinking/thermal transfer
- Afternoon Session - Electrical integration
  - Plenary – Charlie Sullivan?
  - VIRT – Mike Ranjram (ASU) ✓
  - Simulation – Alfonso Martinez (Wurth) ✓
  - Capacitor/Inductor – Phyo Kyaw (Resonant Link)?
  - TLVR – ADI, Eaton, TI, CPES?
  - LLC – ??? (Backup - Lukas Mueller)
  - Coupled Inductors - ???

Morning Session need plenary presentation plus 5 lecture presentations

Afternoon Session need plenary presentation plus 4 lecture presentations

PSMA Magnetics Committee Meeting Agenda Workshop Planning Notes
July 10, 2024

- Plenary Speakers
  - Presenters from first workshop
    - Candidates to pursue
      - David Perreault
      - Charlie Sullivan
    - Topics
      - Advances in magnetics over the past ten years
        - » Electrical performance
        - » New structures
- Candidates for future workshop leadership
  - Candidates to pursue
    - Paul Ohodnicki – UPITT – confirmed interest
    - Mike Ranjram – ASU – confirmed interest
    - Andres Arias – Premier – need to contact

PSMA Magnetics Committee Meeting Agenda Workshop Planning Notes
July 10, 2024

- Tech Demos - Confirmed
  - Zimmer wattmeter ✓
  - Fair-Rite – dimensional resonance, fringing mitigation, core design – Mike Arasim ✓
  - Open magnetics demo – Alfonso Martinez ✓
  - MicroMetals – active damping of EMI filters using low Q powder materials – Lukas Mueller ✓

PSMA Magnetics Committee Meeting Agenda Workshop Planning Notes
July 10, 2024

- Tech Demos - Identified
  - Core Loss Database project
    - Demonstration of the website database
      - Visualization of core loss data
  - Our other project – core permittivity and permeability characteristics
    - Jonas' student either a tech demo or a poster
    - IEC TC51 WG10 (Saito)
    - University of Padaborn - Till Piepenbrock
    - Bruce Carsten
  - JC Sun – integrated instrument to measure losses with Zimmer
  - PE System – dual pulse test – Alfonso to contact
  - Partial Discharge system (Chroma, Hipotronics, Hubbel, …)
    - Doble Falk Werrner
  - Capacitor with magnetics (Alan) LLC – capacitor voltage rating
  - Build an integrated device
  - Component manufacturers of Integrated Magnetics
    - Premier Magnetics – Andres Arias – Matt to send invitation
    - Payton Magnetics

PSMA Magnetics Committee Meeting Agenda Workshop Planning Notes
July 10, 2024

- Posters
  - HLSU – Frederic (maybe someone else – contact Jonas M)
    - Core permittivity and permeability characteristics
  - UPITT – TBD (Sturdivant?)
    - Application of multiple objective optimization relative magnetics integration or other magnetic design topic
  - ASU – TBD
    - TBD
  - MIT – Rachel Yang
    - TBD

PSMA Magnetics Committee Meeting Agenda
July 10, 2024

- Introductions
- 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

PSMA Magnetics Committee Meeting Agenda - Industry Session Planning Notes
July 10, 2024

Solid State Transformers From Supply Chain to Qualified Installed Product
Solid State Transformers From Genesis to Backbone Product of the Smartgrid Revolution
Focus on Solid State Transformers
ABC's of Solid Sate transformers
The Transformer in the Solid State Transformer

- All aspects of fabricating a Solid-State Transformer (SST)
  - Conductor design
  - Insulation/Isolation Issues
    - *Paul Ohodnicki – UPITT – P3105 Subgroup 2 Isolation Issues for SST* ✓
  - AC Power Loss
  - Magnetic Core materials –AMPED (NCSU, UPITT) CorePower Magnetics?
  - Thermal Design – NCSU?
  - Environmental Design
  - Capacitance – *Hongbo Zhao (Aalborg University)*
  - Coupling and Leakage Inductance
    - *Drazen Dujic – EPFL – Inductance and Leakage Inductance Measurements for MFT*
  - Other? SMART transformer?
- **Focus on the transformer of Solid-State Transformer**
  - Too many APEC and ECCE session on SST focus on topology rather than the transformer

North Carolina State

Coolmag – thermal potting (demo too)
url: https://coolmag.net/
Contact is Alfonso

Core Loss – Ensuring the Quality of the Data
Core Loss – Making the Data Reliable and Useable
Core Loss – Consolidating Too Much Data
Core Loss – Making All the Data Useable

- Additional four-presentation industry session
  - Core Loss Testing & Modelling
    - Scientific Network of Magnetics – Jens Friebe – Kassel ✓
    - HFEMAG European Metrology Labs Correlation Project – Massimo Pasquale – INRIM ✓
    - Triple Pulse Core Loss Testing - Jun Wang – University of Bristol
    - PSMA – Core Loss Database website – George Slama – Wurth Elektronik
    - ETTC P393 Core Loss measurement proposal – Matt Wilkowski – Wurth Elektronik
    - Impact of machine learning to predict core loss – Minjie Chen - Princeton

PSMA Magnetics Committee Meeting Agenda
July 10, 2024

- Introductions
- 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

2024 PSMA PTR Webinar Series
Potential Contributions from the Magnetics Committee

- Fraunhofer – Torben Dankwort
  - PowderMEMS – a novel technology for fabrication of functionalized MEMS structures
  - Thursday June 13 √
- CBMM - Bharadwaj Reddy Andapally
  - Technology Roadmap for Nanocrystalline Cores
  - Tentatively scheduled for Thursday July 25
- Utah State University – Reebal Nimri
  - High Power (1 MW) Charging
  - Re-Confirmed June 3
    - October 2024 timeframe

2024 PSMA PTR Webinar Series
CBMM – Thursday July 25

https://psma.com/technical-forums/roadmap/news-events

To receive invitations to future webinars, join our mailing list.

Upcoming 2023-2024 Roadmap Presentations

Title: Technology Roadmap for Nanocrystalline Magnetic Materials

Date: Thursday, July 25, 2024 10 AM Central Time

Abstract:

As the power electronics landscape evolves, nanocrystalline soft magnetic materials are at the forefront of technological advancements, particularly in the e-mobility sector. This webinar will present a comprehensive technical roadmap of these cutting-edge materials, emphasizing their transformative impact on common mode chokes (CMC) and electromagnetic compatibility (EMC) filters used in onboard chargers and inverters.

Nanocrystalline soft magnetic materials are celebrated for their exceptional magnetic properties, including high permeability, low core losses, and impressive thermal stability. These characteristics make them ideal for high-frequency applications and compact power supply designs. With the growing demand for electric vehicles (EVs), the need for efficient, reliable power management solutions has never been greater. This webinar will explore the latest innovations in nanocrystalline technology and their critical role in meeting the stringent performance requirements of modern e-mobility systems.

innovations in nanocrystalline technology and their critical role in meeting the stringent performance requirements of modern e-mobility systems.

We will delve into the specific advantages of nanocrystalline materials in the design and optimization of CMC and EMC filters. These components are essential for minimizing electromagnetic interference (EMI) and ensuring compliance with global EMC standards. By leveraging the unique properties of nanocrystalline cores, engineers can achieve significant improvements in performance and efficiency, leading to more compact and reliable onboard chargers and inverters.

Key topics will include:

- The inherent properties and benefits of nanocrystalline soft magnetic materials.
- Their application in enhancing the efficiency and reliability of CMC and EMC filters.
- Design considerations and best practices for integrating these materials into EV power management systems.
- Case studies and real-world examples demonstrating successful implementations.

Presenters: Bharadwaj Reddy Andapally, CBMM

Bharadwaj Reddy has a master's degree in electrical power engineering from the Technical University of Delft (Netherlands), specializing in power electronics and magnetics design, and a Bachelor of Technology in Electrical and Electronics from VIT University in India. Since 2014 he has been active in the engineering field. He worked at Philips LED platform development (2014-2015) in Eindhoven (Netherlands) to develop efficient power supplies for LED retrofit tubes. He worked from 2015 to 2021 at ISE Magnetics – Netherlands (Spinoff of Philips medical systems & Aperam alloys) as an R&D engineer to design custom magnetics for power electronics and executed successful projects with top automotive and aerospace clients during his tenure. He gained vast experience from Philips magnetic materials division that developed magnetic components for TV & Medical power supplies (Flyback, DAB, LLC, DC-DC inductors, PFC inductors) and pioneered high-power planar transformers design (100KW) for demanding applications. During his work at ISE, he served as a magnetics innovation coordinator at the European Center of Power Electronics (ECPE) – Nuremberg- Germany. In 2020 he started working at CBMM as a Technical advisor for nanocrystalline soft magnetic material market development. In 2022 he joined CBMM full-time as a Technical Market development specialist – in global nanocrystalline materials.

Register Here

PSMA Magnetics Committee Meeting Agenda
July 10, 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

PSMA Magnetics Committee Meeting Agenda – Special project
July 10, 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
July 10, 2024

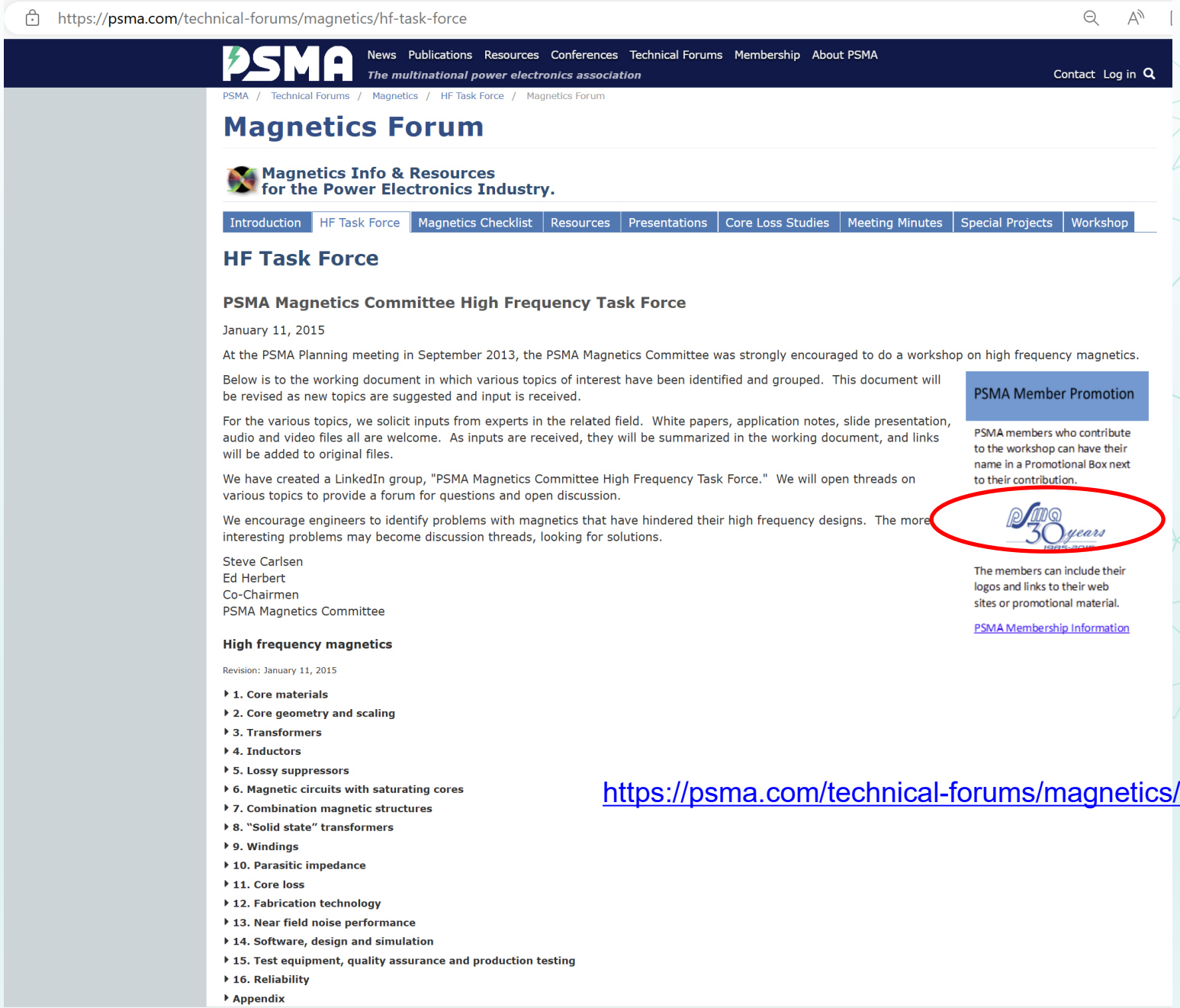
- Core Loss Database
  - Database should be on its own website
    - Link to the website on a tab in the PSMA Magnetics Forum

PSMA Magnetics Committee Meeting Agenda
July 10, 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

PSMA Magnetics Committee –Magnetics Committee Forum on PSMA Website

July 10, 2024



https://psma.com/technical-forums/magnetics/hf-task-force

PSMA — The multinational power electronics association

News Publications Resources Conferences Technical Forums Membership About PSMA

Contact Log in

PSMA / Technical Forums / Magnetics / HF Task Force / Magnetics Forum

Magnetics Forum

Magnetics Info & Resources for the Power Electronics Industry.

Introduction | HF Task Force | Magnetics Checklist | Resources | Presentations | Core Loss Studies | Meeting Minutes | Special Projects | Workshop

HF Task Force

PSMA Magnetics Committee High Frequency Task Force

January 11, 2015

At the PSMA Planning meeting in September 2013, the PSMA Magnetics Committee was strongly encouraged to do a workshop on high frequency magnetics.

Below is to the working document in which various topics of interest have been identified and grouped. This document will be revised as new topics are suggested and input is received.

For the various topics, we solicit inputs from experts in the related field. White papers, application notes, slide presentation, audio and video files all are welcome. As inputs are received, they will be summarized in the working document, and links will be added to original files.

We have created a LinkedIn group, "PSMA Magnetics Committee High Frequency Task Force." We will open threads on various topics to provide a forum for questions and open discussion.

We encourage engineers to identify problems with magnetics that have hindered their high frequency designs. The more interesting problems may become discussion threads, looking for solutions.

Steve Carlsen
Ed Herbert
Co-Chairmen
PSMA Magnetics Committee

PSMA Member Promotion

PSMA members who contribute to the workshop can have their name in a Promotional Box next to their contribution.

The members can include their logos and links to their web sites or promotional material.

PSMA Membership Information

High frequency magnetics

Revision: January 11, 2015

- 1. Core materials
- 2. Core geometry and scaling
- 3. Transformers
- 4. Inductors
- 5. Lossy suppressors
- 6. Magnetic circuits with saturating cores
- 7. Combination magnetic structures
- 8. "Solid state" transformers
- 9. Windings
- 10. Parasitic impedance
- 11. Core loss
- 12. Fabrication technology
- 13. Near field noise performance
- 14. Software, design and simulation
- 15. Test equipment, quality assurance and production testing
- 16. Reliability
- Appendix

Update

https://psma.com/technical-forums/magnetics/hf-task-force

PSMA Magnetics Committee –Magnetics Committee Forum on PSMA Website
July 10, 2024

PSMA Membership Information

High frequency magnetics

Revision: January 11, 2015

1. Core materials

This section discusses the characteristics of various materials used to make inductor and transformer cores. Manufacturers are encouraged to provide their catalogs and data sheets to be included. Manufacturers who are PSMA members may have a promotional block placed in this report.

A good over-view of the various magnetic materials and their selection criteria can be found in "Magnetic Core Materials in HF Applications."[1]

1.1. Ferrite

1.2. Low temperature cured ferrites

1.3. Powdered metal

1.4. Nanocrystalline and amorphous metals

1.5. Composite cores

1.6. Tape-wound cores

1.7. Selection criteria

[1] Magnetic Core Materials in HF Applications; Dr. Jonas Mühlethaler, Gecko-Simulations, AG; an APEC2014 Industry Session

2. Core geometry and scaling
3. Transformers
4. Inductors
5. Lossy suppressors
6. Magnetic circuits with saturating cores
7. Combination magnetic structures
8. "Solid state" transformers
9. Windings
10. Parasitic impedance
11. Core loss
12. Fabrication technology
13. Near field noise performance
14. Software, design and simulation
15. Test equipment, quality assurance and production testing
16. Reliability
Appendix

Populate section 1.3 and 1.7 with content proposed by Lukas Mueller

PSMA Member Promotion

Tyndall National Institute

Add Micrometals logo with link to Micrometals website to this section of HF task force

https://psma.com/technical-forums/magnetics/hf-task-force

PSMA Magnetics Committee –Magnetics Committee Forum on PSMA Website
July 10, 2024

Proposal By Lukas Mueller on June 28, 2024

Section 1.3 Powder Materials

Powdered metal-based cores are made from small particles of magnetic material that are insulated, mixed with a binder and pressed into a solid core shape. The defining characteristic of powder cores is their low starting permeability ranging from 4 to 550 and soft-saturation characteristic. Unlike a gapped high permeability material, a powder material will gradually lose its permeability with increasing magnetization force. Coupled with powder materials with high saturation flux density, these materials can store higher amounts of energy per unit volume than ferrite. Core loss is generally higher for powder materials than ferrite.

There are three broad subtypes of powder metal cores depending on the base raw material used: iron, carbonyl iron and alloy.

1.3.1 Powder iron cores are made from reduced iron. The main advantage of powder iron is the materials high saturation flux density, high amplitude permeability, high damping and low cost. The main disadvantage of powder iron is its high core loss compared to other materials, making it more suitable for low frequency power conversion, line reactor or EMI filtering applications

1.3.2 Carbonyl iron-based cores feature low eddy current losses due its unique magnetic particle structure. This gives these types of materials a stable permeability over a wide frequency range. The main application for carbonyl iron-based cores is in high Q resonant inductors and broadband transformers at frequencies above 1MHz.

1.3.3 Alloy powder cores feature lower hysteresis losses than powder iron cores. The stability of these materials' permeability versus magnetization force is also significantly better. Alloy powder cores excel in DC inductors in filtering and power conversion applications. There is a large variety of alloy cores including but not limited to: Sendust, Permalloy, Mollypermalloy and Silicon Steel.

PSMA Magnetics Committee –Magnetics Committee Forum on PSMA Website
July 10, 2024

Proposal By Lukas Mueller on June 28, 2024

Section 1.3 Powder Materials

Powdered metal-based cores are made from small particles of magnetic material that are insulated, mixed with a binder and pressed into a solid core shape. The defining characteristic of powder cores is their low starting permeability ranging from 4 to 550 and soft-saturation characteristic. Unlike a gapped high permeability material, a powder material will gradually lose its permeability with increasing magnetization force. Coupled with powder materials with high saturation flux density, these materials can store higher amounts of energy per unit volume than ferrite. Core loss is generally higher for powder materials than ferrite.

There are three broad subtypes of powder metal cores depending on the base raw material used: iron, carbonyl iron and alloy.

1.3.1 Powder iron cores are made from reduced iron. The main advantage of powder iron is the materials high saturation flux density, high amplitude permeability, high damping and low cost. The main disadvantage of powder iron is its high core loss compared to other materials, making it more suitable for low frequency power conversion, line reactor or EMI filtering applications

1.3.2 Carbonyl iron-based cores feature low eddy current losses due its unique magnetic particle structure. This gives these types of materials a stable permeability over a wide frequency range. The main application for carbonyl iron-based cores is in high Q resonant inductors and broadband transformers at frequencies above 1MHz.

1.3.3 Alloy powder cores feature lower hysteresis losses than powder iron cores. The stability of these materials' permeability versus magnetization force is also significantly better. Alloy powder cores excel in DC inductors in filtering and power conversion applications. There is a large variety of alloy cores including but not limited to: Sendust, Permalloy, Mollypermalloy and Silicon Steel.

Proposal By Lukas Mueller on June 28, 2024

Section 1.7 Selection criteria

The defining selection criteria for magnetic materials are: core loss, saturation flux density, inductance stability, temperature range and mechanical ruggedness.
For AC applications like high Q resonant inductors or transformers low core loss at the intended switching frequency is the primary concern. The performance factor of different material grades can be used to identify the material with the lowest core loss at a certain frequency.
For DC switching inductors, like PFC inductors, a mixture of inductance stability and core loss is desirable.
For EMI filter inductors, high damping is beneficial to limit parasitic resonances in the filter. In addition, a high impedance over the desired filtering frequency range is crucial. For DC filter inductors, a high DC bias stability is desired. The material saturation constant can be used to evaluate different materials in this regard. For AC line filter inductors, a high saturation flux density and high amplitude permeability are beneficial.

Proposal By Lukas Mueller on June 28, 2024

Section 1.7 Selection criteria (Continued)

Application	Material 1	Material 2	Material 3	Note
Common Mode Choke	MnZn Ferrite	Nanocrystalline	NiZn Ferrite	Carbonyl iron above 500MHz an option as well
DC Filter Choke	Powder Alloy	MnZn Ferrite	Powder Iron	
AC Line Choke	Power Iron	Powder Alloy	Fe-Si (laminated)	
AC Filter Choke	Carbonyl iron	Powder Alloy	MnZn Ferrute	
CCM Switching inductor	Powder Alloy	MnZn Ferrite	Nanocrystalline	Evaluate DC bias stability vs. core loss
DCM Switching Inductor	MnZn Ferrite	NiZn Ferrite	Carbonyl Iron	Carbonyl iron has higher core loss but lower AC copper loss due to distributed air gap
Tuned RF inductor	Carbonyl Iron	NiZn Ferrite	Air	
Transformer	MnZn Ferrite	Nanocrystalline	NiZn Ferrite	

PSMA Magnetics Committee Meeting Agenda
July 10, 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 – Avoid third Wednesday of the month

PSMA Magnetics Committee Meeting Agenda
July 10, 2024 – Next Meeting

- Wednesday August 7 10:00 AM CDT – 11:00 AM CDT

PSMA Magnetics Committee Meeting
July 10, 2024

- Attendance (11)
  - John Horzepa
  - Mike Arasim
  - Ed Herbert
  - Alfonso Martinez
  - Lukas Mueller
  - Mike Ranjram
  - Rodney Rogers
  - Ranajit Sai
  - George Slama
  - Mark Swihart
  - Matt Wilkowski

Thank You