IEEE EMC SOCIETY

NEWSLETTER

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EMC in Academia: Who's Doing What and Where

By Janet O'Neil

The campus mall at the University of Missouri-Rolla

As little as a decade ago, if you were asked to name universities that offered courses on electromagnetic compatibility (EMC), you would be hard-pressed to name more than a handful. Of course, you would have immediately responded by naming the University of Kentucky and the legendary Dr. Clayton Paul, but what others would you have named a decade ago?

These days, there are several respected universities that have joined the University of Kentucky as being well known for their EMC research and related courses. If you answered the above question today, you could rattle off at least ten universities. Following is a sampling of these world-wide institutions. Students who are considering obtaining an advanced degree may want to consider attending one of these institutions. Likewise, corporations who are seeking R&D assistance with their products as related to EMC may wish to contact one of these institutions. Bottom line is that EMC is a hot topic these days and while universities are catching on by adding the topic to their engineering course curriculum, corporations are also learning that experts residing at these institutions offer cost-effective assistance in furthering their product development and sales objectives.

Likewise, the Education and Student Activities Committee of the IEEE EMC Society is one of the hot committees these days. Just read the article on page 17 of this newsletter by Maqsood Mohd, Chairman of the Education and

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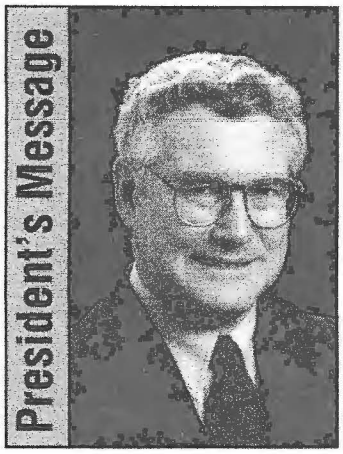

DAN HOOLIHAN
PRESIDENT, EMC SOCIETY

EMC Society Membership

In this newsletter I would like to take this opportunity to write about EMC Society Membership for the purpose of generating some discussion on the topic in the local Chapters in our Society. For logical reasons, I have presented the discussion in three parts; Past, Present, and Future.

PAST

Historically, the EMC Society and the entire IEEE membership has been centered around the United States and the members within the United States. This is primarily a result of its origination as the American Institute of Electrical Engineers (AIEE) in 1884 coupled with its merger in 1963 with the Institute of Radio Engineers. The fact that the IEEE is headquartered in the United States in a city that has an American Indian name (Piscataway) adds to the perception on the part of many of our Society members in Regions 7-10 that the IEEE is a "United States" organization.

The EMC Society actually started as a Professional Group on Radio Frequency Interference (PGRFI) one of several Professional Groups in the Institute of Radio Engineers (IRE). This group was approved by the IRE on October 10, 1957. In 1964, as a result of the merger, with the AIEE, the EMC Group was reformulated as a Society of the IEEE.

The early records indicate an enrollment of 380 or so engineers in 1958 which grew to around 1500 engineers in 1964. There is no indication as to what percent of those RFI engineers were from outside the United States, at least, as reported in the IEEE Transactions on EMC dated August of 1983 (the 25th anniversary edition- Silver anniversary edition - of the EMC Society).

PRESENT

The records on membership information from the IEEE indicate an EMC Society membership total around 4300 in December of 1992 and 5200 in December of 1998 (a 21% increase). In 1992, the Society Membership was 65% from within the United States, 18% from Region 8 (Europe), 11% from Region 10 (Pacific Rim), 5% from Region 7 (Canada), and 1% from Region 9 (South America). By 1998, only 57% of our Society's members came from the United States while Region 8 had increased to 24%! Region 10 had increased to 13% and Region 9 had doubled to 2% while Region 7 had slipped a percentage point to 4%.

If the trend over the last 7 years continues, it is evident that in about 10 years (2010) the majority of the EMC Society's membership will come from outside the United States!

What will be the implications of this geographical membership distribution for the EMC Society?

FUTURE

With a majority of the EMC Society members coming from outside the United States, the EMC Society of the IEEE will truly be a global/international/transnational organization. What changes in policy and procedure and administrative bylaws should our Society be considering to handle this change?

One change I think we should consider is having the Board membership reflect the regional distribution in a more equitable manner. One possible way of doing that is

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EMC Society President Dan Hoolihan is pictured addressing the audience at EMC Zurich '99. He provided a short introduction to the IEEE and EMC Society. Seated behind the podium are Professor M. Ianoz, URSI Swiss National Committee, and Professor Peter Leuthold, Zurich Symposium President (partially pictured).

A Gap That Needs a Bridge

To the Editor:

The "gap" referred to here is a communications gap. It lies between theoreticians and researchers—those apparantly in the know—and practitioners—those with an everyday need to know. The mathematics used to characterize electromagnetics, for example, are really an extensive shorthand code. And, that code is used not only by researchers, but also by teachers. As a result, to make real progress in EMC engineering, those mathematics need to be simplified as much as possible, decoded, and carefully explained. They need to be made easier to understand, both for practitioners and for students. Then, more of today's students who later become teachers and researchers will be better able to communicate and better able to teach. And, that will make electromagnetics in general, and EMC engineering in particular, easier to understand and easier to practice.

The basic problem was described by Richard Courant and Herbert Robbins in their book entitled "What is Mathematics?" (Oxford University Press, 1941). They said:

"Without doubt, all mathematical development has its psychological roots in more or less practical requirements. But once started under the pressure of necessary applications, it inevitably gains momentum in itself and transcends the confines of immediate utility."

In other words, mathematics is a very useful tool, but quite often its users get carried away and it becomes overused. That has created the need for EMC practitioners to understand both the physics of electromagnetics and the mathematical shorthand used to describe those physics. The result makes genuine understanding doubly difficult.

To further envision this gap, consider two comments made by Morris Kline in his book entitled "Mathematics and the Physical World" (Thomas Y. Crowell Company, 1959): "Science has become a collection of mathematical theories adorned with a few physical facts." . . . "Unfortunately the relationship of mathematics to the study of nature is not presented in our dry and technique-soaked textbooks."

At the time he wrote those comments Kline was a professor of mathematics, and the director of the Division of Electromagnetic Research at New York University as well! That clearly indicates the strength of the connection between mathematics and electromagnetics forty years ago. And, the two are no less connected today.

It certainly would seem that Morris Kline was saying exactly what I am saying—the physics and the mathematics of electromagnetics need to be more clearly related to one another. We need to back up, slow down, and think about how to rid electromagnetic theory of explanatory gaps due to unnecessarily abstract mathematics. Electromagnetic phenomena need to be characterized with more pictures and with simpler mathematics. Then, and only then, will the communications gap between theoreticians and practitioners become bridgeable. And, teachers will be better able to communicate with their students.

W. Scott Bennett
Carr, Colorado
w.scottbennett@juno.com

Newsletter Staff

Editor

Janet Nichols O'Neil
Lindgren RF Enclosures, Inc.
22117 NE 10th Place
Redmond, WA 98053
Tel: 425-868-2558 Fax: 425-868-0547
e-mail: j.n.oneil@ieee.org

Associate Editors

ABSTRACTS
Professor Osamu Fujiwara
Dept. of Elec. & Comp. Engineering
Nagoya Institute of Technology
Gokiso-cho, Showa-ku, Nagoya
466-8555 Japan
+81-52-735-5421
fax: +81-52-735-5442
e-mail: fujiwara@odin.elcom.nitech.ac.jp

BOOK REVIEWS
Reinaldo Perez
c/o Lockheed Martin
MS: S8700, P.O. Box 179
Denver, CO 80201
303-977-5845
fax: 303-971-4306
e-mail: ray.j.perez@ast.lmco.com

J.L. Norman Violette
Violette Engineering Corp.
120 East Broad St., Ste. B
Falls Church, VA 22046
703-532-1355
fax: 703-538-3810
e-mail: enviolette@msn.com

CHAPTER CHATTER
Todd Hubing
Univ. of Missouri-Rolla
120 Emerson Electric Hall
Rolla, MO 65401
573-341-6069
fax: 573-341-4532
e-mail: t.hubing@ieee.org

DoD E^3 ACTIVITIES
Robert D. Goldblum
R&B Enterprises
20 Clipper Road
West Conshohocken,
PA 19428
610-825-1960
fax: 610-825-1684
e-mail: rgoldblum@RBitem.com

EMC PERSONALITY PROFILE
William G. Duff
Computer Sciences Corp.
Systems Engr. Div., Ste. 300
5501 Backlick Road
Springfield, VA 22151
703-914-8450
e-mail: w.duff@ieee.org

EMC STANDARDS ACTIVITIES
Donald N. Heirman
143 Jumping Brook Road
Lincroft, NJ 07738-1442
732-741-7723
fax: 732-530-5695
e-mail: d.heirman@worldnet.att.net

EMCS BoD ACTIVITIES
Janet Nichols O'Neil
Lindgren RF Enclosures, Inc.
22117 NE 10th Place
Redmond, WA 98053
Tel: 425-868-2558
Fax: 425-868-0547
e-mail: j.n.oneil@ieee.org

EMCS PHOTOGRAPHER
Dick Ford
6 Westcot Place
Falmouth, VA 22405
202-767-3440
fax: 202-404-4064
e-mail: dford@radar.nrl.navy.mil

EMCS EDUCATION COMMITTEE
Maqsood Mohd
Sverdrup Technology, Inc.
TEAS Group, Bldg. 260
P. O. Box 1935
Eglin AFB, FL 32542
850-729-6115
fax: 850-729-6377
e-mail: MOHD@eglin.af.mil

INTER-SOCIETY ACTIVITIES
David Case
Aironet Wireless Comm., Inc.
3875 Embassy Pkwy.
Akron, OH 44333-0292
330-665-7396
fax: 330-665-7301
e-mail: dcase@aironet.com

PRACTICAL PAPERS, ARTICLES & APPLICATION NOTES
Bob Rothenberg
Technical Product Marketing
P.O. Box 551
Carlisle, MA 01741
978-369-2860
fax: 978-369-3581
e-mail: rothenberg@ieee.org

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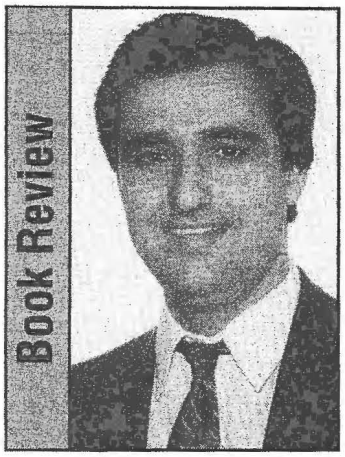

RAY PEREZ
ASSOCIATE EDITOR

Book Review: Simplified Design of Switching Mode Power Supplies by John D. Lenk

Publisher: Butterworth & Heinemann, 1995

In the arena of EMI measurements, conducted emission from power supplies and converters rank very much at the top of noise sources that EMC engineers spend most time in suppressing. No only can you measure this noise in conductive tests, but also in radiated tests since a lot of these conducted noise sources also act as unintentional common mode voltage sources capable of causing radiated noise in unintentional antennas (e.g power cables, I/O cables,...etc). I'd like to spend some time in the next issues of the EMCS Newsletter (only when my turn arrives) reviewing a series of switching mode power supply (SMPS) design books that I've found useful in the past. These are non-EMC books from the point of view that EMI is addressed only as a chapter or as several sections in the books. However, though these are basically design books, if you are an EMC engineer you are certainly aware that a lot of what EMI does to your hardware depends mostly on how you designed your power supply boards. It is to the benefit of all EMC engineers that they also be well versed in design issues so that they can contribute primarily in the early design process of power subsystems rather than doing "patch work" in containing EMI at the end of the product cycle.

The first of these books is a paperback version written by John Lenk who is a well-known writer for the prestigious electronic design magazine known as EDN. John has written quite a few books, of which some have become best sellers (a difficult thing for an engineering book). This is really a simplified "hands-on" SMPS book which I consider useful for those who want to acquire a practical, yet not detailed design background in these types of power supply design. The book provides sufficient information to design and build switching power supplies from scratch. There are five chapters in the book. The first four chapters provide the basics for all phases of practical design, including test and troubleshooting for switching supplies. The final chapter includes about 100 worked-out design examples, using the techniques described in the first four chapters. In the design examples, each example starts with several approximations or guidelines for choosing the components on a trial basis assuming a set of design goals and initial conditions. Using then these approximate values in experimental circuits, the desired results are produced by varying the test component values.

The first chapter covers basic switching power supply design circuits. The emphasis is on switching regulators which are available these days in integrated circuits (IC). The data sheets for IC switching regulators often show the connections and provide all the necessary design parameters to convert the IC to a complete supply by just adding the needed external components. Chapter 1 describes the functions and operations of switching mode regulators, such as basic switching regulator functions and typical switching regulator circuits. Switching regulator theory is described in good detail for the five typical kinds of switching regulator circuits such as: booster or step-up, buck-boost or inverting, buck or step down, fly back, and forward.

Chapter 2 covers the interesting subject of heat sinks for SMPS. It is often assumed that switching regulators do not require heat sink. Although this is sometimes true in many cases, it may be necessary to use heat sinks for high current switching regulators. Switching supplies contain at least one shunt or series transistor that must pass the load current. The power dissipated can be significant and the need for proper design of heat sinks is necessary. Would you believe that temperature problems and bad design of heat sinks can affect the EMI noise in SMPS? Believe it, and here is why. Most data sheets specify components parameters (transistors, diodes, rectifiers, ICs, etc.) at a given temperature. However, most of these parameters change with temperature. Because components rarely operate at the exact temperature shown on the data sheets (usually 25C is chosen), it is important to know the parameters at the actual operating temperature. For example, in the case of transistors, the critical parameters that change with temperature are current gain, collector leakage, and power dissipation. A temperature increase, for example, can also increase the current gain of a transistor and hence the possibility of more switching noise being generated. Furthermore, heat sinks introduce parasitic effects into the overall circuit design and such parasitics can affect the current distribution paths of common mode currents which are the major generator of noise. Therefore, not only is it important to properly design heat sinks to offset the effects of temperature, but also to diminish

the effect of parasitics. Chapter 2 covers such topics as thermal resistance, thermal runaway, heat sink ratings, a commercial heat sink selection guide, and calculating heat sink capabilities (e.g power dissipation).

Chapter 3 is devoted to the inductors and transformers used in SMPS. The magnetic components are the greatest source of design problems and design failures in switching supplies. Inductors design basics are covered in the chapter, such as inductor value basics and the procedures to use the correct inductance value, optimum inductance, saturation effects, core material trade-off, high frequency core losses and high flux MPP cores. The solution to EMI problems usually depend on application trade-off (such as usage of shielded inductors if EMI must be kept to a minimum). The chapter goes through the design principles in selecting the inductors for step-up regulators, step-down regulators, and inverting regulators. Transformer design and selection is also addressed in the chapter with an example of a transformer design.

Troubleshooting and testing is discussed in chapter 4. The chapter is devoted to testing and troubleshooting for switching supplies in general. The first sections of the chapter cover testing as the first step in troubleshooting is to test the circuit. The testing sections start by describing test procedures that are generally sufficient for most practical applications. The troubleshooting section provides a series of notes to localize problems if the circuits are failing to perform as expected. These notes are included primarily for those readers who are not familiar with switching supplies. Among the tests discussed are: output tests, load regulation tests, basic line-regulation tests, efficiency tests, ripple tests (conducted emissions), transformer characteristics, transformer impedance ration, and transformer winding balance. Switching power supplies present particular problems when they are being tested, some of which are quite unique. Ground loops is one of the most common.

The last chapter of the book, Chapter 5, occupies about half of the book. All of the general design information in the previous four chapters will be used in the last chapter. However, each IC has special design requirements, all of which are discussed in great detail. The circuits in this chapter can be used as is or modified by altering component values. Among the IC regulator design considered in detail are those using Raytheon, Harris, and Linear Technology IC for switching regulation. For each of the design processes, the following is covered: basic design approach, step-up design, step-down design, inductor selection, low battery detector, bias current shutdown, buck boost application, feedback compensation, short circuit protection, output filter capacitor, controlling output EMI, input and output filtering, switching diodes selection, and others.

I would recommend this book as a primer for SMPS design. The book is also filled with manufacturer data sheets and many specifications typically found in SMPS design IC. In my next review, we will visit one more of these books before we address more detailed books.

TODD HUBING
ASSOCIATE EDITOR

Art Glazar, a Life Senior Member of the IEEE EMC Society, sent in the following EMC limericks:

Looking up from my scope I declared,
To my client whose face was despaired,
"Your prototype sucks"
"But for eight hundred bucks"
"And some ferrites it can be repaired."

There was a young man from T.I.
who suffered a mote in his eye;
When his pain had subsided,
To his boss he confided,
"It's less painful than this EMI."

Thanks, Art! Art's limericks and others can be found on the web at http://www.emcs.org/limericks.html. If you would like to contribute to our EMC limerick collection, email your contribution to me at t.hubing@ieee.org.

Did you solve the puzzle in the last Chapter Chatter column? Did you notice there were actually three messages? I didn't think so. If you took the time to find the first message, you probably stopped there. EMC engineers are generally in the fix-it-and-get-it-out-of-here mode. Once a problem is solved (i.e. the product passes), they move on to the next crisis. You can find all three solutions to the puzzle by visiting the IEEE EMC Society's web page at http://www.emcs.org. Click on the "Chapters" button, then in the list of "Chapters with Web Sites," click on the city that doesn't actually have an EMC Society chapter. This will bring you to the secret web page containing both the puzzle and its solutions.

Was the puzzle in the last issue too hard? Did you spend many fruitless hours trying to solve it? If so, here's another puzzle for you.

If u cn rd ths, thn u cn b n ngnerng mgr.

If you have trouble with this one, ask one of your subordinates for help.

Atlanta

Thanks to Bruce Crain, chair of the Atlanta chapter, for submitting the following report. Bruce will soon be moving to "sunnier pastures" in Melbourne, Florida. David Dennis will be the new chair of the Atlanta Chapter. Good luck to both Bruce and David.

The Atlanta EMCS chapter held a meeting on March 23, 1999 at the Lockheed Martin Aeronautical Systems (LMAS) facility in Marietta, Georgia. The speaker was John Osburn, who has recently joined the Electromagnetic Environmental Effects group at LMAS. Mr. Osburn presented "Evaluating and Improving Radiated Immunity Test Systems Performance." After presenting the textbook nuts-and-bolts of how to put together a radiated immunity test system, Mr. Osburn gave the "real story" of how to specify components to account for antenna calibration distances, amplifier linearity, and signal modulation effects. He also gave us the benefit of his experience in the field by discussing practical issues such as signal generator non-ideal characteristics, signal generator switching characteristics and E-field probe response.

Baltimore

Vil Arafiles reports that the Baltimore chapter has a new web page that is accessible from the IEEE Baltimore Section web page at http://www.ewh.ieee.org/r2/baltimore. The page contains announcements for new meetings and current officers. The Baltimore chapter will announce future meetings on this web site and provide e-mail reminders to members who provide e-mail addresses. Postal mail notices will continue to go out to all members who do not have internet access. It is hoped that this move will dramatically reduce operating costs, as mailings comprise more than 75% of the budget.

The 1999 officers are:

Mr. Fred Kirby of EMC Technologist, Chairman; e-mail: fred2@shore.intercom.net

Mr. John Anderson of IITRI, Vice Chairman

Mr. Charles W. Gaston, e-mail: cwg3@juno.com

Ms. Angela J. Johnstone of IITRI; e-mail: Ajohnstone@iitri.org

Central New England

The February meeting of the Central New England chapter featured a talk on "Telecom Circuit Safety: The Interpretation and Implementation of EN60950 Clause 6, Connection to Telecommunication Networks" by Daniel C. Clarkson of BABT Product Service. The rapid growth in telecommunications technology and the

Internet has insured that almost all Information Technology Equipment (ITE) has a connection to the Product Service Telecommunication Network (PSTN). However, connections to the PSTN present unique challenges to the design and compliance communities, one of which is interpreting and implementing the requirements of Clause 6 of EN60950 (which may include unique national requirements).

Central and Southern Italy

On December 7, a successful meeting of the Central and South Italy Chapter was held in Rome. The General Vice-Director of the Environment Ministry, Dr. Biondi, gave a Seminar on the new law (Nov. 1998) regulating the levels of electromagnetic field in the high frequency range (above 100 kHz), in Italy. These limits will be effective beginning in January 1999. Also, the evolving situation in the EC was clarified and presented. More than 100 hundred people attended the conference. The 90-minute presentation was followed by many questions.

Germany

Prof. Heyno Garbe reports that an International Symposium on Electromagnetic Compatibility will be held together with the German IEEE EMC Chapter at the Otto-von-Guericke-University Magdeburg in Magdeburg, Germany from 5 to 7 October 1999. For the Call for Papers, Author's Schedule, Topics, Commercial Exhibitions, and further information, please visit the web page at http://iele96.et.uni-magdeburg.de/EMC-MD. While you're at it, you can also visit the new chapter web site at http://www.geml.uni-hannover.de/grund_elektr/mitarbeiter/ieee/ieee.html.

Korea

The newest IEEE EMC Society chapter is in Korea. Dong Chul Park is the new chapter chair. This year the Korea Chapter will conduct one or two technical meetings and co-sponsor several EMC-related symposia held in Korea. For more information you can contact Prof. Park (dcpark@hanbat.chungnam.ac.kr).

Orange County

At the October 1998 Meeting, John Osburn spoke on EMC antennas and their applications. Mr. Osburn was kind enough to make a special trip from Austin just to join the Orange County Chapter for this presentation. All of the attendees (over 25 of them) left the meeting with a little more understanding of EMC antennas and how to use them effectively.

At the December meeting, a special presentation was given on the Broadband Gigahertz Field Simulation Chamber. The information presented by Jozef Baran of AST Research and Mark Frankfurth of Cymer Laser Technologies indicated that the BGF Chamber could very well replace Anechoic chambers, GTEM Cells, and even Open Area Test Sites for EMC and EMI testing. The topic was very well received, with lots of questions for the speakers asked by the audience. Over 25 people attended this meeting, although it is not clear if they came for the presentation or the gourmet Italian meal.

Over 30 EMC professionals attended the Orange County Chapter's February meeting, among them – Well-known EMI Guru Mike King.

The February,1999 meeting of the Orange County Chapter of the EMC Society featured Douglas Smith of Auspex Systems. Mr. Smith presented a very entertaining talk on Unusual and Hidden forms of Electrostatic Discharge. Covering some of his entertaining experiences in the past, his demonstrations and ESD Mitigation war stories kept the thirty attendees smiling and laughing, while dining on chicken, rice and valentines cookies.

The Orange County Chapter is sponsoring a one-day tutorial on October 4th, 1999. The tutorial, called "EMC Fest '99", will feature such reknowned speakers as Dr. Howard Johnson, Mr. Lee Hill, and Mr. Daryl Gerke. So, mark your calanders! You don't want to miss this one! For

Speaker Doug Smith entertained the crowd with a demonstration of an unusual source of Electrostatic Discharge Disturbances. Doug is shown shaking a bag of change in front of an ESD sensor, with surprising results.

Pat Malloy of Amplifier Research is shown explaining various methods of radiated immunity testing.

more information, please contact the Chapter Chair, Randy Flinders, at (714) 513-8012, or at r.flinders@ieee.org.

Phoenix

The February meeting of the Phoenix Chapter of the IEEE EMC Society featured Pat Malloy of Amplifier Research speaking about RF Immunity Testing. He provided a general update of the EU requirements, followed by specific details on RF immunity testing. Issues discussed included "Real Time" leveled loop testing versus "Substitution" methods (also known as pre-calibration without the EUT present). Mr. Malloy also provided information on power amplifier compression, harmonics, VSWR effects on output power, directional coupler basics, antenna concerns, and device monitoring.

The twenty attendees at the meeting confirmed unanimously the three individuals railroaded/nominated for Chairman, Vice-Chairman, and Secretary/Treasurer. These individuals will serve a one-year term and include:

Chairman
Terry Donohoe, terry.donohoe@cas.honeywell.com
Vice-Chairman
Daryl Gerke, dgerke@emiguru.com
Secretary/Treasurer
Harry Gaul, p19850@email.mot.com

Although the Phoenix chapter is only several months old, we've already created a web page at http://www.ewh.ieee.org/r6/phoenix/phoenixemc/. Stay tuned to the web page for upcoming meeting notices! Also, the Phoenix chapter is presenting an EMC Colloquium and Exhibition on May 3 at the DoubleTree - La Posada Resort in Scottsdale, AZ. We hope to see many of the EMC'ers from Arizona, California, and New Mexico at the colloquium!

Rocky Mountain

Thanks to Lyle Luttrell, chair of the Rocky Mountain chapter, for sending in the following chapter update.

The Rocky Mountain Chapter is off to a great start on our 1999 program. A strong turnout for our February 16 meeting confirmed that our chapter program vision is "on-track" with plans to bring more valuable EMC training opportunities to the regional community.

A total of 35 people, including 10 non-members, ate their fill of pizza sponsored by EMC Integrity for lunch,

Doug Smith provides advice on calibration of the probe to RMC members including Rich Gonzales, Matt Aschenberg, Chas Grasso, Otto Buhler, "Rip" Van Winkle, Forest Dillenger and Tim Groat.

then filled the meeting room at NIST in Boulder for a presentation by Doug Smith, EMC Manager of Auspex Systems Inc. Doug is well known for presentations that bring out the fundamentals of EMC measurements in an understandable and affordable manner. The topic of the meeting was "High Frequency Signal Measurement and Probe Building". Doug lead with an hour of background in high frequency signal integrity measurement using scope probes, covering some of the pitfalls and limitations of probing as well as solutions to common measurement problems. As Doug explained the shortcomings of conventional probes, he presented a probe design that avoids these problems, and can be constructed using materials that cost only a few dollars.

After the talk, materials were provided for attendees to build their own calibrated 1 GHz passive 20X probes; the materials for 30 probes cost about $100. With Doug's expert guidance, most attendees built a probe before leaving the meeting, while others took parts and instructions to do it at home. Eight assembly stations and one calibration

Mark Moyer and Scott Gurst of Exabyte Corporation produced the best performing probe with a frequency response better than 1dB from DC - 1GHz!

Doug Smith and Rick Hansen hand out parts kits for building probes at the RMC meeting.

station provided by StorageTek and Breece Hill were busy for the afternoon. The "best" probe was better than 1dB from DC to 1GHz! Several members report they are using the new probes on a daily basis.

February meeting attendees also completed a program survey. The results are providing the executive committee with useful information for planning future chapter meetings. Our Chapter website continues to be updated often to include information on meeting announcements and program information for the Rocky Mountain Chapter, plus links to other sites for EMC engineers. The URL is http://www.ewh.ieee.org/r5/denver/rockymountainemc/.

Santa Clara Valley

The Santa Clara Valley chapter is in full swing with new officers, meeting location, format of presentation and more job opportunities available than engineers looking for work. Typical meetings attract a minimum of 75 engineers and guests, with some meetings reaching up to 120 attendees. Due to problems in the past with meeting locations throughout Silicon Valley, we finally settled into Auspex Systems in Santa Clara, courtesy of Doug Smith.

The technical program for the 1998-1999 calendar year was developed by vice-chairman Zorica Pantic-Tanner. Our last six meetings are reported herein.

We began our new year with a dinner meeting in September at a local restaurant, the same location where we have been holding this planning session for over 10 years. This gave us the opportunity to talk about the symposium in Denver, plus to catch up on gossip from our summer break. The *only* business conducted at our monthly meetings, beside the guest speaker, is to have companies with job openings make an announcement (usually five opportunities or more per month), and for those seeking employment to speak-up (almost never).

Our first technical meeting of the year began in October with Dr. Jose Perini, IEEE EMC Society Distinguished Lecturer. The topic was "Radiated and Injected Tests - When are They Equivalent?" This was well attended with considerable discussion on various aspects of the topic. When the Q&A session started, it was easily determined who specialized in the mathematics of testing.

November's meeting was quite enjoyable when Diethard Moehr of Siemens AG was the guest speaker. His topic was "EMC in the European Union." During the presentation, we learned things that are not readily known to EMC engineers, much less the marketplace. Diethard's ability to provide humor kept attendees for well over 2-1/2 hours. Items discussed included measures US manufacturers can take now and in the future to simplify the EU EMC compliance process, including the European EMC Directive and national EMC laws. In addition, legal requirements on EMC emission and immunity testing in the Europe was presented, including how to test modules, apparatus, systems, installations and guidelines on the application of the EMC Directive. The interesting part was hearing how European companies buy their competitor's products, have them tested, and then report non-conformity to the authorities, along with real-life examples. Also, secrets were shared on how the authorities *actually* perform audit testing and the criteria for passing or fining (includes failing) companies. Over 100 attendees were present.

Only in Silicon Valley can one learn about new technology being designed for use in testing products. Neven Pischl of Bay Networks discussed "A New Common-Mode Voltage Probe for Predicting EMI from Unshielded Differential-Pair Cables" in December. Not only were colored handouts on high-gloss paper provided, instrumentation was used to demonstrate a probe developed at Bay Networks (patent pending) using an Ethernet hub, spectrum analyzer, and support equipment. This common-mode probe, plugged into an RJ45 Ethernet port, provides insight into various design concerns, measuring common-mode energy presented within this I/O cable interconnect. Again, a large turnout was present. The probe was, unfortunately, "not" for sale at the meeting!

Photo by Mark Montrose

The meeting location for the Santa Clara Valley chapter at Auspex Systems.

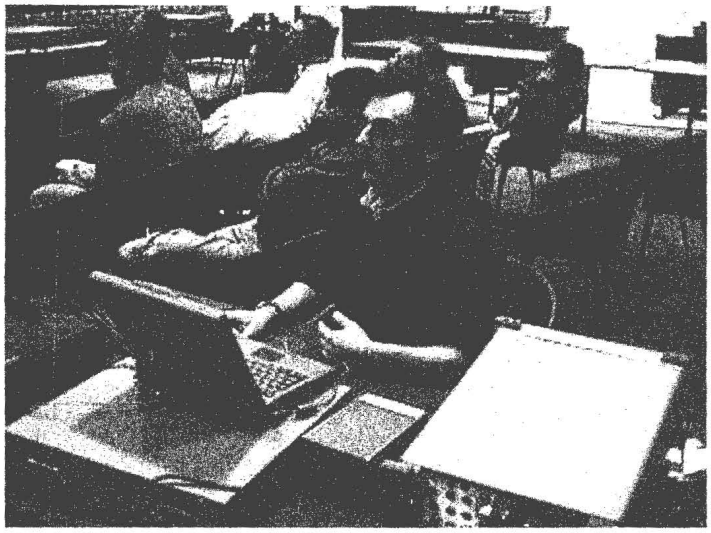

Photo by Mark Montrose

Neven Pischl of Bay Networks is shown setting up equipment to demonstrate his "common-mode probe".

The January meeting hosted Don Bush of dBi Corporation and IEEE EMC Society Distinguished Lecturer on "Spread Spectrum Clock Techniques." Mr. Bush, one of the founders of spread spectrum technology, presented the historical background on how this technique was discovered, the pains in getting the FCC to accept this technology, and the advantage/disadvantage of use. Attendance was 120, one of the largest gatherings we have had in several years.

In February, Robert Dockey, another IEEE EMC Society Distinguished Lecturer, presented "New Techniques for Reducing PCB Radiation" to an audience of 115 attendees. A lively question and answer session followed, with numerous technical questions, much to Bob's enjoyment. The Santa Clara chapter is a tough, but fun group to present papers to.

Our March meeting had 85 attendees hear David Pommerenke of HP, Roseville, CA, give a presentation on "Conducted Immunity IEC 61000-4-6." David brought numerous clamps and probes to illustrate problems within the standard, alternate methods of testing, and solutions to test configurations in order to meet the intent of the directive.

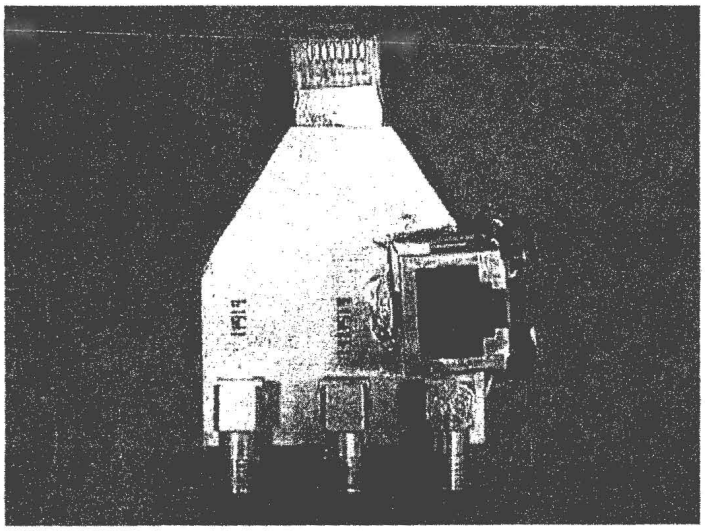

Photo by Mark Montrose

Engineering prototype "common-mode probe" Patent pending – not for sale, yet.

Future meetings will include for April 13th "Solving Real World EMC Problems using the FDTD Modeling Code" by Dr. Gary Haussmann, Silicon Graphics Inc. and on May 11, "San Francisco State University Recent Research on EMC."

Seattle

The chapter kicked off the new year with Dick Ford as the speaker at its January meeting. Complimentary pizza and soft drinks were provided by CKC Laboratories, at whose Redmond facility the meeting was also held. Dick is a member of the EMC Society Board of Directors, a NARTE certified EMC engineer and an independent E3 consultant. The presentation was entitled: "The Navy/NAVAIR Model Program (NPFE) for EMC Excellence." Dick gave an historical review of where EMC was in the Navy and the roots of the program that has, among other things, resulted in a number of us adding the letters "NCE" or "NCT" after our names. It was an informal, interactive presentation which chapter members greatly enjoyed. A surprise guest, Russ Carstensen, was present to add a unique perspective to the discussion as he was involved in the formative days of the program. Russ is a long-time member of the NARTE Board of Directors and his comments were truly appreciated by the chapter members.

In February, Hans-Peter Bauer of Rohde and Schwarz spoke on the topic "Speeding Up EMI Measurements". Hans-Peter explained that minimizing the total measurement time is an important goal of automated emission measurements. Special attention was given to the proper detection and measurement of all kind of disturbances: both continuous and intermittent narrowband as well as broadband disturbances. Hans-Peter led a discussion on minimum measurement times, including strategies for pre-scan and data reduction. In his introduction of the speaker, Chairman Ghery Pettit advised that Hans-Peter worked as a sales and application engineer for Rohde and Schwarz-Germany, where he focused on EMC solutions. Since the beginning of 1998, Hans-Peter has been working at the Marketing and System Support Center of Rohde and Schwarz-America in Beaverton, Oregon. This explains his nice accent! Chapter members enjoyed complimentary pizza prior to the meeting courtesy of chapter supporter Lindgren RF Enclosures. Yum!

At the March chapter meeting, Joe Butler, Market Manager, Chomerics Division of Parker Hannifin Co., presented: "Shielding Effectiveness - Why Don't We Have Consensus Industry Measurement Standards." Joe explained that EMC engineers involved in the design or procurement of shielded enclosures and/or related shielding components must be especially vigilant about published technical specifications in the area of shielding effective-

Photo by Janet O'Neil

At the January Seattle Chapter meeting, (L-R) Speaker Dick Ford is warmly greeted by Pat Andre of CKC Labs, the meeting host, and Ghery Pettit of Intel, the chapter chairman. Dick's presentation on the "Navy/NAVAIR Model Program for EMC Excellence" drew a surprise guest, Russ Carstensen, a NARTE Director.

Photo by Janet O'Neil

Hans-Peter Bauer of Rohde and Schwarz (L) was the charming speaker at the February Seattle Chapter meeting. Everyone appreciated his accent as well as his insightful presentation. He was joined by Ben Hess, the local sales representative for Tektronix/Rohde and Schwarz.

ness. Further, Joe advised that this is especially true regarding the test methods for EMI shielding effectiveness. Despite the existence of published consensus standards from organizations such as IEEE, ASTM, and SAE, the existing standards are not uniformly embraced by manufacturers who publish technical specifications. Two manufacturers marketing the same product will often use completely different specification test methods. Still others will modify an existing standard method without fully disclosing the modification. The presentation reviewed current industry shielding effectiveness test methods for shielded rooms, as well as floor standing and tabletop shielded enclosures. Shielding effectiveness test methods for conductive paints and coatings, shielded windows, shielded air ventilation panels, and EMI gasketing were also reviewed. Joe concluded his presentation by emphasizing the need for industry accepted consensus shielding effectiveness measurement standards.

The chapter felt fortunate to have Joe Butler as a speaker. Joe is a member of the EMC Society Board of Directors and was recently named President-Elect of the Society. It's not everyday the chapter features the President or President-Elect of the Society as a speaker. The March meeting was also unique as the location was the Hyatt Regency Hotel in Bellevue. Chapter members gathered in the hotel's Chadfield's Sports Bar before the meeting for a one hour social, followed by dinner and the presentation in the meeting room. One of the chapter's supporters, Northwest EMC, graciously subsidized the cost of the dinner so chapter members paid a minimal fee for the wonderful three-course, sit-down dinner. Chapters members raved over the menu selected by Jerry Page of Northwest EMC: Caesar Salad, Oven Roasted Chicken Breast Stuffed with Spinach and Roasted Peppers, and an Italian Forest Berry Torte for dessert. Wow!

The Seattle EMC chapter is actively involved in several upcoming EMC events including the one day tutorial entitled "Introduction to EMC" with Clayton Paul on August 1

Photo by Janet O'Neil

(L-R) Mike Caruso of Underwriters Laboratories, Mark Chase of CKC Labs and Christie Bishop of EMC Technology Services chatted at the January Seattle Chapter meeting. Mike was in the area from Northbrook, Illinois and Christie came from Fremont, California. They planned ahead and combined a business trip with a visit to the chapter meeting. All "out-of-towners" are welcome to attend the Seattle Chapter meetings!

Photo by Janet O'Neil

At the March Seattle Chapter meeting, Joe Butler of the Chomerics Division of Parker Hannifin gave a stellar presentation on the status of EMI standards as related to shielding components and table-top enclosures, among other products. Joe proved he's got the "right stuff" to be the next President of the EMC Society! (L-R) Todd Sousa, the local Chomerics Territory Sales Manager, joined Janet O'Neil, Seattle Chapter vice-chairman, Joe, and Dean Ghizzone of Northwest EMC, the meeting host, after the meeting.

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Photo by Janet O'Neil

Rob Steinle of Boeing and James Tilley of Northwest EMC (L-R) obviously enjoyed the March Seattle Chapter meeting. James recently joined Northwest EMC in Bothell, Washington and is a new Seattle Chapter recruit!

Photo by Janet O'Neil

Also lending a hand on the Seattle Symposium Committee are (L-R) Rob Steinle of Boeing, Jeannie Olson of Kalmus, and Bill Price of Boeing. Rob is Treasurer, Jeannie handles Exhibits, and Bill Price is Vice-Chairman.

Photo by Janet O'Neil

Seattle Symposium Committee is hard at work planning the best symposium ever this August. Pictured at a recent committee meeting are Rick Covill and Diane Heidlebaugh, both of Boeing. Rick is the committee secretary and Diane is handling local arrangements.

Photo by Janet O'Neil

Attending to details on the Seattle Symposium Committee are (L-R) Bill Gjertson of Boeing who is the Committee Chairman, Bill Hall of William P. Hall Contract Services who is handling exhibits, and Marianne Gjerston who will ensure the companions have a great time in Seattle.

(register now on-line at www.acmetesting.com) and, of course, the 1999 IEEE International Symposium on EMC, August 2-6, at the Washington State Convention and Trade Center (visit the website http://www.seattleemc99.org for more information). Plans are also being made to schedule monthly speakers for the September 99 to May 00 chapter calendar. There's never a dull moment in Seattle! Drop in and visit the chapter if you come to Seattle. Check the schedule of events on the chapter's web page at http://home1.gte.net/joecool/ieee/.

Twin Cities

Brodie Pedersen reports that the Twin Cities EMC Chapter held their annual half-day EMC Workshop on March 10, 1999. The event was hosted by Program Chair and IEEE EMC President, Dan Hoolihan. Robert Rynkiewicz gave a presentation on "Low Noise Switching Regulators." Edwardo Villaseca presented "FDTD Analysis to Predict EMC." Dennis Swanson presented "A Comparison of the 'e-mark' to CE-mark' Approval Process for Vehicles and Mobile Machines." Brodie Pedersen presented "A Comparison of the Current 60601-1-2 to the New Draft." And last but definitely not least, Dan Hoolihan gave a talk on "ISO Guide 25 General Lab Requirements." The speakers also shared other bits of information and answered questions following each talk and over beverages and cookies provided by our sponsors.

The chapter would like to thank the sponsors of this event: Jerry Zander of Murnco, Joel Larsen of Hewlett Packard, Garry Keaster of Chomerics, Bob Karr of Instrument Specialties, Scott Sandstrom of Comtel Midwest, and Bob Patrick of EIA. Much fun was had by all. Everyone enjoyed Dan's jokes and the fellowship that we all share in practicing our 'Black Magic'. Just remember, waving the rubber chicken over an EMC problem does no good until after midnight.

Congratulations to the following members of the EMC Society who were elected to Senior Member grade at the March 1999 meeting of the IEEE Admission and Advancement Panel:

David Larrabee
Robert Dockey
Rik DeDoncker
Achim Dreher
Volodymyr Shostak

IMPORTANT SEATTLE EMC SYMPOSIUM NEWS!

At the 1999 IEEE International Symposium on EMC in Seattle, fully registered attendees will receive a complimentary CD-ROM containing four years of EMC Symposia Records (1996-1999) AND a print copy of the 1999 Seattle Symposium Record.

EMC Society members who do not attend the 1999 IEEE International Symposium on EMC in Seattle will receive the 1996-1999 CD-ROM only in the mail following the symposium. Print copies of the 1999 Seattle Symposium Record will NOT be mailed to EMC Society members automatically as in prior years. Print copies will be available upon request only. Details for requesting the print copy will be provided in the next issue of the EMC Society Newsletter.

President's Message

continued from page 2

mandating that we have at least one Board member from each Region on the Board every year. We would then have eight board members elected at an At-Large basis over three years thus giving us an 18-member board of directors. I am not prepared at this time to describe the exact way that would happen but the idea would be to elect six members every year to the Board, in some combination of Region representatives and At-Large representatives.

We should continue to technically support (that is, no financial involvement) a major EMC Symposium outside the United States at least once a year by holding a Board of Directors Meeting at the Symposium and hosting and supporting other IEEE activities during the week. We have done this for 1997 (Zurich) and 1998 (Rome) and we are planning on doing it in May of 1999 for Tokyo.

We should encourage holding our IEEE International Symposium on EMC outside the United States as we will in 2001 (Montreal) and 2003 (Israel).

We should consider having a membership development office in each of the Regions 7, 8, 9 and 10. This EMC Society Regional membership development office should have the authority and tools to recruit and retain new members for the EMC Society. The office should attend EMC Symposia within its Region (local, regional, national, and international). Each Regional Office should have a table-top display unit to be used at the symposiums to recruit members.

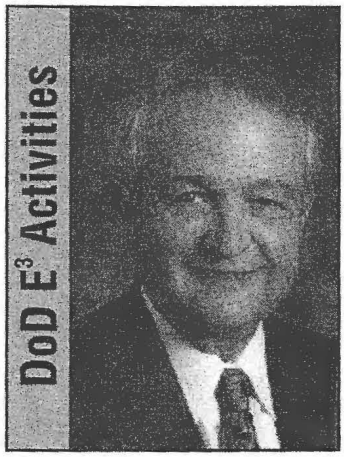
The membership fee for the Society should be reviewed and revised to reflect the geographical disparity in member's incomes. Instead of relying on the Member's fees to fund the EMC Transactions, the EMC Newsletter, the EMC International Symposium Record and other benefits, we should continue to consider other funding sources.

At one time, I used to consider the EMC Society to be about 1% of the IEEE (we had 3000+ members and the IEEE had over 300,000 members). Now, we are approaching 2% of the IEEE (5000+ members out of a total of 340,000 IEEE members) and maybe that is a legitimate goal for our 50th anniversary in 2007. That is, the EMC Society should have approximately the number of members on its rolls that would be equal to about two percent of the total IEEE membership. A secondary goal for 2007 would be to have our membership be 50% from inside the USA and 50% from outside the USA.

SUMMARY

The above thoughts and ideas represent some concepts that have been rolling around in my head over the past year and a half as your Society's President. My purpose in putting them down in "written" format is to promote some discussion on our Society's future and, especially, the future of our Society's membership.

DoD E^3 Activities



BOB GOLDBLUM
ASSOCIATE EDITOR

The sixth annual DoD Electromagnetic Environmental Effects (E^3) Program Review (or conference in civilian terms) was held in Colorado Springs from March 22-26, 1999. Approximately 160 people were in attendance. The primary purpose of this conference was to exchange E^3 and spectrum management current events and technology breakthroughs. Even though this was a DoD-sponsored event, there were no classified sessions as there have been in the past. There were many stimulating presentations, tours and workshops. In addition, two half-day seminars were presented, one on the MIL-STD-461D/462D update and the other on E^3 and spectrum certification in the acquisition process. On Wednesday, 24 March, two tours were offered to the attendees. One, limited to Government only, was to Cheyenne Mountain, and the other to Schriever AFB.

In the DoD, E^3 is ruled by regulations, the highest level being DoD Regulation 5000.2-R. The workshop centered on Appendix III of this regulation."Test and Evaluation Master Plan Mandatory Procedures and Format" focused on the development of Critical Operational Issues (COIs) and how to evaluate the system against the COIs and technical E^3 and spectrum certification requirements. Partial operational requirements documents were distributed to attendees on four sample systems: the Star Rover Satellite Communications and Control System; the FALCON Aircraft; the Whirly Bird Helicopter; and the Battle Command. There were numerous additional papers presented, and unofficial conversations relating to test laboratory accreditation proved to be of special interest. Although there was still considerable resistance to implementing the NVLAP PROGRAM which NAVAIR is using, recognition was given to the fact that some sort of quality control, such as ISO 25, should be imposed on test laboratories. A conclusion on this topic was not reached, and opinions varied widely. A decision should be made at the next MIL-STD-461E revision meeting, which is scheduled for April 13th (by which time this article will have gone to press).

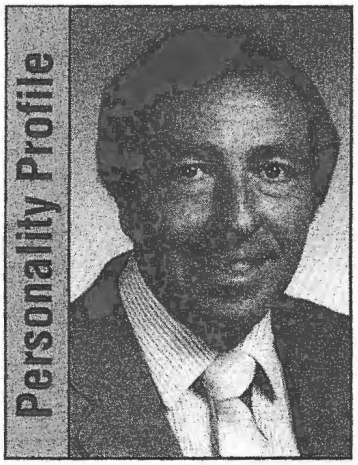
John Zenter, ASC/ENAE, WPAFB, OH <zentnejc@asc-en.wpafb.af.mil> gave the feature paper on MIL-STD-461E. He pointed out that the Air Force has been designated the Preparing Activity for this document which consolidates MIL-STD-461D and 462D into one document. However, official approval by the Defense Standardization Council is still pending. He then went into some of the more significant changes of MIL-STD-461E, such as changes in limits, sweep and dwell times, receiver bandwidth, susceptibility frequency scanning, changes to the general requirement and a new test setup diagram.

The appendixes from 461D and 462D have been revised and combined. The testing of large equipment has been acknowledged, along with some suggested provisions. Space in this article does not allow a thorough treatment of this subject, but I will address it in greater detail in future *ITEM* publications.

Newsletter readers continue to be interested in DoD activities related to E^3. However, my personal involvement in these DoD activities is diminishing, since I have assumed a more administrative role at work and have reduced my direct involvement after 39 years as an EMC engineer, manager and teacher. As a consequence, my access to DoD activity information is declining, and I can no longer provide timely and accurate information in this area on a regular basis. Having spoken with editor Janet O'Neil about the situation, we agreed that this would be my last regular article. If I come across some related and significant information, I will relay it to Janet. Thus, it is farewell for now and thank you all for you kind comments and support.

Bob Goldblum
rgoldblum@rbitem.com

Editor's Note: Many thanks to Bob Goldblum for his contributions to the Newsletter as Associate Editor for DoD E^3 Activities. You'll be pleased to know that Bob will retain his affiliation with the Newsletter as "Editor Emeritus". He'll provide future articles as warranted by newsworthy events in the DoD community. Thus, Bob will continue his 31-year association with the EMC Society Newsletter. Thank you Bob!



DR. WILLIAM G. DUFF
ASSOCIATE EDITOR

ANDY DROZD

Many of you may best know Andy Drozd from his work on behalf of the Experiment Demonstrations Special Sessions for the annual EMC symposia since 1992. Together with his Co-Chair Larry Cohen and under the sponsorship of the EMC Society Education Committee, Andy has successfully launched a highly-popular and well-attended forum at the symposia which emphasizes both the technical and educational aspects of EMC. His efforts have added a new dimension to our annual symposia as well as helped to promote our Society's goals to further EMC education at all levels.

Others know Andy from his work for over 22 years in developing new approaches to computational electromagnetics modeling and simulation, and advancing the state-of-the-art of EMC analysis and prediction tools. He has and continues to be involved in enhancing system-level modeling and analysis codes such as the Intrasystem Electromagnetic Compatibility Analysis Program (IEMCAP). Andy was active in coordinating and conducting IEMCAP training courses for government and industry since 1978. Based on his in-depth knowledge of IEMCAP and other EMC software codes, he has written a number of topical reports and technical papers on the subject, and has implemented many software modifications to enhance the modeling and simulation capabilities of these codes.

More recently, he has investigated the application of artificial intelligence methods, expert system technologies, and knowledge-based approaches to EMC problem solving. These are leading to the development of new tools which automatically mimic the way an EMC engineer performs a modeling and analysis task for a complex system.

Andy has a B.S. degree in Physics with a minor in Mathematics graduating Magna Cum Laude in 1977, and an M.S. degree in Electrical Engineering which he received in 1982, both from Syracuse University. He is also a NARTE certified EMC Engineer since the inception of the program in the late 1980s.

Andy is President of and Chief Scientist for ANDRO Consulting Services, a small business which he established in 1994, providing technical and consultation services in EMC and collaborative engineering disci- plines. These services include electromagnetics engineering research and development, EMC test and evaluation support, and independent hardware design evaluations to ensure system/product compliance to electromagnetic environment specifications, in particular, MIL-STD-461/462, MIL-E-6051, and MIL-STD-1818. Very recently, ANDRO expanded and relocated its operations to a technical complex in the city of Rome, NY. The company employs six people.

Andy is currently a Senior Member of the IEEE. He is serving the second of a three- year term on the EMCS Board of Directors. He is also on the EMCS Standards Development Committee Board, and is a member of the IEEE Standards Association. Andy is Membership Development Chair for EMCS Member Services and is Vice Chair of the EMCS Education Committee. Additionally, he is a member of the Applied Computational Electromagnetics Society (ACES) and is Technical Features Article Editor for the ACES Newsletter.

Andy serves as Senior EMCS Representative for the newly-formed IEEE TAB Intelligent Transportation System (ITS) Technical Council which was inaugurated on 1 January 1999. He has supported the ITS initiatives since 1996 while it was still operating as an ad hoc committee. The ITS Council has a key leadership role in addressing technical and societal issues as well as the development of standards that affect the intelligent transportation and wireless telecommunications sectors.

In 1997, he received the IEEE Region 1 Award for Contributions to the 1997 IEEE Dual-Use Technologies and Applications Conference. He was the General Chair of the 1997 conference whose theme centered on information age technologies, systems, and strategies. Andy was responsible for establishing information technology tracks including special sessions devoted to defining the role of electromagnetics and multi-discipline engineering in the evolving information age. He was the Senior Technical Advisor to the 1998 Information Technology Conference Steering Committee.

Andy became Chairman of the IEEE Mohawk Valley EMC Chapter in 1998. His efforts have helped to increase the awareness of EMC at a local level.

Andy lives in Rome, NY with his wife Barbara, a Social Work Manager for NY State, and their son Evan, 2. Andy enjoys recreational travel, occasional hiking, wine tasting, and an eclectic range of musical styles. Especially, Andy enjoys being with his family and playing with his son during those rare quiet times.

EMCS Standards Activity: Volunteers Needed!

By H. Robert Hofmann,
Chairman of the EMC Society Standards Advisory and Coordination Committee

The EMC Society Standards Advisory and Coordination Committee (SACCom) is looking for persons willing to act as liaisons between the EMC Society and several organizations that are involved in developing, preparing, and/or approving EMC-related standards. Duties are to keep the IEEE EMC Society appraised of standards work in these organizations through e-mail and other means, passing the information to the chairman of the SACCom, and passing information on the standards interests of the EMC Society to the relevant organization. The interface with the EMC Society is Bob Hofmann, chairman of the SACCom.

There are currently openings for representatives to the following five organizations:

Electronic Industries Alliance (EIA) R1/R2 committee
Electronic Industries Alliance (EIA) G46 committee
CENELEC 210A (European Organization for electrotechnical standardization) committee
SAE Automotive EMI committee
SAE Automotive EMR committee

We have representatives identified to act as liaisons to the following organizations:

CISPR SC A (Measurements and Statistical Techniques)
CISPR SC B (Industrial, Scientific and Medical Devices)
CISPR SC E (TV and Broadcast Receivers)
CISPR SC G (Information Technology Equipment)
SAE AE-4 (Aerospace EMC)
ASTM D09.12.14 (Shielding Effectiveness)
ASTM E06.53 (Reusable Structures)
ANSI ASC C63 (EMC)
Radio Technical Committee on Aeronautics (RTCA) SC 135
Radio Technical Committee on Aeronautics (RTCA) SC 177
Electrostatic Discharge Association
European Telecom Standards Institute (ETSI) TC-EMC/Radio Mattersn (ERM)
ISO TC22/SC3 WG3 (Interference to Motor Vehicle Electrical and Electronic Equipment)
Mil-Specs / Defense Department

Please contact Bob Hofmann, phone 630-979-3627, fax 630-979- 5755, e-mail hrhofmann@lucent.com, if you are interested in serving as liaison to one of the five committees listed above, or if you know of any other organization that is involved in standards activities that is not listed above. Please respond by July 1 so that we can make an official appointment and invite you to the annual SACCom meeting and luncheon during the 1999 IEEE International Symposium on EMC in Seattle. This year the meeting and luncheon will be on August 2.

MAQSOOD MOHD
ASSOCIATE EDITOR

IEEE EMC-Society Education and Student Activities Committee:

The charter of this committee is two-fold: education and student activities. Let me take this opportunity to familiarize you with the mission, vision, and goals of this committee, and how we try to accomplish these.

Mission: To promote education related activities of the IEEE EMC Society

Vision: To provide opportunities for individuals and organizations involved with electrotechnology and products to become aware of EMC at levels consistent with their needs.

Goals:

- Establish an awareness of EMC fundamentals throughout industry and academia
- Enhance EMC education through the development of improved education techniques, materials, opportunities and communications
- Foster the involvement of students in EMC technology

We accomplish our goals through various means. Some I will describe here and the rest in a future article.

We provide Educational and Tutorial Workshops at the annual IEEE International Symposium on EMC. On Monday, the first day of the symposium week, a full day tutorial is organized. Six speakers who are leaders in their respective fields present their knowledge in a tutorial manner. Each educator presents his/her material for 50 minutes followed by a 10-minute question and answer period. The topics are selected based upon the theme of the conference and the needs of the local industry and students. These sessions have proven to be very informative and educational for both novice and seasoned professionals alike.

Another significant educational activity of this committee is to organize hands-on Experimental Demonstrations to explain and demonstrate in a touchy-feely way important and at times difficult to understand electromagnetic concepts. The experimental demonstrations are arranged for three days during the main symposium days (Tuesday, Wednesday, and Thursday). The experiment demonstrators are educators from academia as well as from industry. This activity is very popular among the symposium attendees. The experimental demonstrations are going to expand to the international scene starting with the Tokyo, Japan EMC conference the week of May 17, 1999.

Our members interact with their respective local area colleges and universities to educate them about the EMC field and influence the students in the EE schools to participate in the EMC field. One of the attractive mechanisms is the Student Paper Contest, which will allow the best paper author to win an expense-paid trip to the symposium. The President's Scholarship Fund is also available for deserving students. Lastly, but not least, the Education and Student Activities Committee also awards "seed money" to start an EMC course in any university through the University Grant Fund.

To become NARTE certified in the EMC area, a workshop is conducted at every annual symposium on Mondays. Besides learning EMC material in the workshop, a few good test-taking skills are also reviewed.

This year, at the 1999 IEEE International Symposium on EMC in Seattle, we have organized the Monday Fundamentals Tutorial to include such topics as nonlinear interference effects in receivers, aircraft-triggered lightning effects, EMI due to antenna coupling, impedance of PCB ground plane, EMC in high-speed circuits, and troubleshooting tips and techniques. Speakers include Henry Ott, Howard Johnson, Daryl Gerke, Jose Perini, Don Weiner, and Rod Perala. The experimental demonstrations will be arranged for three days and some 20 experiments will be demonstrated. One highlight of this year's experiments is an experiment about the effects of corrosion on EMC. The student paper contest is in full swing and look for some good student papers this year. Lastly, but not least, an excellent NARTE workshop on Monday and the test on Friday are also planned. So, come join us and be educated, because knowledge is power!

To conclude this column, let me share some exciting news about education. The

IEEE has established an online Virtual Reading Room on the web at http:// www.ieee.org/eab. You can browse through the books just like you would in a real library. Once inside the virtual room, viewers can click on any book in the best-selling IEEE Selected Readings Series or Engineers' Guides To Business Series, and "flip through" the full text of its pages. Titles up for browsing include Cellular Radio and Personal Communications, Smart Antennas, Recent Developments in Power Electronics, Marketing for Engineers, Working in a Global Environment, Writing for Career Growth, and more!

Logical and user-friendly in its design, the reading room features:

- Keyword, title, and author search options
- Full table-of-contents displays for each title
- Navigation tools that enable viewers to move from page to page and section to section, and to zoom in for a closer look at diagrams and formulas
- Online ordering options

"Having a reading room on the Internet gives visitors the opportunity to browse through books before buying them, just as they would in a traditional bookstore," says Alan Trembly, Business Development Manager for IEEE Educational Activities. "A distribution medium such as this really enhances the IEEE's image as practitioner of the technology of the future." For more information about the reading room contact Alan Trembly at a.trembly@ieee.org.

To know more about your Education and Student Activities Committee or to participate in whatever way you can, please contact me at mohd@eglin.af.mil. To know more about the specific subcommittees, please contact the chair of the subcommittee. Contact any one of the following or me to become a part of the ongoing revolution in EMC engineering through education.

Vice chair	Andy Drozd (andro1@aol.com)
Chair – Student Activities	Mike Bogusz (mike_bogusz@nt.com)
Chair – Demonstrations	Andy Drozd (andro1@aol.com)
Vice Chair - Demonstrations	Larry Cohen (phone 202-404-7726)
Chair – Video Productions	Dick Ford (EMC4D@aol.com)
Chair – University Committee	John Howard (jhoward@emcguru.com)
Chair - Experiments Manual II	Jim Drewniak (drewniak@ee.umr.edu)
Chair - Standards Education	Vichate Ungvichian (ungvich@fau.edu)
Co-Chairs NARTE	Jim Whalen (jjw@ubvms.cc.buffalo.edu), Dave Case (dcase@aironet.com)
Chair – Nominations	Bob Nelson (r.m.nelson@ieee.org)
Secretary	Bob Nelson (r.m.nelson@ieee.org)
Chair – Life-Long Learning	Kimball Williams (k.williams@ieee.org)
Chair - Continuing Education	Andy Drozd (andro1@aol.com)

devices, which are ubiquitous in airports and stores, emit magnetic fields around 1.6G peak, with different modulations and frequencies. Concern is with interaction with pacemakers and other active implanted medical devices.

European Competent Association of Bodies (ECAB) (EMC Society Representative: Dave Imeson)

The ECAB held its last meeting in Brussels on March 4th. The group drafted five Technical Guidance Notes for review by the main committee on:

- Testing of PC cards
- Clarification of classes for emission testing
- Ambiguity in EN61000-3-3
- A problem in EN55014-2
- Classes in EN61000-3-2

There were also discussions on Mutual Recognition Agreements (MRAs) and it seems likely this will have to wait for the meetings in Washington at the end of April to progress the appointment of Conformity Assessment Bodies (CAB).

The meeting concluded with a farewell to Elena Santiago who has completed her assignment to the Commission and is returning to Spain. Her replacement is Alejandro Ulzurrun. The next meeting is in Spain on October 1.

EMC Lab Accreditation Work Group (ELAWG) (EMC Society Representative: Bill Hurst)

The last meeting was held on January 27, 1999. The major objective of the meeting was to plan the Workshop to be held as required by the US-EU MRA. The date of the EU Workshop is April 27, 1999.

A meeting was also held with representatives from the National Institute of Standards and Technology (NIST) and Chinese Taipei. As a result of the recent APEC MRA activity, there will be an exchange of letters between the US and Taipei which will bring the terms of the MRA into force. NIST will act as the government body which will designate US based laboratories for testing to Chinese Taipei EMC and Telecom requirements.

As a result of the FCC Docket No. 98-68, which was approved on December 17, 1998, the FCC is in the process of creating Telecommunications Certification Bodies (TCB). Don Heirman and Bill Hurst are Co-Chairmen of a TCB Working Group to provide input to the FCC. The schedule calls for TCBs to be in operation by January 2000. The FCC plans to release a Public Notice listing the criteria for TCB designation by June 1999. The working group is meeting on a regular basis to help prepare these criteria.

Texas Governor George W. Bush presents the NARTE National Service Award to Ray Thrower. (Left to right) Mrs. Frankie Thrower, NARTE President Ray D. Thrower, Governor George W. Bush, Mrs. Brenda Berger, and NARTE Director Steve Berger. Mr. Berger is an active member of the EMC Society.

National Association of Radio and Telecommunications Engineers (NARTE): (EMC Society Representative: Dave Case)

NARTE will be participating in the 1999 IEEE International Symposium on EMC once again offering the EMC Engineer and Technician Test as well as offering the pre-exam workshop.

John Holmberg will be stepping down as Executive Director on June 30. Russ Carstensen will be replacing him as Executive Director. Susan Stillwell will serve as operations director for the organization.

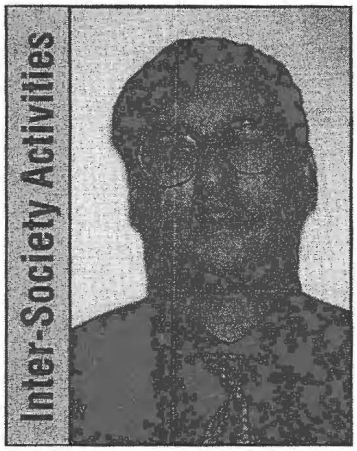
NARTE is adding endorsements to the EMC certification program for those working in accredited EMC test labs. Current certified engineers and technicians can get endorsements for compliance testing to FCC Part 15, FCC Part 68, ANSI C63.4, Mil-Stds, or CISPR, based upon the NVLAP, A2LA or equivalent accreditation of the test lab.

For those engineers and technicians at the test labs who do not hold NARTE certification, or lack the number of years to qualify, they are eligible to be certified as NARTE Lab Engineers or Technicians. NARTE will have a one-year grandfather period for this starting on July 1, 1999 and ending June 30, 2000. Contact NARTE via the web at www.narte.org.

NARTE is also working on a certification for wireless system installers and hopes to offer that later this year.

United States Council of EMC Labs (USCEL) (EMC Society Representative: Dave Case)

The last meeting was held in Washington DC on February 9, 1999. Currently USCEL has 50 members in the organization. The topics at this meeting ranged from the MRAs to lab accreditations. The proposed round robin testing is going forward and will include up to 20 labs in the first go around. Both NVLAP and A2LA will receive anonymous copies of the data. Technical Guide Notes 18 and 19 were adopted by USCEL and are available to non-members for a cost of $10 each. The next USCEL meeting will be in Seattle at the 1999 IEEE International Symposium on EMC on August 2 at 7:00 pm.



DAVID CASE, NCE
RAC CHAIRMAN

Representative Advisory Committee Report

It seems that wireless issues are the hot topic. Wherever you look, everyone is using wireless or so it seems. I saw this first hand during a recent visit to my old alma mater, Purdue, where I had a chance to talk to the students there on several issues involving wireless and compliance issues. The interest in wireless is starting to boom! I also noted the greatly increased attendance at a recent wireless symposium I attended that was sponsored by a couple of the trade magazines.

While most of the students I talked to were learning the basics of wireless and appeared interested in the compliance issues, most of the symposium attendees I spoke with were not overly concerned about any of the regulatory issues. Most were not overly concerned unless a serious problem showed up. However, when I raised issues like proposed FCC, Canadian and European rule changes, the ever increasing problems with installing towers due to local zoning ordinances and of course the growing concern of RF safety, they suddenly grew interested.

Since I suspect very few of these people ever attend the IEEE International Symposium on EMC, how can we get the required information to these people, the system installers and the system integrators who put the wireless systems together and who are responsible for making the systems comply? Short of kidnapping them and dragging them to the EMC symposium, we must find a way to provide the needed information to those working in wireless.

As chairman of the Representative Advisory Committee (RAC), I have initiated steps to make inroads into these uncharted waters. At this year's IEEE International Symposium on EMC in Seattle, RAC will be hosting a special session on EMC and Wireless Compliance issues on Tuesday morning, August 3. I have talked to the organizers of the previously mentioned wireless symposium and have offered to present something similar at this symposium.

The RAC chairman also plans to start making contact with several of their committees to better coordinate information between the EMC Society and various interested wireless groups. RAC is also busy in expanding its membership of other technical societies and is actively pursuing new members. Dave Millard has been appointed the RAC Representative to the Energy Committee.

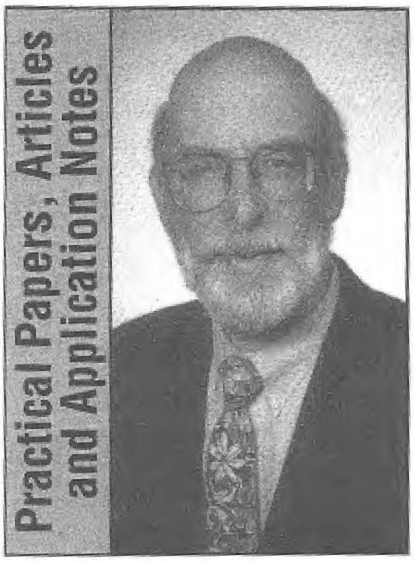
The various groups that make up the membership of RAC have also been busy. Following are some interesting reports from a few of these groups.

Committee on Man and Radiation (COMAR) (EMC Society Representative: Dan Hoolihan)

COMAR has a web page where you can check membership of the committee and status of their activities. See:

http://homepage.seas.upenn.edu/~kfoster/members.htm (members)
http://homepage.seas.upenn.edu/~kfoster/comar.htm (homepage)

The last COMAR Meeting was held November 14, 1998 at the Holiday Inn Riverwalk in San Antonio, Texas. Items reviewed included the history of IEEE's development of a review procedure for approval of Technical Information Statements (TIS) by IEEE (above COMAR). A draft procedure was circulated at the June meeting. The IEEE Technical Activities Board (TAB) took up the final version recently, and we hope that it will be approved. The policy is appended to the meeting minutes and simply requires us to submit our TISs to the IEEE Engineering in Medicine and Biology Society (EMBS) Administrative Committee for review and approval. The process is intended mainly to protect IEEE from liabilities. The last two TISs, one of these being the Heat Sealer TIS, have been submitted and approved using this procedure. The Heat Sealer TIS has been edited by G. Lapin and is presently in press, expecting to come out in spring in the EMBS magazine. COMAR published a Technical Information Statement in the January/February issue of IEEE Engineering in Medicine and Biology magazine. The TIS addressed: "Human Exposure to Electric and Magnetic Fields from RF Sealers and Dielectric Heaters." Howard Bassen of the FDA discussed hazardous RFI. Anti-theft and metal detector



BOB ROTHENBERG
ASSOCIATE EDITOR

The purpose of this section of your Newsletter is to exchange among EMC practitioners the knowledge gained from experience—both successes and failures. Articles need not be lengthy, mathematical, heavily footnoted or profound. They can reflect knowledge gained during the simulating, designing, prototyping, testing, production or deployment phases of a project, or from activities in standards development, field measurement, or materials and component testing.

The following article by Clark Vitek of CKC Laboratories proposes a common approach to test site calibration which might satisfy the many standard-setting bodies (CISPR, ANSI, IEC, ETSI) whose "similar but different" requirements for radiated emission and immunity measurements create a confusing burden for equipment manufacturers and test labs.

Reader feedback is welcome, either directly to the author or as a Letter (or e-mail) to the Editor. To submit a practical paper or article for publication, send it via fax, e-mail or snail mail to this Associate Editor. See page 3 for addresses and fax number.

A Method of Simultaneous, Traceable Calibration of Free Space Measurement Systems for Radiated Emissions and Radiated Immunity Testing

Clark Vitek
EMC Staff Engineer
CKC Laboratories, Inc.

ABSTRACT

This paper describes a harmonized method to calibrate the test facility and equipment used to perform radiated electromagnetic field immunity and emissions measurements. The method is based on the use of a simulated free space environment such as a Fully Anechoic Room (FAR). A discussion of the relationship of this method with existing requirements is discussed including Field Uniformity (reference: IEC 1000-4-3)[1], Normalized Site Attenuation (NSA) (reference: CISPR 22 and ANSI C63.4)[2,3] and Dipole Substitution methods (reference : ETSI standards, such as ETS 300 220)[4]. This paper demonstrates that there is not a need for separate facilities, equipment, and calibrations and suggests that a harmonized standardization approach can be developed when a free space test facility is used for both emissions and immunity measurements. In addition, the method described in this article provides for direct calculation of measurement uncertainty in accordance with the ISO Guide for Expression of Uncertainty in Measurement[5] and NIST Technical Note 1297.[6]

INTRODUCTION

EMC standards in recent years have made it increasingly difficult for manufacturers and test laboratories to satisfy all of the required test environments and calibrations. Recent work suggested that harmonization between many of the standards is needed to reduce confusion and the burden imposed by the development of so many independent, yet clearly related standards.[7] A comparison of radiated electromagnetic field test standards shows that such standards have adopted different required model environments and introduced fundamentally different definitions of the role of the test facility during measurement. Table 1 provides a comparison of three radiated electromagnetic field test standards, their required model environments, and the requirement inherent in the test standard to either compensate or not compensate for the characteristics of the test facility during measurements.

Table 1 shows that a single standard test environment and common definitions for related measurements and effects would be of benefit to the EMC measurement industry. This paper demonstrates that a method of calibration based on a simulated Free Space measurement environment can be used to satisfy the intent of all of the above standards for radiated electromagnetic field measurements, and at the same time introduce definitions of measurement uncertainty that are consistent with the ISO Guidelines for the Expression of Uncertainty in Measurement and NIST Technical Note 1297.

BACKGROUND

To illustrate the direct relationship between required NSA verification of

Standard	Type of Standard	Required Environment	Test Facility Characteristics Bounded or Compensated during test?
IEC 1000-4-3	Immunity	Free Space	Compensated (by pre-calibration)
CISPR 22, ANSI C63.4	Emissions	Ground Plane	Bounded by NSA but not compensated
ETS 300 220, other ETSI standards	Emissions	Free Space	Compensated (by dipole substitution)

TABLE 1: Comparison of Radiated Electromagnetic Field Test Facility Requirements for Common Standards

emissions test facilities and the "Uniform Plane" calibration method of IEC 1000-4-3, one may begin with the equation for Normalized Site Attenuation (NSA) as it appears in ANSI C63.4 (1992) or CISPR 22 (1997) :

$$NSA = \frac{Vdirect}{Vsite} \cdot \frac{1}{AF_1} \cdot \frac{1}{AF_2} \quad (1)$$

where Vdirect is the voltage that appears on a spectrum analyzer or receiver with the feed cables connected together, Vsite is the voltage that appears when transmitting antenna to antenna, and AF_1 and AF_2 are the antenna factors used for the NSA measurement, which must be previously determined.

Through the relationship of power and voltage, Vdirect can be rewritten as follows assuming a matched source, line and load impedance :

$$Vdirect = \sqrt{P_F \cdot R_L} \quad (2)$$

where P_F is the Forward Power presented to the calibration point and R_L is the Load Impedance of the receiver or spectrum analyzer, usually 50 ohms.

By definition of Antenna Factor, Vsite can be rewritten as :

$$Vsite = \frac{E}{AF_2} \quad (3)$$

where E is the electric field presented to Antenna Number 2 (the receive antenna), and AF_2 is the free space antenna factor of the receive antenna.

Substituting Equations (2) and (3) into Equation (1), the following expression is obtained :

$$NSA = \frac{\sqrt{P_F \cdot R_L}}{E/AF_2} \cdot \frac{1}{AF_1} \cdot \frac{1}{AF_2} \quad (4)$$

from which it is observed that AF_2 cancels and it is immediately observed that two antennas are not required to measure NSA as long as forward power and E field can be measured. It is noted at this point that this is the method used for the IEC 1000-4-3 uniform plane calibration method which uses a single antenna for transmit, and requires measurement of electric field generated in the area to be occupied by the EUT and the forward power required to generate this field. If desired, Equation (4) can be employed directly to obtain NSA if a single, previously known antenna factor (AF1) is provided in addition to the E-Field and forward power measurement data. However, the proposed method of calibration that follows illustrates that the requirement for any previously determined antenna factors can be eliminated if the antenna, facility, and feed cables are considered together as a simulated free space measurement system and referenced to the results that would be obtained for an ideal free space environment.

As a basis for the proposed harmonization of calibration methods, the ideal far field free space characteristics of an isotropic source are taken as the baseline reference. Note that this is very similar to the ideal, short dipole pattern used for the development of NSA.[8] The general relationship between electric field, E (V/m) and Power Density, P_D (watts/m^2) in this case is as follows:

$$E^2 = P_D \cdot Z_0 \quad (5)$$

where Z_0 is the free space impedance of approximately 120 π ohms.

The power density from a spherical, isotropic source is related to the transmit forward power, P_F (watts), of the source as :

$$P_D = \frac{P_F}{4\pi \cdot d^2} \quad (6)$$

where d is the distance in meters from the source.

The power density of a source, with gain over isotropic, is then by definition of gain as follows:

$$P_D = \frac{P_F}{4\pi \cdot d^2} \cdot G \quad (7)$$

where G is the numeric power gain.

Substituting equation (7) for P_D into equation (5) and converting to decibels one obtains:

$$G_{dBi} = 10 \cdot \log\left(\frac{E^2 \cdot d^2}{30 \cdot P_F}\right) \quad (8)$$

The corresponding system transducer factor, CdB, can be computed through the relationship between gain and transducer factor for an isotropic radiator as derived in SAE ARP 958[9] and presented as follows (in decibel form) :

$$C_{dB} = 20 \cdot \log(f_{MHz}) - 29.77 - G_{dBi} \quad (9)$$

During calibration, if the point of monitoring of the forward power is prior to the system of the feed cable to the antenna, the gain over isotropic and resulting system transducer factor include the entire system of the feed cable, antenna and non-ideal characteristics of the test facility.

This interpretation of the antenna, cables and facility as a measurement system is consistent with the IEC 1000-4-3 approach, and the Substitution methods required for measurement of emissions in the ETSI standards. In both of these standards, the calibration method results in compensation for the cables, antenna, and test facility as a unique system. However, it is important to note that this interpretation is not presently consistent with the CISPR 22 and ANSI C63.4 standards as these standards assume that the characteristics of the antenna, cable and facility

can be treated as independent interchangeable components, and also that the non-ideal facility characteristics need not be compensated for during subsequent testing. This approach is viewed by this author as a non-ideal interpretation since traceability requires consideration of all known characteristics of a test system and expression of the resulting uncertainty. Furthermore, it is observed that the NSA method of ANSI C63.4 and CISPR 22 assumes that the devices of the test system act independently from each other, and can be changed out, raising the question of validity, for example, if a facility's NSA is verified with precision dipoles for NSA and then a broadband antenna is always used for subsequent measurements. The requirement to consider the antenna, feed cables, and facility together as a measurement system allows the exact same equipment to be used for testing in the exact same geometry as was used during calibration. This is viewed as an improvement over the NSA method for the case when the same facility, antenna, and cables will always be used in the same fixed position for future testing. Furthermore, this definition of the measurement system (including the facility) allows the measurement uncertainty to be quantified based on calibration data that is specific to the facility and equipment used and inherently includes consideration of how these devices interact to simulate the ideal, isotropic free space result.

Method of Simultaneous, Traceable Calibration of Free Space Measurement Systems for Radiated Emissions and Radiated Immunity Testing

The method of simultaneous, traceable calibration of free space facilities is presented as follows:

1. With an isotropic field probe, directional coupler, and power meter, data is collected at multiple locations in the area to be occupied by the equipment under test. At each calibration frequency, the E-field is recorded as measured by the isotropic field probe and the forward power required to generate the field is also recorded. This data collection is similar to the calibration for IEC 1000-4-3. It is noted that IEC 1000-4-3 is only used as an example, and a required calibration geometry encompassing sample points over a test volume could also be utilized. After collection of the E-field and forward power data, the results are normalized to represent the required forward power to generate 1 V/m at each sample location.
2. The average power (in watts) required to generate 1 V/m is computed as follows :

$$\overline{P_f}(watts) = \sum_{i=1}^{n} \frac{P_{f_i}(watts)}{n} \qquad (10)$$

where P_{fi} is the normalized forward power required to generate 1 V/m at each of the individual sample points, and n is the number of sample points.

3. The standard deviation of the required normalized forward power is then also computed :

$$s = \sqrt{\frac{n \cdot \sum_{i=1}^{n} P_{fi}^2 - \left(\sum_{i=1}^{n} P_{fi}\right)^2}{n \cdot (n-1)}} \qquad (11)$$

4. The system gain over isotropic is then computed from the average value of P_F and equation (8) above. Note that for equation (8) a test distance must be assumed. It is suggested that by using the free space specification test distance (i.e. 3m or 10m) the resulting average gain over isotropic is computed directly referenced to the ideal, free space isotropic result regardless of the actual geometry of the sample collection points.
5. The average system transducer factor (C_{dB}) is calculated based on P_F and equation (9) above. This is the average transducer factor for the free space system to be used for future emissions measurements.
6. Note that it is recommended that Gain, Transducer Factor, and Standard Deviation be computed separately for Horizontal and Vertical polarity data populations if a linearly polarized antenna is used. Although a free space measurement system should theoretically have no difference in characteristics depending on polarity, real (non-ideal) measurement systems will show a difference at some frequencies. Furthermore, during the measurement of actual equipment under test, the transmit or receive antenna may be polarized with respect to radiation of the EUT suggesting that both polarities should be investigated.
7. The Type A (standard, k=1) uncertainty in the Gain and System Transducer Factor are calculated from the standard deviation. This value is computed as follows :

$$u = \frac{s}{\sqrt{n}} \qquad (12)$$

where s is the standard deviation of the sample population data, and n is the number of data points included in the computation of s. Note that for the standard 16 point IEC 1000-4-3 plane, n=16 for each polarity. The selection of equation (12) for computation of standard uncertainty instead of u=s is based on the recognition that in the ideal case for a perfect measurement system (no uncertainty), all sample locations would provide the same result. In actuality this may not be achievable, but the multiple samples collected in step 1 are intended to obtain multiple samples of the system deviation from the ideal free space result computed using the ideal free space distance in equation (8).
8. The resulting Type A uncertainty of equation (12) is then combined with Type B factors for the

instrumentation used during the calibration. This includes the isotropic field probe and equipment used to monitor forward power. The Type A and Type B factors are combined by the Root Sum Squared (RSS) technique, and then expanded by an expansion factor of k=2 to represent a 95% confidence level. This represents the 95% confidence uncertainty in the Gain and Transducer values determined by the calibration.

9. For future measurements, the calibration uncertainty may be further combined with additional factors for additional instrumentation used or additional Type B considerations. An example of this is an emissions pre-amplifier, which would not be typically used for the above described calibration, but would likely be used for future emissions tests. Thus, the emissions measurement uncertainty stated for the system has to include combination and re-expansion to consider the additional uncertainty of the emissions pre-amplifier.

CONCLUSIONS

This article demonstrates that it is possible to develop a single, harmonized procedure for calibration of free space facilities for both radiated emissions and radiated immunity measurements. It is further demonstrated that it is possible to introduce traceability to these methods in accordance with ISO Guidelines and NIST Technical Note 1297 through the calculation of measurement uncertainty by a combination of Type A (calibration data) and Type B (instrumentation) factors. The inclusion of Type A consideration ensures that the characteristics of the individual facility and equipment under calibration are included in the expression of measurement uncertainty. The method proposed in this article would eliminate the need for separate calibration of antennas, cables, and facilities (such as in ANSI C63.4 and CISPR 22) which is likely to introduce more transfer uncertainty into the process once all parameters are considered. Furthermore, by the selection of an isotropic field probe and power meter as the principal devices to perform the calibration, no new instrumentation or calibration facilities (such as the proposed CISPR antenna calibration site)[10] are needed to introduce traceability because international transfer standards already exist for the devices proposed to be used by this method. Lastly, it is suggested that the total combined, expanded measurement uncertainty, including all instrumentation, should become the primary benchmark for acceptability of facilities and measurement systems, replacing the present indirect criteria such as +/-4 dB NSA, 75% Field Uniformity, or dipole substitution. The use of total, combined, expanded measurement uncertainty as the benchmark for site and instrumentation acceptability would align the EMC community with the ISO Guidelines for Expression of Uncertainty in Measurement. The choice of Free Space as the international reference environment would permit simplified calibration methods and uncertainty calculations to satisfy the intentions of multiple present day EMC standards.

REFERENCES

[1] IEC 1000-4-3 (1995), "Electromagnetic Compatibility (EMC), Part 4: Testing and Measurement Techniques, Section 3: Radiated, radio-frequency, electromagnetic field immunity test", Copyright 1995 by International Electrotechnical Commission (IEC), Rue de Varembe, Geneva, Switzerland. This standard has also been published with some modifications as a European Norm entitled EN61000-4-3 (1996).

[2] CISPR 22 (1993), "Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment, 2nd Edition", copyright 1993 by International Electrotechnical Commission, Rue de Varembe, Geneva, Switzerland.

[3] ANSI C63.4 (1992), "American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz", ISBN 1-55937-212-5, Copyright 1992 by the Institute of Electrical and Electronics Engineers.

[4] ETS 300 220, "Radio Equipment and Systems; Short Range devices technical characteristics and test methods for radio equipment to be used in the 25 MHz to 1000 MHz frequency range with power levels ranging up to 500 mW". European Telecommunications Standards Institute (ETSI), October 1993. This reference is provided as an example of dozens of ETSI standards that accept free space measurements for intentional radiators and spurious emissions.

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[7] Mardiguian, Michel, "For a Better Consistency Between EMC Tests", IEEE 1997 International Symposium on EMC, Austin Texas, pages 370 - 373.

[8] Smith, A.A, German, R.F., and Pate, J.B., "Calculation of Site Attenuation from Antenna Factors," IEEE Transactions on Electromagnetic Compatibility, Volume EMC-24, No. 3, August 1982.

[9] SAE ARP 958. Society of Automotive Engineers, Standard 958, Revision A (Issue Date 1992-11-5). "Electromagnetic Interference Measurement Antennas, Standard Calibration Methods", pages 4 -5.

[10] CISPR A / WG1 "Specification and Validation of a CISPR Antenna Calibration Test Site for the Frequency Range of 30 - 1000 MHz", draft document 1997, International Electrotechnical Commission, Rue de Varembe, Geneva, Switzerland..

Clark Vitek is EMC Staff Engineer for CKC Laboratories, Inc. He has published multiple articles on EMC in industry publications and at the IEEE EMC symposia. He holds a BSEE from the University of California at Davis. Mr. Vitek may be reached via e-mail at cvitek@ckc.com.

SCOTT ROLESON
CHAIRMAN

Distinguished Lecturer Program Goes International

by Scott Roleson
Chairman
EMCS Distinguished Lecturer Program

The EMC Society's Distinguished Lecturer program has expanded internationally by increasing the total number of lecturers to five, and appointing two lecturers outside of North America. By letter vote in January, the EMCS Board of Directors approved the appointments of Elya B. Joffe of Israel, Michel Mardiguian of France, and Mark Montrose of the U.S.A. to two-year terms as Distinguished Lecturers.

Elya Joffe

Elya Joffe has worked in EMC and related disciplines for 18 years, and is currently V.P. of Engineering and EMC/E3 Engineering Specialist with K.T.M Project Engineering in Kfar-Sava, Israel. He is a Registered Professional Engineer, and holds NARTE certifications as an EMC engineer and ESD Control Engineer. He has published 29 papers, has lectured widely on EMC, and is fluent in English and Hebrew. Joffe is a Senior Member of the IEEE, and has been chairman of the Israel EMC Chapter for more than five years. He acted as Technical Chairman for the 1992 IEEE Regional Symposium on EMC in Israel.

Michel Mardiguian

Michel Mardiguian started his EMC career in 1974 while working for IBM in France, and was a French delegate to the CISPR working group on computer RFI in 1976 - 80, participating in what became CISPR 22. From 1980 until 1990 he was with ICT (a.k.a. Don White Consultants) in Gainesville, VA, during which time he taught over 160 EMC classes. He has published 21 papers, seven widely sold handbooks, and co-authored two books with Don White. He has been a private EMC consultant since 1990, is a Senior Member of the IEEE, and is NARTE certified.

Mark Montrose

Mark Montrose is principal consultant of Montrose Compliance Services specializing in EMC and product safety. He prefers using a simplified approach to educating clients in EMC to allow them to become self-sufficient in a cost-effective manner. Montrose is a Certified Instructor for Postsecondary Education in California, is a Senior Member of the IEEE, and is a member of the TC-8 Product Safety Technical Committee. He is the author of two EMC books published by IEEE Press, and has written numerous papers on PC board design, theory, layout, and signal integrity issues.

Montrose, Mardiguian, and Joffe join Donald Bush and Robert Dockey as EMC Society Distinguished Lecturers. The terms of Bush and Dockey continue through the end of 1999.

The EMC Society's Distinguished Lecturer program provides speakers for Society chapter meetings and similar functions. Each speaker typically can offer one of several presentations on various electromagnetic compatibility topics. Speakers may present a maximum of six talks each year under this program. Distinguished Lecturers are appointed by the Board of Directors to two-year terms. Currently the EMC Society has five speakers on alternating terms.

The Society reimburses speakers for their approved traveling expenses up to a recommended limit of $750 per engagement, or up to $1000 for intercontinental engagements with advance approval. Whenever possible, hosting chapters are encouraged to absorb

some part of the cost, such as providing local transportation for the speaker, paying his hotel bill, or providing some of his meals.

For more information about the EMCS Distinguished Lecturer Program, see our Web site at URL http://www.emcs.org/lectur.html, or contact the Program Chairman, Scott Roleson, at +1-619-655-4809 or via e-mail to sroleson@ieee.org.

EMC in Academia

continued from page 1

Student Activities Committee, to learn about the breadth of their activities scheduled for the 1999 IEEE International Symposium on EMC in Seattle this August. John Windell, Technical Papers Chairman of the Seattle Symposium, advised that there were 17 initial student paper abstracts submitted and 16 were accepted! John commented, "The response to the advertisement for the Student Paper Contest was much stronger than anticipated. We didn't know what to expect, but we were hoping that the cash prize of $900, plus $2,100 for travel expenses to attend the symposium and present the paper, would be an incentive." Further, John revealed that he is "extremely pleased with the caliber of the student papers submitted." For reference, the student paper abstracts were circulated to the reviewers with no distinction made to identify them as student papers; they were evaluated along with all the other abstracts submitted. John advised that the selection of the Best Student Paper will be "a very difficult task." This student paper contest is funded by the EMC Society Education and Student Activities Committee – just one more example of their many varied activities.

It is also interesting to note that there are several institutions, such as the Georgia Tech Research Institute (GTRI) and universities, such as Oklahoma University, Center for the Study of Wireless EMC, that are closely affiliated with industry on projects involving EMC studies. These institutions and universities will be profiled in a future article in this newsletter. Only those universities or institutions that regularly offer specific EMC courses are included in this article.

Let's visit then some of the leading EMC universities worldwide....

Central Building of University Politecnico di Torino.

Politecnico di Torino, Turin (Italy)

Contact: Flavio Canavero, Ph.D, phone +39-011-5644060, e-mail: canavero@polito.it

Year Formal EMC Program Initiated: This institution holds the distinction of being the first to offer an EMC course in Italy, beginning in the 70s. The present EMC group was formed in 1986.

Primary Areas of Expertise: Analytical and numerical modeling of EMC problems, electromagnetic simulation of 3D structures, characterization of new materials for shielding, shielding theory, spectral theory of transmission lines, crosstalk on cables, effects of losses on interconnects, susceptibility of active IC's, EMC measurements

EMC and Related Courses Offered: Introductory EMC, EMC Standards and Directives, EMC Design by Simulation, EMC related to Transmission Lines and Crosstalk, Emission and Immunity, EMC of Digital Systems, Shielding, ESD, PCB Design, Signal Integrity

Research Work: Theoretical and numerical modeling of EMC problems, and software development

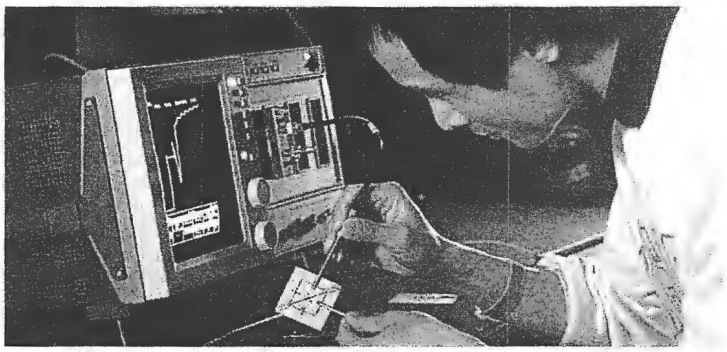
Number of Students in Program: 60 at the undergraduate level, 50 at the master level, one at the Ph.D level per year

Number of Faculty: Three full professors, two associate professors, two assistant professors

University of York, York (United Kingdom)
Contact: Mrs. Maryan Marshman, phone +44-1904-432319, e-mail: acm4@york.ac.uk
Year Formal EMC Program Initiated: 1982
Primary Areas of Expertise: EMC measurements, design for EMC, EMC antennas, computational electromagnetics
EMC and Related Courses Offered: Fundamental and specialist EMC topics including design, measurement and management issues.
Research Work: EMC measurement techniques, EMC design techniques, EMC antenna design and computational electromagnetics. Through their associated company York EMC Services, they offer technical construction files and design consultancy.
Number of Students in Program: 40 at the master level (some 200 students took various EMC courses in 1998)
Number of Faculty: Five

University of Missouri-Rolla, Rolla, Missouri (USA)
Contact: James L. Drewniak, Ph.D, phone 573-341-4969, e-mail: drewniak@ece.umr.edu
Year Formal EMC Program Initiated: 1985
Primary Areas of Expertise: PCB layout and design, computational electromagnetic modeling, system EMC, shielding, power electronics, machines and drives, cabling.
EMC and Related Courses Offered: Introduction to EMC, High-Speed Digital Design, Antennas and Applications to EMC, Microwave Engineering, Advanced Electromagnetics I, Electromagnetic Waves II, Computational Electromagnetics
Research Work: PCB design layout and evaluation for EMC, DC power bus design, CAD tool development, shielding enclosure analysis and design
Number of Students in Program: 18 graduate students and six undergraduate students
Number of Faculty: Four full-time and one visiting scholar

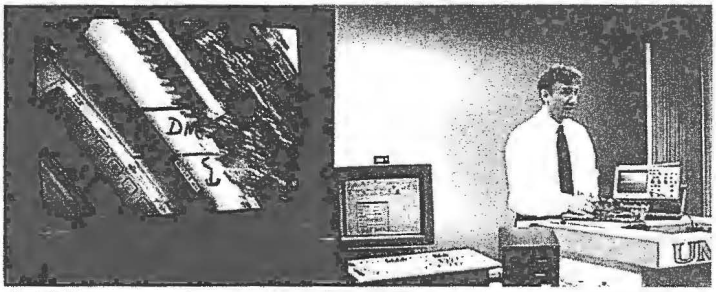
Jim Drewniak and students in the UMR RF shielded enclosure. UMR has received several donations from manufacturers of EMC related products, including the shielded enclosure shown. These donations enable the University to expand their EMC research and teaching capabilities.



A student in the "High Speed Digital Design" course making a measurement in the UMR EMC Laboratory.

Students relaxing on the "hockey puck" at UMR.

Professor Jim Drewniak with students Min Li (1998 President's Memorial Award recipient) and Xiaoning Ye in the UMR EMC Laboratory.



An EMC course being presented in the video conference room at UMR by Professor Todd Hubing.

Florida Atlantic University, Boca Raton, Florida (USA)

Contact: Vichate Ungvichian, Ph.D, P.E., phone 561-338-1650, e-mail: ungvich@fau.edu

Year Formal EMC Program Initiated: 1987

Primary Areas of Expertise: EMC/RF measurement, PCB design, EM math modeling

EMC and Related Courses Offered: General EMC course where a PCB design project including an EMI emission measurement is mandatory.

Research Work: EMC compliance, redesign of PCB or grounding systems, crosstalk and ultra-high speed microstrip lines

Number of Students in Program: Two Ph.D students and three undergraduate students

Number of Faculty: Four full-time

University of L'Aquila, (Italy)

Contact: Antonio Orlandi and Mauro Feliziani, e-mail: orlandi@ing.univaq.it

Year Formal EMC Program Initiated: 1990

Primary Areas of Expertise: Numerical techniques for EMC problems and EMC in power electronics

EMC and Related Courses Offered: Numerical Techniques to Approach EMC Problems, EMC in Biomedical Devices, Electromagnetic Pollution in Industry and High Frequency. (The EMC Laboratory of the Department of Electrical Engineering at the University of L'Aquila has based its practical lectures on the IEEE EMC Society Education Manual as well as the Experiments Manual and demonstrations which are presented annually at the IEEE International Symposia on EMC.)

Research Work: LEMP coupling, active and hybrid shieldings, EMC in power drive systems, PCB signal integrity analysis

Number of Students in Program: 122

Number of Faculty: Five

Library of the School of Engineering of the University of L'Aquila. The School is 1000m above sea level on the hill of Roio.

Classrooms' building of the School of Engineering.

Washington State University, Pullman, Washington (USA)

Contact: Robert G. Olsen, Ph.D, phone 509-335-4950, e-mail: olsen@eecs.wsu.edu

Year Formal EMC Program Initiated: 1990

Primary Areas of Expertise: Power system EMC (EMI from high voltage systems, low frequency shielding)

EMC and Related Courses Offered: Basic Electromagnetic Theory, Distributed Parameter Systems, Electromagnetic Compatibility

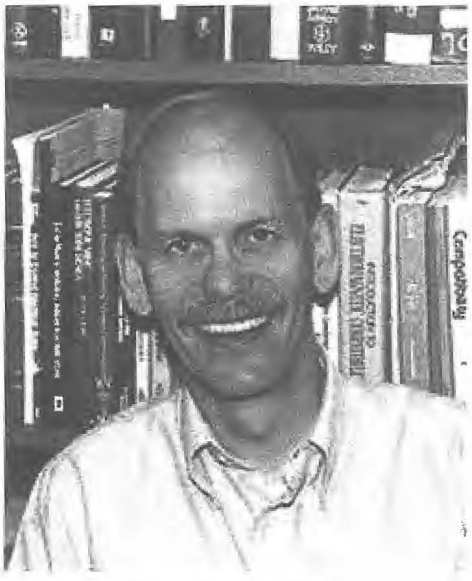
Research Work: EMC of power systems and other electronic equipment (e.g. shielding of computer monitors from ELF magnetic fields)

Number of Students in Program: 8-12

Number of Faculty: Two

North Dakota State University, Fargo, North Dakota (USA)

Contact: Robert Nelson, Ph.D, phone 701-231-7619, e-mail: r.m.nelson@ieee.org

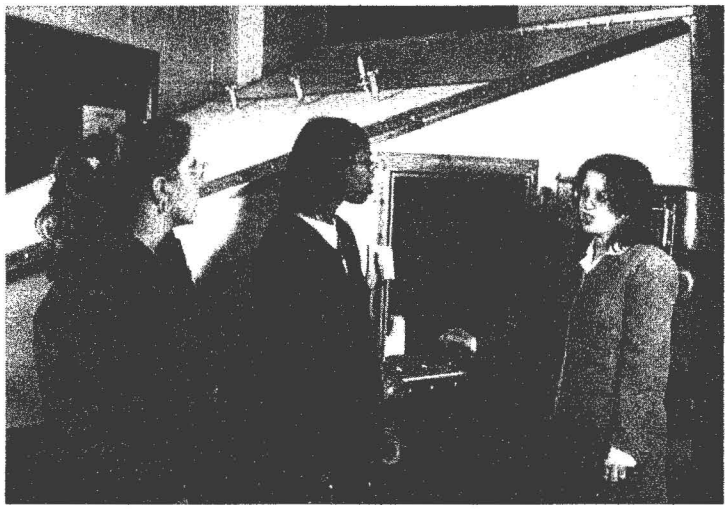


Bob Nelson of North Dakota State University and Secretary of the EMC Society Education Committee.

Year Formal EMC Program Initiated: 1991
Primary Areas of Expertise: PCB design, ESD, numerical modeling and simulation of EMC effects, lightning effects, EMI in medical products, transmission lines and antennas
EMC and Related Courses Offered: Designing for EMC, Signal Integrity, and course presenting EMC Concepts in Communications Electronics, Power Electronics, Optical Signal Transmission, Digital Systems, Instrumentation, Microwave Engineering, Advanced Electromagnetics, Signal Processing
Research Work: Simulation and design of PCB layout (especially relating to signal integrity issues), EMC in medical electronics, modeling and simulation of radiation, ESD, and lightning.
Number of Students in Program: 40
Number of Faculty: Two

University of Rome "La Sapienza", Rome (Italy)
Contact: M.D'Amore, Ph.D, e-mail: damore@elettrica.ing.uniroma1.it
Year Formal EMC Program Initiated: 1992
Primary Areas of Expertise: Shielding, characterization of composite materials, EMC in avionics, EM coupling
EMC and Related Courses Offered: Electromagnetic Compatibility for Industrial Engineers, Post-Graduated School in EMC
Research Work: Shielding, characterization of composite materials, EMC in avionics, coupling
Number of Students in Program: 50
Number of Faculty: Five

San Francisco State University, San Francisco, California (USA)
Contact: Zorica Pantic-Tanner, Ph.D, phone 415-338-7739, e-mail: zpt@sfsu.edu
Year Formal EMC Program Initiated: The program was started in 1993 with "seed money" provided by the Santa Clara Valley Chapter of the EMC Society



Dr. Pantic-Tanner (right) demonstrates the use of a GTEM cell as a tool for radiated emission measurements. Listening intently are students Monica Harrison and Wesley Imani.

Primary Areas of Expertise: Electromagnetic field theory, applied electromagnetics, EMC
EMC and Related Courses Offered: EMC concepts are integrated throughout the EE curriculum in the following courses: Introduction to Engineering Electromagnetics, Communication Systems, Electromagnetic Waves and Engineering Electromagnetic Compatibility
Research Work: Time/frequency domain analysis of PCB crosstalk mechanisms, minimization of signal integrity waveform distortions, radiated field coupling into shielded enclosures with apertures, radiated field coupling onto unshielded and shielded cables
Number of Students in Program: 20 undergraduate students take the EMC related courses each year. Extensive student research projects include 10 undergraduate students and one MS student.
Number of Faculty: Two full-time and one part-time

Mercer University, Macon, Georgia (USA)
Contact: Clayton R. Paul, Ph.D, phone 912-752-2213, e-mail: paul_cr@mercer.edu
Year Formal EMC Program Initiated: There is no formal department; Dr. Paul's department is the Electrical and Computer Engineering Department in the School of Engineering.
Primary Area of Expertise: Crosstalk
EMC and Related Courses Offered: Introduction to All Aspects of EMC for MSEE students.
Research Work: Not offered
Number of Students in Program: Two at the master level (35 students took the course in fall 1998)
Number of Faculty: One

Editor's Note: Many thanks to Bob Nelson of North Dakota State University, and Secretary of the EMC Society Education Committee, for his assistance in soliciting the universities worldwide to participate in this article. (Those universities who responded to the survey were included in this article.) Thanks also to Maqsood Mohd, Chairman of the EMC Society Education and Student Activities Committee, for his guidance in the writing of this article and to John Howard for his input on the University Grant Program which follows this article.

Funding For EMC Education: The University Grant Subcommittee

by John Howard, Chairman of the University Grant Subcommittee,
A Subcommittee of the EMC Society Education and Student Activities Committee

HISTORY

The University Grant Subcommittee was formed at the 1994 IEEE International Symposium on EMC in Chicago. Kimball Williams, who was then chair of the Education Committee, was the driving force behind creating the University Grant program and nursing it to fruition. The author was asked by Kimball to initially chair this effort and continues in this capacity. Membership in the committee is voluntary and many people have contributed over time. In particular, Clayton Paul of Mercer University, Bob Nelson of North Dakota State University, and Todd Hubing of the University of Missouri-Rolla have been members from the beginning and have provided valuable insight into the workings of academia.

PURPOSE

The purpose of this subcommittee is to annually award a one time grant to a qualifying university or college which will be used to *initiate* a regular class on EMC. The ideal recipient will be an accredited institution with a well-established EM fields curriculum in place and an interest in expanding to include an EMC class. The subcommittee goal is to find a university with all of the requisite pieces in place and by means of the grant, motivate them to begin teaching EMC on a regular basis. A university with an EMC curriculum already established does not generally qualify since the intent is to encourage more universities to add EMC to their offerings.

PRIOR GRANT RECIPIENTS

Recent recipients have been Northern Illinois University (in 1997) and University of Nevada, Reno (in 1998). The original grant amount was $7,000 but this has increased over time. The grant offered in 1999 will be $10,000.

HOW TO APPLY FOR A GRANT

Each year a Request for Proposal (RFP) is announced via e-mail to the members of the National Electrical Engineering Department Heads Association (NEEDHA). This has restricted the audience to the Western Hemisphere and the subcommittee is now trying to find a comparable method of distributing the RFP to all parts of the world. Proposals must be submitted by May 31 with the winner notified by July. The grant is personally awarded in August during the Awards Luncheon held at the annual IEEE International Symposium on EMC. For more information or to submit a proposal, please contact:

John Howard
1632 Grosbeak Avenue
Sunnyvale, CA 94087-4804, USA
E-mail: jhoward@emcguru.com
Fax: 408-739-1461

Education Committee

University Survey

The Education Committee of the IEEE Electromagnetic Compatibility Society has started a

Survey

of the EMC courses offered in the Universities throughout the world. University Instructors of EMC courses are invited to fill out the

on-line questionnaire

at the following URL:

http://dau.ing.univaq.it/art

For any questions and comments, please contact the Chairman of the EMC University Survey subcommittee:

Professor Antonio Orlandi
Dept. of Electrical Engineering
University of L'Aquila
L'Aquila, Italy

office: +39-0862-434432
EMC Lab: +39-0862-434426
fax: +39-0862-434403
e-mail: orlandi@ing.univaq.it

1999 IEEE INTERNATIONAL SYMPOSIUM ON ELECTROMAGNETIC COMPATIBILITY

Welcome to the 1999 IEEE EMC Symposium in the Emerald City, Seattle, Washington.

Come in, sit down... and enjoy the show.

hurry, our best seats are going fast...

Steep hills. Lush greenery. Glimpses of sparkling water everywhere - Puget Sound, bays, lakes, rivers, canals. And snowcapped Mt. Rainier in the distance suddenly emerging from its mantle of clouds. A visitor soon learns why Seattle is known as "The Emerald City". High standards abound - Boeing, Microsoft, Nordstrom and Starbucks are based here, and a youthful creativity flourishes. Seattle is a welcoming place. The natural boundaries of the hills and water produce a city of neighborhoods that feel like small towns, vibrant and intriguing. This year promises the IEEE attendees to be one they won't soon forget. We're offering an EMC Educational Program to appeal to all levels of experience in the area - from novice to the most advanced engineers. There will be 2 days of Practical Tutorials and Workshops with 3 days of Technical Sessions, 2 days of Open Forum Papers and Hands-On demonstrations. And not to miss is this year's Symposium Gala Event to be held at an off-shore island, Kiana Lodge, serving fresh barbequed salmon. We welcome everyone to the 1999 IEEE EMC Symposium to help join in making waves into the 21st century. For an on-line tour of Seattle, visit the Seattle/King County Visitors Guide at http://www.seeseattle.com, then click "Let's Explore". Don't miss the opportunity to enjoy SeaFair Week during your stay, leave some extra time available to enjoy this wonderful week of festivities; cruises through Puget Sound, the Blue Angels streaking across the Seattle sky, and the exciting Hydro boat races on Lake Washington. We look forward to seeing you this summer, and we're sure you will be looking forward to seeing us!

GENERATING WAVES INTO THE 21ST CENTURY

AUGUST 22, 1999

Seattle

WASHINGTON

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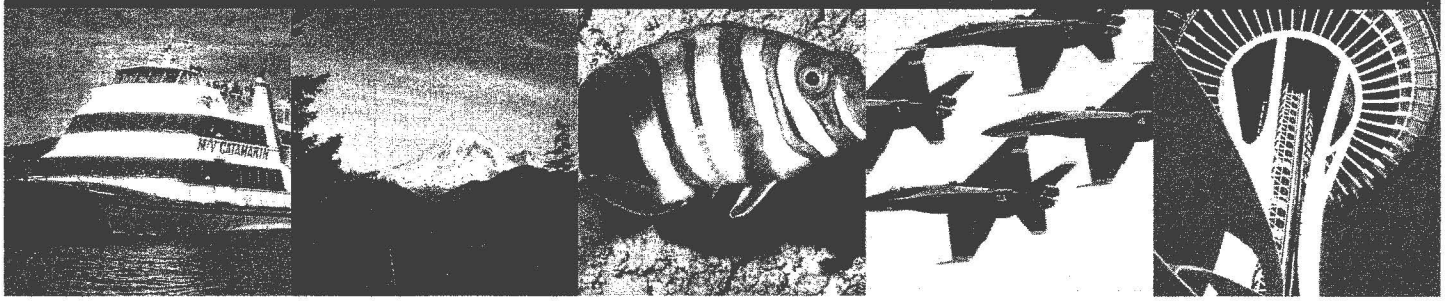
EMC SOCIETY



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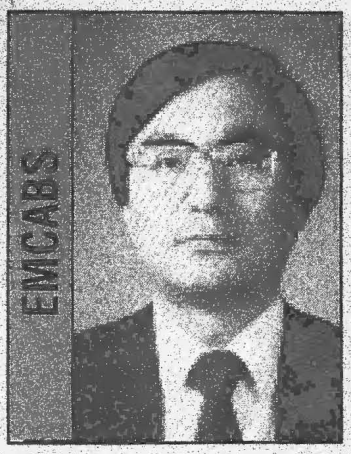

OSAMU FUJIWARA
ASSOCIATE EDITOR

Following are abstracts of papers from previous EMC symposia, related conferences, meetings and publications.

EMCAB COMMITTEE

Bob Hunter, Consultant
r.d.hunter@ieee.com
Sha Fei, EMC Research Section, Northern Jiatong University, Beijing, China
emclab@center.njtu.edu.cn
Ferdy Mayer, L.E.A.D., Maisons, Alfort France
FerdyMayerLEADFrance@compuserve.com
Maria Sabrina Sarto, Department of Electrical Engineering, University of Rome, Italy
sarto@elettrica.ing.uniroma1.it

"HOW CAN I GET A COPY OF AN ABSTRACTED ARTICLE?"

Engineering college/university libraries, public libraries, company or corporate libraries, National Technical Information Services (NTIS), or the Defense Technical Information Center (DTIC) are all possible sources for copies of abstracted articles of papers. If the library you visit does not own the source document, the librarian can probably request the material or a copy from another library through interlibrary loan, or for a small fee, order it from NTIS or DTIC. Recently it became clear that EMCABs were more timely than publications which were being listed in data files. Therefore, additional information will be included, when available, to assist in obtaining desired articles or papers. Examples are: IEEE, SAE, ISBN, and Library of Congress identification numbers.

Also, the steering staffs of the Japan Technical Group and the EMC Japan Tokyo Chapter have offered to act as a central point for requests of papers abstracted here. Most of the papers will be available in Japanese only. Abstracts of papers from EMC Japan will be clearly identified. As a member of the steering staff, I will assist in routing your request to the author(s) but will not translate the papers.

Some of the Chinese papers are not available in English. Professor Sha Fei, EMC Research Section, Northern Jiatong University, has offered his time and assistance in routing requests for papers to appropriate author(s). He is not furnishing a translation service.

As the EMC Society becomes more international, we will be adding additional worldwide abstractors who will be reviewing articles and papers in many languages. We will continue to set up these informal cooperation networks to assist members in getting the information or contacting the author(s). We are particularly interested in symposium proceedings which have not been available for review in the past. Thank you for any assistance you can give to expand the EMCS knowledge base.

EMCABS: 01-5-99

HUMAN EXPOSURE TO ELECTRIC AND MAGNETIC FIELDS FROM RF SEALERS AND DIELECTRIC HEATERS – A COMAR TECHNICAL INFORMATION STATEMENT

IEEE-EMBS (Engineering in Medicine and Biology Society) Committee on Man and Radiation (COMAR).
IEEE ENGINEERING IN MEDICINE AND BIOLOGY, January/February 1999, pp. 88-90

Abstract: RF energy at several assigned frequencies is used for industrial heating such as sealers and dielectric heaters. Concerns for the safety of such devices prompted studies to measure the fields of such devices; it was found that in some, operators were subject to fields in excess of certain standards, e.g., IEEE C95.1-1991. In this report, it is recommended that shielding between the operator and the devices and grounding of the devices be employed to reduce operator exposure be used. It is also recommended that operators be insulated from ground to reduce body to ground currents among other precautions. Numerous literature citations are included in this paper.

Index terms: RadHaz, nonionizing radiation, RF exposure guidelines, RF Heating

EMCABS: 02-5-99

REDUCTION OF SAR IN HUMAN HEAD BY SUPPRESSION OF SURFACE CURRENTS DUE TO A PORTABLE TELEPHONE

J. Wang and O. Fujiwara
Principal contact: wang@odin.elcom.nitech.ac.jp
Wang@odin.elcom.nitech.ac.jpNagoya Institute of Technology, Nagoya 466-8555, Japan
Proceedings of 13th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility, Zurich, Switzerland, February 16-18, 1999, pp.59-62

Abstract: To reduce the spatial peak specific absorption rate (SAR) in the human head, the authors previously proposed attaching a ferrite sheet to a portable telephone. In this paper, its mechanism is investigated by using the finite difference time domain (FDTD) method in conjunction with detailed models of a human head and portable telephone. The findings reveal that the SAR reduction by ferrite sheet attachment is due to the suppression of current flowing on the device surface close to the head. This leads that a low SAR portable telephone can be realized by controlling the current distribution on the device surface.

Index terms: Portable telephone, health hazard, SAR reduction, ferrite sheet attachment

ELECTROMAGNETIC INTERFERENCE INDUCED ON A TRANSMISSION LINE BY AN ELECTROSTATIC DISCHARGE INSIDE METALLIC ENCLOSURES

EMCABS: 03-5-99

G. Cerri, R.De Leo, V. Mariani Primiani, M. Palmucci and A. Ciccolella*
University of Ancona, Ancona, Italy, * ESA-ESTEC, Noordwijk, Netherlands
Principal contact: r.deleo@ee.unian.it
Proceedings of 13th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility, Zurich, Switzerland, February 16-18, 1999, pp.83-86

Abstract: A lot of well documented operation anomalies, but also many catastrophic failures on board of orbiting spacecraft are due to electrostatic discharge (ESD). Moreover, the evolution of the electronic systems is leading to a denser packaging and to the use of lower intensity signals, increasing in this way the susceptibility of the electronic equipment. Therefore an accurate design is necessary to protect the circuitry from the effects of a board band disturbing field due to an ESD, but this can be achieved when effective simulation tools are available. In this sense, this paper presents a model for the evaluation of the disturbance induced in a transmission line by an ESD occurring inside a metallic enclosure, representing the metallic shield of an apparatus. The model highlights the effects of the resonant nature of the structure on the intensity and on the duration of the disturbance; theoretical results have been validated by measurements.

Index terms: Electrostatic discharge, electromagnetic interference, transmission line, metallic enclosure

A NEW METHOD TO EVALUATE THE IMPULSE RESPONSES OF LOSSY MULTICONDUCTOR TRANSMISSION LINES

EMCABS: 04-5-99

A. Maffucci and G. Miano
amaffucc@unina.it, miano@unina.it
Universita di Napoli "Federico II", Napoli, Italy
Proceedings of 13th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility, Zurich, Switzerland, February 16-18, 1999, pp.121-126

Abstract: This paper deals with the evaluation of the time-domain describing input and transfer impulse responses of linear lossy multiconductor transmission lines with frequency dependent parameters. These responses cannot be evaluated analytically and, due to the presence of "irregular" terms such as Dirac pulses, a brute numerical evaluation is not possible. In this paper an analytical method based on the perturbation theory of the spectrum of symmetric matrices is applied to evaluate exactly all the irregular terms. Once the irregular parts of the impulse responses are known, it is possible to evaluate accurately the regular ones through simple numerical methods, as shown through some examples.

Index terms: Lossy multiconductor transmission line, impulse response, perturbation theory, analytical method

INTRODUCING HEIGHT CORRECTION FACTORS FOR ACCURATE MEASUREMENTS WITH BICONICAL ANTENNAS ABOVE GROUNDPLANE

EMCABS: 05-5-99

W. Mullner and M. Buchmayr
Emc@arcs.ac.at
Austrian research center Seibersdorf, A-2444 Seibersdorf, Austria
Proceedings of 13th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility, Zurich, Switzerland, February 16-18, 1999, pp.153-157

Abstract: The antenna factor of the biconical antenna is a function of antenna height above a ground-plane. Variations in the antenna factor of up to 1.9dB are observed when the antenna is used in the typical height range of 1 m to 4 m on an open area test site (OATS). The magnitude of this variation depends on the impedance of the antenna balun from the antenna factor simulations we have derived height correlation factors which account for the coupling of biconical antennas above a ground plane. We have demonstrated with antenna calibration measurement what the simulated predictions show. The new method of height correction can be applied to all measurements with biconical antenna, when the balun impedance of the antenna is known. It removes the systematic error caused by the height depedance of the antenna factor. Examples are demonstrated for precision field strength measurements on an OATS, accuracy enhancement for antenna calibration according to the standard site method given ! in ANSI C63.5 and conversion of OATS antenna factors to free space antenna factors and vice-versa.

Index terms: Open area test site, antenna factor, biconical antenna, height correction factor

RESPONSE OF SHIELDED CABLES TO AN EXTERNAL ELECTROMAGNETIC FIELD EXCITATION—MODELING AND EXPERIMENTAL VALIDATION

EMCABS: 06-5-99

D. Orzan, M. Ianoz and B. Nicoara*
Principal contact: michel.ianoz@epfl.ch
Swiss Federal Institute of Technology, Lausanne, Switzerland
University <Politecnica>, Bucarest, Rumania
Proceedings of 13th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility, Zurich, Switzerland, February 16-18, 1999, pp.185-190

Abstract: Two methods for the calculation of internal responses of shielded cables submitted to an external impulse electromagnetic field are analyzed. One is the classical frequency-domain approach, the second is a new mixed frequency-time-domain model, which uses a link to a well-known transient analysis code. This last feature makes possible the application of the second model to complex networks with several branches. In both models, measured values of the cable transfer impedance values have been used. The comparison between internal currents and voltages calculated with both models and measurements using an EMP simulator shows a reasonable good agreement. These comparisons validate the analyzed models and in particular the new combined frequency-time domain approach.

Index terms: Shielded cable, electromagnetic field excitation, impulse response, frequency-time-domain approach

COMMON-MODE CURRENTS AND PRINTED CIRCUIT BOARDS

EMCABS: 07-5-99

F.B.M. van Horck, A.P.J. van Deursen* and P.C.T. van der Laan
*Philips Components, 5600 JB Eindhoven, the Netherlands
Principal contact: a.p.j.v.deursen@ele.tue.nl
*Eindhoven University of Technplogy, 5600 MB Eindhoven, the Netherlands
Proceedings of 13th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility, Zurich, Switzerland, February 16-18, 1999, pp.227-232

Abstract: Common-mode (CM) currents through cables attached to printed circuit boards are often the main cause of interference and many even dominate the direct radiation of the board. In this contribution we predict the coupling between the differential-mode (DM) circuit on the board and the CM circuit in a Bersier setup, by means of a rapid transmission-line model. This coupling is expressed as the ratio of the CM current and the DM current. Several boards with different complexity were studied in the frequency domain. For demonstration purposes a board with modern digital electronics was developed. Measurements between 100 KHz - 1 GHz agree with the TL models.

Index terms: Printed circuit board, common-mode current, circuit coupling, transmission-line model

ELECTRICAL PACKAGE MODELING INCLUDING VOLTAGE AND GROUND REFERENCE PLANES USING THE PARTIAL ELEMENT EQUIVALENT CIRCUIT (PEEC) METHOD

EMCABS: 08-5-99

B. Archambeault and A. Ruehli* IBM Personal Systems Division,
NC 27709, USA, *IBM Research Division, T.J. Watson Research Center, NY 10598, USA
Proceedings of 13th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility, Zurich, Switzerland, February 16-18, 1999, pp.233-238
Abstract: Proper decoupling of power and ground plane structures has been a subject of much controversy. Some EMC engineers believe proper decoupling design should be performed one way, and others will believe a different approach to decoupling design is best. Measurement of the effectiveness of different decoupling strategies is difficult and very time consuming. Today's focus is on rapid product design, and the need to have an effective design the first time. It is important to be able to analyze decoupling design strategies rather than employing the trial and error process which is often used. The need to be able to simulate the effectiveness of decoupling design approach is obvious. However, by it's very nature, this type of analysis is difficult since it includes metal planes coupled to a large number of circuit elements. Many modeling techniques are not well suited to this type of problem. We show that Partial Element Equivalent Circuit (PEEC) technique is useful for the solution of this type of problem. This paper describes work performed using PEEC to model large decoupling structures. Results show great promise for further work using PEEC for decoupling simulations.
Index terms: Decoupling design, decoupling simulation, package modeling, partial element equivalent circuit technique

DIAKOPTICS: AN EFFICIENT TECHNIQUE FOR EMC APPLICATIONS

EMCABS: 09-5-99

M.M. Ney and S. Le Maguer, michel.ney@enst-bretagne.frEcole Nationale Superieure des Telecommunications de bretagne,
France, Proceedings of 13th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility, Zurich, Switzerland, February 16-18, 1999, pp.339-344
Abstract: The paper describes a numerical procedure, called diakoptics, that allows one to solve for sub-domains of a large structure in a rigorous manner. Hence, one can optimize such a sub-domain during subsequent simulations without meshing the whole structure. This feature is very attractive for EMC applications that involve, for instance, shielding apertures. In addition, the technique is naturally well suited for transmission-line matrix (TLM) computations. Although diakoptics is very demanding in terms of computer cost for three-dimensional cases, an accelerating procedure can substantially reduce the memory and CPU time requirement. Examples of applications related to shielding and radiation show the validity of the approach.
Index terms: Numerical technique, transmission-line-method, diakoptics, three-dimesional problem

EQUIVALENT CIRCUIT MODELS FOR THE TIME-DOMAIN SIMULATION OF FERRITE ELECTROMAGNETIC WAVE ABSORBERS

EMCABS: 10-5-99

J. Paul, C. Christopoulos and D.W.P. Thomas, Principal contact: jdp@eee.nottingham.ac.uk, University of Nottingham, UK
Proceedings of 13th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility, Zurich, Switzerland, February 16-18, 1999, pp.345-350
Abstract: In this paper, the reflectivities of various ferrite absorbing structures are analyzed in the frequency-domain and Z-transform techniques are applied to develop time-domain models. For flat tiles an equivalent circuit is developed to describe the surface impedance and thus the reflectivity. For grid tiles and wood-backed tiles, the frequency-domain Prony method is used the extract the coefficients of the model from the analytic data. The frequency-domain Prony method is reviewed and the structure of a general discrete time model is described. These methods offer a systematic and general approach to the modeling of reflectivity functions in transmission-line modelling (TLM) or the modeling of surface impedance functions in the finite-difference time-domain (FDTD) method. results are presented comparing the reflectivity performance of the models with analysis. Finally, the performance of a practical anechoic chamber modeled using this approach is compared with measurements.
Index terms: Ferrite electromagnetic wave absorber, reflectivity, transmission-line modeling, equivalent circuit

NEW FREQUENCY-DEPENDENT MODELS FOR CLOSE-SPACED MULTIWIRE LINES OVER A CONDUCTING PLANE

EMCABS: 11-5-99

M. Kane, Ph. Auriol*, L. Krahenbuhl* and F. Buret*,
Kanem@csa.ca , Canadian Standards Association, Ontario,
M9W 1R3 Canada, *Ecole Centrale de Lyon, 69131 Ecully Cedex, France
Proceedings of 13th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility, Zurich, Switzerland, February 16-18, 1999, pp.431-436
Abstract: Electrical systems are often interconnected by wires arranged over ground or over a conducting plane. The paper highlights the importance of proximity effect consideration. Matrix impedances and admittances of very close spaced conductors over a ground plane are determined. The proposed model has been evaluated in a wide frequency range and compared to the case in which skin effect alone is considered. The results obtained are in good agreement with expectations. The model can obviously complete existing analytical models, which often neglect proximity effects.
Index terms: Close-spaced multiwire-line, proximity effect, impedance matrix, frequency-dependent model

CAPACITIVE VOLTAGE PROBE FOR NON-CONTACT MEASUREMENT OF COMMON-MODE VOLTAGER.

EMCABS: 12-5-99

Kobayashi, K. Tajima*, Y. Hiroshima* and N. Kuwabara*NTT Technical Assistance & Support Center, Japan*NTT Multimedia Networks Laboratories, Japan, Proceedings of 13th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility, Zurich, Switzerland, February 16-18, 1999, pp.545-550
Abstract: Capacitive voltage probe is described that can measure the common-mode voltage on a cable without touching its conductor. This capacitive voltage probe has with two coaxial electrodes; the inner electrode works as a voltage pickup, and the outer one shields the inner electrode. These electrodes separate into two parts for clamping to the cable. Using a high input impedance circuit, this probe measures the common-mode voltage by detecting the voltage difference between the two electrodes. The probe's characteristics were evaluated by measuring its linearity and frequency response. The results show that this probe has a dynamic range of 100 dB and flat frequency response from 10 kHz to 30 MHz. Errors in measurement due to the position of the clamped cable in the inner electrode and to differences in the cable radius were evaluated theoretically and experimentally. The results indicate that the influence of the cable position is small and the deviation in sensitivity induced by differences in the cable radius can be calibrated using compensatory data.
Index terms: Common-mode voltage, non-contact measurement, capacitive voltage probe, calibration

Calendar

EMC Related Conferences & Symposia

1999

June 7-9
MODE-STIRRED, ANECHOIC CHAMBER, AND OATS USERS MEETING - New Location, New Date (Originally scheduled in October 1998)
Underwriters Laboratories
Northbrook, IL
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June 22-24
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Jim Brahney, fax 724-776-1830

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EMC YORK '99
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Chris Marshman
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Register on-line at:
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October 4
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EMC COLLOQUIUM AND EXHIBITION
With keynote speakers Lee Hill and Howard Johnson and others
The DoubleTree at
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Costa Mesa, CA
Randy Flinders, 714.513.8012
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November 1-4
Sponsored by the IEEE Beijing Section and others
1999 INTERNATIONAL CONFERENCE ON COMPUTATIONAL EMC AND ITS APPLICATIONS (ICCEA'99)
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November 2-4
EMC ASIA 99: 2nd INTERNATIONAL EXHIBITION (WITH WORKSHOPS) ON EMC
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December 2-8
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2000

May 3-7
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September 11-15
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Prof. Johan Catrysse
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(For information on all meetings, contact Janet O'Neil, 425.868.2558)

May 21
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Tokyo, Japan

August 1 and 5
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EMCS Cooperating Symposia

U.K.: Biannually, even years, in September
Zurich: Biannually, odd years, in February
Wroclaw: Biannually, even years, in June

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1999 Tokyo, Japan
May 17-21
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August 2-6
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2000 Washington, DC
August 21-25
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