

Investigating R&D Committee on Technology Using High Frequency Properties of Magnetic Materials

Technical Committee on Magnetics

1. Objective

Increasing frequencies, such as driving frequencies and radio waves, to a high level is a means of accelerating and miniaturizing electronic devices. To achieve this, although new high-frequency magnetic materials have been under continuous development, high-frequency magnetic/micromagnetism remains an important academic and technical issue. One of the latest trends is the especially remarkable advancements in the fields of electromagnetic noise suppression, switching power supply, and measurement, which are raising consumer expectations. Specifically, in the field of noise-suppression, investigations have begun into the application of magnets to the 28-GHz band of Early 5G in communication. In the power supply field, magnetic loading-type reactors that can handle speeding up to 100-MHz band for high-power switching frequencies using switching elements consisting of GaN and other wide gap semiconductors, are being investigated. In the measurement field, high-frequency measurement limits, such as permeability are extended to ≥ 10 GHz, and further increase in frequency has been intensively investigated. Moreover, the target frequencies of research on air-core high-frequency magnetic applications that do not use magnets have been extended to millimeter-wave (30 GHz) and terahertz bands (300 GHz), which are much higher than those used in magnetic applications; however, new magnets that may be utilized have appeared.

Therefore, based on the latest trends, we propose the establishment of an investigation committee on the aforementioned topic, accounting for the future importance of investigations focused on the aforementioned fields, to systematically investigate technologies using the high-frequency properties of magnetic materials, including related micromagnetic elements and analysis.

2. Background and internal and external research activities

The Technical Committee on Magnetics has carried out systematic and continuous investigations on high-frequency magnetism/micromagnetism since the establishment of the Investigation Committee on Micromagnetism in 1982. Furthermore, branches of the IEEE Magnetics Society have been established in various parts of Japan, and international conferences, such as the ICMM (IEEE International Conference on Microwave Magnetics) held every two years since its foundation in 2008, which are mainly hosted by those involved in high-frequency magnetics/micromagnetics belonging to the IEEJ, play a major role in gathering information and the global spread of cutting-edge research. Regarding air-core high-frequency magnetic applications, there are active discussions domestically within the IEICE and abroad within the IEEE Microwave Theory and Techniques Society (MTT-S).

Regarding overseas research and development, there is the case of Intel, the shares of which have been increasing after Toshiba and Fuji Electric plunged into the demand-based era; a result of being too far ahead of the curve in terms of their global leadership of commercializing high-frequency micro power supplies, and thus being forced to withdraw. In addition to such European and US progress, the rise of Asian countries is remarkable, and research activities inside and outside of Japan are indispensable to construct a collaborative framework while maintaining dominance in domestic high-frequency magnetic engineering.

3. Investigative matters

- (1) Investigate trends in the research on materials and technology related to high-frequency electromagnetic noise suppression
- (2) Investigate trends in research on materials and technology related to high-frequency power supplies
- (3) Investigate trends in research on high-frequency magnetism measurement

- (4) Investigate trends in research on high-frequency magnetism/micromagnetism, including high-frequency magnetic elements and analysis

4. Expected effects

- (1) Advancement of high-frequency electromagnetic noise suppression technology using magnets
- (2) Advancements in miniaturization and greater efficiency in high-frequency power supplies through magnets
- (3) Advancements in high-frequency magnetism measurement technologies
- (4) Higher precision in magnetic loading and analysis for micromagnetic elements in bands with higher frequency compared with conventional bands

5. Term of investigation

April 2020 to March 2023 (3 years)

6. Committee members

Position	Name	Affiliation	Member/Non-member category of IEEJ
Chairperson	Masayuki Naoe	Research Institute for Electromagnetic Materials	Member
Member	Shinji Ikeda	Komatsu University	Member
"	Takaaki Ibuchi	Osaka University	Member
"	Tetsuya Ueda	Kyoto Institute of Technology	Non-member
"	Yuji Uehara	Magnetic Device Laboratory, Ltd.	Member
"	Hideo Kaiju	Keio University	Member
"	Yoshiki Kayano	The University of Electro-Communications	Non-member
"	Tadashi Kawai	University of Hyogo	Member
"	Tetsuro Kawai	Yokohama National University	Non-member
"	Hiroaki Kikuchi	Iwate University	Member
"	Masaki Kuramae	Riken Corporation	Non-member
"	Futoshi Kuroki	National Institute of Technology (KOSEN), Kure College	Member
"	Taichi Goto	Toyohashi University of Technology	Member
"	Kosuke Sato	Nagano Prefecture General Industrial Technology Center	Member
"	Toshiro Sato	Shinshu University	Member
"	Yuki Sato	Texas Instruments Japan, Ltd.	Member
"	Makoto Sonehara	Shinshu University	Member
"	Masaaki Takezawa	Kyushu Institute of Technology	Member
"	Shingo Tamaru	National Institute of Advanced Industrial Science and Technology	Non-member
"	Hidetoshi Nakayama	National Institute of Technology (KOSEN), Nagano College	Member
"	Asuka Namai	The University of Tokyo	Member
"	Kiyozumi Niizuma	Nihon University	Member
"	Kenichi Nishijima	National Institute of Technology, Toyama College	Member
"	Naoyuki Fujita	National Institute of Technology (KOSEN), Nara College	Member
"	Sho Muroga	Akita University	Member
"	Hiroyuki Morikaku	Soshin Electric Co., Ltd.	Member

Position	Name	Affiliation	Member/Non-member category of IEEJ
Member	Shin Yabukami	Tohoku University	Member
"	Masahiro Yamaguchi	Tohoku University	Member
"	Keiju Yamada	Toshiba Corporation	Member
"	Naoki Wako	Research Institute for Electromagnetic Materials	Member
Secretary	Satoshi Sugahara	Fukuyama University	Member
"	Yasushi Endo	Tohoku University	Member
Assistant secretary	Shinichiro Mito	National Institute of Technology ,Tokyo College	Non-member

7. Activity schedule

Committee meetings: 4 times/year; Cooperative Technical Meetings: 2 times/year

8. Reporting format

Reporting will be done through a special issue of Society A transactions.

(Reasons for reporting in the form of a special issue Society A transactions)

By reporting in the form of a special issue of Society A transactions, members of IEEJ Society B and D, who exchange information through committee research activities, and non-members belonging to the IEICE and other organizations, may be asked to contribute, it will be possible to report research results with more comprehensive content as there will be a greater number of researchers contributing. In addition, posting research papers incorporating special commentary on the latest trends contribute to an increased number of citations of the transactions of Society A. In addition, this will lead to contributors joining the IEEJ, posting more papers, and sales of the transactions, which will contribute to Society A.