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2015 EMC SYMPOSIUM GUIDE



MARCH 15-20 SILICON VALLEY, CA

YOUR COMPREHENSIVE GUIDE TO THE IEEE INTERNATIONAL SYMPOSIUM ON EMC

BACK COVER

ENHANCED EDITION

FEATURED INSIDE

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WELCOME TO SILICON VALLEY, THE LAND OF SUNSHINE AND GREAT WINE. Did you know that it used to be called Santa Clara Valley before it became the symbol of high tech startups?

This is an unusual year where we have a national symposium in Santa Clara, CA, USA and the International one in Dresden, Germany. Although it is only seven months since the 2014 Raleigh symposium, the size of this symposium is comparable to the International symposium, running from Monday to Friday with the combination of EMC and Signal/Power Integrity topics. We have three unique special events planned for this symposium. Our featured Keynote Speaker is Dr. Thomas H. Lee, graduate of MIT and current electronic engineering professor at Stanford University. Dr. Lee will be summarizing three historical events that have proven the fragility of the Earth's electronics systems which is a subject that greatly affects us all. Our Technical Committee has been working hard in planning an excellent program including new Plenary Sessions with four technical keynote speakers and a Panel of Experts that will offer very informative dialogue about topics relevant to our industry.

While visiting the workshops/tutorials, the high quality Technical paper presentations, which will include unique Industry papers, and then passing through the Special Sessions, don't forget to visit the Exhibit Hall where product show cases and panelists might inspire you to your next innovation.

The Symposium Organizing Committee has planned and designed the EMCSI 2015 Symposium with the goal of ensuring the most enriching technical and professional networking opportunities possible through multiple exhibits, technical programs, companion programs, and social events. We are offering three days of top-rated, peer-reviewed technical papers presented by experts in multi-track sessions and more than two days of practical workshops and tutorials, plus experiments and demonstrations presented by industry professionals.

Also included are collateral industry meetings and a full exhibit hall to learn about the latest offerings in EMC products and services. In addition to the number of regular sessions, special sessions and workshop/tutorial sessions on 'standard EMC' and 'Signal and Power Integrity', there will also be papers on Radio-Frequency Interference and Wireless EMC, Uncertainty Quantification in Computational EM and many more topics! There is certainly something new for everyone, regardless of your interests, within the broad EMC & SI world.

Our main host hotel is the Hyatt Regency Santa Clara, which is attached to the Convention Center and almost directly across from the new state-of-the-art Levi's Stadium for the 49ers.

Our Welcome Reception will feature wine tasting while you mingle and chat with friends and colleagues with live music. The Gala will include a limited Awards presentation while you are being treated to true Californian cuisine.

I would also like to extend a welcome to the Santa Clara Valley IEEE EMC Chapter where many of our officers are also volunteering at this conference. If you have a chance, come join us on the second Tuesday of the month for the monthly chapter technical meeting.

Welcome!

Caroline Chan

Caroline Chan
EMCSI 2015 General Chair

EMC 2015 SYMPOSIUM COMMITTEE

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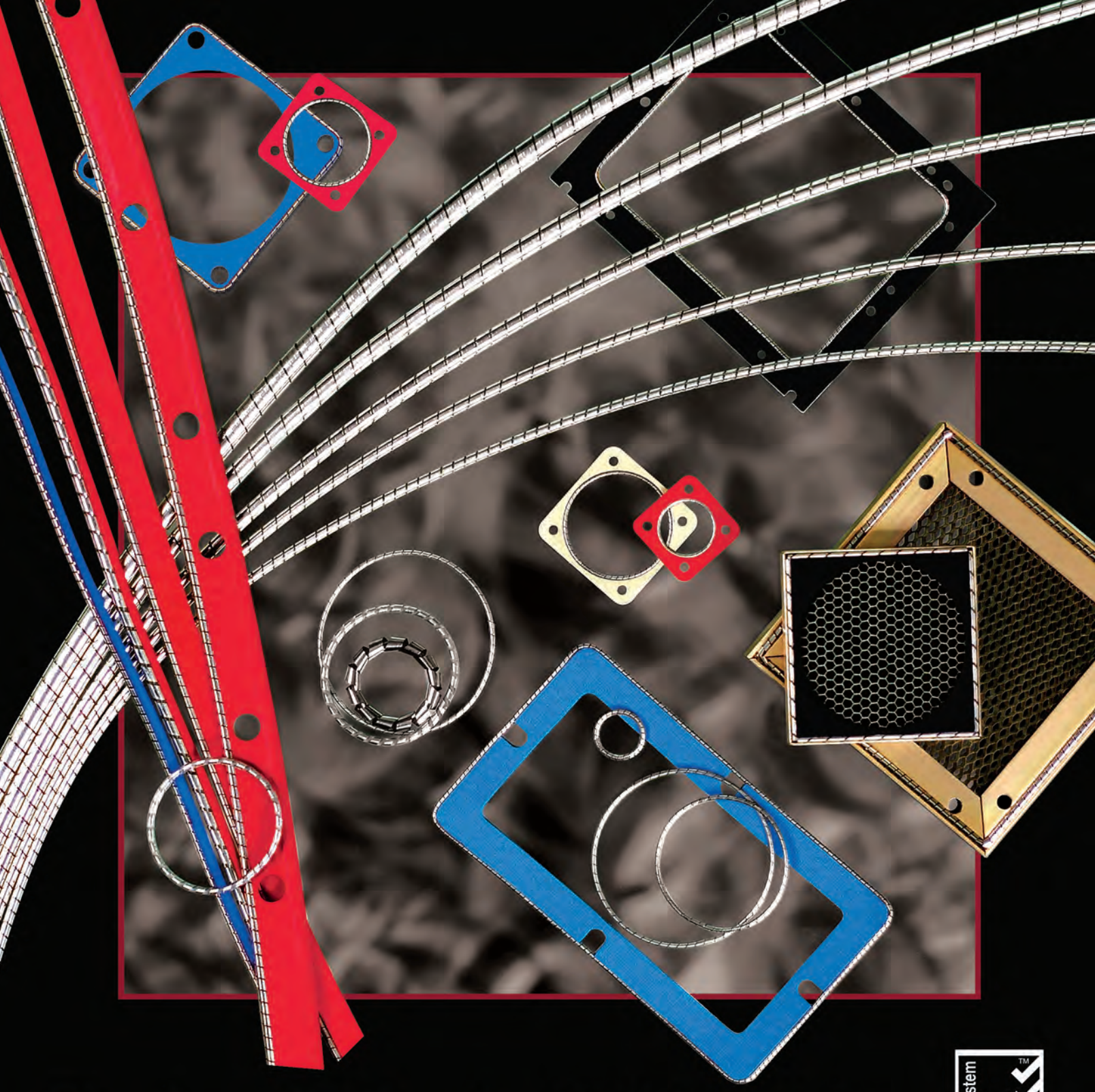
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OVERVIEW

SANTA CLARA, CA
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WELCOME TO SANTA CLARA AND THE 2015 IEEE SYMPOSIUM on Electromagnetic Compatibility. This Symposium Overview is designed to give you a day-by-day summary of the technical, social, and educational programs available to attendees of the IEEE EMC Symposium and their families. Use it to plan your days and nights and get the maximum benefit of five days plus of non-stop immersion in everything EMC.*

SUNDAY, MARCH 15

- 8:00 AM – 6:00 PM
  - Exhibitor Move-In

MONDAY, MARCH 16

- 8:00 AM – 6:00 PM
  - Exhibitor Move-In

MORNING WORKSHOP & TUTORIALS PROGRAM

- 8:30 AM – 12:00 PM
  - MO-AM-1 ESAC FundAMentals of EMC & Signal Integrity
  - MO-AM-2 TC1 Calibration of EMC Test Facilities and Measurement Instrumentation Tutorial
  - MO-AM-3 SC4 Product EMC Challenges for Emerging Wireless Technologies
  - MO-AM-4 Application of Reverb ChAMbers
  - MO-AM-5 TC5 Lightning Protection of Wind Turbines

AFTERNOON WORKSHOP & TUTORIALS PROGRAM

- 1:30-5:30 PM
  - MO-PM-1 ESAC FundAMentals of EMC & Signal Integrity (continued)
  - MO-PM-2 Testing of Wireless Devices in the Modern World
  - MO-PM-3 EMC Consultant's Toolkit
  - MO-PM-4 Smart Grid EMC Update
  - MO-PM-5 TC5 Intentional Electromagnetic Interference (IEMI) Update



TUESDAY, MARCH 17

- 9:00 AM – 5:00 PM
  - Keynote Address (8:30AM - 10:00AM)
  - Exhibit Hall Open

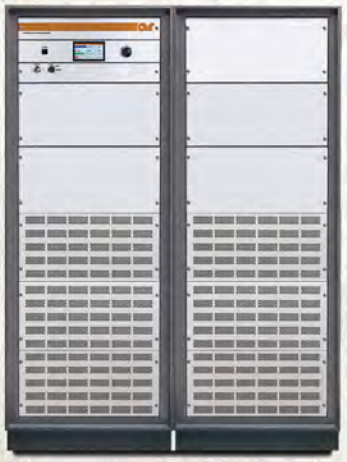
MORNING WORKSHOP & TUTORIALS PROGRAM

- 10:30 AM – 12:00 PM
  - TU-AM-1 EMC Management
  - TU-AM-2 Passive Component Modeling and Measurement I
  - TU-AM-3 Jitter/Noise Modeling and Analysis I
  - TU-AM-5 Numerical Modeling and Simulation Techniques I
  - TU-AM-6 Electromagnetic Environment and ESD

AFTERNOON WORKSHOP & TUTORIALS PROGRAM

- 1:30-5:30 PM
  - TU-PM-1 TC9 Special Session: Radio-Frequency Interference and Wireless EMC

*All events are subject to change. Check www.emc2015usa.emcss.org and the Registration Area daily for updates.



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adjective
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[predic] (unique to) belonging or connected to (one particular person, group, place or thing)

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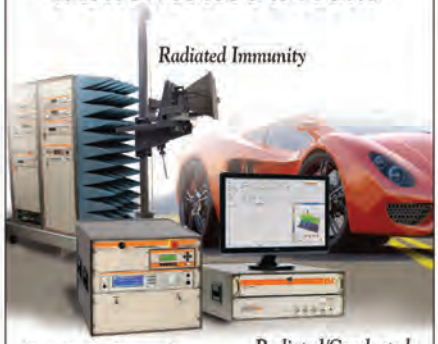
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- TU-PM-2 TC4 Electromagnetic Interference Control
- TU-PM-3 Special Session: SC4 High Speed Link Design I
- TU-PM-4 Special Session: TC11 SI/PI/EMC Co-Simulation and Co-Design
- Panel: Optimizing Interference Control Using Material Science
- Panel: Brazil, Argentina, Mexico Regulatory Updates, Trends and Best Practices for Successful Product Certification

WEDNESDAY, MARCH 18

- 9:00 AM – 5:00 PM
  - Exhibit Hall Open

MORNING WORKSHOP & TUTORIALS PROGRAM

- 8:30 AM – 12:00 PM
  - WED-AM-1 TC4 Automotive EMC Measurements
  - WED-AM-2 TC2 Passive Component Modeling and Measurement II
  - WED-AM-3 TC9 Jitter/Noise Modeling and Analysis II
  - WED-AM-4 TC7 Power Integrity and Power Delivery Network I
  - WED-AM-5-SIPI Applications of Numerical Modeling
  - WED-AM-7 Poster Session

AFTERNOON WORKSHOP & TUTORIALS PROGRAM

- 1:30-5:30 PM
  - WED-PM-1 Time Domain Emission Measurements and Modeling
  - WED-PM-2 Capturing Pulsed/ Intermittent Signals with Frequency Swept, Frequency Stepped, and Time Domain Scan Methodologies
  - WED-PM-3 TC1 Working EMC Engineer Skills
  - WED-PM-4 ESD Assoc. Integrated ESD Device and Board Level Design
  - Panel: Are EMC/SI/PI Closely Related Now or in the Future?
  - Panel: Electrical Characterization of High Frequency Interconnects at Bandwidths up to 50 GHz

THURSDAY, MARCH 19

- 9:00 AM – 1:00 PM
  - Exhibit Hall Open
- 1:00 PM – 6:00 PM
  - Exhibit Hall Move Out

MORNING WORKSHOP & TUTORIALS PROGRAM

- 8:30 AM – 12:00 PM
  - TH-AM-1 EMC Measurements and Calibration

- TH-AM-2 High Speed Link Design II
- TH-AM-3 Special Session: Modeling and Simulation for Large-Scale and Multi-Scale Power Delivery Network
- TH-AM-4 Numerical Modeling Approaches
- Plenary Electromagnetic Integrity

AFTERNOON WORKSHOP & TUTORIALS PROGRAM

- 1:30-5:30 PM

- TH-PM-1 Wireless Testing and RF Interference
- TH-PM-2 Numerical Modeling and Simulation Techniques II
- TH-PM-3 TC1 Power Integrity and Power Delivery Network II
- TH-PM-4-Special Session: Uncertainty Quantification in Computational EM and Signal/Power Integrity Verification
- Panel: ESD in Data Centers

FRIDAY, MARCH 20

- 8:00 AM – 12:00 PM

- Exhibit Hall Move Out

MORNING WORKSHOP & TUTORIALS PROGRAM

- 8:30 AM – 12:00 PM

- FR-AM-1 Introduction to Medical EMC
- FR-AM-2 TC2 Basic EMC Measurements
- FR-AM-3 TC11 Nanotechnology and Advanced Materials Applied to EMC
- FR-AM-4 TC9 New Opportunities and Challenges for Validation of Computational Electromagnetics Standardization - the Review of IEEE Std 1597.1
- FR-AM-5 TC1 Conformity Assessment Topics for EMC Laboratories

AFTERNOON WORKSHOP & TUTORIALS PROGRAM

- 1:30-5:30 PM

- FR-PM-1 TC4 Debugging EMI Test Failures
- FR-PM-2 TC9 Field Sources and their Application in Computational EMC
- FR-PM-3 EMC Risk Management Workshop
- FR-PM-3 TC11 Crosstalk - Theory, Modeling, Characterization, and Design Optimization

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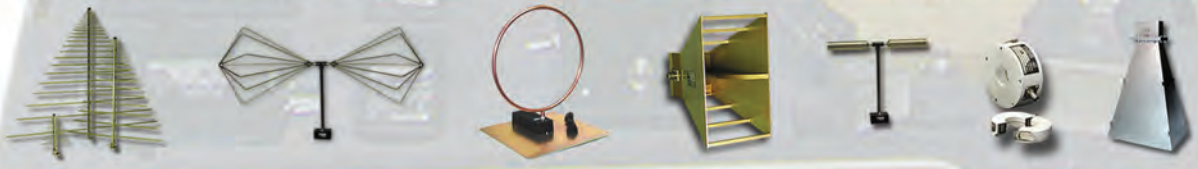
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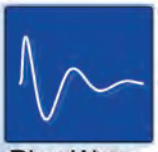

Common Mode


Indirect Lightning

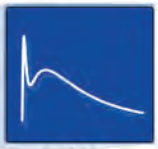

RF CW



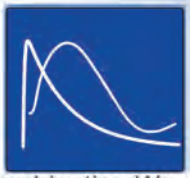
RS 105

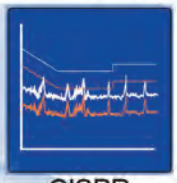

Ring Wave


10/700


ESD

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Combination Wave


CISPR


RS 103


CS 116


RE 102


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DIPS DC


CS 106


CS 115


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ACTIVITIES*

WORKSHOPS/TUTORIALS

>> Fundamentals of EMC & Signal Integrity

>> Calibration of EMC Test Facilities and Measurement Instrumentation Tutorial

>> Product EMC Challenges for Emerging Wireless Technologies

>> Application of Reverb Chambers

>> Lightning Protection of Wind Turbines

>> Testing of Wireless Devices in the Modern World

>> EMC Consultant's Toolkit

>> Smart Grid EMC Update

>> Intentional Electromagnetic Interference (IEMI) Update

OTHER EVENTS

>> Technical Committee Meetings

EXHIBITOR SET UP

>> 8:00 AM - 6:00 PM

*All events are subject to change. Check www.emc2015usa.emcss.org and the Registration Area daily for updates.

Fundamentals of EMC & Signal Integrity

Sponsored by ESAC

Format: Full-day Tutorial – MO-AM-1 and MO-PM-1
8:30AM-Noon Grand Ballroom A

Chair: Mark Steffka, University of Michigan – Dearborn, Dearborn, MI, USA

Abstract

This tutorial is an introduction and overview of many of the major topics that need to be considered when designing a component or system for EMC and to minimize potential SI/PI issues. The tutorial will present the foundational physics and provide an overview of the significance and relevant mathematics that need to be understood to successfully evaluate, diagnose, and solve both EMC and SI/PI issues. After the "background" material on causes of emissions is covered, specific examples of the application of the theory will be discussed in dedicated sessions on grounding, shielding, printed circuit board (PCB) design, as well as important considerations in designing for SI/PI, and the tutorial will conclude with an overview of typical EMC test equipment.

Planned Speakers and Topics

Basic EM and the Source of Emissions
Lee Hill, Silent Solutions, LLC, Amherst, New Hampshire, USA

Topics to be covered: Maxwell's equations, Ampere's law, Faraday's law and how it defines inductance. Current flows in path of least impedance (least resistance at DC and least inductance at high frequencies, and where this transition occurs). Boundary conditions and how this requires electric fields to be zero on perfect electric conductors, a short discussion on skin effect, and harmonic content of digital signals are discussed.

System Level Grounding Overview
Todd Hubing, Clemson University, South Carolina, USA

Topics to be covered: What is a ground? What is its purpose(s)? Ground versus current return paths. Practical grounding issues – bonding, corrosion control, current levels, sizing, etc. Grounding and circuits – PCBs, digital, analog, RF, power supplies. Grounding for systems – automotive vehicles, aerospace vehicles, naval vehicles.

Shielding
Todd Hubing, Clemson University, South Carolina, USA

Topics to be covered: An introduction to the theory of shielding; absorption and reflection loss, the difference between electric and magnetic field shielding in the near field and shielding in the far-field; the influence of apertures and holes on shielding effectiveness; shielding materials, gaskets, and enclosures, effective and ineffective techniques of implementing a shield.

Fundamentals of Signal Integrity (SI)
Xiaoning Ye, Intel, Portland, OR, USA

Topics to be covered: Description of why SI is important, its potential causes and effects upon component/system operation. Discussion of typical corrective actions in the design stage to minimize the development of SI issues and possible mitigation strategies that can be used during system development.

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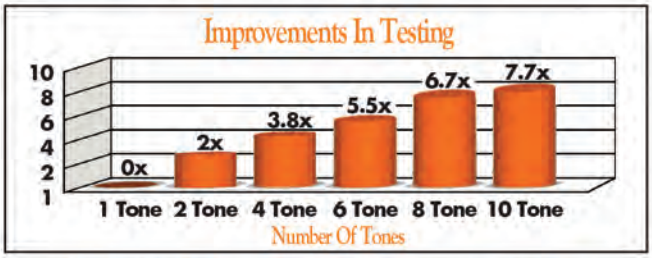


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Calibration of EMC Test Facilities and Measurement Instrumentation Tutorial

Sponsored by TC1

Format: Half-day Tutorial – MO-AM-2
8:30AM-Noon Grand Ballroom B

Co-Chairs: Frans Stork, ETS-Lindgren, Cedar Park, TX, USA
Janet O'Neil, ETS-Lindgren, Cedar Park, TX, USA

Abstract

This tutorial will present detailed information about the state of the art in calibration of EMC measurement equipment and test facilities required by many current international standards. Specific requirements and nuances that can challenge even the most experienced EMC practitioner will be discussed, and methods for practical implementation for real-world application will be shared with attendees. Speakers will include experts who are actively involved in using, writing and maintaining the standards in which the requirements are established.

All new material will be presented, representing activity within the related standards committees, including CISPR, ISO, ANSI ASC C63® and IEEE. This tutorial will take a novel approach to equipment and facility calibration by delving into implementation of specific characteristics and requirements, as opposed to a general treatment of calibration.

Calibration issues related to a variety of test facilities and measurement equipment and the associated standards will be included, including antennas per ANSI C63.5; LISNs according to ISO; field probes according to IEEE 1309; test sites used for antenna calibration and reference test sites, per revision being developed for CISPR 16-1-5 and future CISPR 16-1-6. Clarification will be provided about distinguishing LISNs and AMNs separately, since many engineers and technicians use these terms interchangeably.

Attendees can expect to improve their understanding of both the background of the latest requirements for calibration of EMC measurement equipment and facilities and practical aspects of performing or specifying the required calibrations.



Planned Speakers and Topics

Antenna Calibration and Site Validation for Radiated Emissions Above 1 GHz (CISPR 16-1-4, 16-1-5, 16-1-6)
Martin Wiles, ETS-Lindgren, Stevenage, England, UK

How to Specify an ISO 17025 Accredited LISN Calibration
Peter Drembelas, Fischer Custom Communications, Torrance, CA, USA

Calibration of Field Probes for EMC Measurements (IEEE 1309)
Zhong Chen, ETS-Lindgren, Cedar Park, TX, USA

Traceability of Antenna Measurement and Introduction to Methods in CISPR 16-1-6 for Frequencies Below 1 GHz
David Knight, NPL, Middlesex, England, UK

Verification of Test Chambers for Radiated Emission Testing (ANSI C63.4, C63.25)
Greg Kiemel, Northwest EMC, Hillsboro, OR, USA

Product EMC Challenges for Emerging Wireless Technologies

Sponsored by SC-4

Format: Half-day Tutorial – MO-AM-3
8:30AM-Noon Grand Ballroom C

Co-Chairs: Kefeng Liu, General Test Systems Inc., Shenzhen, China
Seth J. Seidman, Food and Drug Administration, Silver Spring, MD, USA

Abstract

While we are enjoying the benefits from the advent of newer and faster wireless transmissions, design issues related to product converged performance, coexistence with other wireless devices, and compatibility with current EMC regulatory rules are becoming hot topics up for discussion. This workshop, sponsored by SC4 EMC for Emerging Wireless Technologies, will outline the challenges facing the existing 4th Generation (4G), the emerging 4G LTE Advanced, and the 5G wireless technologies. Updates will be provided on the recent developments in test and measurements and standardization activities.

Planned Speakers and Topics

An Overview of Coexistence Problem from Emerging Wireless Technologies
Bill Young, NIST, Boulder, CO, USA

Living with Complex Electromagnetic Environment
Harry Skinner, Intel, Hillsboro, OR, USA

RF Desensitization in Wireless Devices
Jun Fan, Missouri University of Science and Technology, Rolla, MO, USA

Updates on Development of Test and Measurement Techniques
Kefeng Liu, General Test Systems Inc., Shenzhen, China

Application of Reverb Chambers

Format: Half-day Tutorial – MO-AM-4
8:30AM-Noon Grand Ballroom D

Chair: Vignesh Rajamani, Oklahoma State University (OSU), Stillwater, OK, USA

Abstract

This tutorial will provide an introduction to recent applications of reverberation chambers. It is intended to provide EMC engineers who are interested in applying reverberation chambers to various measurement issues and the extension of reverberation chambers to solve a variety of EMC problems.

This half-day tutorial provides a brief overview of Reverb Chamber (RC) theory, followed by recent applications of RCs. The tutorial material will be updated to reflect recent research results and implications. The format will be a conference presentation style (lecture) followed by questions moderated by the chairman. It is designed for both academics and people from industry who will be involved in radiated emission or immunity testing of commercial or military systems using reverberation chambers and will be valuable to personnel evaluating the use of reverberation chambers as a complement to or replacement for other types of radiated test facilities and for personnel who are trying to use statistical methods to characterize the electromagnetic environments.

Planned Speakers and Topics

Introduction – Rationale for RC Testing
Vignesh Rajamani, Oklahoma State University (OSU), Stillwater, OK, USA

Overview of Reverberation Chamber Theory
Chuck Bunting, Oklahoma State University (OSU), Stillwater, OK, USA

Using Reverberation Chambers for Broadband (4G/LTE) Immunity Testing on Devices: Lessons Learned
J. Ladbury, J. Coder and William Young, National Institute of Science and Technology (NIST), Boulder, CO, USA

Evaluation of Material Shielding Effectiveness Using Coupled Reverberant Cavities
Carl Hager and Greg Tait, Naval Surface Warfare Center, Dahlgren, VA, USA

Complex Cavity Measurement Techniques for Precision Metrology Applications and Aircraft/Vehicle Electromagnetic Environment Assessments
Dennis Lewis, Boeing, Seattle, WA, USA

Optimizing Reverb Chamber Design for DO160 Cat G and L
Garth D'Abreu, ETS Lindgren, Cedar Park, TX, USA

Lightning Protection of Wind Turbines

Sponsored by TC-5

Format: Half-day Tutorial – MO-AM-5
8:30AM-Noon Grand Ballroom E

Co-Chairs: Marcos Rubinstein, Inst. for Info. and Communication Tech., Yverdon-les-bains, Switzerland

Farhad Rachidi, Swiss Federal Inst. of Tech. in Lausanne (EPFL), Lausanne, Switzerland

Abstract

Lightning protection and modeling of modern wind turbines exhibit a number of new challenges due to the large size of the blades, the use of carbon-reinforced plastics (CRP) in them, the current reflections at the top, the bottom and at different junctions along the structure, and the growing number of new installations worldwide. In addition, risk assessment estimates are based essentially on downward flashes, even though upward lightning represents a considerable fraction of the flashes to wind turbines. This workshop presents the current knowledge and challenges related to lightning protection of modern wind turbines.

Planned Speakers and Topics

Cloud-to-Ground Lightning and Wind Turbines
Farhad Rachidi, Swiss Federal Institute of Technology in Lausanne (EPFL), Lausanne, Switzerland and Marcos Rubinstein, Inst. for Info. and Communication Tech., Yverdon-les-bains, Switzerland and Farhad Rachidi, Swiss Federal Inst. of Tech. in Lausanne (EPFL), Lausanne, Switzerland

Challenges of Lightning Protection of Modern Wind Turbines
Marcos Rubinstein, Inst. for Info. and Communication Tech., Yverdon-les-bains, Switzerland and Farhad Rachidi, Swiss Federal Inst. of Tech. in Lausanne (EPFL), Lausanne, Switzerland

Lightning Damages to Wind Turbines
Joan Montanya, Technological University of Catalonia Barcelona, Spain

Lightning Observations at Wind Farms in Japan
Takatoshi Shindo Central Research Institute of Electric Power Industry (CRIEPI) Nagasaka, Japan and Masaru Ishii, University of Tokyo Tokyo, Japan

Lightning Protection of Wind Turbine Blades
Søren Madsen, Global Lightning Protection Services A/S Hedehusene, Denmark

Grounding of Wind Turbines
Kazuo Yamamoto, Chubu University, Aichi, Japan

Fundamentals of EMC & Signal Integrity (continued)

Sponsored by ESAC

Format: Full-day Tutorial – MO-AM-1 and MO-PM-1
1:30PM-5:30PM Grand Ballroom A

Chair: Mark Steffka, University of Michigan – Dearborn, Dearborn, Michigan, USA

See MO-AM-1 for description

Planned Speakers and Topics

Introduction to Test Equipment Used for EMC Testing
Kenneth Wyatt, Wyatt Technical Services LLC, Woodland Park, CO, USA

Topics to be covered: Overview and examples of the major types of EMC test and support equipment, associated hardware, and their use in typical test set-ups. Specific items to be covered include spectrum analyzers, EMC receivers, Line Impedance Stabilization Networks (LISNs), antennas (monopole, loop, bi-conical, log-periodic), test chambers, and cables.

Fundamentals of Power Integrity (PI)
James Drewniak, Missouri University of Science and Technology, Rolla, MO, USA

Topics to be covered: Description of why PI is important, its potential causes and effects upon component/system operation. Discussion of typical corrective actions in the design stage to minimize the development of PI issues and possible mitigation strategies that can be used during system development.

SI/PI Concerns in PCB Design
Bruce Archambeault, Archambeault EMI/EMC Enterprises, Four Oaks, NC, USA

Topics to be covered: A brief introduction to the main concepts behind good SI/PI design of PCBs, decoupling for EMI and SI, methods to improve the design of PCBs; typical pitfalls.

Testing of Wireless Devices in the Modern World

Format: Half-day Tutorial – MO-PM-2
1:30AM-5:30PM Grand Ballroom B

Co-Chairs: Janet O'Neil, ETS-Lindgren, Cedar Park, TX, USA
Jari Vikstedt, ETS-Lindgren, Cedar Park, TX, USA

Abstract

With the continuous development of wireless technologies and their tight integration with various electronic/computer/communication devices, EMC issues, at both the system and the intra-system levels, become increasingly important. This tutorial will provide an overview and primer on testing wireless devices, the biggest challenges the test labs face with testing wireless devices and their techniques for addressing those challenges. Planned topics include interference from digital to wireless, noise mitigation (EMC design) through system planning and wireless performance testing methodologies.

Planned speakers include experts active in the ETSI, CTIA and ANSI ASC C63® standards committees on wireless devices, test engineers and managers from Silicon Valley based EMC and wireless commercial test labs, as well as experts from other wireless "hot bed" areas including Portland, San Diego and Seattle.

Planned Speakers and Topics

Practical Considerations for RFI/EMC Testing of Modern Electronics Equipment
Fermin A. Romero Jr., Cetecom, Milpitas, CA, USA

Wireless Coexistence Design for Optimal Performance
Harry Skinner, Intel, Hillsboro, OR, USA

Understanding Radiated Spurious Emissions (RSE) Testing
Garth D'Abreu, ETS-Lindgren, Cedar Park, CA, USA

ANSI C63.26 and C63.10 Wireless Standards Update
Mark Briggs, UL, Fremont, CA, USA

Tips to Simplify Recent Changes to ETSI 300 328 Conducted Testing Standard
Jack McFadden, ETS-Lindgren, Cedar Park, TX, USA

Assessing the Radiated Performance of Machine-to-Machine Devices
Scott Prather, AT&T, Redmond, WA, USA

EMC Consultant's Toolkit

Format: Half-day Tutorial – MO-PM-3
1:30AM-5:30PM Grand Ballroom C

Chair: Jerry Meyerhoff, JDM Labs LLC, Buffalo Grove, IL

Abstract

As more engineering and design firms outsource and reduce staff, more qualified EMC engineers are finding themselves "homeless". As well, there are hundreds of companies that do not have the resources to hire a full-time EMC engineer. The purpose of this workshop is to provide an introduction to the technical, business and marketing skills to interested EMC engineers so that they can successfully locate, market and provide effective services to these companies at a fair profit and with job satisfaction.

Planned Speakers and Topics

Marketing Yourself
Jerry Meyerhoff, JDM LABS LLC, Buffalo Grove, IL, USA

Presenting Yourself Professionally
Patrick André, André Consulting Inc., Seattle, WA, USA

Win-Win Methods for Quoting EMC Consultancy
Keith Armstrong, Cherry Clough Consultants Ltd., Stafford, UK

Networking, Branding & Providing Customer Value
Kenneth Wyatt, Wyatt Technical Services LLC, Woodland Park, CO, USA

Acquiring Test Equipment & Developing a Low-Cost EMC Troubleshooting Kit
Patrick André, André Consulting Inc., Seattle, WA, USA and Kenneth Wyatt, Wyatt Technical Services LLC, Woodland Park, CO, USA

Panel Discussion
All Presenters

Smart Grid EMC Update

Format: Half-day Tutorial – MO-PM-4
1:30AM-5:30PM Grand Ballroom D

Chair: Don Heirman, Don HEIRMAN Consultants, Lincroft, NJ, USA

Abstract

Smart Grid continues to be a hot topic worldwide. This tutorial will review the latest EMC activities of key organizations and meetings on the topic. The focus will be on the EMC implications including what are being accepted and what are not. It will discuss what EMC compatibility level is desirable for all grid connected devices, especially those that are part of the communication channel passing power usage data and use in both directions. The tutorial also brings two speakers who reside on West Coast US to interact with an expected West Coast attendance. Finally, the tutorial will place in perspective the EMC status and the work still needed to be done to make it an integral part of the Smart Grid roll out.

Planned Speakers and Topics

New Smart Grid Interoperability Panel (SGIP 2.0)
Don Heirman, Don HEIRMAN Consultants, Lincroft, NJ, USA

SGIP Electromagnetic Interoperability Issues Working Group Activity
William Young and Galen Koepke, National Institute of Science and Technology (NIST), Boulder, CO, USA

EMC Testing of Intelligent Electronic Devices Installed in Substation and in Distribution Environments
Jerry Ramie, ARC Technical Resources, Inc., San Jose, CA, USA

Immunity for Power Station and Substation Environments
Bill Radasky, Metatech, Goleta, CA, USA

International View of Smart Grid EMC Needs/Activity
Don Heirman, Don HEIRMAN Consultants, Lincroft, NJ, USA

Intentional Electromagnetic Interference (IEMI) Update

Sponsored by TC-5

Format: Half-day Tutorial – MO-PM-5
1:30PM-5:30PM Grand Ballroom E

Chair: Frank Sabath, Bundeswehr Research Institute for Protective Technologies and NBC-Protection (WIS), Munster, Germany

Abstract

The objective of this tutorial is to inform members of the IEEE EMC community of the threat of Intentional Electromagnetic Interference (IEMI) and methods which can be employed to analyse the IEMI Risk, protect IT-Systems and validate IEMI immunity. The tutorial starts with a brief discussion of the IEMI threat and reported IEMI attacks and similar incidents. The following presentations include an update on standardization activities and the presentation of methods for the systematic analysis of the IEMI Risk. The tutorial closes with detailed discussion of the IEEE Std 1642 on recommended practice for protection and a discussion of IEMI immunity test and verification methods.

Planned Speakers and Topics

Description of the IEMI Threat
William A. Radasky, Metatech, Goleta, CA, USA

Lessons Learned from Past IEMI Attacks
Frank Sabath, Bundeswehr Research Institute for Protective Technologies and NBC-Protection (WIS), Munster, Germany

Review of IEMI Standardization
William A. Radasky, Metatech, Goleta, CA, USA

IEMI Risk Analysis at the System Level
Frank Sabath, Bundeswehr Research Institute for Protective Technologies and NBC-Protection (WIS), Munster, Germany

IEEE 1642 Recommended Practice for Protecting Public Accessible Computer Systems from Intentional EMI
William A. Radasky, Metatech, Goleta, CA, USA

IEMI Immunity Test and Verification Methods
Matthias Kreitlow, Bundeswehr Research Institute for Protective Technologies and NBC-Protection (WIS), Munster, Germany

Facts

During the Gold Rush of 1849, many of those searching for gold failed. They instead turned to working the fertile land in Santa Clara Valley and began to settle in Santa Clara.

ACTIVITIES*

TECHNICAL SESSIONS

>> EMC Management
>> Passive Component Modeling and Measurement I
>> Jitter/Noise Modeling and Analysis I
>> Numerical Modeling and Simulation Techniques I
>> Electromagnetic Environment and ESD
>> Special Session: Radio-Frequency Interference and Wireless EMC
>> Electromagnetic Interference Control
>> High Speed Link Design I
>> SI/PI/EMC Co-Simulation and Co-Design

EXPERIMENTS AND DEMONSTRATIONS

>> Computer Modeling & Simulations Demonstrations (Page 48)
>> Hardware Experiments and Demonstrations (Page 48-49)

OTHER EVENTS

>> Global University (Pages 52-53)
>> Technical Paper Sessions
>> IEEE EMC Young Professionals
>> Keynote Presentation
>> Panel of Experts

EXHIBIT HALL OPEN

>> 10:00 AM - 5:00 PM

*All events are subject to change. Check www.emc2015usa.emcss.org and the Registration Area daily for updates.

EMC Management

Format: Half-day Tutorial – TU-AM-1
10:30AM-Noon Grand Ballroom A

Chair: Kimball Williams, Dearborn, MI, USA

Planned Speakers and Topics

China CCC Implementation Rules
Grace Lin, Crestron Electronics, Inc., Rockleigh, NJ, USA

A New Framework for the EU EMC Directive
Mark Maynard, SIEMIC, Inc., Milpitas, CA, USA

Passive Component Modeling and Measurement I

Format: Half-day Tutorial – TU-AM-2
10:30AM-Noon Grand Ballroom B

Co-Chairs: Jim Nadolny, Samtec, Inc., New Albany, IN, USA; Zhichao Zhang, Intel Corp., Chandler, AZ, USA

Planned Speakers and Topics

Effects of Temperature and Humidity Variation on Electrical Performance of High Speed Data Cables
Joseph Diepenbrock, Lorom America, Morrisville, NC, USA; Patrick Casher, Lorom America, North Aurora, IL, USA; Xin Wu, Lorom Industrial Group, Austin, TX, USA; Alan Benner, IBM Corporation, Poughkeepsie, NY, USA; and Sheng Xu, Lorom Industrial Group, Hangzhou, China

Using Joint Time-Frequency Domain Analysis to Evaluate Absorber/Lossy Material Performance in Resonant Cavities
Bruce Archambeault, Michael Varner, and Samuel Connor, IBM Corporation, Research Triangle Park, NC, USA

Suppression of Cavity Resonance In Printed Circuit Board and Packages Using Absorbing Materials along the Edge
Shaowu Huang, Gary Charles, Kai Xiao, Gong Ouyang and Hanqiao Zhang, Intel Corporation, DuPont, WA, USA; Beomtaek Lee, Intel Corporation, Santa Clara, CA, USA

Jitter/Noise Modeling and Analysis I

Format: Half-day Tutorial – TU-AM-3
10:30AM-Noon Grand Ballroom C

Co-Chairs: Brice Achkir, Cisco Systems, Inc., San Jose, CA, USA; Fangyi Rao, Agilent Technologies, Santa Clara, CA, USA

(Continued on page 26)

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SKU 2066	1 kW	500-1000 MHz	5U chassis
SKU 2162	1 kW	20-1000 MHz	5U chassis
SKU 2170	1 kW	1000-3000 MHz	5U chassis
SKU 2175	500W	80-1000 MHz	3U chassis
SKU 2179	250W	2000-6000 MHz	4U chassis

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SKU 1193	100W	20-1000 MHz	7x4x1.2″
SKU 1199	100W	1000-3000 MHz	7x4x1.2″
SKU 1191	100W	2500-6000 MHz	8x6.5x1″

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(Continued from page 24)

Planned Speakers and Topics

Reducing Power-Supply and Ground Noise Induced Timing Jitter in Short Pulse Generation Circuits
Jiwei Sun and Pingshan Wang, Clemson University, Clemson, SC, USA; Hanqiao Zhang, Intel Corporation, DuPont, WA, USA

On-Chip Linear Voltage Regulator Module (VRM) Effect on Power Distribution Network (PDN) Noise and Jitter at High-Speed Output Buffer
Heegon Kim, Joungho Kim and Sukjin Kim, Korean Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea; Changwook Yoon, Altera Corporation, San Jose, CA, USA; Jingook Kim, Ulsan National Institute of Science and Technology, Ulsan, South Korea; Brice Achkir, Cisco Systems, Inc., San Jose, CA, USA; and Jun Fan, Missouri University of Science and Technology, Rolla, MO, USA

Analysis and Comparison of DDR3/DDR4 Clock Duty-Cycle-Distortion (DCD) for UDIMM and Discrete SDRAM Component Configurations
GaWon Kim, June Feng, Marjan Mokhtaari, David Lieby, Janmejay Adhyaru, Raheel Shaikh, Balaji Natarajan and Dan Oh, Altera Corporation, San Jose, CA, USA

Numerical Modeling and Simulation Techniques I

Format: Half-day Tutorial – TU-AM-4
10:30AM-Noon Grand Ballroom D

Co-Chairs: Dan Jiao, Purdue University, West Lafayette, IN, USA; Qinghua Bill Chen, Yangtze Delta Region Institute of Tsinghua University, Jiaxing, Zhejiang, China

Planned Speakers and Topics

Physical Interpretation of Radiation and Transfer Characterization Based on the PEEC Method
Ying S. Cao and Li Jun Jiang, The University of Hong Kong, Hong Kong, Hong Kong; and Albert E. Ruehli, Missouri University of Science and Technology, Rolla, MO, USA

Full-wave Simulation of an Imbalanced Differential Mircostrip Line with Conductor Surface Roughness
Marina Koledintseva, Oracle, Menlo Park, CA, USA; Tracey Vincent, CST of America, Framingham, MA, USA; and Sergiu Radu, Oracle, Menlo Park, CA, USA

Quality Assurance of S-parameters and Rational Function Models for Transient Simulations
Sanghoek Kim, Gerardo Romo Luevano, Kevin Roselle, and Tim Michalka, Qualcomm Inc., San Diego, CA, USA



Electromagnetic Environment and ESD

Format: Half-day Tutorial – TU-AM-5
10:30AM-Noon Grand Ballroom E

Chair: William Radasky, Metatech Corporation, Goleta, CA, USA

Planned Speakers and Topics

Modal Expansion Basis for Statistical Estimation of Maximum Expected Field Strength in Enclosures
Paul Bremner, Robust Physics, Del Mar, CA, USA

Modeling Atmospheric Clutter and Electromagnetic Interference Including Random Waveforms
Robert McMillan, Retired US Army Civilian, St George Island, FL, USA; and Ira Kohlberg, Kohlberg Associates, Reston, VA, USA

Electrostatic Charging Caused by Standing up from a Chair and by Garment Removal
Atieh Talebzadeh, Mahdi Moradian, Yunan Han and David Pommerenke, Missouri University of Science and Technology, Rolla, MO, USA; David E. Swenson, Affinity Static Control Consulting, L.L.C Round Rock, TX, USA

Special Session: Radio-Frequency Interference and Wireless EMC

Format: Half-day Tutorial – TU-PM-1
1:30PM-5:30PM Grand Ballroom A

Co-Chairs: Harry Skinner, Intel Corporation, Hillsboro, OR, USA; David Pommerenke, Missouri University of Science and Technology, Rolla, MO, USA; and Perry Wilson, National Institute of Science and Technology (NIST), Boulder, CO, USA

Planned Speakers and Topics

Measuring a Device's Susceptibility to LTE: Preliminary Approaches
Jason Coder, John Ladbury, and William Young, National Institute of Standards and Technology (NIST), Boulder, CO, USA

A Review of Wireless Coexistence Test Methodologies
William Young and Jason Coder, National Institute of Standards and Technology (NIST), Boulder, CO, USA; and Luis Gonzalez, University of Colorado, Boulder, CO, USA

Wearables/IOT Devices: Challenges and Solutions to Integration of Miniature Antennas in Close Proximity to the Human Body
Soji Sajuyigbe, Intel Corporation, Santa Clara, CA, USA; and Kevin J. Daniel, Intel Corporation, Hillsboro, OR, USA

Gb/s USB: RFI Risk Analysis and Test Methodologies
Pujitha Davuluri, Chung-Hao (Joseph) Chen, Kuan-Yu Chen, and Eric Gantner, Intel Corporation, Hillsboro, OR, USA

PC Client Platform RFI Risks and Mitigation Methodologies
Dongho Han, Intel, Beaverton, OR, USA

Electromagnetic Interference Control

Format: Half-day Tutorial – TU-PM-2
1:30PM-5:30PM Grand Ballroom B

Co-Chairs: John Kraemar, Rockwell Collins, Inc., Cedar Rapids, IA, USA; and Ross Carlton, National Instruments, Austin, TX, USA

Planned Speakers and Topics

Miniaturization Approach for EBG-Based Common Mode Filter and Interference Analysis
Carlo Olivieri, Francesco de Paulis and Antonio Orlandi, University of L'Aquila, L'Aquila, Italy; Bruce Archambeault, IBM Corporation, RTP, NC, USA; Bruce Archambeault and Samuel Connor, Archambeault EMI/EMC Enterprises, Four Oaks, NC, USA

A Study of EMI from Patterned Ground Structures
Albert Wallash and Jack Nguyen, HGST, a Western Digital Company, San Jose, CA, USA

A Comparison of Relative Shielding Provided by Stitching Vias and Edge Plating
Jim Chiappe, Juniper Networks, Sunnyvale, CA, USA

2D Imaging System With Optical Tracking for EMI Source Localization
Hui He, Victor Khilkevich, and David Pommerenke, Missouri University of Science and Technology, Rolla, MO, USA

Frequency Selective Surfaces for EMI/Thermal Applications
Paul Dixon and Mohammad Ali Khorrami, Laird, Randolph, MA, USA ; Yoeri Arien, Laird, Geel, Belgium; John Song, Laird, Schaumburg, IL, USA; and Keith Johnson, Laird, Cleveland, OH, USA

High Speed Link Design I

Format: Half-day Tutorial – TU-PM-3
1:30PM-5:30PM Grand Ballroom C

Co-Chairs: Joy Li, Cadence Design Systems, San Jose, CA, USA; Chunfei Ye, Intel Co., DuPont, WA, USA

(Continued on page 28)

Facts

The garage in which Bill Hewlett and Dave Packard developed HP's first product in 1939, the Model 200A audio oscillator, is now California Historic Landmark No. 976 in Palo Alto, California. HP's first customer was Walt Disney Studios. The company purchased HP's 8 audio oscillator, which is an electronic test instrument used by sound engineers, for the classic movie "Fantasia".

(Continued from page 27)

Planned Speakers and Topics

Design of Package BGA Pin-out for >25Gb/s High Speed SerDes Considering PCB Via Crosstalk
Wei Yao, Jane Lim, Ji Zhang, Kenneth Tseng, Kelvin Qiu, and Rick Brooks, Cisco Systems, Inc, San Jose, CA, USA

Effective Equalization of a High Speed Differential Channel with Re-driver - Screening and RSM DOE Method Applied to a Real System
Maria Garcia, CINVESTAV, ZAPOPAN, Mexico; Raul Enriquez and Jose A. Ramos, Intel Tecnologia de Mexico, ZAPOPAN, Mexico

Method for Accurate and Efficient Signaling Analysis of Nonlinear Circuits
Dan Jiao, Purdue University, West Lafayette, IN, USA; and Jianfang Zhu, Intel, Hillsboro, OR, USA

DDR4 Address Bus Interconnect Optimization
Syed Bokhari, Fidus Systems Inc., Ottawa, ON, Canada

Aggressive Dual Stripline Design for Single Ended Signaling
Gong Ouyang and Kai Xiao, Intel Corp, Dupont, WA, USA

Signal Integrity Qualification and Optimization for the High Speed Tester Loopback Channel
TAO WANG, Brian Brecht and Ray Mirkhani, TERADYNE, Agoura Hills, CA, USA ; Benjamin Harding, TERADYNE, North Reading, MA, USA

System Level Modeling of Supply Noise Induced Jitter for High Speed Clock Forwarding Interface
Yujeong Shim and Dan Oh, Altera Corporation, San Jose, CA, USA

SI/PI/EMC Co-Simulation and Co-Design

Format: Half-day Tutorial – TU-PM-4
1:30PM-5:30PM Grand Ballroom D

Co-Chairs: Olena Zhu and Duo Chen, Intel Corporation, Santa Clara, CA, USA

Planned Speakers and Topics

Signal Integrity and EMI Evaluations of An RFID- Sensor Tag for Internet-of-Things Applications
Abdulhadi E. Abdulhadi, McGill University, Montreal, QC, Canada; Svetoslav Mandev and Ramesh Abhari, Santa Clara University, Santa Clara, CA, USA

Analytical PDN Voltage Ripple Calculation Using Simplified Equivalent Circuit Model of PCB PDN
Biyao Zhao, Chenxi Huang, Ketan Shringarpure, Jun Fan, Bruce Archambeault and James Drewniak, Missouri University of Science and Technology, Rolla, MO, USA; Chenxi Huang, Huazhong University of Science and Technology, Wuhan, China; Brice Achkir, Cisco Systems, Inc., San Jose, CA, USA; Samuel Connor, IBM Corporation, Research Triangle Park, NC, USA; Michael Cracraft and Matteo Cocchini, IBM Corporation, Poughkeepsie, NY, USA; Albert Ruehli, Missouri University of Science and Technology, Windham, NH, USA

Using Co-Design Techniques to Minimize IC Package Cost without Compromising Performance: Simulation and Measurement Validation
Rajen Murugan, Texas Instruments, Inc., Dallas, TX, USA

Optimization of MIM Cap Layout for Simultaneous Switching Noise Reduction
Guang Chen and Dan Oh, Altera Corporation, San Jose, CA, USA

Signal and Power Integrity Challenges in Small Form Factor Mobile Devices
Duo Chen, Intel Corporation, Santa Clara, CA, USA; and Fan Yu, Google Inc., Mountain View, CA, USA

ISI and Crosstalk Challenges in FPGA Memory I/O design
Janani Chandrasekhar, Hui Liu, and Dan Oh, Altera Corporation, San Jose, CA, USA

Facts

J. M. Kimberlin and Co. was the first seed company to take root in Santa Clara in 1875. Soon it would become the largest grower of seed on the Pacific Coast.

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TECHNICAL PROGRAM



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ACTIVITIES*

WORKSHOPS/TUTORIALS

>> Automotive EMC Measurements
>> Passive Component Modeling and Measurement II
>> Jitter/Noise Modeling and Analysis II
>> Power Integrity and Power Delivery Network I
>> Applications of Numerical Modeling
>> Poster Session
>> Time Domain Emission Measurements and Modeling
>> Capturing Pulsed/Intermittent Signals with Frequency Swept, Frequency Stepped and Time Domain Scan Methodologies
>> Integrated ESD Device and Board Level Design

EXPERIMENTS AND DEMONSTRATIONS

>> Computer Modeling and Simulation Demonstrations (Page 48)
>> Hardware Experiments & Demonstrations (Page 48-49)

OTHER EVENTS

>> Global University (Pages 52-53)
>> IEEE EMC Young Professionals
>> Chapter Chair Training Session and Dinner
>> Panel of Experts

EXHIBIT HALL OPEN

>> 10:00 AM - 5:00 PM

*All events are subject to change. Check www.emc2015usa.emcss.org and the Registration Area daily for updates.

Automotive EMC Measurements

Format: Half-day Tutorial – WED-AM-1
8:30AM - NOON Grand Ballroom A

Chair: Craig Fanning

Planned Speakers and Topics

On the Interplay Between the Engine Cooling Fan and Heat Exchanger for Automotive AM Band Radiated Emission Measurement
Cyrous Rostamzadeh, Bosch, Plymouth, MI, USA; Kimball Williams, Retired, Dearborn, MI, USA; Dennis Schwaiger, Retired, Plymouth, MI, USA; David Maciejewski, ASEE, Plymouth, MI, USA; and Mark Steffka, General Motors, Milford, MI, USA

Electromagnetic Susceptibility Testing on Vehicles – Effects of Testing in the Near-Field with Cavity Measurements on a Slotted Circular Cylinder
Marsellas Waller, US Army Redstone Test Center, Redstone Arsenal, AL, USA; Thomas Shumpert, Auburn University – Retired, Auburn, AL, USA; Robert Scharstein, University of Alabama, Tuscaloosa, AL, USA; and Steve Wong, AFRL/RCM (Engility Corporation), Wright-Patterson AFB, OH, USA

Impact of Mismatch Loss on Mobile Phone Simulation for Automotive Testing
Keith Frazier, Ford Motor Company, Dearborn, MI, USA; and Peng Peng, Ford Motor Company (Asia Pacific and Africa), Nanjing, China

Passive Component Modeling and Measurement II

Format: Half-Day Tutorial – WED-AM-2
8:30AM - NOON Grand Ballroom B

Chair: Antonio Ciccomancini, Apple Inc., Cupertino, CA, USA; Shaowei Deng, F5 Networks, San Jose, CA, USA

Planned Speakers and Topics

Comparison of TRL Calibration vs. 2x Thru De-embedding Methods
Se-Jung Moon and Xiaoning Ye, Intel, Hillsboro, OR, USA; and Rex Smith, Intel, Dupont, WA, USA

Investigation of S21 Magnitude Extraction Methodologies by Using a Pattern Generator and Sampling Oscilloscope
Xinyun Guo, Ketan Shringarpure and Jun Fan, Missouri University of Science and Technology, Rolla, MO, USA ; Fadi Daou, MultiLane SAL, Santa Clara, CA, USA

Investigation of Signal Integrity Issues in Multi-path Electrostatic Discharge Protection Device
Yang-Chih Huang and Tzong-Lin Wu, National Taiwan University, Taipei, Taiwan; Chung-Hao Chen, Intel Corporation, Portland, OR, USA

Jitter/Noise Modeling and Analysis II

Format: Half-Day Tutorial – WED-AM-3
8:30AM - NOON Grand Ballroom C

Co-Chairs: Zhiping Yang and Jihong Ren, Altera, San Jose, CA, USA

Planned Speakers and Topics

A Methodical Approach to DDR Clock Jitter Analysis
Anita Ekren and Steve Stefek, Avago Technologies, Fort Collins, CO, USA

Duty Cycle Distortion Amplification in High Speed Data Channels
Yan Duan, Iowa State University, Ames, IA, USA;, Yan Duan , Wenyi Jin and Jihong Ren, Altera Inc., San Jose, CA, USA

A Slope and Amplitude controllable Triangular-Current Generator for the Injection of a Broad-band PDN Noise
Changwook Yoon, Altera Corporation, San Jose, CA, USA; Sukjin Kim, Kiyeong Kim, Heegon Kim, and Joungho Kim, Korean Advanced Institute of Science and Technology (KAIST), Daejeon, South Korea; Jingook Kim, Ulsan National Institute of Science and Technology, Ulsan, South Korea; and Jun Fan, Missouri University of Science and Technology, Rolla, MO, USA

Power Integrity and Power Delivery Network I

Format: Half-Day Tutorial – WED-AM-4
8:30AM - NOON Grand Ballroom D

Co-Chairs: Dale Becker, IBM, Poughkeepsie, NY, USA; and Guang Chen, Altera Corporation, San Jose, CA, USA

Planned Speakers and Topics

Challenges and Solutions for Core Power Distribution Network Designs
Dan Oh and Guang Chen, Altera Corporation, San Jose, CA, USA

Power Archipelago for GHz Power Filtering on Printed Circuit Boards
Christopher Ferguson and A. Ege Engin, San Diego State University, San Diego, CA, USA

A Multistage "Power Integrity Surgery" for Designing Complex Automotive Electronic Control Units
Ralf Bruening, EMC Technology Center, ZUKEN, Paderborn, Germany; Torsten Wagner and Ralf Kakerow, Division Interior, Continental Automotive GmbH, Wetzlar, Germany

Applications of Numerical Modeling

Format: Half-Day Tutorial – WED-AM-5
8:30AM - NOON Grand Ballroom E

Co-Chairs: Vignesh Rajamani and James West, Oklahoma State University, Stillwater, OK, USA

Planned Speakers and Topics

Analysis of Field Probe Perturbation in a Mode Stirred Reverberation Chamber
Luca Bastianelli, Valter Mariani Primiani, and Franco Moglie, Università Politecnica delle Marche, Ancona, Italy

Robust and Efficient RLGC Extraction for Transmission Line Structures with Periodic Three-Dimensional Geometries
Yunhui Chu, Intel Corp, Hillsboro, OR, USA; Jason Zhenwei Yu, Intel, Seattle, WA, USA; and Zhiguo Qian, Intel Corporation, Chandler, AZ, USA

An Augmented Electric Field Integral Equation Formulation for Dielectrics and Conductors at Low Frequencies
Tian Xia, Hui Gan, Michael Wei and Weng Chew, University of Illinois, Urbana-Champaign, Urbana, IL, USA; Henning Braunisch, Zhiguo Qian and Kemal Aygun, Intel Corporation, Chandler, AZ, USA; and Alaeddin Aydiner, Intel Corporation, Hillsboro, OR, USA

Poster Session

10:30AM - NOON Grand Ballroom A-D Foyer

Co-Chairs: Jingook Kim, Ulsan National Institute of Science and Technology, Ulsan, South Korea; and Alpesh Bhobe, Cisco Systems, Inc., San Jose, CA, USA

Planned Speakers and Topics

Modeling of SOL Calibration Standards for PCB Channel Probing
Juyoung Lee, Oracle Corporation, Santa Clara, CA, USA

Handling PDN Resonance Modes
Sherman Chen, EMC Corp., Shanghai, China; Greg Fu, Molex Corp., Shanghai, China; and Tao Hu, LUXSHARE-ICT, Inc, Milpitas, CA, USA

Experimental Characterization of Supply Induced Jitter in High Speed Serial Links
Yujeong Shim and Dan Oh, Altera Corporation, San Jose, CA, USA

An Improved Multiple Edge Responses Method for Memory Simulation Considering Worst Case and Nonlinear Crosstalk
Shiji Pan, Inphi Corporation, Santa Clara, CA, USA; and Jiangyuan Qian, Qualcomm Technologies, Inc., San Diego, CA, USA

(Continued on page 32)

(Continued from page 31)

Common-Mode Noise Reduction on Broadside-Coupled Delay Line
Ding-Bin Lin and Chung-Pin Huang, National Taipei University of Technology, Taipei City, Taiwan; Hsin-Nan Ke, PEGATRON Corporation, Taipei City, Taiwan; and Wen-Sheng Liu, WIESON Technologies Co., Ltd., New Taipei City, Taiwan

Design of a Dual-stage Dual-FIR Channel Emulator
Wei Qian, David Pommerenke, Atieh Talebzadeh and Guanghua Li, Missouri University of Science and Technology, Rolla, MO, USA; Chong Ding, Stephen Scearce and Douglas White, Cisco Systems, Inc., San Jose, CA, USA; Yaochao Yang, Cisco Systems, Inc., NA, NC, USA; and Jianchi Zhou, Huazhong University of Science and Technology, Wuhan, China

Reconstruction of Currents from EMC Near-Field Measurements by Means of Continuity Equation Constraints
Martin Schmidt and Manfred Albach, Friedrich-Alexander University Erlangen-Nuremberg, Erlangen, Germany

Radiation Physics from Two-Wire Transmission Lines
Jing Li, YaoJiang Zhang, Dazhao Liu, James Drewniak and Jun Fan, Missouri University of Science and Technology, Rolla, MO, USA; Alpesh Bhobe, Cisco Systems, Inc., San Jose, CA, USA

Time Domain Emission Measurements and Modeling

Format: Half-day Tutorial – WED-PM-1
1:30PM - 5:30PM Grand Ballroom A

Co-Chairs: Janet O'Neil, ETS-Lindgren, Cedar Park, TX, USA
Zhong Chen, ETS-Lindgren, Cedar Park, TX, USA

Abstract

As equipment that uses time domain techniques for measuring electromagnetic emissions and presents the data in frequency domain terms for compliance with CISPR and FCC standards has emerged onto the market with remarkable popularity in recent years. Such equipment has great potential to improve measurement efficiency, thereby reducing test time. Accuracy of test results must not be sacrificed for efficiency, however. All indications are that accuracy is maintained. The time domain emission measurements method in EMC and site validations will be discussed.

Numerical modeling is increasingly used in design to identify potential EMC issues. Time-domain techniques are ideal for simulating transient susceptibility effects such as ESD and broadband radiated emissions. We will demonstrate how time domain numerical modeling can also be used to model site validations above 1 GHz. Wave propagation will be visualized to identify and isolate reflections and verify how time domain data processing in real measurements can achieve the same effects. Practical considerations in measurements will be discussed and validation will be shown through numerical simulations.

Planned speakers include an expert in EMC software as well as an expert in time domain measurements who is chair of ANSI ASC C63® Subcommittee 1 "Techniques and Development" and also a member of the working group developing the new draft standard on time domain measurements.

Planned Speakers and Topics

Time Domain Modeling
David P. Johns, CST of America Inc, Framingham, MA, USA

Time Domain Measurements to Verify the Modeling
Zhong Chen, ETS-Lindgren, Cedar Park, TX, USA

Understanding Time Domain / Frequency Domain Transformation and Data Processing
Bob Johnk, Institute for Telecommunication Sciences (NTIA/ITS), Boulder, CO, USA

Update on Latest Work for Draft ANSI C63.25 Standard: Validation Method for EMC Radiated Emission Test Sites
Zhong Chen, ETS-Lindgren, Cedar Park, TX, USA

Capturing Pulsed/Intermittent Signals with Frequency Swept, Frequency Stepped, and Time Domain Scan Methodologies

Format: Half-Day Tutorial – WED-PM-2
1:30PM - 5:30PM Grand Ballroom B

Chair: Faride Akretch, Rohde & Schwarz USA Inc., Kildeer, IL, USA

Abstract

Pulsed and/or intermittent signals are difficult to detect and even more difficult to properly characterize the amplitude across frequencies. The ability to properly capture and characterize these intermittent signals is an important capability to the EMC engineer. There are several methods to perform the task and each has its own strengths and weaknesses. Thorough understanding of the method of measurement is necessary. During this technical session, we will compare three methodologies, namely Frequency Swept, Frequency Stepped and Time Domain Scan. We will demonstrate the details of each for a pulsed signal stimulus and provide insight for best measurement techniques for each method

Planned Speakers and Topics

Frequency Swept Scan Methodology
Bill Wangard and Darren McCarthy, Rohde & Schwarz USA,

Inc., Kildeer, IL, USA)

This first section focuses on the anatomy of a pulsed signal from a time/frequency correspondence and on understanding how time domain characteristics affect the frequency domain content. We will explore the architecture employed by traditional spectrum analyzers to measure the spectrum by continuously sweeping across frequency. Demonstrations will point out the effects that sweeping through the spectrum has on characterization of pulse/intermittent signals.

Frequency Stepped and Time Domain Scan Methodology
Bill Wangard and Darren McCarthy, Rohde & Schwarz USA, Inc, Kildeer, IL, USA)

In this section we will focus on the architectural differences going from a frequency swept method to a frequency stepped method and the corresponding considerations of spectrum characterization. Provide a background of FFT methodology, commonly referred to as Time Domain Scan, and the important parameters in the FFT algorithms to the EMC community. Demonstration in this section will make clear the differences between time domain scan and frequency swept/stepped on spectrum characterization of pulsed/intermittent signals.

Working EMC Engineer Skills

Sponsored by TC-5

Format: Half-Day Tutorial – WED-PM-3
1:30PM - 5:30PM Grand Ballroom C

Chair: Kimball Williams, IEEE Southeastern Michigan Section, Dearborn, MI, USA

Abstract

Explore some of the more critical aspects of working as an EMC engineer that are of a non-technical nature. These skills are not taught in any engineering curricula but, can be critical to building a successful engineering career.

Planned Speakers and Topics

Fundamentals of Leadership
Elya Joffe, Tel Aviv, Israel, and Kimball Williams, IEEE South eastern Michigan Section, Dearborn, MI, USA

Code of Ethics
Dave Staggs, Austin, TX, USA

EMC for Business Managers
Joanna Hill, Hazel Park, MI, USA

Effective Presentations
Bruce Archambeault, Archambeault EMI/EMC Enterprises, Four Oaks, NC, USA

Integrated ESD Device and Board Level Design

Sponsored by ESD Association

Format: Half-Day Tutorial – WED-PM-4
1:30PM - 5:30PM Grand Ballroom D

Chair: Gianluca Boselli, ESD Association, Rome, NY, USA

Abstract

Efficient ESD design for system level ESD can only be achieved if board and device level protection circuitry coincide. The purpose of this tutorial is to develop an understanding of board/IC interaction under IEC 61000-4-2 testing conditions and to discuss useful design strategies supported by appropriate tools. This is meant to be beneficial both for ESD engineers of ICs and board designers responsible for EMC/ESD compliant design of the system.

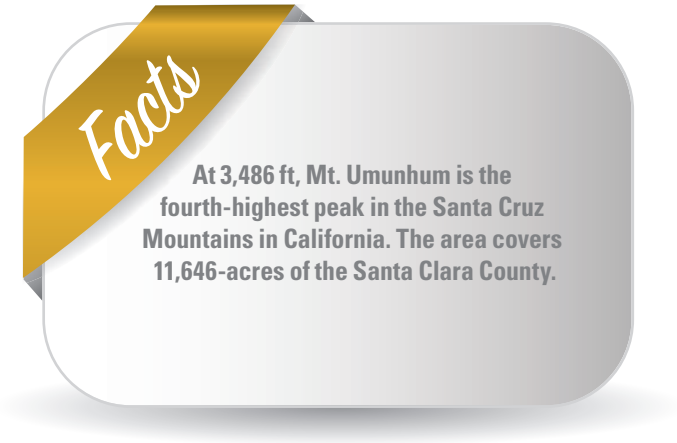
While it has clearly been pointed out that even elevated IC level HBM targets are insufficient for achieving the required IEC 61000-4-2 ESD level, more awareness has to be developed for the detailed turn-on and clamping behavior of IC level and board level ESD protection components. High current characterization of board protection and IO circuit by TLP is a first step. This enables the board designer to assess the behavior of IC pins and select appropriate board protection elements. The design optimization should be based on high current models of board components and IC IOs and the numerical simulation of the protection network under ESD conditions. Finally, various test methods are available to evaluate the efficiency of implemented protection on board level quantitatively.

Planned Speakers and Topics

The Effect of Humidity on ESD Occurrence and Severity in Data Centers
David Pommerenke, Missouri University of Science and Technology, Rolla, MO, USA

Integrated ESD Device and Board Level Design: Part 1
Gianluca Boselli, ESD Association, Rome, NY, USA

Integrated ESD Device and Board Level Design: Part 2
David Pommerenke, Missouri University of Science and Technology, Rolla, MO, USA



ACTIVITIES*

WORKSHOPS/TUTORIALS

>> EMC Measurements and Calibration
>> High Speed Link Design II
>> Modeling and Simulation for Large-Scale and Multi-Scale Power Delivery Network
>> Numerical Modeling Approaches
>> Wireless Testing and RF Interference
>> Numerical Modeling and Simulation Techniques II
>> Power Integrity and Power Delivery Network II
>> Special Session: Uncertainty Quantification in Computational EM and Signal/Power Integrity Verification

EXPERIMENTS AND DEMONSTRATIONS

>> Computer Modeling and Simulation Demonstrations (Page 48)
>> Hardware Experiments & Demonstrations (Page 48 -49)

OTHER EVENTS

>> Global University (Pages 52-53)
>> IEEE EMC Socitey Board of Director's Meeting
>> Plenary Session
>> Panel of Experts

EXHIBIT HALL OPEN

>> 9:00 AM - NOON

EXHIBITOR MOVE OUT

>> NOON - 6:00 PM

*All events are subject to change. Check www.emc2015usa.emcss.org and the Registration Area daily for updates.

EMC Measurements and Calibration

Format: Half-day Tutorial – THU-AM-1
8:30AM - NOON Grand Ballroom A

Chair: Dave Arnett, Hewlett Packard, Vancouver, WA, USA

Planned Speakers and Topics

Characterization and Correction of Calibration Jigs for LISN Impedance Measurements
Alexander Kriz, Seibersdorf Laboratories, Seibersdorf, Austria

Substitution Method for Antenna Calibration by the Use of Broadband Horn Antenna (1 to 18 GHz)
Mitsunobu Samoto, Nobuhito Samoto, and Ikuo Makino, Liberty Labs Asia, Inc., Yokohama, Japan

Innovative Field Receiver Based on a New Type of Active Rod Antenna
Domenico Festa, IBD International Business Development S.a.s., CHIARI (BS), Italy; Alessandro Gandolfo, Narda Safety Test Solutions S.r.l., Cisano sul Neva (SV), Italy; and Renzo Azaro, EMC S.r.l., Genova, Italy

Extension and Verification of Absorbing Material Effectiveness on Reducing Electromagnetic Emissions from Cavities Measured Using a Nested Reverberation Chamber Approach
Eric Drake, Chuck Bunting and James West, Oklahoma State University, Stillwater, OK, USA; Vignesh Rajamani, Bruce Archambeault and Samuel Connor, IBM Corporation, Research Triangle Park, NC, USA

Received Power and Ambient Electric Field from Broadband Emissions in Reverberant Spaces
Gregory Tait, Carl Hager, IV, Timothy Baseler, and Michael Slocum, NSWC Dahlgren, Dahlgren, VA, USA

Maximum Received Power Statistics within RF Reflective Enclosures for HERO/EMV Testing
Carl Hager, IV and Gregory Tait, NSWC Dahlgren, Dahlgren, VA, USA

High Speed Link Design II

Format: Half-day Tutorial – THU-AM-2
8:30 AM - 12:00 NOON Grand Ballroom B

Co-Chairs: Dan Oh, Altera Corporation, San Jose, CA, USA; and Shaowu Huang, Intel Corporation, DuPont, WA, USA

Planned Speakers and Topics

Effective Methodology for Correlating Measurement to Simulation for IBIS-AMI Models
Seungyong Baek, Mike Sapozhnikov, and Amendra Koul, Cisco Systems, San Jose, CA, USA

TECHNICAL PROGRAM

Signal Integrity Considerations in Implementing USB On-The-Go for Mobile Designs
Sudeep Puligundla and Vijay Kasturi, Intel Corporation, Hillsboro, OR, USA; Khang Choong Yong and Wil Choon Song, Intel Corporation, Penang, Malaysia; Steven Ji and Xiaoning Qi, Intel Corporation, Santa Clara, CA, USA

Design of Very Low Distortion High Density Meander Lines for Skew Compensation in High Speed Interconnects
Raul Enriquez, Intel, Guadalajara, Mexico

Novel IBIS-AMI Simulation with Measurement Waveform
Weifeng Shu, Intel Asia Pacific Research and Development Ltd, Shanghai, China; Chunfei Ye, Intel Co., DuPont, WA, USA; and Xiaoning Ye, Intel Corporation, Hillsboro, OR, USA

A Study of the Impact of Trace to Via Coupling on High-speed Differential Signaling Design
Kai Xiao, Intel Corp, Dupont, WA, USA; and Xiaoning Ye, Intel Corporation, Hillsboro, OR, USA

QSFP28 Connector Footprint Co-Optimization of Crosstalk and ILD_rms_dB for 25+ Gpbs Signaling
Il-Young Park, Cisco Systems, San Jose, CA, USA

Modeling and Simulation for Large-Scale and Multi-Scale Power Delivery Network

Format: Half-day Tutorial – THU-AM-3
8:30 AM - 12:00 NOON Grand Ballroom C

Co-Chairs: Qing He, Oracle Corporation USA, Santa Clara, CA, USA; and Xiaoning Ye, Intel Corporation, Hillsboro, OR, USA

Planned Speakers and Topics

Dynamic Analysis of Power Delivery Network with Nonlinear Components Using Matrix Exponential Method
Hao Zhuang, Ilgweon Kang, Xinan Wang, Jeng-Hau Lin, and Chung-Kuan Cheng, University of California - San Diego, La Jolla, CA, USA

Fast Transient Simulation of Multilayered Power Delivery Network by Using the Stabilized Explicit Method
Tadatoshi Sekine, Shizuoka University, Hamamatsu-shi, Japan; and Hideki Asai, Research Institute of Electronics, Shizuoka University, Hamamatsu-shi, Japan

Fast Structure-Aware Direct Time-Domain Finite Element Solver for Large-Scale On-Die Power Grid Simulation
Woochan Lee and Dan Jiao, Purdue University, West Lafayette, IN, USA

System Power Noise Analysis Using Modulated CPM
Di Hu, Yongxue Yu, Lin Shen, Ravi Nimmagadda, Felice Bonardi and Francis Matus, Cisco Systems, San Jose, CA, USA; Antonio Ferrario, STMicroelectronics, Cornaredo - MI, Italy; and Olivier Bayet, STMicroelectronics, Grenoble, France

Vectorless Transient Power Grid Verification: A Case Study with IBM Benchmarks
Xuanxing Xiong, Synopsys, Inc., Mountain View, CA, USA; and Jia Wang, Illinois Institute of Technology, Chicago, IL, USA

Impulse Response Generation from S-Parameters for Power Delivery Network Simulation
Ilgweon Kang, Xinan Wang, Jeng-Hau Lin, Ryan Coutts, and Chung-Kuan Cheng, University of California - San Diego, La Jolla, CA, USA

Numerical Modeling Approaches

Format: Half-day Tutorial – THU-AM-4
8:30 AM - 12:00 NOON Grand Ballroom D

Co-Chairs: Jianmin Zhang, Apple Inc., Cupertino, CA, USA; and Kai Xiao, Intel Corp, Dupont, WA, USA

Planned Speakers and Topics

Method to Improve the Accuracy of Mixed-mode S-parameters Derived from Single-Ended Results and Application to Shorter Test Coupon Design
Shaowu Huang, Intel Corporation, DuPont, WA, USA

USB3.1 Silicon and Channel Design Optimization using Artificial Neural Network Modeling
Mo Liu and Jennifer Tsai, Intel Corporation, Santa Clara, CA, USA

Modeling of Mutual Coupling between Inductors
Gundars Asmanis, Deniss Stepins, Leonids Ribickis, and Aivis Asmanis, Riga Technical University, Riga, Latvia

Rigorous One-Port Measurement Method for the Characterization of On-chip Pad Response
Shaowu Huang and Kai Xiao, Intel Corporation, DuPont, WA, USA; Beomtaek Lee, Intel Corporation, Santa Clara, CA, USA; Xiaoning Ye, Intel Corporation, Hillsboro, OR, USA

Software-related EMI Test Pattern Auto-generation for 2-stage Pipeline Microcontroller
Yung-Chi Tang, 6th EMC Division, BSMI, New Taipei, Taiwan; and Shih-Yi Yuan, Feng Chia University, Taichung, Taiwan

EMC Simulations of Aircraft with Composite Materials
Martin Vogel, Altair Engineering, Hampton, VA, USA

Wireless Testing and RF Interference

Format: Half-day Tutorial – THU-PM-1
1:30 PM - 5:30 PM Grand Ballroom A

Co-Chairs: Yihong Qi, DBJ Technologies, Zhuhai, China; and William Young, National Institute of Standards and Technology, Boulder, CO, USA

Planned Speakers and Topics

An Effective Receiver Sensitivity Measurement
Zixin Liu and Fuhai Li, Hunan University, Changsha, China; Yihong Qi, DBJ Technologies, Zhuhai, China; and Ji Chen, University of Houston, Houston, TX, USA

Conducted-Emission Modeling for a Switched-Mode Power Supply (SMPS)
Yansheng Wang, Siqi Bai, Xinyun Guo, Shuai Jin, Yaojiang Zhang, and Jun Fan, Missouri University of Science and Technology, Rolla, MO, USA; Joakim Eriksson and Lijuan Qu, Microsoft Mobile (China) Investment Co. Ltd., Beijing, China; Jingyu Huang, Microsoft Device Group, San Diego, CA, USA

A Planar Low-Profile Meander Antenna Design for Wireless Terminal Achieving Low Self-Interference
Yihong Qi1 and Fred Yu, DBJ Technologies, Zhuhai, China; Jun Fan and James Drewniak, Missouri University of Science and Technology, Rolla, MO, USA; YeHai Bi, Shenzhen Sunway Communication Co.,Ltd, ShenZhen, China

Near-field Coupling Estimation by Source Reconstruction and Huygens's Equivalence Principle
Liang Li, Jingnan Pan, YaoJiang Zhang, and Jun Fan, Missouri Science and Technology, Rolla, MO, USA; Gyuyeong Cho and Hark Byeong Park, Samsung Electronics, Suwon, South Korea; Chulsoon Hwang, Samsung Electronics, Suwon GyengGi-Do, South Korea

Eliminating Non-Linear RSS Reporting Error in a Radiated RSS-Based TIS Testing Method
Penghui Shen and Fuhai Li, Hunan University, Changsha, China; Yihong Qi and Fred Yu, DBJ Technologies, Zhuhai, China; and Jun Fan, Missouri University of Science and Technology, Rolla, MO, USA

Numerical Modeling and Simulation Techniques II

Format: Half-day Tutorial – THU-PM-2
1:30 PM - 5:30 PM Grand Ballroom B

Co-Chairs: Kai Xiao, Intel Corp, Dupont, WA, USA and Gerardo Romo, Qualcomm Technologies, Inc., San Diego, CA, USA

Planned Speakers and Topics

Frequency Domain Interpolation Problems for Long Structures
Mikheil Tsiklauri, Mikhail Zvonkin, Nana Dikhaminjia, Jun Fan, and James Drewniak, Missouri University of Science and Technology, Rolla, MO, USA

Microstrip Improvement by Using Dielectric Film
Shaowu Huang, Intel Corporation, DuPont, WA, USA; Olufemi Oluwafemi and Gary Brist, Intel Corporation, Hillsboro, OR, USA

Application of a Boundary Element Method Tool in Improving Differential Channel Routing Design
Xiao Ren, Missouri University of Science and Technology, Rolla, MO, USA; Shaowei Deng, Jayaprakash Balachandran and Bidyut Sen, Cisco Systems, Inc., San Jose, CA, USA

A Hybrid 3D/ Equivalent 2D Finite Element Analysis for Vias Passing Through a Parallel Plate Pair Filled with Multilayer Dielectric
Liehui Ren, Peng Shao, Kelvin Qiu, Jane Lim and Rick Brooks, Cisco Systems, Inc, San Jose, CA, USA; YaoJiang Zhang and Jun Fan, Missouri University of Science and Technology, Rolla, MO, USA

Power Integrity and Power Delivery Network II

Format: Half-day Tutorial – THU-PM-3
1:30 PM - 5:30 PM Grand Ballroom C

Co-Chairs: A. Ege Engin, San Diego State University, San Diego, CA, USA; and Yujeong Shim, Altera Corporation, San Jose, CA, USA

Planned Speakers and Topics

Integrated Power Supply Packaging Technique with Reduced Parasitic Inductance for On-die Voltage Regulator Design and Application
Boping Wu, Intel Corporation, Hillsboro, OR, USA; and Shaowu Huang, Intel Corporation, DuPont, WA, USA

Practical Aspects of Embedded Capacitance for Printed Circuit Board Power Distribution Networks
Scott Piper, General Motors, Milford, MI, USA; and James Teune, Gentex Corporation, Zeeland, MI, USA

Effective Power Delivery Filtering of Mixed-Signal Systems with Negligible Radiated Emission
Mohammad Ali Khorrami and Paul Dixon, Laird, Randolph, MA, USA; John Song, Laird, Schaumburg, IL, USA; and Keith Johnson, Laird, Cleveland, OH, USA

Role and Performance of Interposer with Embedded Capacitors for Maintaining Power Integrity
Toshio Sudo, Sho Kiyoshige, Wataru Ichimura and Toma Yamaguchi, Shibaura Institute of Technology, Tokyo, Japan; Daisuke Tanaka, Kyoshi Mihara, Naoyuki Kobayashi and Yoshio Hiyama, Murata Manufacturing Co., Ltd., Kyoto, Japan

Real-time Programmable VR for Power Delivery Efficiency Enhancement
Wei Shen, Weixia Liang, and Herry Hu, Intel Corporation, Shanghai, China

Special Session: Uncertainty Quantification in Computational EM and Signal/Power Integrity Verification

Format: Half-day Tutorial – THU-PM-4
1:30 PM - 5:30 PM Grand Ballroom D

Co-Chairs: Branislav Notaros and Sourajeet Roy, Colorado State University, Fort Collins, CO, USA

Planned Speakers and Topics

Efficient Multidimensional Statistical Modeling of High Speed Interconnects in SPICE via Stochastic Collocation using Stroud Cubature
Majid Ahadi, Sourajeet Roy, and Mounica Vempa, Colorado State University, Fort Collins, CO, USA

A Polynomial Chaos Approach for EM Uncertainty Propagation in 3D-FDTD Magnetized Cold Plasma
Bach Nguyen, Alireza Samimi, and Jamesina Simpson, University of Utah, Salt Lake City, UT, USA

Efficient Multi-Parameteric Uncertainty Quantification Methods for EMC/EMI Applications
Costas Sarris, Zixi Gu, Neeraj Sood, and Xingqi Zhang, University of Toronto, Toronto, ON, Canada

Studying the Effect of Drilling Uncertainty on Signal Propagation through Vias
Yansheng Wang, Srinath Penugonda, Yaojiang Zhang and Jun Fan, Missouri University of Science and Technology, Rolla, MO, USA; and Ji Chen, University of Houston, Houston, TX, USA



ACTIVITIES*

WORKSHOPS/TUTORIALS

>> Introduction to Medical EMC
>> Basic EMC Measurements
>> Nanotechnology and Advanced Materials Applied to EMC
>> New Opportunities and Challenges for Validation of Computational Electromagnetics Standardization – the Review of IEEE Std 1597.1
>> Conformity Assessment Topics for EMC Laboratories
>> Debugging EMI Test Failures
>> Field sources and their application in computational EMC
>> EMC Risk Management Workshop
>> Crosstalk – Theory, Modeling, Characterization, and Design Optimization

OTHER EVENTS

>> iNARTE Examinations (Page 52)

EXHIBITOR MOVE OUT

>> 8:00 AM - NOON

*All events are subject to change. Check www.emc2015usa.emcss.org and the Registration Area daily for updates.

Introduction to Medical EMC

Format: Half-day Tutorial – FR-AM-1

Chair: Darryl Ray, Darryl Ray EMC Consulting, Carlsbad, CA, USA

Abstract

EMC compliance of medical devices is regulated differently from that of other types of equipment, for reasons of patient and operator safety. Medical devices have unique requirements such as very low leakage current requirements (that preclude some of the usual EM mitigation design techniques) and immunity requirements that are very stringent.

The primary standard for medical EMC compliance is IEC/EN 60601-1-2. That standard has been recently revised and it will have a significant impact on the medical device industry. In addition, the IEC and EN standards now have requirements to manage safety risks that could foreseeably be caused by errors, malfunctions and faults caused by EM disturbances. Medical devices are required to comply with an EMC risk management standard, a requirement that is not well understood at present but may become the norm for safety-related and safety-critical equipment of all types.

Medical devices have benefited from the explosion of new wireless technologies. Convergent technologies have emerged where medical devices that historically did not contain radio transceivers, now commonly have multiple radio modules. The desire for greater patient mobility dictate "cable replacement" strategies such as Bluetooth® and WiFi® on many medical devices. In addition, remote patient monitoring is highly desired to maintain sterile surgical environments or to collect telemetry data on patients outside the hospital. The wireless presentation discusses some important trends in medical wireless technologies as well as key strategies that product developers can use to successfully address the EMC regulatory requirements for their wireless medical devices.

For many medical devices, obtaining regulatory approval can be a very involved process. The FDA will share their thoughts and experiences on this issue.

Planned Speakers and Topics

Introduction to Medical EMC
Darryl Ray, Darryl Ray EMC Consulting, USA

Risk Management and IEC 60601-1-2
Keith Armstrong, Cherry Clough Consultants Ltd., Stafford, UK

Testing for Wireless Medical Devices
Greg Kiemel, Northwest EMC, Hillsboro, OR, USA

An FDA Perspective on EMC of Medical Devices
Jeff Silberberg, US Food & Drug Administration, Silver Springs, MD, USA

Basic EMC Measurements

Sponsored by TC-2

Format: Half-day Tutorial – FR-AM-2

Chair: Don Heirman, Don HEIRMAN Consultants, Lincroft, NJ, USA

(Continued on page 40)

TECHNICAL PROGRAM

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ELECTRONIC COMPONENTS

(Continued from page 38)

Abstract

This tutorial will provide information on aspects beyond the test procedure needed in performing EMC tests by competent test labs. Included will be a discussion on the application of measurement uncertainty, measurement instrumentation and its calibration, and what constitutes an acceptable test laboratory. The latest activity in international standards related to EMC immunity measurements and application will also be presented as time allows. Where appropriate, attendees will be asked questions as to what they learned and have an opportunity for extended questioning of the speakers' subjects at the end of the session.

Planned Speakers and Topics

Measurement Uncertainty Highlighting the New C63.23 and Updates of CISPR 16-4-2 Which has Added Input Quantities
Bob DeLisi, UL, Melville, NY

Measurement Instrumentation and Calibration
Werner Schaefer, Schaefer Associates, Novato, CA

Review of Select International EMC Standards Activity
Don Heirman, Don HEIRMAN Consultants, Lincroft, NJ, USA
Alistair Duffy, De Montfort University, Leicester, UK

Tips on Selecting a Test Lab
Dan Hoolihan, Hoolihan EMC Consulting, Lindstrom, MN, USA

Nanotechnology and Advanced Materials Applied to EMC

Sponsored by TC-11

Format: Half-day Tutorial – FR-AM-3

Chair: Emmanuel Decrossas, Jet Propulsion Laboratory, Pasadena, CA, USA

Abstract

Nanotechnology is the engineering of functional systems at the molecular and atomic scale and represents a technological revolution that is shaking scientific academia, industries and almost all areas of society. Nanotechnology has the potential to develop many novel materials and devices with a vast range of applications. Over the last ten years several studies have been focused on carbon nanotubes, graphene nanoribbons, nanostructured multifunctional materials and single/ multi-phase composites filled with nanoparticles. The outstanding performance and capabilities of these novel materials have demonstrated a great impact in different EMC applications: signal integrity of electrical nano-interconnects and nano-vias for high speed electronics, multifunctional electromagnetic shields, lightweight and high performance radar absorbing materials, just to mention some examples.

The workshop is intended to introduce EMC engineers and researchers to nanoscience and nanotechnology showing how fundamental EMC topics (like measurements, transmission line, shielding and protection) should be "revisited" at nanoscale. It will present new materials, devices and processes for EMC applications, with particular attention to theoretical modelling approaches, simulation methods and experimental characterization techniques.

The Tutorial will provide participants with opportunities for professional development and the chance to gain a better understanding of nanotechnology and its implications in EMC issues. The Tutorial will contribute to the development of a debate on the state-of-art as well as on future research possibilities.

Planned Speakers and Topics

Application of Hexagonal Ferrites in EMC
Marina Koledintseva, Oracle, Menlo Park, CA, USA

Applications of Carbon Nanotubes for RF and Microwave Interconnects
Mike Hamilton, University of Alabama, Huntsville, AL,USA

Electrical Response of Spin-Orbit Interaction on a Metasurface
Xingjie Ni, Berkeley University, CA, USA

Conductive Composites in the Space Environment – Material Testing Using Energetic Electrons at the Jet Propulsion Laboratory
Nelson W. Green, Jet Propulsion Laboratory, Pasadena, CA, USA

Metamaterial-EBG Common-mode Filters for Differential Lines at Gigahertz Frequencies
Miroslav Pajovic, Independent Consultant in Antennas and EMC, Sunnyvale, CA, USA

New Opportunities and Challenges for Validation of Computational Electromagnetics Standardization – the Review of IEEE Std 1597.1

Sponsored by TC-9

Format: Half-day Tutorial -- FR-AM-4

Chair: Alistair Duffy, De Montfort University, Leicester, UK

Abstract

IEEE Std 1597.1 (Validation of computational electromagnetics computer modelling and simulation) was a first-of-its-kind standard when it was published in 2008. Since then it has gained widespread use: it is difficult to find a copy of the IEEE Transactions on Electromagnetic Compatibility without finding references to this standard (or to the FSV technique that is embedded in the standard). The standard is as much about a process for managing the validation activity as it is about the specific techniques used to quantify any comparison. As a result, this first round of revision for the standard is looking for input about the how, why, where and when of validation of CEM as well as where the process and techniques used in the standard could be more widely applied. This workshop will encourage wider participation in the standards development process from the EMC Community by setting the scene with a number of presentations and then open the floor in a panel discussion format.

The key objective for this workshop is to encourage wide participation in the standards development process. This will both provide useful input for this standard as well as provide a means of informing the EMC community about the standards development process in the IEEE more generally.

The intended audience is attendees at the symposium who have an interest in computational electromagnetics, which is a significant proportion of EMC symposia attendees. The potential expansion of the application of the techniques used in the standard beyond computational electromagnetics to measurement comparison in a more general sense also makes the workshop of interest to Symposium attendees whose primary interest is measurement.

Planned Speakers and Topics

Introduction to the Session and Overview of the Standard
Alistair P. Duffy, De Montfort University, Leicester, UK

Lessons Learned in the Use of the IEEE Std 1597.1
Bruce Archambeault, Archambeault EMI/EMC Enterprises, Four Oaks, NC, USA

Emerging Opportunities for Validation: Radiowave Propagation Prediction Validation
Bob Johnk, Institute for Telecommunication Sciences, Boulder, CO, USA

Recent Developments in FSV and Difficulties to be Overcome
Alistair P. Duffy, De Montfort University, Leicester, UK

Panel Discussion
Members of the working group

Conformity Assessment Topics for EMC Laboratories

Sponsored by TC-1

Format: Half-day Tutorial -- FR-AM-5

Chair: Daniel D. Hoolihan, Hoolihan EMC Consulting, Lindstrom, MN, USA

Abstract

Conformity assessment enables buyers, sellers, consumers, and regulators to have confidence that products sourced in global market meet specific requirements. It is the demonstration that specified requirements relating to a product, process, system, person or body are fulfilled. Mutual Recognition Agreements (or arrangements) (MRAs) are government-to-government trade facilitating measures aimed at a global approach to conformity assessment. Standards are interwoven into all aspects of these activities and can have a major impact on the outcome of a conformity assessment program. Conformity assessment activities form a vital link between standards (which define necessary characteristics or requirements) and the products themselves. This session is intended to provide an overview of the U.S. participation in telecom mutual recognition agreements, and to explore the conformity assessment system that underpin the agreements. Additionally, the newest information on the changes occurring in the EU with regards to the EMC and the Radio equipment Directives will be offered, along with an introduction into the new designation process being developed, which will include a formal assessment of the notified bodies

Planned Speakers and Topics

EMC/Telecom Mutual Recognition Agreements Reliance on Conformity Assessment and Upcoming Changes in the European Union
Ramona Saar, National Institute of Standards and Technology (NIST), Gaithersburg, MD, USA

Accreditation of EMC Laboratories (ISO/IEC 17025)
Brad Moore and Bethany Hackett, National Voluntary Laboratory Accreditation Program (NVLAP), Gaithersburg, MD, USA

Accreditation of Product Certification Bodies (ISO/IEC 17065)
Adam Gouker, American Association for Laboratory Accreditation (A2LA) Frederick, MD, USA

Overview of the Technical Changes to the EMC Directive and the New Radio Equipment Directive (RED)
Michael Derby, American Certification Body-Europe (ACB), Inc., Winchester, UK

What to Expect During a Notified Body Assessment
Daniel Hoolihan, Hoolihan EMC Consulting, Lindstrom, MN, USA

Debugging EMI Test Failures

Sponsored by TC-4

Format: Full-day Tutorial -- FR-PM-1
1:30PM-5:30PM Rm 306 C

Chair: Ross Carlton, National Instruments, Austin, TX, USA

Abstract

This workshop will explore the challenging area of troubleshooting failures encountered during EMC testing. The objective of this workshop is to provide the EMC practitioner with insight into an area of EMC that is often neglected at the Symposium. The workshop will begin with a discussion of the challenges in managing and leading troubleshooting efforts. The following presentations will focus on the specific test categories that are most likely to result in a failure: radiated RF emissions, conducted RF emissions, radiated/conducted RF immunity, conducted transient immunity, and Electrostatic Discharge (ESD). For each test category, the presenter will discuss typical failure modes and their causes, troubleshooting at your workstation, troubleshooting at the test lab, typical fixes, and other insights, tips, tricks and tools.

The format of the workshop will incorporate Q&A sessions for each category to provide an opportunity for attendees to both ask questions as well as contribute the result of their own troubleshooting experience.

The presenters for this workshop each have over 25 years of practical experience in EMC design, test and troubleshooting. Attendees from novices to test veterans will benefit from their many successes and failures by attending this workshop

Planned Speakers and Topics

Leading and Managing EMI Troubleshooting
John Kraemer, Rockwell Collins, Cedar Rapids, IA, USA

Troubleshooting Radiated Immunity
Ken Wyatt, Wyatt Technical Services LLC, Woodland Park, CO, USA

Troubleshooting Voltage Transients and Conducted Immunity
Patrick Andre, Andre Consulting Inc., Seattle, WA, USA

Troubleshooting Radiated and Conducted Emissions (Simplified)
Mark Montrose, Montrose Compliance Services, Inc., Santa Clara, CA, USA

Troubleshooting ESD Immunity Issues
Ross Carlton, National Instruments, Austin, TX, USA

Field Sources and Their Application in Computational EMC

Sponsored by TC-9

Format: Half-day Workshop -- FR-PM-2

Chair: David P. Johns, CST of America Inc., Framingham, MA, USA

Abstract

This workshop will discuss the use of measured and simulated fields as field sources in computational electromagnetics models. Field sources can be used to replace the geometry of detailed sources thereby reducing complexity in EM models. The workshop will give examples of using field sources to represent antennas and applying the sources in numerical models to assess installed antenna performance and co-site EMI on various platforms. The workshop will also discuss the use of PCB near field scans as field sources for radiated emissions analysis.

The workshop will gives examples of using measured antenna and PCB fields as sources in numerical models. Examples of a multi-scale approach to modeling through the use of field sources will also be given. Validation cases will be provided and the benefits and limitations of field sources highlighted

Planned Speakers and Topics

An Introduction to the Field Equivalence Principle and Field Sources
David P. Johns, CST of America Inc., Framingham, MA, USA

Using Measured Fields as Field Sources in Computational EMC
Lars J. Foged, MVG, Pomezia, Italy

Multi-scale EMC Simulation Using Field Sources
Davide Talline, CST, Treviglio, Italy
David P. Johns, CST of America Inc., Framingham, MA, USA

Very Near Field Measurements as the Basis for Far-Field Computations
R. Patton, EMSCAN, Calgary, Canada

EMC Risk Management Workshop

Format: Half-day Tutorial -- FR-PM-3

Chair: Chair: Keith Armstrong, Cherry Clough Consultants Ltd., Stafford, UK

Abstract

Where safety risks can be increased by the effects of EMI on electronic equipment, EMC must be risk-managed for the full lifetime of the equipment/system/installation concerned, and so must take into account all foreseeable aging, wear, corrosion, faults and misuse.
A consequence is that no affordable time/cost of EMC immunity testing, at any test levels, can provide the necessary design confidence required by the relevant safety standards.

Where the future EM environment is unknown (as it usually is), the traditional approach (e.g. as used by the military) is to use very rugged high-specification EM mitigation, designed to meet or exceed all possible environmental issues (shock, vibration, humidity, salt spray, temperature, EM disturbances, etc.).
However, this 'big grey box' approach can be too large, heavy or costly for many modern safety-critical systems, especially (for example) in road/air transportation, portable medical devices, mobile life-support equipment, etc.

The new approach described in this workshop is the first practical alternative to the 'big grey box' approach, and adds less size and weight.

Planned Speakers and Topics

Introduction to the Risk-Management of EMC
Jeffrey Silberberg, US Food & Drug Administration, Silver Spring, MD, USA

Overview of Approaches: Big Grey Box and IET
Keith Armstrong, Cherry Clough Consultants Ltd, Stafford, UK

Developments in all Related IEC Standards.
Keith Armstrong, Cherry Clough Consultants Ltd, Stafford, UK



IET Method: Detailed Design Techniques and Measures for:
4a. System and Operational Design to Avoid Errors Caused by EMI
4b. Managing EMC Design to Avoid Errors Caused by EMI
4c. Detecting and Controlling Failures During Operation
4d. Design Verification and Validation, and Independent Assessment
Keith Armstrong, Cherry Clough Consultants Ltd, Stafford, UK

Overall Discussions, Questions and Answers
Jeffrey Silberberg, US Food & Drug Administration, Silver Spring, MD, USA

Wrap up: Technical Summary and Conclusions
Keith Armstrong, Cherry Clough Consultants Ltd, Stafford, UK

Crosstalk – Theory, Modeling, Characterization, and Design Optimization

Sponsored by TC-11

Format: Half-day Tutorial -- FR-PM-4

Co-chairs: Xiaoning Ye, Intel Corporation, Hillsboro, OR, USA
Kai Xiao, Intel Corporation, Hillsboro, OR, USA

Abstract

Crosstalk is a major concern in the computer system designs that support various interfaces and speeds. As the serial I/O data rate is approaching 40 Gbps and beyond, and the single-ended memory busses (DDR) are also getting faster, it has become more and more critical to meet the signal integrity requirements and strike a balance between low cost design (form factors, routing density, etc.) and performance. This tutorial will cover fundamentals of crosstalk, modeling, simulation, characterization of crosstalk, and design techniques for crosstalk reduction and mitigation

Planned Speakers and Topics

Fundamentals of Crosstalk
Xiaoning Ye, Intel Corporation, Hillsboro, OR, USA

In this talk, we will cover the fundamentals of crosstalk. First, a brief introduction will be given on the history and origin of the crosstalk, which dated back to the time when telegraph was invented. We will try to categorize crosstalk in different way, such as FEXT and NEXT, capacitive coupled crosstalk, inductive coupled crosstalk, etc. We will talk about the three key elements for coupling, aggressor, victim, and coupling path, including the key factors in these elements that determine the severity of crosstalk.

Crosstalk in Transmission Lines on a Printed Circuit Board
Xiaoning Ye and Kai Xiao, Intel Corporation, Hillsboro, OR, USA

The transmission lines on a PCB, including both microstrip and stripline a major topic for signal integrity. In this talk, the transmission line theory will be reviewed, and the formulation of crosstalk between coupled transmission lines, both differential and single-ended, will be given. The difference in the stackup between microstrip and stripline will be compared, and the implication of the dielectric property on crosstalk will discussed. The advantage of differential design, especially its better immunity to crosstalk, is addressed.

Crosstalk in Vertical Path of High-Speed Links
Xiaoning Ye and Kai Xiao, Intel Corporation, Hillsboro, OR, USA

Vertical path, such as via, socket, etc, is a key contributor of crosstalk in a computer system. In this talk, we will focus on the parameters in a vertical path that have large impact to crosstalk performance, including both single-ended and differential designs. The design parameters that will be covered in this talk include PCB stackup, via geometries, via pitch, pinout pattern, and ground via placement, etc.

Crosstalk Management Techniques in PCB Transmission Lines
Xiaoning Ye and Kai Xiao, Intel Corporation, Hillsboro, OR, USA

This is an advanced topic to the second topic. In this talk, we discuss the capacitive coupling and inductive coupling, the two dominant coupling mechanisms and their impact and interaction. We will then cover various techniques in controlling and reducing crosstalk in the transmission lines of a PCB. These design techniques are practical design optimization method that can be used to manage crosstalk in high-speed PCB board designs.

Inter-layer Crosstalk in Dual-stripline Design and Management Techniques
Kai Xiao, Intel Corporation, Hillsboro, OR, USA

Dual-stripline is gaining popularity in computer design because it provides high signaling density. A major concern of dual-stripline is the inter-layer crosstalk. In this talk, we will cover the mechanism and modeling of inter-layer crosstalk. We will also discuss the key parameters that affect the inter-layer crosstalk, and design techniques for crosstalk management.

Facts

Known at one time as the Valley of Heart's Delight, Santa Clara Valley once overflowed with abundant agricultural riches. Today Santa Clara Valley is known as Silicon Valley, and is the birthplace of the high technology revolution, with a population of nearly 1.7 million within its 1,312 square miles.

NEW! PANEL DISCUSSIONS*

>> Optimizing Interference Control Using Material Science

>> Brazil, Argentina, Mexico Regulatory Updates, Trends and Best Practices for Successful Product Certification

>> Are EMC/SI/PI Closely Related Now or in the Future?

>> Electrical Characterization of High Frequency Interconnects at Bandwidths up to 50 GHz

>> ESD in Data Centers

*All events are subject to change. Check www.emc2015usa.emcss.org and the Registration Area daily for updates.

Tuesday, March 17

Optimizing Interference Control Using Material Science

1:30PM - 3:00PM Grand Ballroom E

Chair: Mark Montrose, Montrose Compliance Services, Inc., Santa Clara, CA, USA

Abstract

Material science plays a significant role in all aspects of a system design. This panel discusses the use of different construction materials found in every system design to minimize development and propagation of unwanted EMI in addition to enhancing immunity protection.

The first panelist will discuss emerging hybrid EMI shielding structures and their feasibility for high volume applications. The second panelist will present aspects of absorber material and their principles of operation including various test methodologies for quantifying absorber effectiveness. A third panelist will discuss printed circuit board construction material that affects signal integrity and which is the primary cause of common-mode current development in high-speed circuit designs. The fourth panelist covers carbon nanotube/graphene based composite materials for EMI shielding applications. The final panelist will present uses of composite materials for both shielding and immunity protection utilized in transportation systems.

Brazil, Argentina, Mexico Regulatory Updates, Trends and Best Practices for Successful Product Certification

3:30PM - 5:00PM Grand Ballroom E

Chair: Elizabeth Perrier, ORBIS Compliance LLC, Morgan Hill, CA, USA

Abstract

This panel will provide an analysis of the regulatory process of regulatory bodies ANATEL and INMETRO, as well as Argentina CNC, and Mexico IFETEL. In-depth review of laws covering 2.4 GHz - 5GHz, 900 MHz and DFS bands and a description of EMC testing, Safety testing (over voltage test), and plug type will also be discussed. Trends in the growth of 700 MHz band, UWB, Femtocell, adoption of 4G technology and new antenna laws will be discussed as well as best practices to achieve successful product certification in all three countries.

Objectives

- To provide the most in-depth regulatory and technical workshop in relation to Brazilian regulatory bodies ANATEL and INMETRO, Argentina CNC and IRAM, Mexico IFETEL. In addition provide important WEEE Take Back Program laws for Latin America.
- To share the latest regulatory changes and telecommunication trends that will affect the development and deployment of equipment.
- To share proven steps to follow for successful product certification in Brazil

Wednesday, March 18

Are EMC/SI/PI Closely Related Now or in the Future?

1:30PM - 3:00PM Grand Ballroom E

Chair: Bruce Archambeault, Archambeault EMI Enterprises, Four Oaks, NC, USA

Abstract

In the past, the disciplines of EMC, Signal Integrity (SI) and Power Integrity (PI) were separate and analysis was usually performed by completely different engineers. However, the time has already come where for most system designs these disciplines can not be separate and must be considered together. This panel will discuss how and why these areas need to be considered simultaneously and the dangers of not doing so.

Electrical Characterization of High Frequency Interconnects at Bandwidths up to 50 GHz

3:30PM - 5:00PM Grand Ballroom E

Chair: Xiaoning Ye, Intel Corporation, Hillsboro, OR, USA

Abstract

As high speed interconnect data rates increase (up to 25Gbps and above beyond 25 Gb/s), the need for an accurate interconnect measurement is ever critical. However, there is a lack of standard practices on how to measure interconnects at high frequencies: Most instruments (such as VNA, TDR/TDT) can make good measurements at the end of a coaxial cable. However, test fixtures need to be inserted between an instrument's coaxial interface and the DUT (PCB, package, connector, cable, etc.). There are various de-embedding approaches already commercially available, however, the de-embedding algorithms are often proprietary, and verification of the accuracy of the computed S parameters is left to the user. A poorly designed test-fixture can lead to inaccurate de-embedded S parameters. An IEEE standard is needed to specify the electrical requirements of a properly designed test fixture to achieve high quality de-embedding. The quality of measured S parameters of a DUT can vary widely. There is no IEEE standard to check and validate the quality of S parameters before they are distributed for use. This has created many complications for engineers who are constructing models for high speed interconnect analysis. An IEEE standard is needed to check S parameters quality right after they are obtained in lab measurement..

Thursday, March 19

ESD in Data Centers

1:30PM - 3:00PM Grand Ballroom E

Chair: David Pommerenke, Missouri University of Science and Technology, Rolla, MO, USA

Abstract

Reliability is a core goal for data center operations. Energy saving can be achieved by allowing a higher range of humidity and temperature within the data center. However, at low humidity the risk for ESD inflicted damage or upsets increases. The panel discussion will present material that analyzes the risk of upset or damage as a function of humidity for data centers and shows how flooring and foot wear can control the risk. Further, it provides data on the charge voltage and probability distribution for ESD induced by walking and other ESD causing events, such as sitting up from a chair.

Facts

The Santa Clara Valley is normally the area thought of as 'Silicon Valley'; however, it can include surrounding areas of the greater San Francisco Bay Area.

Technical Committee (TC) Meetings play an important role in the overall success of the EMC Society by promoting activities in their fields and providing expert knowledge and assistance to generate and review technical papers, organize and operate sessions at symposia, generate and develop standards, and evaluate the state of the art in EMC science. All meetings are open to everyone; join them for breakfast, a break, lunch, or dinner. Listen to the discussions and learn what they are working on. Join your peers who volunteer to make EMC better. Just by attending, you can be part of the solution and the future of EMC!

Technical Advisory Committee (TAC) Meeting: Mon. 7 - 9 AM

SDECom Standards Development and Education Committee: Mon. 8 - 11 AM

SACCom Meeting Standards Advisory and Coordination Committee: Mon. 11:15 - 12 PM

IEEE Std 377: Mon. 1 - 2 PM

ITI Technical Committee-5 Meeting: Mon. 7 - 10 PM

SDECom Meeting: Wed. 7:30 - 9 AM

Special Committee 1: Mon. 5:45 - 6:30 PM

Smart Grid

This special committee is concerned with coordination of the EMC Society activity on providing EMC principles for those organizations and associated documentation and specifications that address the efficient use of the AC power grid including the control of power entering and in some cases exiting a house or building.

Special Committee 4: Mon. 12 - 1 PM

EMC for Emerging Wireless Technologies

This committee is concerned with the design, analysis, modeling and measurement for interference control and mitigation in emerging wireless products. The committee encourages researches including but not limited to the following areas: EMC-based system architecture design and system planning, strategic EMC performance budgeting and distribution, new system interface requirements and new system integration methods, intra-system coupling path analysis, modeling and validation, new EMC evaluation/measurement methods and standards for components/devices, Innovative component designs with integrated EMC functionalities, new EMC material requirements, applications and evaluation methods, and interdisciplinary issues involving EMC, audio, mechanical, and thermal designs.

Special Committee 6: Mon. 12 - 1:30 PM

Unmanned Aircraft Systems EMC

This committee is concerned with design, testing, modeling/simulation required for system level EMC for unmanned aircraft systems that will be engaged in all-weather autonomous single and cooperative flight. Special emphasis is on spectrum management on intra and inter-system interactions (platform integration), mission specific data security and bandwidth requirements, and robust performance in the presence of high intensity radiated fields (HIRF). Engagement in the development of standards will be a key role of this special committee.

Technical Committee 1: Tues. 7 - 9 AM

EMC Management

This committee is concerned with the development and dissemination of Best Practices and Methodologies for the successful leadership, supervision and guidance of EMC related activities. These Best Practices and Methodologies shall be structured so as to provide assistance to all managers, and engineers. Appropriate and convenient tools shall serve as a foundation to these Best Practices and Methodologies

Technical Committee 9: Tues. 12 - 1:30 PM

Computational Electromagnetics

This committee is concerned with broad aspects of Applied Computational Electromagnetic techniques which can be used to model electromagnetic interaction phenomena in circuits, devices, and systems. The primary focus is with the identification of the modeling methods that can be applied to interference (EMC) phenomena, their validation and delineating the practical limits of their applicability. Included are low and high frequency spectral-domain techniques and time-domain methods.

Technical Committee 2: Wed. 7 - 8:30 AM

EMC Measurements

This committee is concerned with the measurementand instrumentation requirements in EMC standards and procedures and how they are interpreted. Also concerned with the adequacy of measurement procedures and measurement instrumentation specifications for radiated and conducted emission and susceptibility tests and the rationale for performance limits for these tests..

Technical Committee 10: Wed. 12 - 1 PM

Signal and Power Integrity

This committee is concerned with the design, analysis, simulation, modeling and measurement techniques useful in maintaining the quality of electrical signals. These activities encompass all aspects of signal integrity from the integrated circuit level to the system level.

Technical Committee 5: Wed. 12 - 1:30 PM

High Power Electromagnetics

This committee is concerned with the effects and protection methods for electronic equipment and systems for all types of high power electromagnetic environments. These environments include electromagnetic pulse (EMP), intentional EMI environments (i.e., narrowband and wideband), lightning electromagnetic currents and fields, electrostatic discharge and geomagnetic storms. In addition this committee deals with the commercial data security issue through electromagnetic information leakage activities. Interactions with subsystems, systems and platforms are included.

Technical Committee 4: Thurs. 12 - 1:30 PM

EMI Control

This committee is concerned with design, analysis, and modeling techniques useful in suppressing interference or eliminating it at its source. Bonding, grounding, shielding, and filtering are within the jurisdiction of this committee. These activities span efforts at the system, subsystem, and unit levels.

Technical Committee 6: Thurs. 7 - 8:15 AM

Spectrum Management

This committee is concerned with the analysis, design, and measurement techniques for intentional RF transmitting and receiving equipment to prevent interference and promote efficient spectrum use through technology and operational based approaches, such as software design, dynamic spectral allocation, waveform control, as well as frequency coordination and management procedures.

Technical Committee 11: Thurs. 12 - 2 PM

Nanotechnology

The newest technical topic area for the EMC Society, the topics include carbon nanotubes, composite materials, and other measurements, design, and analysis applications.

Plenary Session
Thursday, March 19

Electromagnetic Integrity

Four, 45 minute talks in a half-day session.

8:30 AM - NOON Grand Ballroom G

Co-chairs: Dale Becker, IBM, Poughkeepsie, NY, USA
Jun Fan, Missouri University of Science and Technology, Rolla, MO, USA

Abstract

Join us for a half-day plenary session highlighting the advances in EMC and SI and the challenges facing us. Four excellent speakers will give insight from their experience on addressing electrical emissions, propagation and susceptibility across a broad range of emerging technologies. This session will give the attendees a great appreciation for the breadth of components and designs and the innovative techniques for analysis and characterization and get them thinking about the application to their own research and development.

Planned Speakers and Topics

The Future of EMC and SI Engineering
Bruce Archambeault, Missouri University of Science and Technology, Rolla, MO, USA

As data rates increase into the tens of GHz range, and many devices are becoming smaller and including various wireless radios, the traditional approaches to EMC and SI design will not be sufficient to meet the functional and regulatory requirements. This presentation will discuss the future trends and some possible design approaches beyond traditional simple shielding.

Challenges and Opportunities for Power Delivery
Madhavan Swaminathan, Georgia Institute of Technology, Atlanta, GA, USA

With a multitude of applications emerging, power delivery is becoming a major challenge. With the power levels ranging from high, medium, low and ultra-low, a single power delivery scheme cannot be used for all applications. Power delivery consists of three major parts namely, source, distribution and load with control circuitry connecting these sub-blocks. With integration within the chip, package and printed circuit board, these sub-blocks need to be co-designed and co-optimized, without which an efficient power delivery scheme is not possible. This presentation discusses the challenges and opportunities for power delivery in the context of electronic systems. The importance of educating the next breed of engineers in this rapidly growing field will be highlighted as well.

Nanotechnology in EMC
Er-Ping Li, Zhejiang University & Institute of High Performance Computing, Singapore

Recently, nanomaterial is a topic of very attractive research fields from science to potential applications in microwave and electromagnetic compatibility. This paper briefly overviews the graphene and other nanomaterials research for EMC applications. In particular, 2D nanomaterial Graphene is a single layer of carbon atoms bound in a hexagonal lattice structure with extraordinary mechanical properties, superior carrier mobility, and high thermal conductivity. The extraordinary properties and freelance hybridization with other materials make graphene one of the most promising candidates for the future applications in EMC. .

Advanced packaging for EMC/SI/PI
James Drewniak, Missouri University of Science and Technology, Rolla, MO, USA

Increasing data rates and design densities together with new enabling technologies necessitate new approaches in packaging, materials, and design for SI, PI, and EMC to meet design specifications, cost pressures, and regulatory requirements. This presentation will highlight several technologies and examples that are enabling data rates that will soon exceed 50 Gbps over a single lane and very high design densities that result in increasing challenges in packaging, materials, tools, and design methodologies for achieving specifications.

Facts

In 2005 Silicon Valley Power brought online the Donald Von Raesfeld (DVR) Power Plant, a new combined cycle gas turbine plant which produces 147 megawatts of electricity, making electricity in Santa Clara considerably cheaper than most power plants.

COMPUTER MODELING AND SIMULATION DEMONSTRATIONS

TUESDAY, MARCH 17 - 10:00 AM – NOON

Topic: Using Simulated EMC Instruments to Develop, Edit, and Validate EMC Test Routines

Presenter: Joe Tannehill, ETS-Lindgren, Austin, TX, USA

Abstract: Automating the EMC test process has the benefits of improving measurement accuracy and repeatability while also increasing test throughput. EMC testing is complex and requires multiple instruments to work in unison so that data gathered is coherently assembled to determine compliance of a device under test.

Integrity of the test setup is typically done with system checks where a known signal is injected at some point in the system and compared with expected results. This approach is great for validating the entire hardware/software signal chain. Using virtual instruments, the software side of the system can be validated before assembling the instrumentation. This is a significant time saver and allows for scenario testing without tying up test equipment and chamber time.

This demonstration will show how instrument simulation can be used to setup system checks as well as validate actual EMC emissions and immunity tests.

Topic: ERC and SRC for Large-Scale SI Engineering

Presenter: Jiang Li, Cadence Design Systems, San Jose, CA, USA

Abstract: Software demo for advanced layout checks, ERC (electrical rule check) and SRC (simulation rule check) is proposed. ERC is geometry-domain based check showing trace impedance, coupling and reference; SRC is electrical-domain simulation based check showing Tx/Rx/NEXT/FEXT waveforms. ERC/SRC can handle large PCB designs, and provide insight into PCB's SI performance.

This is software demo can be considered as a follow up for presentation 'PCB check for large scale SI/PI engineering' at 2014 IEEE EMC SI/PI symposium by the same author.

TUESDAY, AUGUST 5 – 2:00 PM – 4:00 PM

Topic: : Numerical Modeling of Crosstalk

Presenter: : Scott Piper, General Motors, Milford, MI, USA

Abstract: Unintended electromagnetic coupling, also known as crosstalk, causes a great deal of the EMC problems during product EMC testing. Crosstalk can never be eliminated especially since there is an increasing demand for smaller products so often trade-offs are made which can be investigated using numerical modeling tools. This demonstration will show how crosstalk in wiring and printed circuit boards can be modeled using various numerical modeling methods. Issues will be discussed such as which methods to use, simplification, and meshing requirements

WEDNESDAY, MARCH 18 - 9:00 AM – 11:00 AM

Topic: Using Method of Moments for EMC and SI Application

Presenter: Bruce Archambeault, Archambeault EMI/EMC Enterprises, Four Oaks, NC, USA and Missouri University of Science and Technology, Rolla, MO, USA

Abstract: The Method of Moments (MoM) is one of the most common and popular electromagnetics simulation techniques being used. While all simulation techniques have their strengths and their weaknesses, MoM has proven to be very robust and extremely effective for certain types of simulation problems. This demonstration will use CONCEPT from Technical University of Hamburg-Harburg to demonstrate using MoM simulation technique for EMC and SI applications.

THURSDAY, MARCH 19 – 9:00 AM – 11:00 AM

Topic: Modeling the Shielding Effectiveness Using Integral Equation Techniques: Shielding Effectiveness of Aircraft Structures with Carbon-Fiber Reinforced Composite Materials

Presenter: Dr. M. H. Vogel, Altair Engineering Hampton, VA, USA

Abstract: When lightning or high-intensity radiated fields hit an aircraft, currents will be induced in interior cable harnesses and be injected into electrical systems. This is especially a concern when the aircraft is made of composite materials, since those materials offer less shielding. We will demonstrate how the complete problem can be simulated efficiently and reliably.

HARDWARE EXPERIMENTS & DEMONSTRATIONS

TUESDAY, MARCH 17 – 2:00 PM – 4:00 PM

Topic: ETSI EN 300 328 V1.8.2 and ETSI EN 301 893 V1.7.2 Clarified Requirements and Synchronized Power Sensor Demonstration

Presenters: Jack McFadden, ETS-Lindgren, Cedar Park, Texas, USA

Abstract: The ETSI EN 300 328 V1.8.2. Electromagnetic compatibility and Radio spectrum Matters (ERM); Wideband Transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive and ETSI EN 301 893 V1.7.2 Broadband Radio Access Networks (BRAN); 5 GHz high performance RLAN; Harmonized EN covering the essential requirements of Article 3.2 of the R&TTE Directive has further clarified their power measurement requirements.

The ETSI explained its definition of conducted method of simultaneous data acquisition for multiple input/multiple output products (MIMO). The conducted power measurements are required to be made using synchronized (simultaneous) sensors. The minimum sampling speed of the data acquisition system is 1 Mega-Samples per second with the minimum sample of all sensors to be less than 500 nanoseconds.

The ETSI 300 328 V1.8.2 was published in April 2014 and ETSI EN 310893 V1.7.2 was published in July 2014. The compliance dates are 18 months after their release.

This demonstration is created to enable the viewer to understand the ETSI EN 300 328 V1.8.2 and 301 893 V1.7.2 clarified requirements as well as show how synchronized power sensors meet the ETSI power measurements

WEDNESDAY, MARCH 18 - 9:00 AM – 11:00 AM

Topic: Inductive Effects in Cables

Presenter: Jerry Meyerhof, JDM Labs LLC, Buffalo Grove, Illinois, USA

Abstract:

The laboratory objective : Understand the practical implementation details of "cables" or "transmission lines" which are critical to EMC performance, as used between modules/units, across systems and within Printed Circuit Boards (PCBs).

Demonstrated Observations:
1) Signal currents follow the path of least impedance
2) Cable geometry effects and self-shielding.
3) Conversion mechanisms between differential and common mode signal propagation.
4) Impact of cable mechanical end termination geometry such as "pigtail" connections.
5) Use of Common-Mode Chokes.

Analyze and Predict the observed effects

Another element of the presentation is to talk about the tasks involved in getting an educational lab to work, much like the Chris Semanson article in our EMCS magazine and his own demos in past years.

WEDNESDAY, MARCH 18 - 2:00 PM – 4:00 PM

Topic: Consideration on the EM Noises Before and After the Regular Tests from ESD Generator

Presenter: Makoto Sugihashi, Noise Laboratory Co., Ltd., Kanagawa, Japan
Tony Tokuya, Shinyei Corp of America, New York, NY, USA

Abstract: Electrostatic discharge (ESD) generators cause electromagnetic (EM) noises not only at ESD tests but also even before and after the tests. These phenomena may cause the unexpected test results. To explain the mechanism qualitatively, we investigated a generation source model of EM noises from an ESD generator.

Topic: Minimizing magnetic field susceptibility through the proper use of static and low frequency magnetic shielding

Presenter: Pablo Narvaez and Nelson Huang, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA

Abstract: The Jet Propulsion Laboratory has participated in multiple projects whereby implementation of proper magnetic shielding has been a key component in successful space missions free of static and low frequency magnetic interference. This hardware experiment/demonstration presents magnetic shielding methods similar to those applied on JPL hardware for typical magnetic cleanliness programs.

THURSDAY, MARCH 19 – 9:00 AM – 11:00 AM

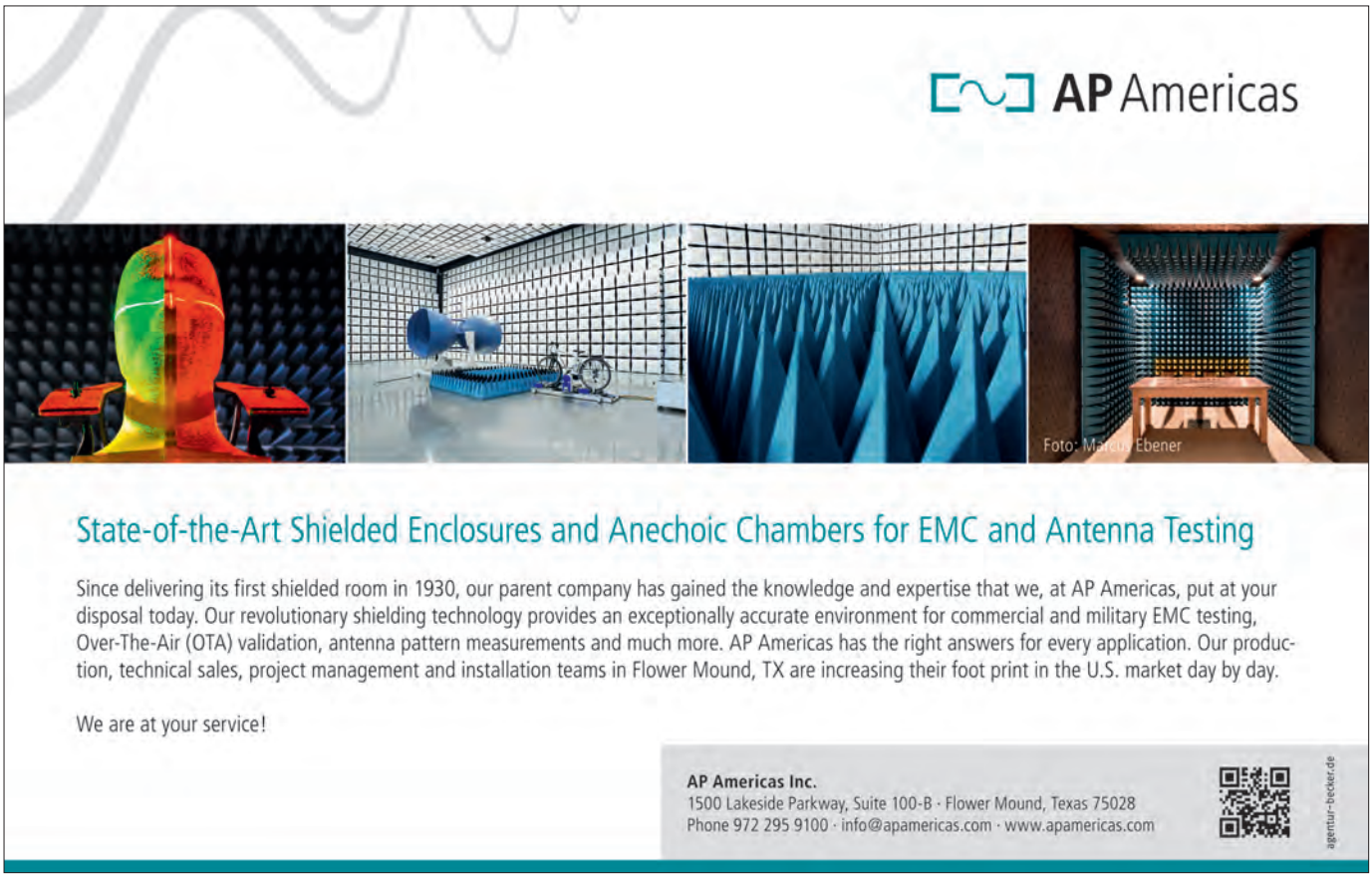
Topic: Radiated Emissions as a Function of Common Mode Current

Presenters: John McCloskey, NASA/Goddard Space Flight Center, Greenbelt, MD, USA

Abstract: For any product, an essential part of EMI testing is the radiated emissions test. However, it is often the case that product development engineers, concerned with more visible design problems, ignore EMI concerns until the very day they take their boxes to an EMI test facility for radiated emissions testing, and then are terribly shocked when they find that they've failed.

At frequencies below about 200 MHz, a significant portion of the radiated energy originates from uncontrolled common mode currents on cables connected to the unit. The product development engineer may perform an early assessment of radiated emissions by directly measuring these currents.

In this demonstration, a controlled current is applied to a wire above a ground plane, and the resulting electric field is measured. The transfer function of electric field per unit current (E/I) is determined and presented as a tool for predicting radiated electric fields from a simple measurement with a clamp-on current probe before the product ever leaves the development laboratory. Product development engineers are encouraged to perform these measurements in order to facilitate diagnosis of potential problems as early as possible in the product's development cycle.



INTERNATIONAL ASSOCIATION FOR RADIO, TELECOMMUNICATIONS, AND ELECTROMAGNETICS

Exemplar Global

iNARTE, a product of Exemplar Global certifies qualified engineers and technicians in the fields of Telecommunications, Electromagnetic Compatibility/ Interference (EMC/EMI), Product Safety (PS), Electrostatic Discharge control (ESD), and Wireless Systems Installation.

iNARTE, a product of Exemplar Global, Inc. (formerly RABQSA)
600 N Plankinton Ave Suite 301
Milwaukee, WI 53203
Phone: 888-722-2440
Fax: 414-765-8661
www.inarte.org or www.exemplarglobal.org

Questions?
Sal Agnello, General Manager,
iNARTE, Exemplar Global
inarte-info@exemplarglobal.org

Facts

A new product, the semiconductor chip, was developed in the 1950s. The resulting electronics industry, based on the silicon chip, gobbled up the remaining orchard land and changed the agricultural nature of Santa Clara and Santa Clara Valley forever. By 1990, the city covered 19.3 square miles and had a population of more than 93,000.

iNARTE Program at EMC 2015 Technical Program

Monday, March 16th

Learn more about iNARTE Certifications

This workshop is a recommended for anyone interested in learning more about iNARTE certifications. During this workshop, you will learn more about the following iNARTE certification programs:

- **EMC Engineer and Technician**
- **EMC Design Engineer**
- **Wireless Device Certification Professional**

You will have an opportunity to ask questions regarding application and examination for these programs, as well as an opportunity to take a practice test.

Register today to take the certification exams for all of these programs by visiting http://www.narte.org/h/examregform.asp. Identify your testing location using the "Special Event Location" feature.

Friday, March 20th

The iNARTE Certification Examinations for the following programs will be held at the Symposium from 8:00 AM to 5:00 PM.

- **EMC Engineer and Technician**
- **EMC Design Engineer**
- **Wireless Device Certification Professional**

Register for the exams by visiting http://www.narte.org/h/examregform.asp. Identify your testing location using the "Special Event Location" feature.

If you attend The Global EMC University lectures, this is an opportunity to validate your knowledge and experience by becoming iNARTE Certified. You may take the Examination at the Symposium and apply for the certification later, or apply now and register for the exam by visiting www.narte.com.

More Information on iNARTE Certifications

The iNARTE EMC certification is an international program that recognizes engineers and technicians practicing in the EMC fields to include bonding, shielding, grounding, EMI prediction, EMI analysis, conducted and radiated interference, lightning protection and more.

Learn more about the EMC program at http://www.narte.org/h/emc.asp.

The iNARTE EMC Design Engineer certification is an international program that recognizes engineers practicing in EMC fields and whose main responsibility is designing electronic circuits, components, sub systems, and equipment to ensure EMC compliance.

Learn more about the EMC Design Engineer program at http://www.narte.org/h/emcdesignengineer.asp.

The iNARTE Wireless Device Certification Professional (WDCP) certification is a new program that recognizes professionals who are skilled and knowledgeable of the global regulatory requirements applicable to the wide range of Wireless Devices now being introduced to market segments.

Learn more about the WDCP program at http://www.narte.org/h/wdcp.asp.

ANSI C63® Workshops

Compliance Testing of Wireless Devices and Unintentional Radiators

C63.10/C63.26 Wireless Workshop and C63.4 Workshop (Visit www.c63.org for more information)

This combined workshop is presented in two parts over a two day period.

Topics Covered Include:

(1) overview of the present standard C63.10 for unlicensed transmitter testing

(2) the future standard C63.26 for licensed transmitter testing

(3) the procedures for testing unintentional radiators contained in the newly published standard C63.4-2014

This workshop covers three standards. The first full day plus a half-day wireless workshop provides an overview of the present standard C63.10 for unlicensed transmitter testing and the future standard C63.26 for licensed transmitter testing. There will be specific emphasis on new procedures. These two standards capture most of the procedures for testing unlicensed and licensed wireless devices to show compliance with FCC requirements. Group discussions and demonstrations will be a highlight of the wireless workshop.

The second half-day unintentional radiators workshop captures the procedures for testing unintentional radiators contained in the newly published standard C63.4-2014. This workshop will present major changes in C63.4 from the 2009 edition to the published 2014 edition.

In the C63.4 workshop, you will learn:

- **RF emission measurement procedures**
- **National and international regulatory implications**
- **Test facility and instrumentation requirements**
- **Equipment test arrangements and configurations**
- **Differences between the 2014 edition and the 2009 edition and earlier**

In the C63.10/C63.26 Wireless Workshop, you will learn:

- **Instrumentation requirements**
- **Average value of pulse emissions**
- **Antenna requirements**
- **Test site requirements**
- **RF output power measurements**
- **Modulation measurements**
- **Occupied bandwidth procedures**
- **Band-edge procedures**
- **Direct and signal substitution radiated emission measurements**
- **Frequency stability measurements**
- **Conducted tests at antenna port**
- **Smart antenna system tests**
- **Revised MIMO procedures**
- **Test procedures for RF repeaters, amplifiers and boosters**
- **Annexes covering example of OOB masks, consumer booster require-ments, ERP/ EIRP guidelines, path loss characterization, sample test report, compliance tests verses regulatory requirements and other informative guidance**
- **In-lab demonstrations will show specific procedures for testing both licensed and unlicensed wireless devices**

Support material provided

- **A complete lecture flash drive**
- **FCC handouts and references**

Who Should Attend

Those responsible for determining compliance with FCC Rules and Regulations (and CISPR 22), including:

- **Product managers and developers**
- **EMC engineers and test technicians**
- **Regulatory compliance managers**
- **Test instrumentation developers**
- **Those using and calibrating antennas in making radiated emission compliance measurements**
- **Calibration technicians**
- **Calibration and measurement accreditation bodies**
- **Lab quality assessors**
- **Test instrumentation and chamber manufacturers**

Expert Instructors

Art Wall, Radio Regulatory Consultants, Wireless Working Group Chairman; Mark Briggs, UL Director, Wireless Certification Program; Bob Delisi, UL TCB Project Lead; Donald Heirman, Don HEIRMAN Consultants, C63.4 Working Group Chairman and workshop director.

Dates and Location

March 13-14, 2015
SIEMIC, Inc., Milpitas, CA.
See www.emc2015usa.emcss.org for hotel info and to reserve your hotel room.

Fee Includes

Shuttle service to/from SIEMIC, Inc. and the symposium host hotel, continental breakfast, lunch and breaks for both days and completion certificates. Soft copy of workshop notes only will be provided. (Fee does NOT include draft or published standards.)

Agenda

C63.10/C63.26 Wireless Workshop: All day March 13 and morning only on March 14

March 13 **Registration:** 8:30 am
Class: 9:00 am to 5:00 pm

March 14 **Class:** 9:00 am to 12:00 pm

C63.4 Workshop: Afternoon only on March 14

March 14 **Registration :** 12:30 pm
Class: 1:00 pm to 5:00 pm

The organizing committee reserves the right to substitute speakers, modify the program (or lecture notes), restrict attendance or to cancel the workshop(s). In the event the workshop(s) is/are canceled, registration fees will be refunded. No refunds will be made to individuals who cancel after February 1. Substitutions are allowed. Workshops without a minimum of 12 attendees signed up by 1 February 2015 will be cancelled and registration fees returned. It is suggested that you book refundable travel arrangements as appropriate if workshop(s) is/(are) cancelled.

GLOBAL EMC UNIVERSITY was first offered at the 2007 IEEE EMC Symposium in Honolulu to provide advanced education on a variety of topics that are an important part of EMC engineering. The overwhelming response to this program caused the EMC Society to add it to the technical program every year since 2007. It has continued to receive high praise from those who attend. This year, the Board of Directors voted to name the Global University in honor of Clayton R. Paul, who dedicated his career to EMC education and was instrumental in setting up the initial Global University. We are pleased to be able to offer Global University once again at the 2014 IEEE International EMC Symposium in Raleigh, North Carolina.

This year's Global University offers 12 hours of instruction. Eight hours are on basic SI related topics and four hours on traditional EMC topics. The sessions are run in parallel with the traditional technical sessions at the symposium. A broader set of EMC topics will be covered at the International Symposium on EMC in Dresden, Germany on Aug 16- 22, 2015. Classes are taught by an international panel of educators, who have been selected for this program based on their reputation for excellence in areas of practical importance to EMC and SI engineers and their demonstrated ability to communicate effectively with students who are new to the field. The targeted audience for GU SI are engineers who have been in the profession approximately 5 years, although past classes have included many veterans wanting to improve their understanding. The overall objective of this sequence of lectures and activities is to provide a comprehensive exposure to the basic concepts and skills that are necessary to be successful in the profession.

GLOBAL UNIVERSITY SCHEDULE

TUESDAY, MARCH 17

CLASS I: 1:00 PM - 3:00 PM

- **Radiated Emissions and Conducted Emissions**
  Lee Hill Silent Solutions LLC, Amherst, NH, USA

CLASS IIa & IIb: 3:30 PM - 5:30 PM

- **Grounding Essentials**
  Todd Hubing, Clemson University, Clemson, SC, USA
- **ESD**
  Todd Hubing, Clemson University, Clemson, SC, USA

WEDNESDAY, MARCH 18

CLASS III: 1:00 PM - 3:00 PM

- **Introduction to Signal Integrity**
  Jun Fan,Missouri University of Science and Technology, Rolla, MO, USA



CLASS IV: 3:30 PM - 5:30 PM

- **Introduction to Power Integrity**
  Ege Engin, San Diego State University, San Diego, CA, USA

THURSDAY, MARCH 19

CLASS V: 1:00 PM - 3:00 PM

- **SI and EMC Design for High-speed Differential Signaling**
  Tzong-Lin Wu, NTU

CLASS VI: 3:30 PM - 5:30 PM

- **SI/PI Issues and Solutions for High-Speed Single-Ended Signaling**
  Dan Oh, Altera Corp, San Jose, CA, USA

OTHER INFORMATION

WHO IS IT FOR:

Engineers, technicians and professionals who want to gain insight into EMC and SI and the application to today's technology.

OVERALL OBJECTIVE:

To provide an in-depth exposure to the concepts and skills that are necessary to be successful in EMC and SI/PI.

PREREQUISITES:

Engineering or Technology Degree with Electrical Theory A certificate of completion will be provided to students who have signed in and signed out each day thereby confirming 100% attendance at all lectures. Continuing Education Units (CEUs) will be assigned to this course.

REGISTRATION:

Attendance is based on those who pre-register for the Clayton R. Paul Global University (on-site registration limited to openings due to cancellations), pay the full symposium registration fee, and an additional registration fee for these special classes.

FEES:

ADVANCED RATE: $275

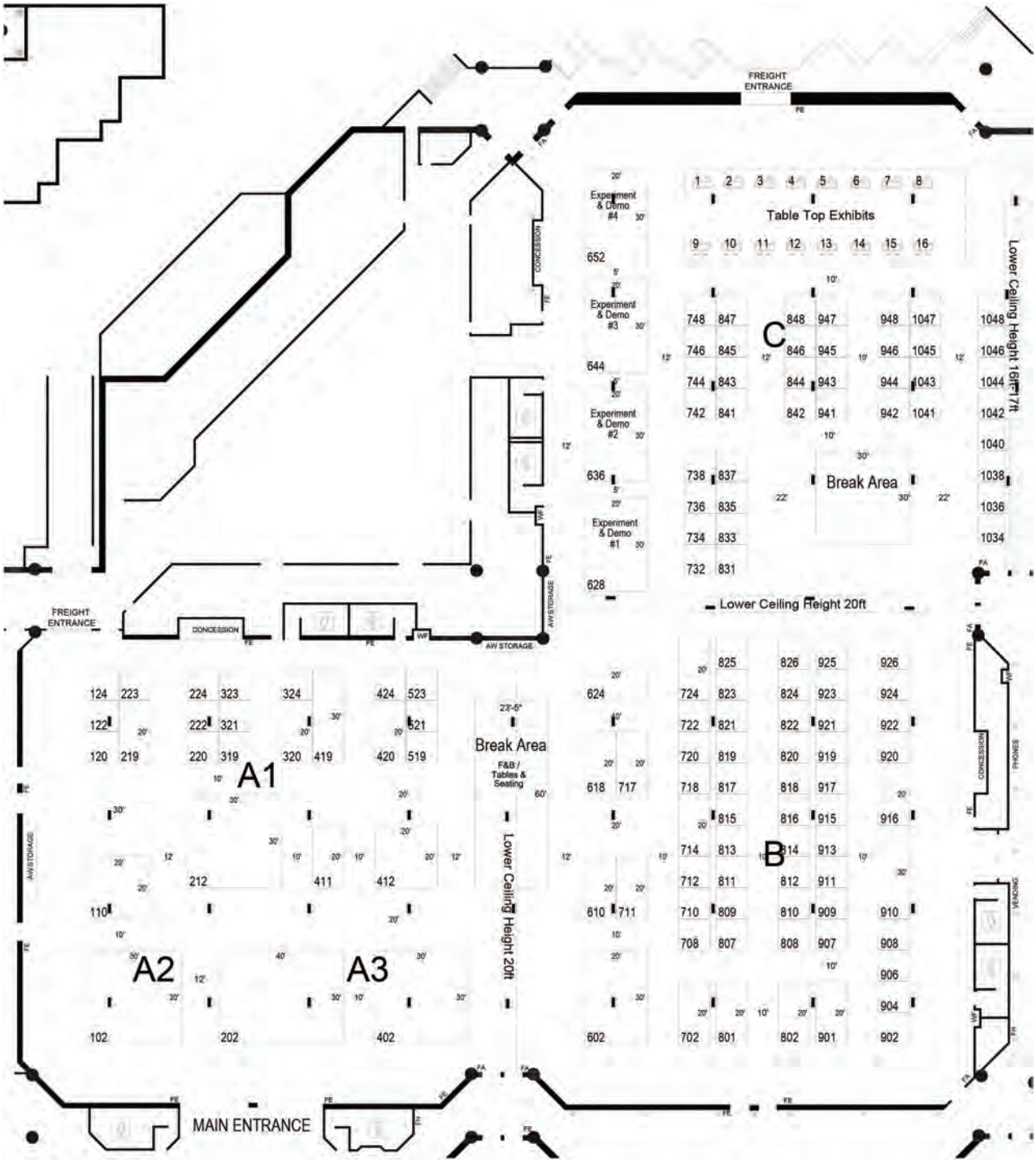
REGULAR RATE: $375



EXHIBIT HALL MAP

3G Metalworx, Inc. 824
A2LA - American Association for Laboratory Accreditation 521
ANSI-ASC C63 Committee on EMC 908
AR RF/Microwave 202
Advanced Test Equipment Rentals 502
AE Techron, Inc. 420
A.H. Systems, Inc. 419
Amphenol Canada 831
Anechoic Systems LLC 007
ARC Technologies, Inc. 734
Boonton/Noisecom (Wireless Telecom Group) 821
CKC Laboratories, Inc. 720
Communications and Power Industries CPI 825
Com-Power Corporation 714
Comtest / DMAS 219
CST of America, Inc. 412
Cuming-Lehman Chambers, Inc 925
Detectus 812
D.L.S. Electronics Systems, Inc. 324
EE - Evaluation Engineering 920
Electro Magnetic Applications 822
Electro Magnetic Test, Inc. 001
Electro Rent Corporation 002
Elite Electronic Engineering Inc 837
EMCoS Ltd 710
EMC PARTNER AG 602
EMI Solutions Inc. 003
Empower RF Systems 711
ENR/Seven Mountains Scientific Inc. 006
ESDEMC Technology LLC 321
Espresso Engineering 922
ETS-Lindgren 402
Exemplar Global/iNARTE 120
Fair-Rite Products Corp. 742
Fischer Custom Communications 110
GAUSS INSTRUMENTS GmbH 602
HAEFELY HIPOTRONICS 724
HV TECHNOLOGIES, Inc 602
IEEE 2016 International Symposium on Electromagnetic Compatibility 916
IEEE Antenna and Propagation Society 906
IEEE EMC Society 910
IEEE EMC SOCIETY HISTORY COMMITTEE 904
IEEE EMC Society Standards 902
IEEE PSES - Product Safety Society 004
In Compliance Magazine 624
Innco systems GmbH 602
Interference Technology/Item Media 702
Keysight Technologies 618
Kitagawa Industries America, Inc. 523
Laboratory Accreditation Bureau 015
Langer EMV-Technik GmbH 736
Liberty Calibration Corps 835
MET Laboratories Inc. 013
Michigan Scientific Corp. 124
mk-messtechnik GmbH 907
Moss Bay EDA/IBM 808
MVG 202
National Technical Systems (NTS) 901
NEC TOKIN 802
Newtons4th (N4L) 010
NEXIO 223
National Voluntary Laboratory Accreditation Program (NVLAP) 926
Nolato Silikonteknik AB 718
Northwest EMC, Inc. 424
OnRule 732
Ophir RF Inc. 610
ORBIS COMPLIANCE LLC 738
Panashield LLC, A Braden Shielding Systems Company 708
Pearson Electronics Inc. 009
Prana R&D 602
Reliant EMC 841
RF Exposure Lab 807
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SOCIAL EVENTS

2015 EMC SYMPOSIUM GUIDE
SILICON VALLEY, CALIFORNIA

Welcome Reception

Tuesday, March 17
6:00 PM – 8:00 PM

Join us in the gorgeous Mission City Ballroom in the Santa Clara Convention Center for an evening of wine tasting, live music and catching up with friends. One ticket to this event is included in all 5-Day technical registrations and the Companion Program registration. All others may purchase a ticket to the Welcome Reception as an add-on to your registration.

- **An Adult Reception Ticket price:** $65 ($75 after January 20, 2015)
- **A Junior (Age 8 to 17, inclusive) Reception Ticket is:** $25 ($35 after January 20, 2015)
- **Children under age 8 are free, but must be accompanied by a registered adult.**

EMC Society Band

Tuesday, March 17
6:00 PM – 8:00 PM

EMC Society Musicians will perform at the Welcome Reception! Come see our gifted colleagues share their musical talents!

This is a comeback event that was first featured in Austin at EMC 2009.

Veteran EMC Society Band members and newcomers alike are welcome to participate.

If you would like to perform, please contact our fearless bandleader Jeff Silberberg at jeffrey.silberberg@verizon.net. If needed, he can arrange for backup musicians to allow your talent to shine!tour will begin at the main entrance of the exhibit hall.

IEEE EMC Young Professionals Party

Tuesday, March 17
8:15 PM – 10:00 PM

Show off your fancy bowling skills (or laugh at your lack of skills) with your fellow EMC Young Professionals. This is a great opportunity to socialize and connect with like minded individuals in an informal setting.

- **Event:** Bowling
- **Fee:** $10 includes bowling/shoes and pizza
- **Location:** Homestead Bowl, 20990 Homestead Rd, Cupertino, CA 95014
- **Transportation:** Free (looking for volunteers with a car)

Evening Gala Event

Wednesday, March 18
6:30 PM – 9:30 PM

Our evening Gala is a must attend event with an awards ceremony and our delicious California style menu. This event will be in the Mission City Ballroom in the Santa Clara Convention Center.
One ticket to this event is included in all 5-Day technical registrations EXCEPT student registrations. This is a change from last year, made to keep student registration costs down. Extra tickets to the Gala may be purchased as an add-on to your registration.

- **An Adult Reception Ticket price:** $80 ($90 after January 20, 2015)
- **A Junior (Age 8 to 17, inclusive) Reception Ticket is:** $35 ($45 after January 20, 2015)
- **Children under age 8 are free, but must be accompanied by a registered adult.**

Chapter Chair Training Session and Dinner

Wednesday, March 18
12:00 PM - 2:00 PM

The Chapter Chair Training Session provides a forum for providing focused training to the Chapter Chairs, provides the Chapter Chairs with the opportunity to discuss their chapter issues and get group feedback, gives the Chapter Chairs the opportunity to meet other Chapter Chairs from around the world and for the Chapter Coordinator to disseminate important information from IEEE headquarters and the EMC Society Board of Directors.

A Social Session will precede the Dinner, to give the Chapter Chairs the opportunity to socialize with the other Chapter Chairs and their Angels.

The Dinner will be served at the end of the Social Session. Besides a great meal, each Chapter Chair or their representatives will have the opportunity to share what their chapter has been doing for the past year.

After the Dinner, an interactive brainstorming session will conclude the meeting. This session is intended to exchange information and new ideas for effective chapter management, as well as to discuss best practices and suggestions for future development and growth of the EMC chapters.

This is a free event open to Chapter Chairs or their representatives. Please check with your Chapter Chair, as you can be that representative for your chapter if your Chapter Chair cannot attend this event.

Team EMC

Thursday, March 19
7:00 AM

Meeting place:
at Convention Center, outside the Registration Area. The ride will depart from the Convention Center.

Interested in exploring some of Santa Clara on bike with your fellow EMCS members? The third annual Team EMC bike ride is scheduled for Thursday, March 19th. Please join us for a morning ride to get some exercise and to experience part of the area in a refreshing way. Based upon participation, this year we will host two levels of escorted riding: leisure and performance.
A Team EMC jersey will be included for 1st-time participants on a first come first serve basis, while quantities last. If you received a jersey on one of our past rides, please don't forget to bring it with you.
Bike rentals are the responsibility of the rider. Rentals are available at UDC, 877.322.1667. (http://udcbikerental.com/carbon-road-bikes-for-rent.php).

New for this year . . . rental bike delivery. See UDC website for how to have your rental delivered to the hotel for $13.

Please plan on renting the bike the night before the ride since bike shops typically don't open until 10:00 AM. You will need to provide the type of bike you want and size (or your height if you don't know). If you have a cycling helmet, it is recommended that you bring it.
Please sign up early to ensure availability. You are also welcome to bring your own bike. To sign up, contact Ray Adams at r.k.adams@ieee.org or (310) 387-7201. We are putting together the route information and logistics.
Chapter Chairs and their Angels.



Founders and Past-Presidents Luncheon

Thursday, March 19

11:30 AM - 1:30 PM

The Luncheon is open to the Founders of the EMC Society, Past-Presidents of the EMC Society, current members of the Board of Directors, and students. The luncheon is a chance for the old and the new to mix, exchanging experiences of the past, challenges of the future and learning about the EMC profession. A sit down lunch is provided. When making your reservation, please indicate that you plan to attend so there will be seating and food for you.





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RESTAURANTS

2015 EMC SYMPOSIUM GUIDE
SILICON VALLEY, CALIFORNIA

SYMPOSIUM TRIPS ARE EXPENSIVE - IS THERE ANYTHING CHEAP TO EAT?

Golden Crown Restaurant
Chinese

4537 Stevens Creek Boulevard
Santa Clara, CA 95051
t: 408-243-9551
w: https://plus.google.com/100866856954746018103/about
UNDER $10

Taqueria La Veracruzana 1
Mexican

1510 Jackson Street
Santa Clara, CA 95050
t: 408-261-2108
w: https://plus.google.com/116324385443694680678/about
UNDER $10

Bamboo Leaf Vietnamese Cuisine
Vietnamese

3074 Scott Boulevard
Santa Clara, CA 95054
t: 408-988-8520
w: http://www.bambooleafrestaurant.com/
UNDER $10

Kenny's Café
Cafe

2315 De La Cruz Boulevard
Santa Clara, CA 95050
t: 408-588-1508
w: https://plus.google.com/118163831563640957355/about
UNDER $10

Lily Coffee and Sandwiches
Vietnamese, Sandwiches, Coffee & Tea

3170 De La Cruz Boulevard #103
Santa Clara, CA 95054
t: 408-748-9880
w: https://plus.google.com/107539510281110069923/about
UNDER $10

LOOKS GOOD BUT I'M TRYING TO IMPRESS MY CLIENT!

Tomatina
Italian: Pasta & Pizza

3127 Mission College Boulevard
Santa Clara, CA 95054
t: 408-654-9000
w: http://www.tomatina.com/
$11-30

sushi o sushi
Japanese Cuisine

McWhorters Village Shopping Ctr.
2789 El Camino Real
Santa Clara, CA 95051
t: 408-241-1677
w: http://www.sushiosushi.com/
$11-30



Sara's Kitchen
Sandwiches

1595 Franklin Street
Santa Clara, CA 95050
t: 408-247-7272
w: http://www.saraskitchen.biz/
$11-30

Fish Market Restaurant 2
Seafood

3775 El Camino Real
Santa Clara, CA 95051
t: 408-246-3474
w: https://www.thefishmarket.com/
$15-30

Mongolian BBQ
Buffet

3380 El Camino Real
Santa Clara, CA 95051
t: 408-241-2413
w: http://elcaminomongolianbbq.com/
$11-30

Lillie Mae's House of Soul Food 3
Southern BBQ

1290 Coleman Avenue
Santa Clara, CA 95050
t: 408-980-0668
w: http://www.houseofsoulfood.net/
$11-30

Jang Su Jang
Korean, BBQ

Lawrence Square Shopping Center
3561 El Camino Real
Santa Clara, CA 95051
t: 408-246-1212
w: http://jangsujang.com/santa-clara/
$11-30

China Delight Restaurant
Chinese

596 Homestead Road
Santa Clara, CA 95051
t: 408-985-9688
w: https://plus.google.com/103279776312712309495/about
$11-30

Athena Grill
Greek

1505 Space Park Drive
Santa Clara, CA 95054
t: 408-567-9144
w: http://www.athenagrill.com/
$11-30

I MEAN I REALLY WANT TO IMPRESS MY CLIENT!

Birk's Restaurant

American

3955 Freedom Circle
Santa Clara, CA 95054
t: 408-980-6400
w: http://www.birksrestaurant.com/
$31-60

Parcel 104

Upscale creative Californian cuisine

Santa Clara Marriott
2700 Mission College Boulevard
Santa Clara, CA 95054
t: 408-970-6104
w: http://www.marriott.com/hotel-restaurants/sjcga-santa-clara-marriott/parcel-104/71299/home-page.mi
$31-80

Alexander's Steakhouse 4

Steakhouse

Vallco Fashion Park
10330 North Wolfe Road
Cupertino, CA 95014
t: 408-446-2222
w: http://www.alexanderssteakhouse.com/
Above $61

2



3



4



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ATTRACTIONS

2015 EMC SYMPOSIUM GUIDE
SILICON VALLEY, CALIFORNIA

De Saisset Museum

500 El Camino Real
Santa Clara University
Santa Clara, CA 95053

Part of Santa Clara University, the De Saisset is home to thousands of items detailing the history of the Santa Clara mission as well as artworks ancient to modern.

http://www.scu.edu/deSaisset/



Edward Peterman Museum of Railroad History

1005 Railroad Ave
Santa Clara, CA 95050

Developed by our former museum curator Edward Peterman, the SBHRS provides a railroad-related museum free of charge to the community. The museum consists of three major areas: the historic buildings, railroad artifacts, and operating scale model displays. For members, we also have an extensive library of railroad related books and video tapes.

http://sbhrs.org/



Triton Museum of Art

1505 Warburton Ave.
Santa Clara, CA 95050

This museum is famous for its Theodore Wores collection, as well as folk, contemporary and classic works.

http://www.tritonmuseum.org/

K1 Speed Santa Clara

2925 Mead Avenue
Santa Clara, CA 95051

Experience electric indoor go kart racing in the San Jose, Sunnyvale, Silicon Valley and Palo Alto area at K1 Speed Santa Clara! If you are a motor sport enthusiast or you would like to try European-style kart racing with friends and family, a visit to K1 Speed is a must! Our high tech indoor kart track provides an authentic racing experience that is great for both novice and experienced drivers. With 20hp electric karts that can approach speeds of 45mph and a high-grip racing surface, drivers can push the limit through high-speed corners and feel a rush of adrenaline! We must warn you though: speed can become addictive!

http://www.k1speed.com/

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Mission Santa Clara de Asis

The Alameda
Santa Clara, CA 95050

Founded in 1777, this historic mission is located on the campus of Santa Clara University.

http://www.scu.edu/mission/

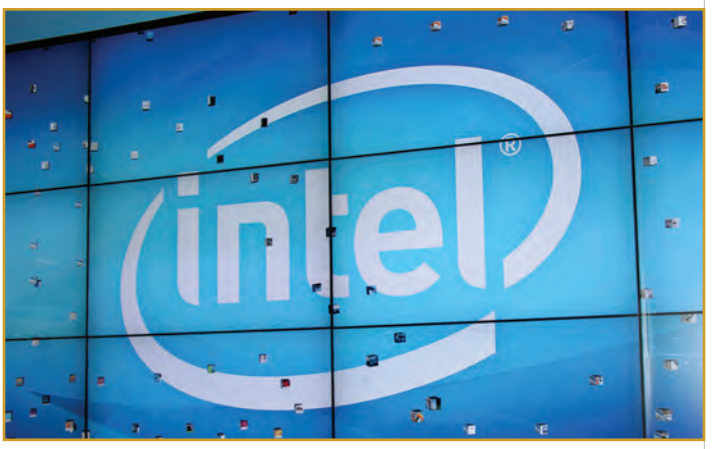


Intel Museum

2200 Mission College Boulevard
Santa Clara, CA 95054

Explore the people and technology that changed our world through Intel Museum online exhibits, and view event, location, and tour information.

http://www.intel.com/



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https://www.cagreatamerica.com/

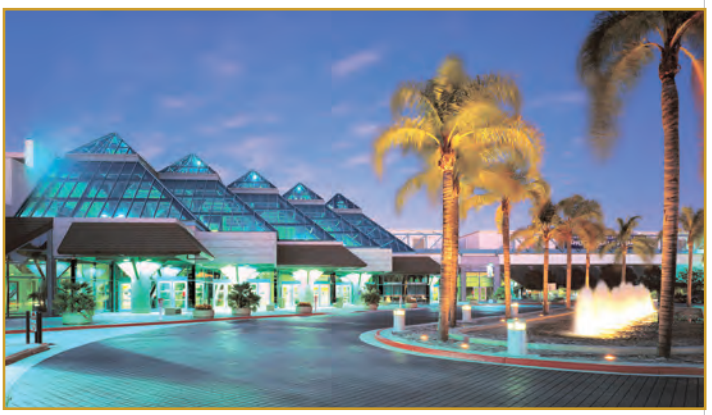


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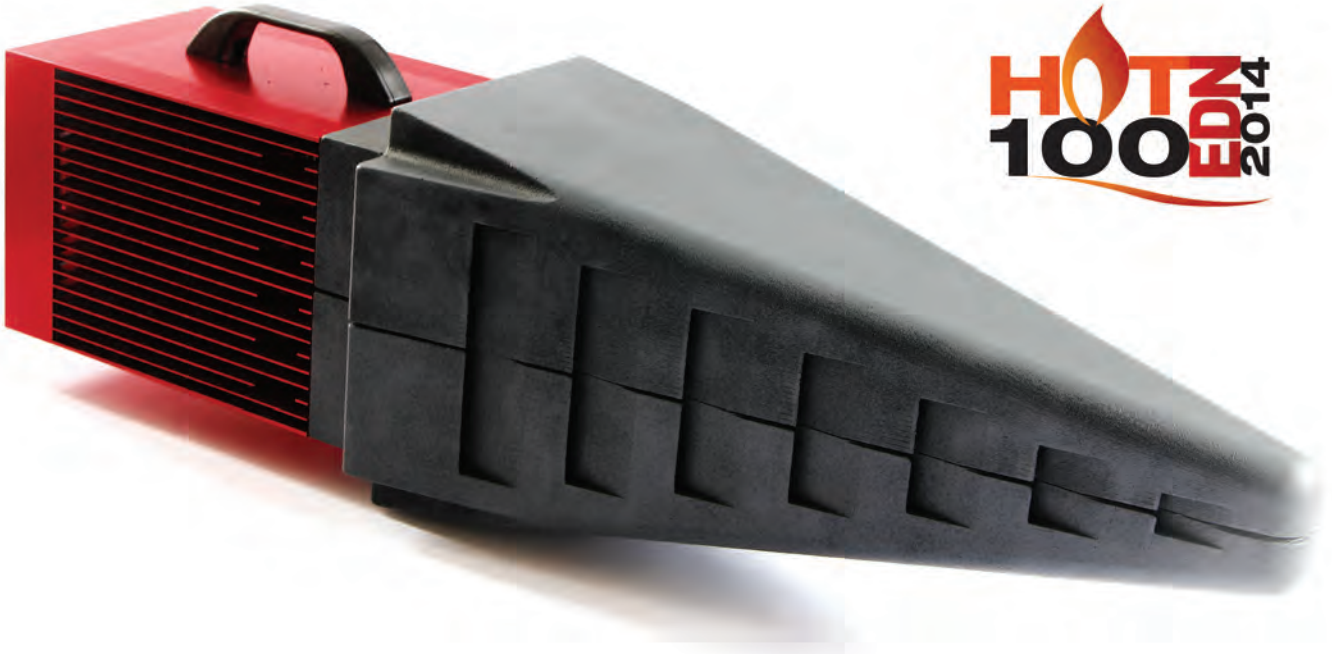
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