

Agenda
IEEE EMC Society TC 5: High Power Electromagnetics (HPEM)
Wednesday, 7 August 2023 (Noon-1:30 PM MST)
Room 131C, Webex 2633 768 6739
Phoenix, Arizona USA

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| 1. Opening of the meeting and approval of the agenda | W. Radasky, Chair |
| 2. Review and approval of the minutes of the last TC 5 Meetings in Grand Rapids, Michigan, USA and Okinawa, Japan | W. Radasky |
| 3. Present TC 5 membership list
New Member | W. Radasky
M. Steffka |
| 4. Report on the paper review process for Phoenix
- Review Tutorials, Special Sessions, Regular Sessions | W. Radasky |
| 5. Report from the Lightning Subcommittee | F. Rachidi, M. Rubinstein |
| 6. Report from the EM Information Leakage Subcommittee | Y. Hayashi |
| 7. Report from the HEMP/IEMI Subcommittee | M. McNerney, W. Radasky,
S. Fisahn |
| 8. Report from ESD Subcommittee | S. Marathe, M. Khazhinsky,
J. Kinnear |
| 9. Coordination with SC 1, Smart Grid | M. McNerney, Chair SC 1 |
| 10. Status of the TC 5 web page | M. McNerney,
TC 5 Vice Chair |
| 11. Review of HPEM activities since last TC 5 meetings
(Grand Rapids, Okinawa) | All |
| 12. Discussion concerning whether tutorials, workshops, and/or special sessions should be organized for next year in Raleigh, North Carolina, USA | All |
| 13. Discussion of standardization activities
PAR 2838 Lightning Test Standard Working Group Meeting | All |
| 14. Note the status of TC 5 officers (serving 3 year term, ending 31 December 2025) | All |
| 15. Any other business | All |
| 16. Adjournment | All |



IEEE TC 5: High Power Electromagnetics (HPEM) Technical Committee

**Minutes of Grand Rapids Hybrid Meeting
Wednesday, 2 August 2023 (Noon – 1:30 PM Eastern Daylight U.S. Time)**

Confirmed Minutes

1) Opening of the meeting and approval of the agenda – Bill Radasky, Chairman

Chairman Dr. William (Bill) Radasky brought the meeting to order at 12:10 PM, Eastern Daylight Time. It is noted that this was a hybrid meeting with 19 individuals attending in person and 2 individuals attending virtually (we started 30 minutes before the meeting to set up the virtual system, and it took 40 minutes to get it done with the help of a local expert). The Chairman, Bill Radasky, the Vice Chairman, Mike McInerney and the Secretary, Yuichi Hayashi were all present. Radasky welcomed the attendees, reviewed the agenda and asked for suggested changes; none were offered. McInerney made a motion to approve the agenda. Motion Seconded and Carried (MSC).

2) Review and approval of minutes of previous TC 5 meeting – Bill Radasky, Chairman

The unconfirmed minutes from the Spokane TC 5 meeting on 3 August 2022 were approved without any changes. They are attached to these minutes and will separately be placed on the TC 5 web page.

3) TC 5 membership list update – All

The TC 5 membership list covering the past 5 years was reviewed. The previous membership list was displayed without email addresses, and it was noted that several attendees during the past 2 virtual meetings do not have email addresses known. Thus it will not be possible to reach them by email. We had 21 attendees at this meeting with 19 in person and 2 virtual. We do not publish the detailed (with email addresses) 5-year list on the website or in the minutes, as there may be private information contained in it. Only the officers' and subcommittee chairs' email addresses are published on the website, and this procedure has been approved by the IEEE.

4) Report on the paper review process and sessions for Grand Rapids – Bill Radasky

Radasky reviewed the paper review process for this Grand Rapids conference and also the tutorial that was presented. There were 10 regular and 5 abstract papers submitted; 15 were

accepted. We ended up with an all-day session on Thursday for the TC 5 papers. There were some problems in assigning session chairs due to limitations in the software being used. In addition, we tried to assign each grouping of papers in the session with a subtitle, but that also did not work due to the limitations in the software. Once all of the papers were put into 1 very long session, it was not possible to assign subtitles or different session chairs for the “sub-sessions”. We complained about the process and the TAC promised this would be fixed for the next year. The papers presented covered the topics of HEMP, EM Information Leakage, IEMI, and ESD. There were no lightning papers.

We had a sufficient number of reviewers this year, and they should be recognized for their hard work. The reviewers were: Homma, Khazhinsky, McNerney, Sabath, Savage, Thomas and Willemen.

A tutorial was presented on Wednesday afternoon:

- WE-PM-G: Wednesday, 2 August 2023
 - Recent Advancements in HEMP, EMP, and IEMI Protection – A Global Perspective
 - Organizers: Tara Kellogg and Chaouki Kasmi
 - Presentations by: Chaouki Kasmi, Sergio Longoria, Ryan Marietta, Frank Sabath

It is especially notable that 3 papers submitted for this conference were nominated for best EMC Paper and/or best EMC Student paper. The papers are:

1. Best EMC Paper Finalist: “Early-time Electromagnetic Pulse Response Validation of Surge Arrester Models,” by Tyler Bowman, Thomas Kmiecik, Laura Biedermann
2. Best EMC Paper and Best EMC Student Paper Finalist: “Reconstruction of Sound Information Leakage Signals Obtained from Multiple Demodulation Methods,” Taiki Kitazawa, Seiya Takano, Yuichi Hayashi
3. Best EMC Student Paper Finalist: “Failure Mechanisms Analysis in GaN HEMTs under High-Power Microwave Pulses,” Yue Zhang, Liang Zhou

While none of the papers was selected as the Best Paper, Paper 2 above was given an honorable mention for the Best Student Paper.

5) **Report from the Lightning Subcommittee – Marcos Rubinstein and Farhad Rachidi**

A presentation audio/visual presentation was prepared by Marcos Rubinstein and Farhad Rachidi. Marcos prerecorded his voice while presenting the charts. The charts are attached, but the audio/visual presentation is a very large file that cannot be included with these minutes. The conferences and other events planned and held thus far in 2023 were discussed along with the events planned for 2024. Also 9 WGs in CIGRE Study Committee C4 currently working were identified during the presentation. One WG in IEEE PES was also mentioned. In addition, other lightning activities were summarized. Radasky thanked the Lightning Subcommittee for providing a comprehensive report.

Further details can be found on this agenda item in the Attachments.

6) **Report from the EM Information Leakage Subcommittee – Yuichi Hayashi**

Yuichi Hayashi provided his report beginning with an overview of the 5 regular papers submitted and presented at this year's conference. He also reviewed the special session to be presented at EMC Europe this year (8 papers) and a workshop on Tempest (with 5 talks). He also mentioned the activities that they have supported in the IEEE Digital Privacy Initiative.

Hayashi mentioned that from 20-24 May 2024, APEMC and Japan's EMC2024 Conferences will be combined in Okinawa, Japan and there will definitely be coverage of EM Information Leakage at this symposium. Of course all EMC researchers are welcome to submit papers and attend. Radasky mentioned that TC 5 should plan on a meeting at this conference, as we have on occasion met in Asia (Singapore for APEMC) and at EMC Europe (Dresden for EMC Europe). This gives regional engineers an opportunity to attend a TC 5 meeting when it is difficult for them to attend the meetings in the U.S. Hayashi indicated that he will carry this proposal forward to the conference organizers.

Prof. Hayashi was complemented on his efforts to provide a complete review of activities in the EM Leakage area, worldwide.

Further details can be found on this agenda item in the Attachment.

7) **Report from the HEMP/IEMI Subcommittee – Mike McInerney**

Mike McInerney presented the HEMP/IEMI report in two parts. For the HEMP aspects, Bill Radasky provided a summary of HEMP activities (which have continued since 2021) including:

- The U.S. Department of Energy has published an open document to specify recommended HEMP waveforms to use to evaluate the vulnerability of the U.S. infrastructure. Many power companies are still reacting to this development.
- The IEC is updating IEC 61000-2-9 (HEMP radiated environment): the first draft document has been produced, and the IEC is evaluating the update. Depending on the comments, it is possible this update could be published in 2025.
- Power companies are investigating ways to protect their electronics from HEMP (and IEMI). One company has selected their best substation building construction design after testing, and is planning to update the design to reduce the penetration of high-frequency fields. If successful, this new design will be their prototype for their future substation control house construction.

With regard to the IEMI aspects, Sven Fisahn compiled the report. The report covered the 2023 IEEE EMC Symposium tutorial in Grand Rapids, and a workshop held at EMC Europe in 2022 in Gothenburg. Frank Sabath presented the report at the meeting and provided additional information on the tutorial and workshop.

8) **Report from ESD Subcommittee – Shubhankar Marathe and Misha Khazhinsky**

Shubhankar Marathe presented the report from the ESD subcommittee, which was coauthored by Michael Khazhinsky. He discussed the paper exchange program between ESDA and the IEEE EMC Society. In particular the EOS/ESD Symposium scheduled for October 2023 in Riverside, California has 5 ESD papers, including 2 papers under the paper exchange agreement with the IEEE EMC Society. Also an update of ESD standards mainly from ANSI was provided.

Radasky commented that there were other ESD activities at the AP EMC and EMC Europe conferences that should be reported upon in the future. In addition, the important ESD standard, IEC 61000-4-2 is being updated, and it would be good to know what changes are being planned, as they will affect ESD testing worldwide. The purpose of the subcommittees in TC 5 are to update its members on worldwide activities in each field.

Further details can be found on this agenda item in the Attachment.

9) **Coordination with SC-1, Smart Grid – Mike McInerney**

McInerney introduced the activities of Special Committee 1 (Smart Grid), which is a coordinating committee, and he indicated that the SC 1 meeting had been held on Monday, with good attendance. It is noted that Mike McInerney is the Chairman of SC 1 and Bill Radasky continues in his role as Vice Chair while Prof. Thomas was not able to continue as Secretary. Leonardo Sandrolini was elected as Secretary. McInerney commented that TC 5 is keeping track of any issues involving Smart Grid and HPEM, and both the Chair and the Vice Chair of TC 5 have been attending the SC 1 meetings for many years.

10) **TC 5 web page – Mike McInerney, Vice Chairman**

McInerney is continuing in his role as webmaster for TC 5. He is usually able to quickly update the website, although this year there is a new system and software for updating the web page, and unfortunately the TCs were not notified of this in advance. The TAC promises to try to warn the TCs in the future of changes. The webpage for TC 5 can be found at: <https://www.emcs.org/committees/technical-committees/tc-5-high-power-electromagnetics/>

11) **Review of HPEM activities since last TC 5 meeting in Spokane – All**

Due to a lack of time, there was no detailed discussion concerning new developments in HPEM. McInerney asked that any new documents of a public nature be sent to him to post on our website.

12) **TC 5 Tutorials/Special Sessions planned at the EMC 2024 in Phoenix**

Based on the presentations provided at this meeting from the subcommittees, it appears that several tutorials and a special session will be proposed. Three proposals were discussed: one tutorial on HEMP/IEMI IEC Standards (Radasky); one special session on IEMI Risk Management (Sabath); and one tutorial on EM Information Leakage (Hayashi).

It is expected that in the December time frame, new proposals will be due, and the Chairman, Bill Radasky, will remind the subcommittee chairs to prepare their proposals for the 2024 conference. It is important that all proposals be coordinated with the management of TC 5 in order to ensure the proper endorsements are made.

13) **Discussion of Standardization Activities**

After many years of discussion concerning the need for a new IEEE standard dealing with the effects on electronics when an aircraft is struck by lightning, a new PAR 2838 has been approved. It is titled, "Aircraft Component Lightning Strike Direct Effects Qualification." Fred Heather mentioned that he is still looking for more experts to join the WG, and he has organized a meeting for the next day, Thursday. TC 5 members were encouraged to attend.

14) **Election Status of TC 5 Officers**

The current officers of TC 5 are serving 3-year terms that ends on 31 December 2025.

15) **Any other business - All**

No other business was raised.

16) **Adjournment**

The meeting was adjourned at 1:30 PM.

Attachments (labeled with agenda item)

- 1-Meeting Agenda
- 2-Confirmed Spokane Minutes
- 3-TC 5 Membership Update (including 2023 meeting attendees)
- 4-Report on Paper Review Process
- 5-Lightning Subcommittee Report
- 6-EM Information Leakage Subcommittee Report
- 7-HEMP/IEMI Subcommittee Report
- 8-ESD Subcommittee Report
- 12-Tutorial Proposal for 2024: IEC Standards for HEMP/IEMI



IEEE TC 5: High Power Electromagnetics (HPEM) Technical Committee

Minutes of Okinawa Meeting at Japan EMC/APEMC Symposium

Okinawa, Japan

Wednesday, 22 May 2024 (1:00 – 2:00 PM Japan Time)

Confirmed Minutes

1) Opening of the meeting and approval of the agenda – Bill Radasky, Chairman

Chairman Dr. William (Bill) Radasky brought the in person meeting to order at 12:00 PM, Japan time. This meeting was organized to attract attendees to the Japan EMC/APEMC Conference. The Chairman, Bill Radasky, and the Secretary, Yuichi Hayashi, were present and the Vice Chair, Mike McInerney was not able to attend. Radasky welcomed the attendees, reviewed the agenda (Attachment 1) and asked for suggested changes; none were offered. A motion was made to accept the agenda as written. Motion Seconded and Carried (MSC).

2) Review and approval of minutes of previous TC 5 meeting – Bill Radasky, Chairman

The unconfirmed minutes from the Grand Rapids, Michigan, TC 5 meeting on 2 August 2023 were mentioned, but due to the short time available for the meeting and the fact that most of the attendees at this meeting did not attend the meeting in Grand Rapids, it was decided to skip the review of these minutes. The minutes will be reviewed in Phoenix at the IEEE TC 5 Meeting on Wednesday, 7 August 2024. See Attachment 2.

3) TC 5 membership list update – All

The TC 5 membership list covering the past 5 years was reviewed by Radasky. The previous membership list was displayed without email addresses, although it was noted that several attendees during the past 2 virtual meetings did not provide email addresses. Thus it will not be possible to reach them by email. This previous list is provided in Attachment 3.

We had 25 attendees at this meeting, and they will be added to the overall membership list, so they will receive information concerning HPEM topics. Their names and affiliations are provided in Attachment 4, without email addresses. We do not publish the detailed 5-year list (with email addresses) on the website or in the minutes, as there may be private

information contained in it. Only the TC 5 officers' and subcommittee chairs' email addresses are published on the website, and this procedure has been approved by the IEEE.

4) **Report on the paper review process and sessions for Okinawa – Bill Radasky**

Radasky reviewed the paper review process for both this Summer's IEEE EMC Phoenix Symposium and this Okinawa Symposium. For the IEEE EMC Symposium there were only 3 regular papers submitted and 4 abstract papers. Of the 7 papers, 5 were accepted. Three of the papers dealt with ESD, 1 with EM Information Leakage, and 1 with immunity of equipment. We had a sufficient number of reviewers this year, and they should be recognized for their hard work. The reviewers were: Bowman, Hayashi, Khazhinsky, McInerney, Nicolae, Savage and Willemen.

In Okinawa, 43 papers were submitted for the HPEM topic, which is a record for any EMC conference. There were 16 regular papers submitted, and 4 special sessions were organized as follows:

- SS-3 on HEMP/IEMI: 5 submitted and accepted
- SS-5 on ESD 8 submitted and accepted
- SS-9 on HPEM transients 5 submitted and accepted
- SS-10 on EM Info Leakage 9 submitted and accepted

Of the 43 papers, 41 were accepted and presented. The review process was performed mainly through the efforts of the Japan EMC technical experts with some support from the IEEE EMC TC 5.

5) **Report from the Lightning Subcommittee – Marcos Rubinstein and Farhad Rachidi**

A presentation was prepared by Marcos Rubinstein and Farhad Rachidi, but as they could not attend, Radasky reviewed the charts for the attendees. They listed the planned lightning community meetings and conferences for the rest of 2024 and 2025. The status of the 9 CIGRE working groups dealing with lightning was reviewed, along with one WG in the IEEE PES Society. Finally a tutorial is planned for GlobalEM 2024 in Austin, Texas in July 2024. Radasky thanked Marcos and Farhad for their usual high quality presentation indicating the worldwide activities in the field of lightning. The presentation is provided in Attachment 5.

6) **Report from the EM Information Leakage Subcommittee – Yuichi Hayashi**

Yuichi Hayashi provided his report beginning with an overview of the 10 special session papers submitted and presented at this year's Okinawa conference. He then reviewed the planned tutorial to be presented in Phoenix at the August IEEE EMC Symposium. He also mentioned the special session with 12 papers to be presented at EMC Europe in Bruges in September this year.

Radasky complemented Prof. Hayashi on his efforts to organize special sessions and tutorials in the EM Information Leakage area, worldwide. Further details can be found on this agenda item in Attachment 6.

7) **Report from the HEMP/IEMI Subcommittee – Mike McNerney**

Mike McNerney presented the HEMP/IEMI report in two parts. For the HEMP aspects, Bill Radasky provided a summary of HEMP activities including:

- The IEC is updating IEC 61000-2-9 (HEMP radiated environment): the CDV was circulated and accepted with a unanimous vote. It is expected that Edition 2 will be published in 2025.
- Power companies are investigating ways to protect their electronics from HEMP (and IEMI). One company has selected their best substation building construction design after testing, and is planning to update the design to reduce the penetration of high-frequency fields. If successful, this new design will be their prototype for their future substation control house construction.
- GlobaleM is the new name for the old AMEREM/EUROEM/ASIAEM series of HPEM conferences. The next conference is in Austin, Texas from 14-19 July 2024. <https://www.globalemconf.com>.

With regard to the IEMI aspects, Sven Fisahn compiled the report. The main point was that a workshop chaired by M. Lanzrath and S. Fisahn: “Risk Management for Critical Infrastructures“ is planned for the International Symposium and Exhibition on Electromagnetic Compatibility (EMC Europe 2024) in Bruges in September.

This presentation can be found in Attachment 7.

8) **Report from ESD Subcommittee – Shubhankar Marathe, Misha Khazhinsky and John Kinnear**

Radasky presented the charts prepared by the ESD Subcommittee of TC 5, as the authors were not able to attend. The status of the paper exchange program between ESDA and the IEEE EMC Society was discussed. In particular the EOS/ESD Symposium planned for 2024 will have 4 ESD papers, including 1 paper under the paper exchange agreement with the IEEE EMC Society. Also an update of ESD standards was provided. Further details can be found on this agenda item in Attachment 8.

9) **Coordination with SC-1, Smart Grid – Mike McNerney**

McNerney prepared the presentation that reviewed the activities of Special Committee 1 (Smart Grid), which is a coordinating committee among the IEEE EMC Society, and Radasky presented the charts. It was indicated that the SC 1 meeting will be held on Monday, 5 August 2024 in Phoenix. It is noted that Mike McNerney is the Chairman of SC 1 and Bill Radasky continues in his role as Vice Chair. Leonardo Sandrolini is the Secretary.

The presentation also indicated that there will be a tutorial in Phoenix this Summer covering the major topics covered by SC 1. See Attachment 9 for more details.

10) **TC 5 web page – Mike McInerney, Vice Chairman**

McInerney is continuing in his role as webmaster for TC 5, and he prepared a short presentation regarding the status of the TC 5 web page, which was presented by Radasky. The TC 5 web page is up-to-date. The EMC society TCs continues to update the society web pages, and McInerney has been able to keep up with the changes. The webpage for TC 5 can be found at: <https://www.emcs.org/technical-committees/tc-5-high-power-electromagnetics/>

11) **Review of HPEM activities since last TC 5 meeting in Grand Rapids – All**

There was a short discussion of the work within the IEC to update HEMP and IEMI standards (IEC 61000-2-9, 61000-4-23, and 61000-5-6) and the fact that Norway is protecting their high voltage grid against the threat of HEMP using IEC standards. Some power companies in the U.S. are also increasing their efforts to protect the grid.

Another organization increasing its activities in the field of HPEM is The Technology Innovation Institute (TII) in Abu Dhabi, UAE; they are focusing on applied research with emphasis on UAVs and the use of HPEM to defend against hostile UAVs.

There was a discussion about the safety of self-driving cars from HPEM threats whether intentional or accidental. Also there was a mention that the ITU-T has been engaged for some time in the HPEM field, including some new work on radiation effects on electronics. It is noted that the ITU-T standards are freely available for download on their website.

As many new members of TC 5 have joined our meeting here in Okinawa, Radasky suggested that researchers make an effort to check the TC 5 website for public papers that are found there dealing with HPEM, and that the attendees contribute more by sending additional papers to one of the officers of TC 5 to add to the website. In addition, we welcome proposals for special sessions and tutorials in the future.

It was mentioned again that the GlobalEM 2024 Conference is being held in Austin, Texas in July 2024, and there will be concentration on the topics of both HEMP and IEMI. Also the IEEE EMC TC 5 welcomes all of the Okinawa attendees to our TC meeting in Phoenix on 7 August 2024.

12) **TC 5 Tutorials/Special Sessions planned at the EMC 2024 in Phoenix**

Three proposals were discussed in 2023 for the 2024 Symposium: one tutorial on HEMP/IEMI IEC Standards (Radasky); one special session on IEMI Risk Management (Sabath); and one tutorial on EM Information Leakage (Hayashi). It turned out that the IEMI Risk Management Special Session has been converted to a tutorial and will not be presented in Phoenix, but rather in Bruges at the EMC Europe Conference in September 2024.

The two tutorials sponsored by TC 5 to be presented in Phoenix are:

- Progress in IEC SC 77C Standards Regarding HEMP and IEMI Environments, Test Methods and Protection Methods
- Electromagnetic Wave Information Security to Enhance the Reliability of the Information Infrastructure as the Foundation of Society

13) **Election Status of TC 5 Officers**

The current officers of TC 5 are serving 3-year terms that end on 31 December 2025. New elections will be held at the IEEE EMC Symposium TC 5 meeting in the Summer of 2025.

14) **Any other business - All**

No other business was raised.

15) **Adjournment**

The meeting was adjourned at 2:00 PM.

Attachments

- 1-Okinawa Meeting Agenda
- 2-Unconfirmed Grand Rapids (2023) Minutes
- 3-TC 5 Membership after Grand Rapids meeting in 2023
- 4-TC 5 Membership from the Okinawa meeting in 2024
- 5-Lightning Subcommittee Report
- 6-EM Information Leakage Subcommittee Report
- 7-HEMP/IEMI Subcommittee Report
- 8-ESD Subcommittee Report
- 9-SC 1 (Smart Grid EMC) Report

2024 TC 5 Membership List	Updated: 2 September 2024					
		Glasgow-Virtual	Spokane	Grand Rapids	Okinawa	Phoenix
Name	Affiliation	2021	2022	2023	2024	2024
Soki Akutsu	Mitsubishi Heavy Industry				X	
Carlos Aviles	USAF			X		
Dr. Daryl Beetner	Missouri University of Science and Technology	X			X	
Edwin van Bladel	Dutch MOD					X
Dr. Tyler Bowman	Sandia National Laboratories	X	X	X		X
Ross Carlton	Gibbs & Cox					X
Dong Hoon Choi	Yonsei University				X	
Paul Clem	Boeing			X		
Larry Cohen	Consultant			X		
Sven Fisahn	Bundeswehr Research Institute, Germany	X	V			X
Dr. Ali Foudazi	Amazon Lab126		*	V		
Juwichi Fujigaki	Noise Laboratory				X	
Daisuka Fujimoto	NAIST				X	
Dave Garagnani	Armag Corp.					X
Dr. Heyno Garbe	Leibniz University, Hannover, Germany	X		V		V
Petter Gardin	Swedish Armed Forces					X
Flavia Grassi	Politecnico di Milano				X	X
Mikael Grudd	Roxtec				X	
Ed Hare	AARL	X				
Aaron Harmon	MST EMC Lab			X		
Dr. Yu-ichi Hayashi	NAIST		X	X	X	X
Fred Heather	USN	X	X	X		X
Greg Hiltz	Consultant					X
Harry Hodes	NASA JSC					X
Takuya Hoshino	NTT-AT				X	
Tom Hussey	Consultant					X
Kengo Iokibe	Okayama University, Japan				X	X
Takeshi Ishida	Noise Laboratory				X	
Shinobu Ishigami	Tohoku Gakuin University				X	
Tom Jarse	Boeing		X	X		
Randy J. Jost	Utah State University			X		

Dr. Michael Khazhinsky	Silicon Labs and ESDA					#
Ken Kawamata	Tohoku Gakuin University				X	
Tara Kellogg	ETS-Lindgren					X
Youngwoo Kim	Sejong University				X	
John Kinnear Jr.	ESDA					V
Masahiro Kinugawa	The University of Fukuchiyama				X	
Taiki Kitazawa	NAIST				X	
Sebastian Koj	Jade HS					X
Takayuki Kubo	Noise Laboratory				X	
Jong Hwa Kwon	ETRI		X	X		X
Matt Lara	APELC		X			
Euibum Lee	Yonsei University				X	
Dr. Frank Leferink	Thales, Univ of Twente, Netherlands	X			X	X
Dr. Sergio Longoria	ETS-Lindgren			X		X
Jim Lukash	Lockheed Martin		X			X
Shubhankar Marathe	Amazon Lab126	X	X	X		X
David Martinez	Technology Innovation Institute				X	
Mike McInerney	USACE-ERDC	X	X	X		X
Dr. Nicolas Mora	University of Columbia	X	X			X
Truong Nguyen	NASA					X
Mike Oliver	MAJR Products Corp.			X		
Dr. Michal Pietrzyk	Thyssenkrupp Marine Systems			X		
Dr. Andrew Podgorski	Consultant	X	V			
Prof. Farhad Rachidi	Swiss Federal Institute of Technology					#
Dr. William Radasky	Metatech	X	X	X	X	X
Martin Robertsson	Roxtec				X	
Dr. Marcos Rubinstein	Univ. of Applied Science, Switzerland					#
Dr. Frank Sabath	Bundeswehr Research Institute, Germany	X	X	X		
Dr. Edward Savage	Metatech		X			
Martin Schaarschmidt	Bundeswehr Research Institute, Germany	X	X			
Harry Skinner	Intel		X			
Hywel Sollis	UK Ministry of Defence		X			
Abtin Spantman	AETANT					V
Mark Steffka	IQM Research Institute					X

Dr. Adrian Sun	Aerospace Corporation	X		X		
Kin Sze	National Defence QETE, Canada	X		X		V
Akiyoshi Tatematsu	CRIEPI				X	
Tetsuya Tominaga	NTT-AT				X	
Dr. Joost Willemen	Infineon Technology, Germany	X				
Jong-Gwan Yook	Yonsei University		X			
Takahiro Yoshida	Tokyo University of Science				X	
<u>Corresponding Members</u>						
Dr. Harald Gossner	Intel					
Joe P. Huynh	Boeing/BR&T					
Phil Johns	Johns Hopkins APL					
		17	20	22	25	29

Mark Steffka Request to Join TC5

- Industry Experience
 - Military Communication System Design and EMP hardening.
 - Automotive System EMC design and testing of conventional and electric vehicle components and systems.
- Academic/Research Experience
 - Adjunct Faculty Member at the *University of Michigan* and *University of Detroit – Mercy*
 - Full time Faculty Member at the *University of Detroit – Mercy* (recently retired)
 - Technical Fellow at *IQM Research Institute*
- Current Areas of Interest:
 - Intentional EMI disruption of systems (to affect their functionality and/or create “Cybersecurity” issues).
 - Reception of unintended EM energy emissions and attempts for data extraction from those emissions.

2024 IEEE EMC Society TC 5 (HPEM) Paper Review Process and Tutorials, Special and Regular Sessions

Prepared by
Bill Radasky, TC 5 Chair
7 August 2024

Paper Review Process for Okinawa

- This was a combined APEMC (annual) and Japan 2024 Conference (every 5 years) held in May 2024
 - Radasky is APEMC Chair for HPEM and supported the reviews for this conference
- There were a total of 43 papers submitted under HPEM with 41 accepted
 - 16 regular HPEM papers (14 accepted)
 - 4 special sessions (27 accepted)
 - HPEM/IEMI: 5 submitted and accepted
 - ESD: 8 submitted and accepted
 - HPEM Transients: 5 submitted and accepted
 - EM Info Leakage: 9 submitted and accepted
- It is noted that this is the largest number of HPEM submitted papers for any international EMC Conference

Paper Review Process for Phoenix

- We reviewed 3 regular papers and 4 abstract papers
 - All regular papers were accepted as were 2 abstract papers
 - Smallest number of submitted papers in recent memory
- The reviewers did a fine job
 - Bowman, Hayashi, Khazhinsky, McInerney, Nicolae, Savage, Willemen
- Reviews were summarized by the Chair under the current procedures (cut and paste process)
- The quality of abstract papers is still a problem, with 50% of the abstract papers rejected.

Paper Session Organization

- Two Sessions have been organized
 - ESD (Wednesday, 1:30 - 3:00 PM in Room 125AB)
 - Immunity and EM Info Leakage (Thursday, 4:30 - 5:30 PM in Room 127A)
- Best Paper Nominees
 - Peng, et al, “A model for Corona Streamer Propagation on Glass during an Air Discharge” (Student Paper Semi-finalist and Best Paper finalist)
 - Yang, et al, “Time-Dependent Resistance-Based Dynamic Behavior Model of Spark Gap Device under ESD Pulse,” (Student Paper Semi-finalist)
 - Best EMC Paper will be announced at the Thursday Awards Luncheon

Special Sessions

- No special sessions were organized this year

Tutorial-1

- Monday, 5 August 2024, 8:30 AM - Noon, Room 127A
- “Electromagnetic Wave Information Security to Enhance the Reliability of the Information Infrastructure as the Foundation of Society”
 - Organizers: Yuichi Hayashi
 - Presentations by: Yuichi Hayashi, Chulsoon Hwang, Kengo Iokibe, Shahin Tajik, Youngwoo Kim

Tutorial-2

- Friday, 9 August 2024, 1:30 - 5:00 PM, Room 128A
- “Progress in IEC SC 77C Standards Regarding HEMP and IEMI Environments, Test Methods and Protection Methods”
 - Organizers: William Radasky
 - Presentations by: Edl Schamiloglu, William Radasky, Sergio Longoria, Richard Hoad

2025 Conference Plans

- As usual we will review the submitted regular papers, abstract papers, and also any special session papers that may be organized for the Raleigh, North Carolina IEEE EMC Conference from 18-22 August 2025
- We will support the reviews for the following conferences, when requested
 - From 19-23 May 2025, the APEMC Conference will be held in Taipei, Taiwan
 - EMC Europe will be held from 1-5 September 2025 in Paris, France
 - GlobalEM will not hold a conference in 2025, but in 2026

TC-5 Meeting, Phoenix, Aug 7, 2024

Report on Lightning Activities

M. Rubinstein
F. Rachidi

Main Events with Lightning Related Content in 2024

- APEMC. 20-24 May, Okinawa, Japan
- URSI AT-AP-RASC, 19-24 May, Gran Canaria, Spain
- IEEE EMC & SIPI. 5-9 August, Phoenix, AZ
- ICLP, 1-7 September, Dresden, Germany
- EMC Europe. 2-5 September, Bruges, Belgium
- ICOLSE, 9-12 September, Sao Paolo, Brazil
- GlobalEM, 14-19 July, Austin, TX, USA

Main Events with Lightning Related Content in 2025

- AMS Annual meeting. Jan 12-16, New Orleans, USA
- IEEE EMC & SIPI, Aug 18-25, Raleigh, NC, USA
- URSI AP-RASC 2025. Aug 17-22, Sydney, Australia
- EMC Europe 2025. Sep 1-5, Paris, France
- SIPDA, no information available at this time
- APEMC, no information available at this time
- AGU Fall Meeting. Dec 15-19, New Orleans, USA

CIGRE Working Groups on Lightning

- ◆ WG C4.57, “Guidelines for the Estimation of Overhead Distribution Line Lightning Performance and its Application to Lightning Protection Design”, Convenor: Koji Michishita (JAPAN)
- ◆ WG C4.59, “Real-time Lightning Protection of the Electricity Supply Systems of the Future”, Chair: Chong Tong (China)
- ◆ WG C4.61, “Lightning transient sensing, monitoring and application in electric power systems”, Chair: Jinliang He (China)
- ◆ WG 4.66. “New concept for analysis of multiphase back-flashover phenomena of overhead transmission lines due to lightning”, Megumu Miki (Japan)
- ◆ WG4.67, Lightning Protection of Hybrid Overhead Lines, Alexandre Piantini, Brazil.
- ◆ WG C4.69, “Quantifying the lightning response of tower-footing electrodes of overhead transmission lines, methods of measurement”. Convener: Silverio Visacro (Brazil)
- ◆ WG C4.70, Jan 2022-, “Application of space-based lightning detection in power systems”, Convenor: Joan Montanyà (Spain)
- ◆ JWG C4_B4.72, “Lightning and Switching Induced Electromagnetic Compatibility (EMC) issues in DC power systems and new emerging power electronics-based DC equipment”, Convenor: Qingmin Li (China)
- ◆ JWG B2_C4.76, “Lightning & Grounding Considerations for Overhead Line Rebuilding and Refurbishing Projects, AC and DC”, Convener: William A. Chisholm (CA)

Other Working Groups

- ◆ IEEE PES Lightning Performance of Overhead Lines Working Group
 - ◆ This year, meeting held 21–25 July in Seattle, Washington.
 - ◆ Next year's annual meeting will be held in conjunction with the 2025 IEEE PES GM (no information at this time will be held in).

This year's activities

- ◆ Papers to be presented at EGU in Vienna and ILCP in Dresden.
- ◆ A tutorial on lightning, lightning incidence, and lightning location was given at GlobalEM in Austin, Texas last month.
- ◆ A keynote presentation was also given at GlobalEM on an update of the lightning work at the Säntis Tower, including the Laser Lightning Rod project and the detection of x-rays from upward positive lightning.

Proposed work for 2025

- ◆ Organize lightning session at one of the conferences
- ◆ Papers at different events with lightning content

22 May 2024

IEEE EMC Society TC5 Subcommittee: Electromagnetic Information Leakage

Yuichi Hayashi



Special Session in EMC Japan/APEMC Okinawa 2024

MonPM1A/2A: Recent Research Trends in Offensive Electromagnetic Information Security Supporting Hardware as the Root of Trust (Sponsored by TC-5)

Session Organizers: Yuichi Hayashi (Nara Institute of Science and Technology, Japan) , Jong-Gwan Yook (Yonsei University), and William Radasky (Metatech Corporation)

Number of papers: 10 papers

	Title	Authors
14:10	Recent Research Trends in Offensive Electromagnetic Information Security Supporting Hardware as the Root of Trust	Y. Hayashi, J. Yook, W. Radasky
14:30	Extraction of Audio Information From EM Emission Caused by Loose Connectors	T. Kitazawa, D. Fujimoto, Y. Hayashi
14:50	Enhancing Video System Security Through TMDS Encoding With Color Combination	D. Choi, E. Lee, T. Nam, W. Choi, J. Yook
15:10	Non-Uniform Sampling for Signal Reconstruction Using EM Signatures of Spread Spectrum	E. Lee, D. Choi, T. Nam, J. Yook
15:30	Fundamental Study of Investigation of Vulnerable Frequencies on Echo TEMPEST	M. Kinugawa, Y. Hayashi
15:50	Secured Power Delivery Network Design for Cryptographic Devices	Y. Kim
16:40	Challenges in Feasible Simulation of Side-Channel Attack Resistance for Cryptographic Hardware	K. Iokibe, M. Himuro, Y. Toyota
17:00	Fundamental Study on Electromagnetic Analysis Attack Detection Using Oscillation Shift of Ring Oscillator	D. Fujimoto, T. Sato, K. Abe, Y. Hayashi
17:20	Find Vulnerable EM Emitting Points via Pre-Trained Deep Learning Models With Power Consumption	J. Hwan Kim, K. Hee Choi, D. Han
17:40	Measured Traces Reduction Using SNR of Leakage for Tolerance Evaluation to Deep Learning-Based Side-Channel Attack	T. Sakagami, M. Himuro, K. Iokibe, Y. Toyota

Tutorial Session in EMC+SIPI 2024 Symposium

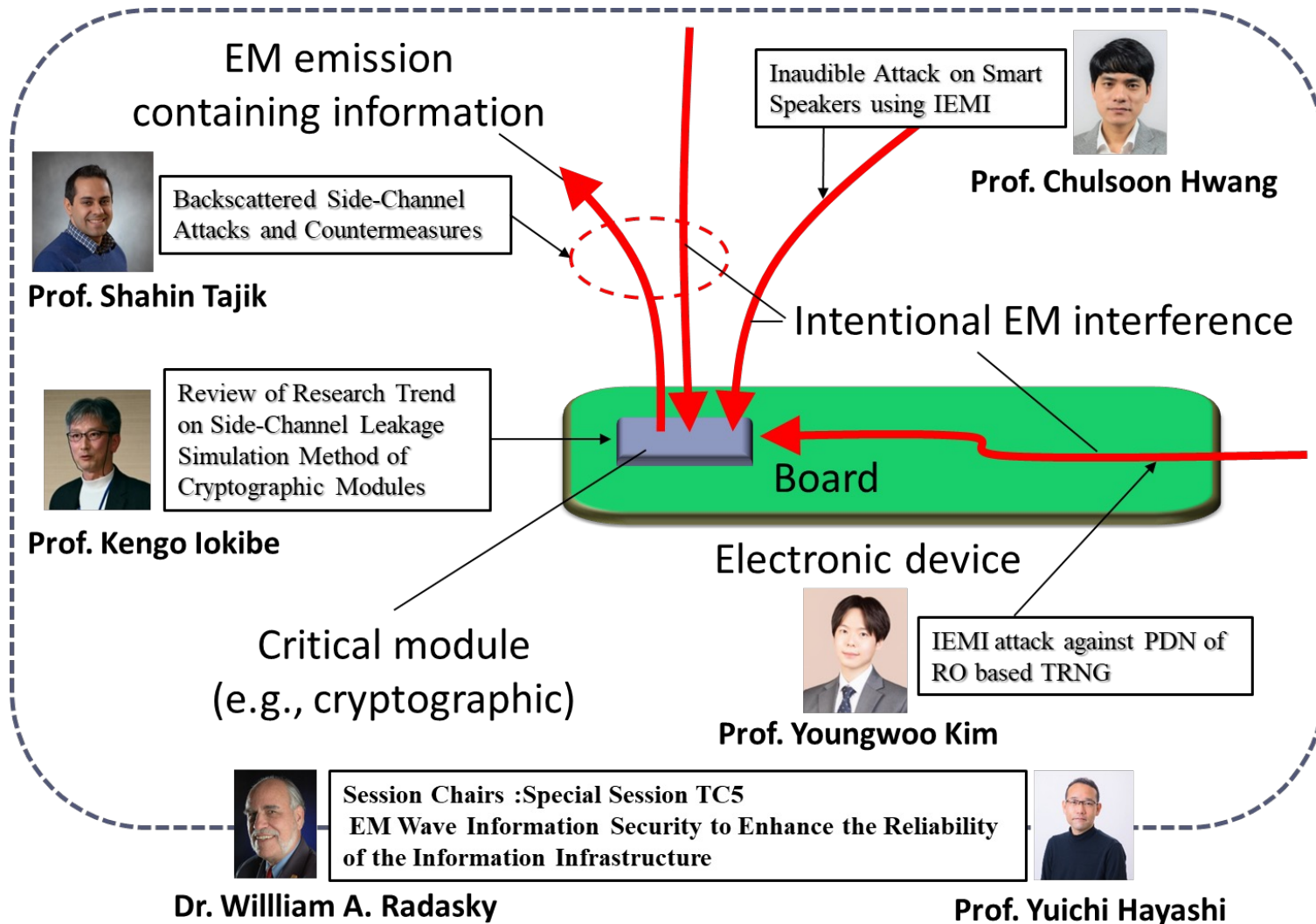
Title: EM Wave Information Security to Enhance the Reliability of the Information Infrastructure (Sponsored by TC-5)

Session Organizers: Yuichi Hayashi (Nara Institute of Science and Technology, Japan) and William Radasky (Metatech Corporation)

Abstract

In today's digital world, protecting information systems is crucial due to the sensitive data they handle, like personal information, financial records, and intellectual property. Securing systems at all layers is important, but hardware security is particularly vital as it forms the trust foundation. This tutorial session will focus on electromagnetic wave-based hardware attacks, a major concern since they can compromise security without leaving evidence. The session will also cover emerging research trends and countermeasures and offer foundational knowledge for those less familiar with hardware security.

1. Introduction
2. Inaudible Attack on Smart Speakers using IEMI
3. Review of Research Trend on Side-Channel Leakage Simulation Method of Cryptographic Modules
4. Backscattered Side-Channel Attacks and Countermeasures
5. IEMI attack against PDN of RO based TRNG



Workshop in EMC Europe 2024

WS-TEMP-I/WS-TEMP-II: Workshop on TEMPEST compromising emanations, side channel attacks

Session Organizers: Frank Leferink (University of Twente/THALES, Netherlands) and Yuichi Hayashi (Nara Institute of Science and Technology, Japan)

Number of Talks: 6 Talks

	Title	Authors
9:00 - 9:05	Short introduction	
9:05 - 9:15	Increasing TEMPEST awareness	Duncan van Meeteren or Frank Leferink (Thales)
9:15 - 9:35	Introduction to Emission Security, TEMPEST, Physical Layer Security, Side-Channel Attack	Yuichi Hayashi (Nara University, Japan)
9:35 - 10:00	How Secure is your Video Information against Electromagnetic attacks?	Pieterjan de Meulemeester (Royal Military Academy, Belgium)
10:00 - 10:30	Break	
11:00 - 11:25	Synchronizing IQ-down converted video signals using complex-valued cross-correlation	Dimitrije Erdeljan, Markus G. Kuhn (University of Cambridge, UK)
11:25 - 11:50	Side-channel security requirements for electronic voting equipment	Markus G. Kuhn, Dimitrije Erdeljan (University of Cambridge, UK)
11:50 - 12:10	International TEMPEST regulations, and TEMPEST and side-channel attack protection measures	Frank Leferink (University of Twente & Thales, Netherlands)
12:10 - 12:30	Discussion	

Special Sessions in EMC Europe 2024

SS-TEMP: Special Session on TEMPEST

Session Organizers: Frank Leferink (University of Twente/THALES, Netherlands) and Yuichi Hayashi (Nara Institute of Science and Technology, Japan)

Number of papers: 12 papers

	Title	Authors
11:00	Fundamental Study on Simple Power Analysis Using Backscattering from Switching Regulators	T. Kitazawa, D. Fujimoto, Y. Hayashi
11:22	Electromagnetic Information Leakage of Audio Signals Induced by RF Illumination	F. BULUT, HASAN SEÇKİN EFENDİOĞLU, V. SOLAK
11:45	SDR-Based Shielding Effectiveness Measurement Technique Using Signals-of-Opportunity	R. Aba, M. Figueirinhas, R. Vogt-Ardatjew, F. Leferink
12:07	A SDR-Based Inside-Out in-situ Shielding Effectiveness Measurement Technique	M. Figueirinhas, H. Schipper, R. Aba, R. Vogt-Ardatjew, F. Leferink
14:00	Fundamental Study on Detection of Counterfeit Parts with Abnormal Aging Characteristics Using Electromagnetic Backscattering from I/O Circuits	S. Kaji, M. Kinugawa, D. Fujimoto, Y. Hayashi
14:22	Counter-Screen - A No-Hardware Method To Prevent Eavesdropping Of Video Using TMDS	R. Groot, Duncan Van Meeteren, F. Leferink
14:45	Timing-Controlled EM Fault Injection Method Focusing on EM Leakage from Communication Channel	H. Nishiyama, D. Fujimoto, Y. Hayashi
15:07	Practical Considerations for the Use of Comb Generators in Shielding Effectiveness Measurements	M. Figueirinhas, H. Schipper, R. Aba, R. Vogt-Ardatjew, F. Leferink
16:00	Benefits of coherent demodulation for eavesdropping on HDMI emissions	D. Erdeljan, Markus G. Kuhn
16:22	Fundamental Study on Restoration Method of Encoded Data from Electromagnetic Leakage Focusing on Error Detection Codes	K. Abe, T. Kitazawa, D. Fujimoto, Y. Hayashi
16:45	Shielding Effectiveness of a Filled Cabinet	H. Schipper, M. Figueirinhas, F. Leferink
17:07	A Novel Approach to Measure Shielding Effectiveness in TEMPEST-Protected Buildings	F. BULUT, V. SOLAK, Hasan Seçkin EFENDİOĞLU

Future activity

Activities to be carried out at future EMC symposiums and related conferences to promote the field of EM information security.

- Workshop/Tutorial Session in Workshop in EMC Europe 2024 (2-5 September 2024, Bruges, Belgium) (accepted)
- Special Session in IEEE Symposium on EMC, SI & PI 2025
- Workshop/Tutorial Session in Workshop in EMC Europe 2025

HEMP/IEMI Subcommittee Report to TC 5 (HPEM)

Mike McInerney

7 August 2024

TC 5 HEMP / IEMI Subcommittee

- Created in 2020 to improve the organization of the website and ease subcommittee reporting
 - Mike McInerney is the General POC for the HEMP / IEMI subcommittee
 - Bill Radasky is the POC for the HEMP subcommittee
 - Sven Fisahn is the POC for the IEMI subcommittee

Recent HEMP Activities

Report from the TC 5 Subcommittee on HEMP
Compiled by William Radasky
25 July 2024

Recent HEMP Activities

- Several important HEMP activities have continued since our last IEEE EMC and APEMC/Japan 2024 Conferences and TC 5 meetings in 2023 and 2024
 1. The IEC is updating IEC 61000-2-9 (HEMP radiated environment) and is preparing an FDIS; it should be published in 2025
 2. IEC 61000-5-6 Ed. 2 (Mitigation of external EM influences) was published in April 2024
 3. CIGRE Study Committee C4 has a working group considering approaches to protect high voltage power control house electronics against HEMP
 4. Power companies are investigating ways to protect their electronics from HEMP (and IEMI)
 5. GlobalEM 2024 Conference was held in Austin, Texas in July 2024 and will meet again in 2026
 6. Items 1 and 4 are discussed in more detail in the following two charts

IEC 61000-2-9 Update Plans - 1

- IEC Subcommittee 77C has started maintenance on its body of both IEMI and HEMP publications
 - Several HEMP and IEMI publications are being updated
- For the HEMP radiated environment, there are several areas of IEC 61000-2-9 that have been discussed for more than 4 years to improve the standard which was published in 1996
- The maintenance work for IEC 61000-2-9 is underway
 - Project Leader: Dr. William Radasky
 - Document will be circulated as a Final Draft International Standard (FDIS) by October 2024 and should be published in 2025
 - Summary of improvements are on the next chart

IEC 61000-2-9 Update Plans - 2

- Key improvements being evaluated
 - Provide information for the variation of the E1 HEMP fields as a function of position. This will include range-dependent variations for the peak values and the pulse shapes for E1 HEMP
 - Add new additional analytic E1 HEMP waveforms with different rise times and pulse widths for the variations
 - Provide new analytic E3 HEMP waveforms (both B- and E-fields) based on new openly published information from the U.S. EMP Commission
 - Provide information on how to compute the E3 E-field from the incident B-field and provide a few ground conductivity profiles for those calculations
 - Provide an annex that shows an equivalent QEXP (Quotient of Exponentials) waveform that is more accurate above 100 MHz for the E1 HEMP waveform. This will help those who try to apply the DEXP (Difference of Exponentials) waveform in the frequency domain for coupling problems above 100 MHz
 - Explain why the E1 HEMP waveform in time does not require a “zero area”. This has caused a great deal of confusion regarding the way the E1 HEMP waveform is specified

Power Company Activities

- Over the past 3 years several power companies are evaluating the shielding effectiveness of their existing transmission substation buildings to protect internal electronics
- One U.S. power company has upgraded their current metal building design to improve its shielding effectiveness
 - Screen mesh windows
 - Shielded yard cables or the use of fiber optic cables
 - Better external cable bonding before entry into buildings
 - Testing before and after changes to demonstrate the effectiveness of improvements
- Many of the improvements in protection are based on papers from IEEE EMC Conferences and Transactions and IEC standards

Special Session Recommendations

- For 2025 in Raleigh a special session is recommended
- The session should emphasize the basic physics of the generation of E1, E2 and E3 HEMP
- It should also emphasize how the different HEMP environments should be applied for coupling
- Radasky will organize the session

Recent IEMI Activities

Report from the TC 5 Subcommittee on IEMI
Compiled by Sven Fisahn
26 July 2024

Report from the TC 5 Subcommittee IEMI

2023 IEEE International Symposium on Electromagnetic Compatibility, Signal & Power Integrity (EMC+SIPI 2023 Grand Rapids)

- Workshop chaired by Tara Kellogg: “Recent Advancements in HPEM, HEMP, and IEMI Protection –A Global Perspective”, Contribution “Tolerance Values and Confidence Level of HEMP System Tests” by Frank Sabath
- Workshop chaired by M. Lanzrath and S. Fisahn: „Risk Management for Critical Infrastructures“ (accepted for) International Symposium and Exhibition on Electromagnetic Compatibility (EMC Europe 2024)

TC5 Subcommittees

- We encourage all TC 5 committee members to submit information on TC 5 related activities to subcommittee POCs
 - Lightning
 - EM (Information) Leakage
 - HEMP / IEMI
 - ESD

ESD Update

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TC-5 (HPEM) Meeting

August 2024



ESD Technical Exchange – 2024 Updates

- The 2024 EOS/ESD Symposium again has a focus on EMC and system-level related topics.
 - 1 Sessions with 4 papers
 - 1 EMC Society exchanges
 - 2 Accepted
 - 1 Invited Talk
- Paper exchange program between IEEE EMC+SIPI Symposium and ESDA continues in 2024.
 - ESD Behavior of RF Switches and Importance of System Efficient ESD Design

ESD Standards – 2024 Updates

- 10 ESD standard documents have been published:
 - ANSI/ESD S20.20 – Korean Translation
 - ANSI/ESD S20.20 – Traditional Chinese Translation
 - ESD TR5.5-04-23 – Transmission Line Pulse (TLP) User Guide
 - ESD TR25.0-02-23 – Charged Board Event (CBE) Characterization Methods for Electronic Assemblies
 - ESD TR26.0-01-23 – Behavioral IC Modeling to Perform System Level ESD Simulations – General Description and Trends
 - ANSI/ESD SP5.0-2023 – Reporting ESD Withstand Levels on Datasheets
 - ESD ADV1.0-2024 – Glossary of Terms
 - ESD TR26.0-02-24 – Quasistatic Model Definition – Building Models
 - ESD TR29.0-01-24 – Guidance for Control of Electrostatic Hazards in Healthcare Facilities
 - ANSI/ESD STM3.1-2024 - Ionization
- Upcoming publications
 - ANSI/ESDA/JEDEC JS-002 – Charged Device Model (CDM)
 - ANSI/ESDA/JEDEC JS-001 – Human Body Model (HBM)
 - ESDA/JEDEC JTR002-01 – CDM user guide
 - ANSI/ESD SP5.1.4 – HBM Testing – A Method for Random Sampling of Power Pins
 - ANSI/ESD SP27.1 - Recommended Information Flow for Potential EOS Issues between Automotive OEM, Tier 1, and Semiconductor Manufacturers

IEEE
P2838 Standard for Aircraft Component Lightning Strike Direct Effects
Qualification
Working Group

Meeting Agenda 8 Aug 2024 –9:30 AM PDT

1. Call to Order
2. Introduction and [Affiliation Declarations](#)
 - a. Establish Quorum
3. Approval of Agenda
4. Approval of Previous Meeting Minutes (11 Jan)
5. IEEE Policies
 - a. IEEE SA [Call for Patents](#)
 - b. IEEE SA [Copyright Policy Presentation](#)
 - c. IEEE SA [Entity Participation](#)
6. Technical Presentation(s), Contribution(s) or Discussion(s)
 - a. IEEE-SAE Coordination and Plans Forward
 - b. Review of Standard and comments
 - c. Rolling Action Item List
 - d. Draft Standard Actions 28 Feb 2024
7. New Business
 - a. None
8. Future Meetings
Two Weeks away
9. Adjourn