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Janet O'Neil, Editor



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President's Message Joe Butler - President, EMC Society

s I enter my second year as President of the IEEE EMC Society, I'm beginning to appreciate what I don't know about this job. I think by the time my two-year term ends at the end of 2001, I'll have figured it out. I'm fortunate to have the continuing support of Dan Hoolihan, past president, Janet O'Neil, secretary, newsletter editor, and chief protocol adviser, and Warren Kesselman who serves as treasurer and part-time administrator for the Society. The Board of Directors elected them to continue in these roles at our meeting last November. We have a new President-Elect, Todd Hubing. Todd has served on the Board of Directors for several years, most notably as VP Member Services and Associate Editor in this newsletter

for Chapter Chatter. Todd will serve one year as President-Elect then automatically assume the presidency for two years, followed by two years as past president. The Society is indeed fortunate that the Board of Directors has made such a wise choice in electing Todd. Todd brings a unique combination of strong technical bearings, very competent administrative skills, outstanding work ethic, and perhaps most importantly, humor to an otherwise potentially droll area of science and engineering. I look forward to effecting this transition year with him.

The Board of Directors also re-elected Don Heirman as VP Standards, Len Carlson, VP Communications Services, and Kimball Williams as VP Technical Services. Andy Drozd was elected as VP Member Services. The November meeting also allowed us to officially welcome those recently elected to the Board of Directors by the membership. These included new board member, Bruce Crain, past board members Dick Ford and Jim Muccioli, and continuing board members, Henry Ott, Henry Benitez, Mark Montrose, and Takeo Yoshino.

In my recent travels as President of the EMC Society I was fortunate to be able to travel to Paris, in part to attend an October 1st, IEEE Region 8, Division I and IV, Chapter Coordination Meeting. Elva Joffe, your Society's Region 8 Membership Chair, also attended this meeting and prepared an interesting report for this issue of the Newsletter. (See page 10.) This event, attended by many European Chapter chairs as well as fellow Society presidents, allowed me to gain some valuable insight into chapter support activ-

ities in countries where the cost of IEEE membership is essentially prohibitive. This is an area of discussion that has gotten significant airtime at our Board of Directors meetings and

Newsletter Staff

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

Editor Emeritus Robert D. Goldblum ITEM Publications 3 Union Hill Road West Conshohocken, PA 19428 610-834-0400 fax: 610-834-7337 e-mail: rgoldblum@RBitem.com

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: \$8700, PO, Box 179. Denver, CO 80201 303-977-5845 fox: 303-971-4306 e-mail: ray.j.perez@Imco.com

J.L. Norman Violette Violette Engineering Corp. 6927 Tyndale Street McLean, VA 22101 703-506-0528 fax: 703-506-0549 e-mail: enviolette@msn.com

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

EMC PERSONALITY PROFILE William G. Duff SENTEL 7601 South Valley Drive Fairfax Station, VA 22039, 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: dheirman@ worldnet.att.net EMCS BoD ACTIVITIES Janet Nichols O'Neil ETS-Lindgren 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. ntl.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: maqsood@ieee.org

INTER-SOCIETY ACTIVITIES David Case Cisco Systems 3875 Embassy Pkwy, Akron, OH 44333-0292 330-665-7396 fax: 330-665-7301 e-mail: davecase@cisco.com

PRACTICAL PAPERS, ARTICLES & APPLICATION NOTES Robert G. Olsen, Professor School of EECS Washington State University Pullman, WA 99164-2752 509-335-4950 fax: 509-335-3818 e-mail: olsen@eccs.wsu.edu

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President's Message

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will likely increase. Takeo Yoshino has been looking into potential IEEE Region 10 EMCS chapter formation outside Japan, i.e., China, while Carlos Sartori is doing similar work in IEEE Region 9, i.e., Brazil. Elya Joffe has been looking into such places as South Africa and the former countries of the USSR, and has recently effected a new joint chapter arrangement in Turkey. Further, with the election of Andy Drozd as VP Member Services, Bruce Crain has recently accepted the role of Membership Chair. This entire area of membership development and new chapter formation is likely to be a centerpiece of the Society's future activities.

Following our Board of Directors meeting in November, I attended the IEEE Technical Activities Board (TAB) meetings. This is the area of IEEE activity in which I am still learning. TAB consists of the presidents of the 36 Societies and three Councils, the ten division directors as well as some TAB elected officers. This organization meets three times yearly in order to address the activities of the IEEE. The topics discussed range from membership development, IEEE publications, Society initiatives, awards, and almost anything else you might think of which is involved in the IEEE. TAB is always looking for a few good men or women to serve on various committees. If you'd like to get more involved in the IEEE activities and improve your global view of the IEEE, please let me know and I can pass your name on to the correct people at IEEE headquarters.

As always, I hope to continue meeting the members of the Society as I travel around and about. If you have any questions or issues, please feel free to contact me at the Chomerics Division of Parker Hannifin in Woburn, MA at phone 781-939-4267 or by e-mail at j.e.butler@ieee.org. **EMC**

NOTICE: BYLAWS CHANGE

The EMC Society Board of Directors, at its November 2000 meeting, approved a motion to change scheduling dates in its Bylaws paragraphs 4.5, 4.6 and 4.7 relative to the Director-at-Large election cycle. The IEEE has approved the amendment and it will become effective following distribution of this notice. The amended paragraphs are as follows:

4.5 On or before 15 July, the Chairman of the Nominating Committee shall mail to IEEE Headquarters the slate of at least 12 nominees for election to the six offices to be filled on the Board of Directors.

4.6 On or before 15 August, IEEE Headquarters will mail ballots to Society members, with the request that the ballots be returned to IEEE Headquarters by 1 October.

4.7 IEEE Headquarters will have completed ballot count, and by 15 October will have notified all nominees and the Board of Director officers of the results of the election, to be effective 1 January of the following year.

Chapter Chatter



Todd Hubing, Associate Editor

Have you met Tom Van Doren? Tom's been teaching engineers and engineering students to solve EMC problems since the early days of EMC. (I'm still not sure exactly when the early days were.) If you've ever attended one of his courses, you know that he has a knack for reducing complex situations to their simplest and most intuitive form. You might have a situation where a high-speed computer network with 2,000 components and four miles of wiring fails intermittently. Tom will examine the situation, review the data and say something like "Can't we model the problem like this?" Then he'll draw a circuit with an inductor, two capacitors and a resistor that completely describes the problem at hand and makes the solution obvious.

I've learned a great deal from Tom over the years. He's been both a teacher and a role model to me. He officially retired from the university so that he could spend more time teaching and doing research (yes, I'm aware of the irony). He still actively leads and contributes to EMC research projects. He also travels all over the world teaching engineers to recognize and solve EMC problems.

Anyone who knows Tom will tell you he's a nice person with a sincere interest in making the world a better place.

Signal Ground vs. Signal Return

Many EMC problems are caused by poor grounding strategies. Tom Van Doren feels that many of these problems could be avoided by simply changing our terminology. Safety and power engineers use the word ground to refer to a conductor at a known reference voltage that does not carry current under normal circumstances. Conductors carrying intentional currents that are connected to ground are given a different name (e.g., neutral). Unfortunately, over the years, the designers of digital printed circuit boards and systems have used the word ground to refer to any conductor serving as the zero-potential reference, even when it also carries signal or power currents.

This has resulted in a great deal of confusion. Design rules and grounding strategies that make perfect sense for safety or reference grounds can have disastrous consequences when applied to conductors carrying signal or power currents. The unfortunate terminology has helped to feed and clothe generations of EMC engineers, but the costs resulting from downtime and missed opportunities have been high.

Tom has led a relentless campaign against overwhelming odds to correct this situation. You'll never hear Tom use the phrase ground plane or ground wire unless he is referring to a non-current carrying conductor. Instead, he prefers the terms return plane, power return, or signal return when referring to conductors that carry power or signal currents back to their source. Those who know him well are aware of other characteristics he possesses. For example, he always has been and always will be both a teacher and a student of engineering. He works hard and accomplishes great things, but does not seek rewards or accolades. Also, any engineer who has ever attended one of his courses or talked to him for more than five minutes knows that you should never refer to a current carrying conductor (e.g. a plane in a printed circuit board) as "ground" when Tom is present (see sidebar: Signal Ground vs. Signal Return).

Since these are characteristics that I think all EMC engineers should strive to attain, I've tried to embody them in a song. If there's one thing I've learned during my brief songwriting career, it's that people seem to appreciate my songs more when I don't sing them. So, I'll just put the words down here and you can imagine the music. If you're over 35, I recommend that you imagine that this is a folk song where the tempo of the chorus is twice as fast as the rest of the song. If you are under 35, this will probably sound better as a rap song. If so, keep the tempo constant, shout the words in a monotone voice, and insert scratchy phonograph noises.

The Tom Van Doren Song

As Socrates pondered the nature of life He said, "Why is there war, and why is there strife?" Plato responded with a dull, blank stare, But young Tom Van Doren had his hand in the air

He said ...

{chorus} That's a tough problem and I'll tell you how to work it.
You can model anything with an RLC circuit.
With a little intuition and a minimum of math,
you will find the answer in the current path.

At the Scopes Monkey trial there was no question greater Did man evolve from apes, or was God the creator? The trial took a turn when one witness was sworn in And the man of the hour was Thomas Van Doren

He said ...

{chorus} That's a tough problem and I'll tell you how to work it. You can model anything with an RLC circuit. I recommend you release the defendant. For the problem at hand is source independent.

Sigmund Freud dated girls one after another. None of them it seems was as nice as his mother. He said, "Tom I'm developing an odd complex. Can you help me understand the opposite sex?" Tom said ...

{chorus} That's a tough problem and I'll tell you how to work it.

You can model anything with an RLC circuit. He said women by their nature have a complex reluctance. So you'd better maximize your mutual inductance.

Einstein was working on his theory of light. But he couldn't get the variables to work out quite right. So he sent a telegram to Thomas V, That said, "I think E is equal to m times c."

Tom replied... {chorus} That's a tough problem and I'll tell you how to work it.

Atlanta

David Dennis, Chair of the Atlanta Chapter reports that they held a joint meeting with the Atlanta section on November 15, 2000 featuring Mark Montrose. Mark delivered a presentation entitled "EMC and the PCB: Fundamental Concepts and Design Techniques." The discussion focused on many different aspects of PCB design relative to signal integrity and EMC. All of his concepts and techniques were explained using practical examples and clear explanations. For information on upcoming events please visit the Atlanta Chapter website at http://www.ewh.ieee.org/soc/emcs/ atl/atl-emc.htm.

Austria

The IEEE EMC Society Austria Chapter held their first meeting in Graz, the capital city of Styria. The meeting was held in October and featured a talk about "EMC Measures as a Function of the Number of Pieces" presented by Andreas Suschnig at the Technical University of Graz. After the talk, Mr. Suschnig opened up a discussion with the audience. The discussion was followed by a nice social event in the city of Graz. In November, the chapter organized a lecture on EMC with two presentations. The lecture was held at the Austrian Research Center in Seibersdorf. It started at 9:00 am and ended at 12:30 pm with a short break in between. 36 people attended the meeting. The first presentation was entitled "The European Union's EMC Directive and the CE Marking of

Electronic Products." The second presentation discussed EMC compliant design of electric and electronic appliances. Kurt Lamedschwandner, Chair of the EMC AUSTRIA Chapter, gave both presentations. For information on upcoming meetings you can check the Austria Chapter's website at http://ewh.ieee.org/r8/austria/Chapters/ EMC/home.html.

Central and Southern Italy

During October Dr. Chris Holloway, Research Scientist in the Electromagnetic Field Division at the National Institute of Standards and Technology (NIST), gave three seminars. These included: "Radio Wave Propagation Modeling for Broadband Wireless Communication," "Application of the FDTD Technique for Various EM problems," and "Comparison and Analysis of Various Types of Absorber Used in Anechoic and Semi-anechoic Chambers for Testing of Digital Devices." Dr. Holloway was in Rome as a Visiting Professor at the University of Rome "La Sapienza." He was invited by the EMC group, and in particular by Professor Sarto. Chris is also on the Graduate Faculty at the University of Colorado, Boulder, where he gives courses on EM theory, wave propagation and antenna theory, and directs research for Masters and Ph.D. students.

Central New England

The Chapter meeting on September 13 was a joint meeting with the Northeast Product Safety Society (NPSS). This was the 5th year of this joint event held in

You can model anything with an RLC circuit. He said your equation's relatively impaired. I know you're the genius, but the c should be squared.

Intel was developing their Pentium III. But their boards had problems with the FCC. They waived the rubber chicken and tried incantations, then called Tom Van Doren for his recommendations. Tom said...

{chorus} That's a tough problem and I'll tell you how to work it. You don't need a model that's an RLC circuit. The problem is clear. Here's some advice that's sound. Never, ever, ever gap your signalRETURN!

> September each year to start out the season. The speaker was Independent Consultant and Distinguished Lecturer Douglas C. Smith. The topic presented was: "Unusual Forms of Electrostatic Discharge." The speaker reviewed ESD characteristics and described unusual forms of ESD not covered by existing Standards. This can cause interesting, if not serious, field problems. The presentation included demonstrations of some of these effects. The speaker is the author of the book "High Frequency Measurements and Noise in Electronic Circuits," and is currently working on his second book. There were 46 members and guests in attendance.

> The Speaker at the Chapter meeting held on October 4 was EMCS Distinguished Lecturer, Werner Schaefer NCE, of Cisco Systems, San Jose, California. The topic was "New Advances in Radiated EMI Measurements." The speaker discussed a new test methodology for radiated EMI measurements along with its implementation in a software package. Furthermore, tools for possible data analysis (e.g. signal discrimination) and a description of different measurement systems were also presented. There were 18 members and guests in attendance.

The featured speakers at the Chapter meeting held on November 8 were Clayton Forbes and Jason Crete of National Technical Systems, Boxborough, MA. The topic presented was "The Divergence and Convergence of ETSI ETS 300-19 Series and Telcordia GR-63 Core Environmental Requirements for Telecommunications Equipment." The speakers addressed regulatory and environmental design and testing of telecommunications equipment bound for inter-



Tim Stevens of Dell Computer, Michael Foegelle of ETS-Lindgren and Jim Greenwood of Airep Electronics (L-R) are the newly elected Central Texas Chapter officers for 2001.

national markets. The material presented demonstrated that with proper planning, manufacturers could reduce their test costs and time to market. This will also eliminate redundant testing. There were 32 members and guests in attendance.

Central Texas

The Central Texas Chapter of the IEEE EMC Society has elected officers for the 2001 calendar year. The new chair is Dr. Michael Foegelle with ETS-Lindgren. The

new vice-chair is Tim Stevens with Dell Computer. The new secretary is Jim Greenwood with Airep Electronics. The new officers' terms expire on December 31, 2001. The URL for the chapter's website is http://www.texas-emc. Michel Mardigian taking quesweb- site may be accessed meeting. for news, links, announcements, officer contact information, and the chapter calendar of events.

Dallas

After a break for summer vacations and the 2000 IEEE Symposium on EMC, the first fall meeting of the Dallas Elya Joffe answers questions EMC Chapter was held from the audience relating to on September 21 at KTL ElectroMagnetic Radiation in, Lewisville, Texas. Our (EMR).

speaker was Distinguished Lecturer Michel Mardiguian, who spoke on "Radiated EMI Compliance with Digital Clocks Above 100 MHz." There were 25 in attendance (17 IEEE members). KTL provided pizza and soft drinks prior to the meeting. The second fall meeting was held on October 17 at NTS in Plano, Texas. Our speaker was Jim Press, NTS Chief Engineer, who spoke on the differences in requirements between Bellcore GR-1089-CORE and ETSI 300-386. There were 42 in attendance (16 IEEE members). After the meeting, Jim Press and Jim Abel conducted a tour of the newly installed Bellcore test facility at NTS Plano. NTS provided barbeque and soft drinks prior to the meeting. The final fall meeting was held on November 13 and was also at NTS in, Plano, Texas. Our speaker was EMCS Distinguished Lecturer Elya Joffe, who spoke on "Electrophobia: Why are People Really Scared of Electromagnetic Fields?" He discussed several examples of transmitter installations and several studies conducted to determine RF hazards in Israel. There were 46 in attendance (29 IEEE members). Joe Stanfield of SEI, Richardson, Texas, provided pizza and soft drinks prior to the meeting. KTL



fr.st/ (or http://tstevens. tions from the group in attenhome.texas.net/emc/). The dance at the September 21st



Jim Abel and Jim Press answering questions on Bellcore and ETSI test requirements.



Bob Queen (Dallas Chapter Vice Chair), Gary Shimko (Dallas Chapter Chair), Elya Joffe and Bill Paschetag (Dallas Chapter Secretary/ Treasurer) at the November meeting.



Jim Press explains the NEBS levels of testing.

came to the rescue by providing a pccompatible projector to show Elya's PowerPoint presentation. Our thanks go to Dale Reynolds (of KTL in Lewisville) for his assistance with the projector.

Eastern North Carolina

Despite being a relatively new chapter, the Eastern North Carolina EMC Chapter decided to hold a one-day regional EMC event with Clayton R. Paul as the headline speaker. (Of course, how can you go wrong with a big name speaker like that?) It was their first big event and it was a huge success. Jim Marley of Underwriters Laboratories, Inc. and his staff took care of registration and the general administrative running of the

> event. (Thanks Melissa!) Jim is chairman of the Eastern North Carolina EMC Chapter. Some 80 EMC engineers attended the one-day tutorial presented by Dr. Paul titled "The Fundamentals of EMC." The majority of the engineers present were new to EMC so the topic was perfect. Engineers came largely from the greater Research Triangle Park area, but also from as far away as Atlanta. There were several vendors present who displayed the latest in EMC products and services from the table-top display area. Thanks go to Dr. Paul for donating his time to make this presentation and to the participating vendors for contributing to the event's success.



Jim Marley of Underwriters Laboratories at Research Triangle Park, North Carolina chairs the local EMC chapter and organizes EMC events. He is shown taking a break during the one day tutorial and exhibition he chaired on October 23.

Germany

In November, the Germany chapter elected new officers to three-year terms. The chair is Prof. Dr.-Ing. Heyno Garbe of the University of Hannover. The vicechair is Dipl.-Ing. Diethard E. C. Möhr of Siemens AG. The treasurer is Dr.-Ing. Frank Sabath. The Technical Activities Chair is Dr. Frank Gronwald of the University of Magdeburg.

Israel

On November 23, the Israel IEEE EMC Chapter held the last Chapter meeting of the year 2000. The meeting consisted of a full day workshop, hosted and co-sponsored by the AEAI, the Association of Engineers and Architects in Israel. The meeting was held in the beautiful coastal city of Haifa. Over 120



Clayton Paul and Janet O'Neil participated in the Eastern North Carolina Chapter event on October 23. Dr. Paul provided the tutorial "The Fundamentals of EMC" while Ms. O'Neil organized the vendor activity of table-top displays.

participants took part in this meeting, including representatives from the high tech industry, military, standards organizations and development institutes. The Workshop was dedicated to a professional discussion of biological effects of EMF, and was intended to present facts and upto-date information on this topic, free from public hysteria and bias. Chapter members and guest experts presented the lectures delivered in the workshop. They dealt with "hot" topics in this field, including: "Main Characteristics of Cellular Technology and Environmental Considerations from the Service Providers' Perspective," by Mr. Zvi Sh'hori, Cellcom; "Non Thermal Effects of Exposure to Non-Ionizing Radiation," by Dr. Joshua Weissman, Elbit, Computers, Ltd.; "Possible Effects of Cellular Radiation on Cancer," by Dr. Sigal Sadetzki, Tel-Hashomer Hospital; "Development of Techniques for Increase of



Jeff Marquart (L) of Home Director was the lucky winner of the raffle drawing for a Fischer Custom Communications (FCC) probe. The raffle was held during the reception following the Clayton Paul tutorial. Allen Fischer (R) of FCC was pleased to donate the probe to the Eastern North Carolina Chapter.

of Radiation Efficiency, Quality Communications and Reduction of SAR of Hand-Held Wireless Telephone," by Prof. Jacob Gavan, Holon Academic Technological Center; "Development of Statistical Distributions of Radiated Power Density, for Human Exposure from Base Stations and Hand Held Phones," by Dr. Yuri Zlotnikov and Prof. Jacob Gavan, Holon Academic Technological Center; "Safety of Usage of Personal Hand Free Speakers for Cellular Phones - What Mislead the Britons?", by Dr. Menahem Margaliot, Soreq Nuclear Research Center; "Level of Exposure to Cellular Phone Radiation in the Presence of a Corner reflector," by Mr. Oren Hartal, RAFAEL/ADA; and "Impressions from the Millennium Workshop in



Participating vendors at the Clayton Paul October 23 event included Bill Watts of EMC Technologists and Tom Revesz of Haefely Test (L-R).



The Robde & Schwarz dynamic duo of Sean Emerson and Vic Hudson (L-R) presented the latest in EMC test instrumentation during the Eastern North Carolina Chapter event on October 23.

Crete Regarding Biological Effects of Electromagnetic Radiation," by Mr. Moshe Netzer, RAFAEL/ADA.

At the end of the presentations, an expert panel was held, with all speakers, and Mr. Emil Koifman, Chair of the Society of Electrical and Electronics Engineers in the National AEAI. In addition to the above topics, this meeting was also dedicated to the presentation of awards on behalf of the IEEE EMC Society (presented at the 2000 IEEE International Symposium on EMC in Washington, DC). Awards were given to the following, in the presence of Chapter members and all other attendees: Moshe Netzer, Certificate of Appreciation, for continuing and outstanding support of the Israel Chapter and the development of its technical activities and for promoting the cooperation between the Israel EMC Chapter and related (non EMC) organizations, Moshe Henig, Certificate of Appreciation, for continuing and outstanding support of the Israel Chapter, with particular emphasis on increasing the support and cooperation between high-tech industries and the Israel IEEE EMC Chapter and Moshe Netzer, Certificate of Achievement, for over two decades of significant professional achievements and leadership, in Israel and internationally, in the study and development of models for Electromagnetic Interactions with Ordnance (HERO) and Electrostatic Discharge (ESD) hazards. In addition, the Israel EMC Chapter was awarded the "Most Improved Chapter of the Year" award for the year 1999-2000.

It is noteworthy that another award, Certificate of Appreciation, was presented

O'Neil by Janet



Lunchtime at the Clayton Paul event provided some good networking time for the EMC engineers present, including (L-R) Claude Cesard of Schaffner, Ed Vitek of Ericsson and William Scheer of Quantum Change.

to Mr. Albert Kalo, for his leadership and pioneering in the development of EMC Standardization in Israel, as Chairman of the Israel Technical Committee for EMC, which led to the national recognition of the need for Israeli EMC Standards. This award was presented to Mr. Kalo in a special, ceremonial meeting of the Technical Committee for EMC Standardization, in the presence of the CEO of Israel's Institution of Standards, Mrs. Ziva Patir. The entire event was a great success as noted by all attendees. An extended article on the event was also published in the Newsletter "Mehandesim" ("Engineers") of the AEAI.

Melbourne

Ed Kirchner, secretary of the Melbourne chapter, reports that their November meeting was held on the campus of the Florida Institute of Technology.

28 engineers were treated to a lecture by Mr. Doug Smith, an IEEE EMC Society Distinguished Lecturer. Doug spoke on the subject of "Unusual Forms of ESD." His entertaining lecture, which included both dramatic demonstrations and amusing anecdotes, taught the audience that disruptive ESD discharges might be generated from such unexpected sources as loose change jingling in a pocket, and sitting down in a common office chair. As is often the case for EMI/EMC problems, Doug described how successful identification and elimination of these unique ESD upsets takes a good combination of practical and theoretical engineering skills, as well as an inquisitive and imaginative nature. The audience left the meeting with a great deal of new knowledge, including how to impress your friends with an office chair and an AM radio. A word of thanks goes out to Dave Baker of Agilent Technologies and Joe Bar' of



The Eastern North Carolina Chapter event on October 23 was a huge success thanks to the efforts of the illustrious speaker, Clayton Paul. Jim Marley (R) is shown expressing thanks for a job well done at the conclusion of the tutorial.



Israel Chapter photo of the organizers, including (L to R): Prof. Jacob Gavan, Moshe Netzer, Lt. Col. Amnon Davdevany, Elya Joffe, Dr. Yossi Pecker, Dr. Alex Vilensky, Oren Hartal.

Rubicom Systems for enabling the demos by loaning us test equipment! Prior to Doug's lecture, the crowd enjoyed pizza and cold drinks in the Florida Tech lecture hall lobby, while talking informally about local issues important to EMC engineers. The number of people attending this meeting was the highest total so far for the Melbourne Chapter, which completed its first full year in 2000. We look forward to further growth in 2001.



Israel Chapter opening panel, including (L to R): Moshe Netzer, Elya Joffe, Oren Hartal, Dr. Alex Vilensky, Dr. Yossi Pecker, Jacob Hai (AEAI).

Oregon and SW Washington

Ali Elmi reports that the Oregon and SW Washington chapter started the season in September with a four-hour workshop presented by Dr. Tom Van Doren from the University of Missouri-Rolla. The workshop was held at Intel in Hillsboro. The topic of his presentation was "How to Diagnose Electrical Noise Problems." There are only four mechanisms for transferring electrical energy. Each noise coupling mechanism and the conditions necessary for determining its existence was discussed. Then equivalent circuits were presented to model these mechanisms. At the end of the presentation, teams were created for a competition and the participants were given an opportunity to diagnose several practical examples.

In October, Mr. Kevin Slattery of Intel Corporation presented "Near Field Surface Scanning of VLSI Devices." The presentation described three methods that a designer needs for identifying and characterizing emissions sources, particularly those associated with VLSI devices such as microprocessors, ASICs and other large scale devices that use high speed clocks. The topic was very interesting and even included a slide of the measurement system used, the BMG1 (Big Metal Gizmo).

In November, Mr. Jim Muccioli of Jastech EMC Consulting presented "X2Y Filter Technology as Single Component Solution for Noise Suppres-sion." The presentation was about the new capacitive technology introduced by X2Y Attenuators which is an architecture that can be used to manufacture a variety of devices, including capacitors, decouplers, transient voltage suppressors, and filters, thus overcoming the limitations of currently available signal-integrity solutions by reducing the number of parts while enhancing performance. In December, the chapter held its annual Holiday Social at the Governor Hotel in downtown Portland. This was a chance for Chapter



Melbourne Chapter Chair Bruce Crain (right) presents IEEE EMCS Distinguished Lecturer Doug Smith a Certificate of Appreciation.

nificant others to mingle in a non-technical environment. A good time was had by all that attended.

members and their sig-

Phoenix

Harry Gaul reports that the Phoenix chapter held a half-day EMC workshop on October 19th, 2000. The featured speaker, Doug Smith was delayed by an hour due to airline problems, so

Daryl Gerke filled in at the last minute with an encore presentation of his light-hearted talk on "Design For Failure." In this talk we learned the worst ways to design for EMC such as maximizing emissions through the use of pigtails and other antenna-like structures. The benefits of designing for failure include gaining visibility from the company's vice-presidents and ensuring a steady workload for the EMC department. Many thanks go to Daryl for

warming up the audience prior to Doug's arrival.

The featured speaker, Doug Smith of D. C. Smith Consultants presented an enlightening talk on "Overview of High-Frequency Measurements for Design and Troubleshooting." In this talk, Doug explained how the typical 10x, 10 Megohm off-the-shelf oscilloscope probes are advertised as highimpedance but in reality have an impedance that becomes quite low for frequencies above a few tens of MHz. Indeed, for signal frequencies above 30 MHz, a better probe selection would be a 500-ohm low impedance probe. That probe is easily made by simply inserting a 450-ohm resistor in the end of a coaxial cable.

Another major problem with scope probes is the influence of the ground lead. Balanced probes provide a good way to reduce the ringing effects associated with ground leads. Doug shared with us a design for a balanced coaxial probe that can be built rather inexpensively by using a Mini-Circuits RF combiner. The frequency range of the probe is from 1MHz to 500MHz.

One final thought that Doug left us with was that when performing EMC tests of Category 5 Ethernet products, one should always use new cables. Otherwise, old cables may have kinks that will disturb the balance of the cable with a consequent increase in common mode emissions.

On December 7, Matt Hammond of Tektronix presented a talk entitled "How to Choose the Correct Spectrum Analyzer for Your Application." This talk was a discussion of the differences between swept-heterodyne and real-time spectrum analyzers. The conventional sweptheterodyne spectrum analyzers are very useful when dynamic range and phase noise are important. But they can miss transient signals such as frequency hopping carriers. The real-time spectrum analyzers can be very useful for transient signals because they do not have time gaps in their acquisition. Essentially, the real-time analyzers have an analog RF front end with a 30MHz wide IF. The IF output signal is digitized in the time domain and converted

using FFT techniques into the frequency domain. The resulting measurement then is displayed in three dimensions including frequency, amplitude, and time. Matt concluded his talk with a demonstration of the two types of analyzers with a frequency-hopping signal as the source. Check out our web site at http://www.ewh.ieee.org/r6/phoenix/ phoenixemc/ for the latest schedule on upcoming talks.

Rocky Mountain

At the October meeting, 28 members and guests enjoyed a highly interactive and informative technical program on "Differential Impedance Finally Made Easy" presented by Dr. Eric Bogatin. An increasing number of designs are leveraging the performance features of differential pairs. Yet their behavior and design principles are confusing to most engineers. In this presentation, Dr. Bogatin



Doug Smith demonstrates the problems associated with off-the-shelf scope probes on a 50MHz clock signal.

first reviewed the basic notion of characteristic impedance of one line and then extended this to two lines and introduced the principle of differential imped-

ance. He then looked at how the geometry and material properties affect this important parameter. Finally, he looked at some of the special properties of differential pairs, such as crossing a split in the return path and transitioning from a differential pair on a circuit board to a twisted pair. It doesn't get any simpler than this. Dr. Bogatin divided the afternoon into two, one-hour lectures with a 15minute break in the middle and time at the end for questions. The presentation materials for this and previous meetings are available for download at the chapter website, http://www.ieee.org/rmcemc

The November 30 meeting was another Rocky Mountain Chapter first: a joint meeting with the Colorado State University IEEE Student Chapter, thanks



Matt Hammond explains the differences between swept-beterodyne and real-time spectrum analyzers.

to CSU Chapter Chair, Jennifer Flint, and advisor Dr. Carmen Menoni for working with Chas Grasso and Doug Smith to arrange the special meeting at CSU. 32 RMC and CSU chapter members attended to hear Doug Smith present "EFT Testing Per IEC 61000-4-4 (and some unusual uses for an EFT generator!)." Doug described the background of EFT testing (IEC 61000-4-4) along with common pitfalls. Doug also shared some tips on the testing process, including a common mistake that some test labs make that can nearly double the stress on the EUT. If you have an EFT Burst Generator, what do you do with it when it is not being used (probably most of the time unless you work for a test lab)? Doug covered some test/debug techniques using an EFT generator that have



Lyle Luttrell, RMC Chapter chair, Jennifer Flint, CSU Chapter Chair, Doug Smith, speaker, and Chas Grasso, RMC Vice Chair wrap-up of a successful joint meeting between the Rocky Mountain Chapter and CSU Student Chapter.



RMC Chapter officers Chas Grasso, Lyle Luttrell, and Bob Reinert welcome Dr. Eric Bogatin at his presentation on Differential Impedance Finally Made Easy.



Seattle EMC Chapter Members Len Carlson and Gordon Mills (L-R) enjoy the October chapter meeting.



Speaker Kevin Slattery of Intel pauses to think before answering an in depth question following his presentation to the October Seattle EMC Chapter meeting.

nothing to do with EFT, such as solving ESD problems and measuring noise margins at the PWB and circuit trace level. Doug kept everyone's attention with his anecdotes and war stories about EMC phenomena past, present and future.

In December, the Rocky Mountain Chapter sponsored a one day seminar on "High Frequency Measurements and Noise in Electronic Circuits" by Douglas C. Smith. Ten people attended this seminar where Doug described in depth how to measure signal and noise in high-speed digital and analog circuits as well as switching power supplies. These measurements were then used to characterize high-speed effects in electronic circuits including design verification and troubleshooting. Sources of measurement error were discussed. This seminar also explored the connection between signal integrity and EMC. The measurement techniques were related to design issues to improve equipment EMC and signal integrity performance and improve the overall reliability of electronic systems.

Report for IEEE Division I & IV Region 8 Chapters Meeting

Paris, France, October 2000 By Elya Joffe, EMCS Region 8 Membership Chair

I had the pleasure to represent the EMC Society at the IEEE Division I and IV Region 8 Chapters Meeting. The meeting took place in Paris, France on October 1, 2000.

The Mercure Tour Eiffel Suffren Hotel was beautifully situated, virtually at the base of the Eiffel Tower (the Tour Eiffel), which provided a beautiful background to the meeting as well as a distraction (several attendees were "lost" in the afternoon session).

The primary purpose of the meeting was to get a status report of the current Society/Chapter relationships within Divisions I and IV; the fastest growing Region of the IEEE is Region 8. In addition, the representatives were asked to share experiences and ideas on how we can improve these relationships and the Chapter activities.

More than 50 Chapters from 28 different countries in Region 8 were represented at the meeting, in addition to presidents and representatives from the Societies and Region 8 headquarters. The overall attendance exceeded 80 people!

The key to the meeting was the sharing of individual Society experiences, best practices and the compilation of recommendations, conclusions and feedback. Reports were also given on Society/ Chapter communications, Chapter technical activities, membership development and educational activities.

The importance of the meeting was obvious from the large number of attendees and the high rank of the IEEE officers who attended the meeting. Those included the IEEE Division I Director and our very own EMCS member and past president, Bill Gjertson, IEEE Division IV Director, who delivered the opening remarks at the meeting and set its objectives.

Following the opening remarks, reports were given by the Region 8 Representatives and by the Society Representatives of Divisions I and IV.



Photo by Elya Joffe

The Eiffel Tower provided an ideal backdrop for a meeting of engineers in Paris.

Each were allocated 7 to 10 minutes (although some "borrowed" significantly more time).

Region 8 was represented by the highest ranking officers, including IEEE Region 8 Director, Rolf Remshardt, Region 8 Vice President, Tony Davies and IEEE Region 8 Chapter Coordination Committee Chair, Tony Davies.

From the introduction provided by the IEEE Region 8 Director, it was revealed that Region 8 consists of over 35 countries, some of which are among the lowest income countries in the world. The EMCS is proud to have several Chapters in Region 8, some of which, in fact, are in lower income countries. Apparently, the IEEE has been considering the difficulties arising with this condition, and has established a Region 8 "Help Desk", for assisting in solving administrative and similar problems. In addition, the IEEE has established a Voluntary Contribution Fund (pay attention to that line on your renewal forms) which is used to help low income participants to attend Symposia, for instance.

The importance of meetings such as this should not be minimalized, however,

continued on page 42

it is considered to hold it only bi-annually, rather than annually. Nevertheless, Societies were encouraged to organize Regional/International Society Chapter Retreats. I would like to encourage the EMCS to hold a Region 8 or even an International Chapter Retreat in conjunction with the 2003 IEEE International Symposium on EMC, in Tel-Aviv, Israel.

Following a short welcome address by the French Section Chair, attending presidents or representatives of the Division I and IV Societies provided a short presentation about their respective Societies. This included the following Societies: MTTS (Microwaves), EDS (Electron Devices), APS (Antenna and Propagation), CASS (Circuits and Systems), CES (Consumer Electronics), CPMTS (Component Packaging and Manufacturing Technology), LEOS (LASER and Optics), SSCS (Solid State Circuits) and EMCS. This latter presentation was given by our very own EMCS President, Joseph Butler.

In his presentation, President Butler described the organization of our BoD with particular emphasis on the globalization efforts and representation on the BoD. He provided some statistics on the EMCS membership; total members number approximately 5,000 people of which 1,200 are from Region 8! There are 48 total EMCS Chapters, eight of which are in Region 8.

The global activities of the EMCS cover Technical Co-Sponsorship of EMC Symposia worldwide, and those were listed by Mr. Butler, along with the International Symposia Program, in the US and abroad, including the 2003 Symposium, to be held in Region 8, in Tel-Aviv, Israel.

Mr. Butler put special emphasis on our practices we implement to encourage global participation in the BoD. These include:

- 1. The travel reimbursement policy for BoD members traveling outside their region to attend EMCS Board meetings
- 2. The Distinguished Lecturer (DL) Program, where two of the five DLs reside in Region 8
- 3. The unique election procedures for helping candidates from smaller regions to be elected to the BoD.

It was very enlightening to see what other IEEE Societies were doing, in addition to the EMC Society. There were ideas worthy for the EMC Society to consider. Nevertheless, it is interesting to note that, when considering the difference in size of the Societies, the EMCS definitely has much to be proud about in its achievements. Each Society representative had five to 10 minutes to share Society practices and activities. All societies practice common activities such as:

- 1. Distinguished Lecturer Program
- 2. Chapter Subsidies (equivalent to our EMCS Haislmaier Angel Fund, however, in larger sums)
- 3. Magazines and Newsletters
- 4. Society Web Pages
- 5. Recognition and Awards Programs

Several of the more innovative Society practices, several of which are worthy of consideration by the EMCS, include:

From MTT:

- 1. Provide US\$350 to encourage the Chapters' submittal of Reports
- 2. Regional/International Chapter Chair meetings
- 3. Publish a membership directory
- Provide financial support to Chapter Chairs for traveling to Global Symposia

From EDS:

- 1. A US\$25 life time membership dues (not to be confused with the honorary life membership award) compared to US\$5 annual membership dues (that would be US\$75 for the EMCS)
- 2. Have the membership roster posted on-line
- Conduct short courses independent of Conferences (1 day, quarterly) covering upcoming technologies
- 4. Videotape lending library
- 5. Special subsidy to chapters in low income countries in Region 8
- 6. "Chapter of the year" award (including a financial award)
- 7. Graduate student fellowship awards (up to US\$10K)

From APS:

- 1. Prepare Chapter Handbook (we should have one "on line")
- 2. Technical libraries
- 3. Coordination of Joint presentations and meetings with other societies
- 4. Formation of Student Branches



Elya Joffe, Region 8 Membership Chairman, and his wife Anat enjoyed sightseeing in Paris following the IEEE meeting. Here they are pictured at the world-famous Louvre museum.

From CAS:

- 1. VPs for each region on the BoD
- 2. Hold conferences abroad every 3 years
- 3. Allocate US\$2,000 for DLs traveling outside their regions, and US\$1,000 for DLs traveling within their regions
- 4. Provide travel support to Chapter Chairs to attend BoD meetings
- 5. Collaborate with other non-IEEE organizations in novel locations

From CPMT:

- 1. Web based courses
- 2. Global and Regional Chapter meetings
- 3. Recommend for stronger chapters:
 - International Conferences
 - Encourage contribution to Newsletter Chapter Column
 - Continuing Education Program
 - (and provide certificates for points accumulated)
 - Banner for "Chapter of the Year"

From LEOS:

- 1. Affiliate group membership
 - 10 people for one fee (each pay 1/10th)
 - Only one copy of publications is provided
 - DLs are encouraged to visit membership groups
 - Groups are encouraged to join with other groups into chapters

From SSCS:

1. For countries where income is lower than US\$8,600, the Society will provide 3-year support to start a new Chapter.

Interestingly enough, some other Chapters are about to, or have just celebrated, their 50th anniversary, and it is recommended to communicate with them, to investigate what special activities were planned by them for that special event. The 50th anniversary of the EMCS will take place in 2007.

Following the presentation by the Societies present, Mr. Peer Martin Larsen, Region 8 Membership Development Committee Chair, provided a presentation on Membership Development at the Chapter Level. His presentation covered four main aspects (R4):

- Recruitment (of new members)
- Retention (of current members)
- Recognition (of active members)
- Recovery (of lost members)

He described the services the Societies, Region and IEEE as a whole can provide to assist in the <u>recruitment</u> of new members. These include registration material as well as promotional material for display and "give away" in Chapter and section activities (material can be obtained from w.hunter@ieee.org).

For <u>retention</u> of current members, he recommended that chapters appoint a person to be responsible for allocating arrears status members (members who are backwards in their membership renewal), and to stimulate their renewal.

With respect to <u>recognition</u>, he listed the "Senior membership" levels be provided to worthy members, and recognized in the awards program of the Society.

A short presentation on the Publishing Activities of IEEE followed by Mike Lightner. That presentation focused on the improved services the IEEE could provide to its membership, including IEEE Xplore (see the IEEE web site) and e-improvement of other services of the Society to its membership. It was interesting to learn that about 50% of the IEEE revenue comes from "outside IEEE" sources, i.e. from sales of the IEEE publications and services, such as Transactions, Symposia records, etc. That emphasized the dilema of wanting to increase recruitment, on the one hand; however, due to the subsidized cost of services to the membership, that would lead to a significant reduction in the income of the IEEE (which, beyond being a technical organization, as we'd like to think of it, it is also a "big business" as put by Mr. Wyndrum).

Coffee and lunch breaks took place, and the quality of the French food was noteworthy. But these breaks also gave the participants a chance to—"mingle" and communicate, which was really one of the most important achievements of this meeting.

The main part of the meeting consisted of the Chapter representatives reports. Chapter representatives were present from many countries of Region 8 (financial support was provided to representatives of low-income countries). Those included representatives from Eastern Europe and The Former Soviet Union Chapters, Western Europe and Africa Chapters, Scandinavia and Central Europe and The Middle East Chapters.

When invited to give my presentation on the Israel IEEE EMC Chapter, I also provided a complementary report on the Regional involvement and activities of the EMCS. Bringing my activities and responsibilities as a member "wearing several global hats for the EMCS," for example:

- Member of the BoD from Region 8
- Global Symposium Coordinator
- Region 8 Membership and Chapter Coordinator
- Chairman of the Standards Advisory and Coordination Committee (SACCom)
- Distinguished Lecturer for 1999-2000 in Region 8
- Chairman of the 2003 IEEE International Symposium on EMC in Tel-Aviv, Israel

I tried to emphasize the international involvement and approach of the EMCS, from the BoD level down to its involvement in the single member and Chapter levels.

Chapter presentations were, in general, a good reflection of their Societies' activities and practices. Some of the best practices .presented _by the representatives were as follows:

- 1. Exhibition of IEEE Material in Chapter events
- 2. Student Competition
- 3. Chapter web pages
- 4. Joint payment through the credit card of the Chapter Treasurer (in many countries a fixed "tax" is added to foreign currency transactions. When performing the payments jointly as a single transaction, the "tax" is shared by all the members as it is paid once only).
- 5. Corporate sponsorship of the Chapter
- 6. E-mail distribution list of the Chapter membership
- 7. Videotaped lectures

It was interesting for us to find out during the meeting that the EMC-S "had" a Chapter in the Republic of Georgia (from the former the USSR). This was a "self proclaimed" Chapter (jointly with the MTT/ED Chapter).

In a side meeting I held with the Chapter Chair, I recommended that we consider the "EMC Chapter" non-existent and the Chapter will not present itself as the EMC Chapter. I also explained to him the advantages of being a "registered" Chapter of the EMC-S. In parallel, I recommended that the procedure shall be initiated for forming a new Chapter in the Republic of Georgia, an action I have already initiated.

Overall the meeting was deemed a great success and was a well spent day in Paris. EMC

Visit our web site: http://www.emcs.org



Practical Papers, Articles and Application Notes

Bob Olsen, Associate Editor

In this issue you will find two practical papers that should be of interest to the EMC community. The first is a study by Henk Klok of the Royal Netherlands Navy about the differences between military and civilian EMC standards. Anyone who uses equipment designed for the civilian market in a military environment will be interested in this topic. The second is a survey by Diethard Hansen of recent European activities in the area of high-speed power line communications. Since frequencies of up to 30 MHz are being used on unsymmetrical power lines, EMC is a major issue.

The purpose of this section is to disseminate practical information to the EMC community. In some cases the material is entirely original. In others, the material is not new but has been made either more understandable or accessible to the community. In others, the material has been previously presented at a conference but has been deemed especially worthy of wider dissemination. Readers wishing to share such information with colleagues in the EMC community are encouraged to submit papers or application notes for this section of the Newsletter. See page 2 for my e-mail, FAX and real mail address. While all material will be reviewed prior to acceptance, the criteria are different from those of Transactions papers. Specifically, while it is not necessary that the paper be archival, it is necessary that the paper be useful and of interest to readers of the Newsletter.

Comments from readers concerning these papers are welcome, either as a letter (or e-mail) to the Associate Editor or directly to the authors.

Risk Analysis by the Use of Commercial Equipment in a Military Environment

Henk A. Klok Royal Netberlands Navy Postbox 1260 2340 BG Oegstgeest The Netberlands phone: 00 31 71 305 2173 fax: 00 31 71 305 2606 e-mail: b.a.klok@bi.nl or adv@meobb.navy.dnet.mindef.nl

The use of Commercial off the Shelf equipment is widely accepted, even in a military electromagnetic environment. Since this equipment has to meet the European EMC-directive 89/336/EC, it is expected that in those cases where equipment needs to comply to the basic EMC-requirements a considerable amount of money will be saved.

In this paper, the differences between the military EMI-standard MIL-STD 461D/462D together with the civil EMIrequirements are compared with respect to measurement methods, frequency range and limits. Also the applicability of the test methods will be taken into account. In the second place, the electromagnetic environment existing on board of Navy ships has been determined to evaluate the risk of using the COTS equipment in this environment. Within these established EM-environments the necessary EMC-requirements applied to the equipment are defined. A few of the assumptions made in the theoretical approach of the comparison are verified by using measurement data taken from commercial equipment.

It is noted that in case the necessary requirements could not be met with civil EMC standards, it is examined whether additional installation rules, or other additional constraints, would lead to the feasibility of using commercial equipment with a acceptable risk of EMI.

1. Introduction

In the Royal Netherlands Navy a project is running to investigate and analyse the risk of installing commercial equipment in a military electromagnetic environment. Because of the fact that, in general, equipment fulfilling military EMC standards is expensive and that commercial equipment has to fulfil the EMC directive, it can be acceptable to install this equipment on board. However, it has to be taken into account that the environment of a naval ship is very different from an industrial and residential environment.

To investigate the difference and to prepare recommendations, the study will focus on a comparison of standards and environments.

The first step is to collect commercial standards, relating to electric and electronic equipment with respect to EMC requirements. Secondly, a comparison was made with the MIL-STD-461D/462D focusing on the frequency band of interest, the measurement methods, the limits, etc.

To analyse the risk by installing commercial equipment, the electromagnetic environment is determined and, with respect to this, conclusions can be made.

The main conclusion is that for operational and tactical equipment it is not allowed to use commercial equipment. The frequency range of a ships EM-environment does not correspond to the measuring frequency range for radiated emissions and immunity methods of the civil standards. It can be recommended to civil organisations to at least extend the frequency range. More investigations will perform to the installations rules on board if stricter rules can partly solve this problem.

Another very important point will be to start discussions on the harmonisation of measurement methods. When the methods are harmonised for the civil as well as the military organisations, the limits can be different depending on the applicability, electromagnetic environment, etc. of the equipment.

2. Comparison of Different Standards

With respect to the commercial standards, several of them are included in the study:

- EN 50081
- EN 50082
- IEC 60533
- IEC 945

The IEC 60533 is an interesting stan-

dard, applicable for electromagnetic compatibility of electrical and electronic installations in merchant ships. This makes a comparison with the military standards more in line of the naval ship's environment. The IEC 945 is a interference standard for navigation equipment installed in a ship's environment.

The other European EN standards are both generic standards for equipment not dealing with a product standard and installed in an industrial environment. EN 50081 is an emission standard, EN 80082 an immunity standard.

Comparing the commercial standards with the MIL-STD-461D/462D, it can easily be concluded that most of the tests are too different for a theoretically correct comparison. However since there is a need for a well founded stand regarding the application of commercial standards, one must make use of the experience, good practice and even experiments.

In general, the commercial standards differ from the military standards in two ways:

- 1. Incomplete frequency range;
- 2. Tests differently executed (where frequencies are involved).

Below, the different methods and limits will be compared and discussed.

2.1. Conducted Emission

Focusing on the MIL-STD, it can be concluded that compared with the last versions (461C) of the MIL-STD, the D and E version use a Line Impedance Stabilisation Network (LISN) instead of a feedthrough capacitor.

This makes the comparison with the commercial standards more easy, because the civil standards also use a LISN. Before comparing the limit lines, some differences are to be noted:

There is a difference between the characteristics (components, frequency range versus impedance response, etc.) of the LISN's.
The MIL-STD measures the current in the frequency range from 30 Hz to 10 kHz. In the frequency range from 10 kHz to 10 MHz, the voltage will be measured.

The commercial standards measure



Graph 1: Comparison of conducted emission limits



Graph 2: Comparison of radiated emission limits

only the voltage between 150 kHz to 30 MHz.

With these differences in mind, the limit lines over the common frequency range can be compared. This comparison shows that the IEC 60533 is more stringent than the other standards. See Graph 1 for the different limit lines. With respect to the IEC limit line it should be noted that this limit is for equipment installed in the bridge and deck zone. For equipment installed in the general power distribution zone the limit is about 20 dB less severe.

2.2 Radiated Emission

In the harmonised commercial standards, only the electric field will be measured. There is a method under consideration for the magnetic field emission. The test method is very compatible with the MIL-STD-461/462.

In radiated emission tests for the electric field, the measuring distance and the environment are not similar.

The commercial standards require an open site environment, while the mili-

tary standard requires a shielder room. The effect of the cage i responsible for a deviation to open site measurements results of maxi mum 6 dB.

However, the commercial standards are more open for the applicability for a screened room instead of the open area. Measurements in an open area are difficult to perform, due to the high ambient. To avoid reflections, a compact range (fully anechoic chamber) can be used.

This test environment makes a comparison easier, but special attention should be paid to performing radiated measurements in screened rooms. The results are very dependent on the amount of absorbing material in the room. Investigations and tests showed a difference of over 15 dB in different cages. When the cage is fully equipped with absorbing material with the proper specifications, the difference will increase to not more than 3 dB.

With respect to the measuring distance, in the commercial standards the distance in most cases is

30 metres, or sometimes, depending on the standard, 10 metres. In some cases a measuring distance of 3 metres is allowable.

In the IEC 60533 however, the measuring distance is 3 metres in all cases. Comparing with the MIL-STD measuring distance of 1 metres, the distance is a problem because of the fact that the antenna is placed in the near field.

In the commercial standards it should be noted that the limit can be corrected linearly as a function of the distance from 30 metres up to 3 metres (far field correction). For a measuring distance to 1 metre, the transfer function is frequency dependent due to near- and far-field corrections.

In the study this correction factor is calculated by assuming the fact that the field of the equipment under test is characterised as a field generated by a half wave dipole.

It is also important to note that the measured frequency range of most of the commercial standards is from 30 MHz to 1 GHz. Only in IEC 60533 is the starting frequency 150 kHz. This will be a very important change.

Comparing the different limits over the common frequency range, taking into account the differences in measuring distances, it is shown that the MIL-STD is more stringent than the commercial standards. For the comparison of the limits, see Graph 2.

It should also be noted that the frequency range of the MIL-STD is from 10 kHz up to 18 GHz.

2.3 Conducted Susceptibility

Military and commercial standards are not really comparable because the injection methods are different.

An experiment could compare the injection methods by comparing the data resulting from a product investigation. A piece of equipment under test should be tested by both methods to determine if it conforms to the standards. During both tests the stress factor should be raised until the equipment under test fails. Comparing the stress factors should give information about the relation between the commercial and military standards.

2.4 Radiated Susceptibility

The radiated susceptibility test with respect to the electric field, refers to a field measured at the location of the equipment under test. This causes no significant difference with the MIL-STD test.

An important difference will be the frequency range covered by both standards. In the MIL-STD the test has to be performed over a very wide frequency range from 10 kHz up to 40 GHz. In the commercial standards this will be from 30 MHz to 1 GHz (80 MHz to 2 GHz in the IEC 60533).

It can be concluded that the frequency range from 2 MHz to 30 MHz is not covered in the commercial standards.

Focusing on the limits of the different standards, it can be noted that equipment fulfilling the MIL-STD has to withstand 200 V/m over the complete frequency range for outerdeck purposes. For other purposes different values are applicable depending on the environment (below deck of a metal hull, non-metallic ship, etc.) and can be increased to 10 V/m. This is the same value as the commercial standard for industrial environment. In the MIL-STD application, the test signal is unmodulated in the frequency range below 1 GHz.

Due to the modulation of 80 % with a 1 kHz signal the commercial test may be considered more severe than the MIL-STD for below deck equipment.

In this study special attention is paid to the frequency range below 30 MHz and above 1 GHz.

See Table 1 for an overview of the comparison.

3. Definition of the Electromagnetic Environment

The military environment differentiates itself from a commercial by radar transmissions, communications in a wide frequency range, electromagnetic pulse, and in inner deck situations by a high density of equipment.

In a commercial environment equipment is placed in an open field while the hull of a frigate provides a screening for the inner deck equipment against the outside world. This screening by the hull will create several areas with a different EM-environment, depending upon the quality of the screening.

The electromagnetic environment on board the Royal Netherlands Navy ships (due to the outside threat), is highly dependent upon the policy of the RNLN to build their own ships. The policy during the design of a ship is that the field strength inside the ship has to be as low as possible. To create an environment as "nice" as possible, installation rules are used. These rules are laid down in a Defence document KN 12330. This document is

developed by the RNLN, based on theoretical measures and investigations to very practical guidelines.

Some of these are, for example:

- Use of screened cable all over the ship.
- Outer deck cables as few as possible and as short as possible.
- Use of special cable glands to connect the

	MIL-STD-461D	EN 50082-2	IEC 60533
Freq. Range	10 kHz - 40 GHz	80 MHz - 1 GHz	80 MHz – 2 GHz
Measuring Method	monitor the field during the test at location of EUT	define a certain area of homogenious field within 6 dB on the place where the EUT will be located	
Limit	up to 200 V/m	10 V/m	up to 10 V/m
Modulation	< 1 GHz: CW > 1 GHz: pulse1 kHz	Amplitude modulation (AM) with 1 kHz and modulation depth 80 %	

Table 1: Radiated Immunity comparison

cable screening over 360 degrees to the hull of the ship, the cabinets or equipment.

- Cable separation of the different cable categories.
- Design electronic compartments with special installation rules.

These measures result in an EM-environment due to outside threats as radar, communications and EMP, which can be described as follows in Table 2.

A field strength below 1 V/m is considered as no threat. Regarding the above table, it seems that commercial equipment can be placed in below and inner deck areas, which have no direct link (by cable) to outer deck areas. However, in these situations the density of equipment in which the equipment has to work without EMI-problems should still be considered.

As already noted, the typical military EM-environment is caused by emissions from noisy inner deck equipment as static inverters at one hand and radar and communication transmitters outside at the other hand.

In most below deck areas the effect of the outside transmitters is negligible due to the installation rules. The concentration of equipment inside the ships

		EM-environment		
Source	Frequency	Outerdeck	Innerd	leck
		whole ship	Above maindeck	Below maindeck
MF/HF comm.	0,5 - 30 MHz	200 V/m	1 V/m	1 V/m
VHF/UHF comm.	30 - 400 MHz	20 V/m	< 0,1 V/m	< 0,1 V/m
Search radar	1 - 10 GHz	2500 V/m	20 V/m	3 V/m
Track radar	5 - 35 GHz	2500 V/m	-	-
EMP	< 1 GHz	50 kV/m	500 V/m	50 V/m

Table 2: Electromagnetic environment of a metal ship

hull is therefore considered a much greater danger.

4. Risk Evaluation

Over the last five years commercial standards have been used incidentally on board RNLN ships. Up to now this has not resulted in a big problem, but it has to be taken into account that this was only valid for ships which are not acting as a real warship (frigate), such as an LPD or Oil Replenisher.

For frigates, the MIL-STD is the specification for all the equipment to be installed on board. In special cases, on request of the manufacturer, it is allowed to deliver equipment which fulfils the commercial standard, but some additional tests have to be performed to make sure that no problems will arise when installing these.

During a part of the study, manufacturers were invited to have a CEmarked product tested to conform to the commercial standard tested to conform to the military standard as well. About one hundred manufacturers were invited of which twenty five responded. Most of them are active in the control, monitoring and in the static inverter industry. All manufacturers have contacts with the RNLN and should have been aware of EMCrequirements.

As a result it can be noted that in some cases, in the frequency range below 30 MHz radiated problems (due to both emission and immunity) were found.

This underlined the importance of having radiated limits for emissions as well as susceptibility tests in the HFrange from 1 MHz to 30 MHz.

So, the product investigations showed that most of the emitted energy is below 30 MHz and this is not covered in the commercial standards except the IEC 60533.

That is one part of the hardening, the other part is of course the susceptibility to electric fields, which is not implemented in the commercial standards.

A risk is taken when relying fully on the CE-marking of a product. The product investigation showed that not all equipment complies to the required standards. This is assumed to be a short term effect. To minimise the risk it is advisable to add EMC-tests to the factory acceptance tests.

5. Conclusions and Recommendations

From a technical point of view, it can be concluded that the commercial standards do not cover the military environment as the MIL-STD does. The IEC-60533 is the most comparable standard which can be used, but with respect to the radiated immunity, also the IEC does not cover the military environment over the whole frequency range, so still problems can be expected.

As a commercial conclusion, it can be noted that the use of commercial EMCstandards as a way to save money, influences the safety margin by an unknown factor. This causes an undefined environment and just saves a considerable amount of money for large quantity of goods, bought off the shelf. Unfortunately there is no way to know if these savings are in balance with possible costs to solve EMIincidents for ships beyond the period of guarantee.

Saving costs and having a defined environment can be established by specifying engineering requirements and having the tests done by the Navy itself.

Regarding the applicability of commercial standards the following can be stated at this moment:

- Due to the threat of radar, HF communications and electromagnetic pulse, commercial limits are insufficient in outer deck areas. This means indirectly that systems complying to commercial limits, should not be located in outer deck areas or have a direct (cable) link with the outer deck area.
- In above deck areas inner deck, like the mast, commercial equipment should be able to withstand radar signals. A test or extra specifications should safe-guard this.
- In most inner deck areas, commercial seems to be complying, however, since there is an undefined safety margin, it is sensible to avoid high densities of equipment or take extra installation measures.
- Since there is no commercial test available that relates to the threat of EMP, great care should be exercised with commercial equipment on ships that are designed to withstand an EMP of 50 kV/m.
- Equipment installed in inner deck areas and not involved with the operational and tactical activities of the ship, can be

accepted as commercial equipment. All equipment which has to operate under all circumstances of the ships operations and which is not allowed to fail, has to meet the MIL-STD.

For current projects as well as for future projects it is very important to specify the EMI/EMC-requirements in an early phase. It is recommended to specify only the MIL-STD-461D/462D or MIL-STD 461E.

When a manufacturer offers commercial equipment, additional tests have to be performed to check if the desired standards are sufficient, taking into account the place of installation and the electromagnetic environment there.

Very important for this additional test is the frequency range of interest. Special care should be taken of the frequency range of 1 MHz to 30 MHz.

To minimise the risk it is therefore advisable to add these EMC-tests to the factory acceptance tests.

6. Harmonisation of Methods

A last point, and in the opinion of the defence organisation a very important point, is the discussion on the harmonisation of, at least, measuring methods.

The study has shown that the differences in test methods for commercial and military standards are that big, that comparison is rather impossible. It will be a big step in a good direction if at least the measuring methods of the military and the commercial standards are the same. It is well known that some defence organisations started a discussion on this item, but it appears that it will be a very long way to go.

The methods can be the same over the total frequency range of threat for the commercial world as well as the military world.

With respect to the limitation, different limits can be proposed for the different environments.

It is expected that equipment installed in an industrial environment in a ground facility without transmitters in the neighbourhood, has to fulfil other limits and to meet other EM-requirements, than equipment installed in a navy environment with a lot of radarand communication transmitters on board the same platform. As a starting point for further discussion, find below a proposal for the measurement methods to be performed as a minimum. The methods cover the whole frequency range of the total EM-environment for all applications.

- Conducted Emissions: 30 Hz to 10 kHz
- Conducted Emissions: 10 kHz to 30 MHz
- Conducted Immunity: 30 Hz to 10 kHz
- Conducted Immunity: 10 kHz to 30 MHz
- Radiated Emissions: 30 Hz to 10 kHz

- Radiated Emissions: 10 kHz to 10 GHz
- Radiated Immunity: 30 Hz to 10 kHz
- Radiated Immunity: 10 kHz to 10 GHz

Further discussions can be focused on the method itself, for example what LISN shall be used, measuring voltage or current, magnetic field and electric field, frequency range, measuring distances, etc.

Before starting discussions on the limits, the methods have to be agreed upon by all bodies, civil as well as military.



Henk A. Klok has worked in the electromagnetic area since 1980. He graduated in Electrical Engineering at the Institute of Technology of The Hague in the Netherlands. He is now working as a senior adviser in the

Electromagnetic Environment Effects (E3) area in the Royal Netherlands Navy. He specialises in Naval EM-engineering, EMC/EMI control, topside design of maritime platforms and radiation hazards. He is a member of different NATO-groups working in that special EMarea. He also recently became a member of the national EMC institute in the Netherlands.

Megabits per Second on 50 Hz Power Lines?

Diethard Hansen EURO EMC SERVICE (EES) Dr.-Ing D. Hansen Bahnhofstr. 39, CH-8965 Berikon 2, SWITZERLAND Phone: +41 566337381, Email: euro.emc.service@t-online.de http://www.euro-emc-service.de

the reason for the removal of the RegTP field trial license, based on numerous protests, is that Digital Power Line Communications (PLC) is trying to increase the speed of data rates into the Megabits per seconds range. Therefore the short wave band of up to 30 MHz will be transmitted over the low voltage distribution network. The recent history of PLC in Germany together with the standardization and measurement procedures used are given. Public opinion in Germany and technological alternatives to PLC like ADSL and wireless communications with low power are discussed and explained. The present approach of the remaining PLC consortia and their attempt to introduce the PLC technology nation wide is questionable.

1. Introduction

Digital power line communications, e.g. mains signalling in the frequency range 3 to 148.5 kHz is a well recognized procedure. The EMC details are documented in EN50065-1 1991 as well as the amendments A1 1992, A2 1995 and A3 1996. The German equivalent is DIN EN50065-1 or VDE 0808 part 1 November 1996, respectively. This standard sets among others the limits for the injected signal level into the 230V/50Hz power grid for the various applications, e.g. for operating, controlling and measuring, in particular switching of the mains signalling receivers for low tariff heating systems.

The company NOR.WEB started the most prominent PLC activity in Europe about 3 years ago. The goal was to transmit data over a broadband medium above 148.5 kHz for telecommunications like ISDN and Internet. According to Shannon's information theory several Megabits per seconds data rate requires corresponding transmission bandwidth of several Megahertz and therefore corresponding higher carrier frequencies. After lengthy considerations and pretests, regionally limited field trials were conducted in the U.K. The transmission path in this low voltage network started at the power transformer all the way down to the distribution into the individual homes, where the signal was decoupled. The preferred operation frequencies were 3 MHz and 5 MHz. The integral power transmission level was below 1 Watt. Using the standardized EMC receiver bandwidth of 10 kHz, according to CISPR 16 (150 kHz - 30 MHz), this results in approximately 0 dBm or -40 dBm/Hz respectively.

Under the observation of the radio communication agency in London close monitoring of the trials was performed to explore PLC technology in general. In parallel this called for the development of a new measurement procedure MPT1570 with the title: Electromagnetic radiation from telecommunications systems operating over material substances in the frequency range 9 kHz to 3000 MHz. Measurements are executed in peak mode using a magnetic loop and applying the limits of the electrical field strength:

$E=20dB(\mu V/m)-7.7log_{10}(f/MHz)$ (1)

This formula applies from 1.6 to 30 MHz for radiated fields . Below 1.6 MHz and all the way down to 150 KHz E = 40 dB(μ V/m) - 7.7 log10f(MHz) at 1m test distance and 9 KHz measurement bandwidth. These field strength limits try to consider the emission statistics of a wide spread area use of many modems, with hopefully not all modems transmitting the same EMI at a time.

Consequently EMC equipment limits like CISPR 22 do not directly apply and must be reduced. Fig. 1 and 2 give a comparison of various limits.

Which disturbance levels are acceptable to radio reception? The problem of compatibility between radiocommunication and high data rate telecommunication services using the power lines or the telephone network is investigated by an ITU-R Study Question. Until now radiocommunication has survived with



Fig. 1: Limits according to Requirements 30 (NB30) of the FreqBZPV, compared with the limit of VDE 0878 part 1/12.1986 class B up to 30 MHz. The diagram also contains the limits of Draft MPT 1570/Feb 2000 of the British Radio Communications Agency. The field strength is measured with a loop antenna in a distance of 3 m from the line (MPT 1570: 1 m from 9 k to 1,6 MHz). For comparison with the limit, the logarithm of the free-space wave impedance 20log10Z0 is added to the magnetic field strength. This is a reaction of the German Ministry of Economy to the increasing use of frequencies in networks. At the time of VDE0878 Part 1 there was ISDN with a frequency range below 148,5 kHz. (Source: Manfred Stecher, EMC Brugge 2000 "EMC Aspects of PLC" – email: Manfred.Stecher@RSD.robde-schwarz.com)

the help of CISPR emission limits. Now the question is asked whether CISPR conducted emission limits on power ports for (e.g. household or IT equipment) can be used for PLC. Some PLC operators even propose to use the higher emission limits for telecom ports acc. to CISPR22/EN55022. For the definition of EMI limits, the minimum receive field strengths of radio planning are essential. From these values the protection ratio, e.g. 30 dB for AM radio is to be subtracted in order to obtain the ideal emission limit. However radio reception is possible with some compromise.

Which is the nature of radio disturbance emitted by PLC systems? For normal AM receivers, PLC-CDMA or OFDM signals are like Gaussian noise, i.e. the radio listener does not always have the typical impression of interference, like clattering, buzzing, clicking, whistling or similar, in contrast there will be an impression of low sensitivity of the receiver, since the ambient noise is like increased Gaussian noise of the receiver front-end. Therefore the problem of searching and identifying the source of interference will be difficult. This problem would also arise when PLC systems were operated in dwelling areas due to their continuous presence everywhere.

The consequence of using the CISPR-22 emission limits on telecommunication ports as injection levels for PLC, can be illustrated by comparing the field strength, which results from using the permitted common-mode current on telecommunication lines, with the minimum field strengths in the short-wave frequency band (see fig. 2). Please keep in mind, that for the reception of the minimum field strength, a protection ratio of at least 26 dB (better 30 dB) is to be taken into account. It is therefore not sufficient to check whether the received radio spectrum changes significantly by the addition of PLC. It is necessary to check whether the PLC spectrum is 26 dB below the minimum field strength.

The actual test reality revealed excessive emissions above these limits, however detailed individual data are unfortunately commercially classified. It is interesting to note, that in contrast to the U.K. emission limits, the German draft of the RegTP: Measurement procedure 322 MV 05 RegTP, is relaxed by approximately 20 dB. This MV 05 covers telecommunication lines and installations in the frequency range of 9 kHz - 3 GHz, using 3 Meter measurement distance (for short wave frequencies) from the critical installation/system cables or modem equipment under test to the small magnetic loop antenna at 1 m height according to CISPR 16. The convention of free space impedance (377 Ohm) conversion between magnetic and electric field strength (51.5dB) is used in spite of clearly doing the test in the near field of the emitting test object. In this specification the IF-bandwidth of the EMI receiver is set to 200 Hz for the frequency range 9 to 150 kHz and 9kHz bandwidth for bands from 150 KHz up to 30 MHz. Deviating from CISPR, not the 1 sec integrating and audio weighting Quasipeak detector is used in the EMI receiver, but rather the peak function.

Due to the enormous approval difficulties in the UK and the massive protests of civil and military frequency users in the short wave range, the PLC activity was shifted to the continent and Germany in particular.

2. PLC in Germany

At the end of 1997 several consortia were formed in the German PLC arena. NOR.WEB tried to implement the British technology in Germany under Nortel DASA. In order to quickly conduct their own field trials with 1 Mbit/s in Herrenberg near Stuttgart, the south German utility company EnBW/Tesion installed the U.K. technology under license from NOR.WEB. BEWAG, the Berlin utility company, got together with HEW Hamburg and GEW Köln to develop a different approach namely a certain spread spectrum technology, covering the total short wave range. This led to a patent claim 1997 and the granted German patent DE 197 14 386 C1 in 1998. Very limited first field trials of this technology seemed unfortunately not to reveal major savings in transmit power due to non-optimal conditions. Siemens

Germany tried to their own develop solution for Internet over the mains, using multi-channel, multifrequency technology with bit rates below 1 The Mbit/s. West German RWE teamed up with the Swiss Ascom company group to develop and establish a PLC system, which was tested near Düsseldorf with simidata rates lar as planned by Siemens. At the CEBIT 99 in Hanover this voice and video transmission system, using ISDN interfaces, was shown in a live presentation.

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All the above-mentioned consortia received a test license by the RegTP for locally and temporary re-

stricted field trials. On the other hand the RegTP initiated a round table to deal with the compatibility in telecommunications (ATRT) under the working group 3 for PLC. For this working group the author was elected as chairman by industry, government and trade associations representatives in autumn 1998. Mr. Stecher from Rohde and Schwarz München accepted the secretariat. It was the main goal to evaluate the new PLC technology and use this input to drive national and international standardization.

Discussions at this PLC WG and international CENELEC indicate the proposed PLC injection levels of around 0 dBm at 10 kHz bandwidth would roughly correspond to 60 dB uV/m radio disturbance field strength in 3m distances, which is unacceptably high for short wave bands!

3. Status and Development of Standards

PLC technology can not just simply be categorized by the historically grown EMC standards. One way to look at it, is to put a PLC modem into the framework of the EMC act (EMVG). However, what is going to happen, if this equipment is

used in a wide spread network? Moreover, the power distribution grid has not been developed as a symmetrical telecom line. The proper definition, in telecom terms, of the media is almost impossible, because of mismatches, stubs, switches, lighting, outlets etc. Unshielded symmetrical, modern telecom cables have a minimum of 35 dB symmetry attenuation in the used frequency band. Unsymmetrical signals eventually become interfering common mode currents and have to be suppressed as far as economically possible. In the low voltage network inside buildings this value could be anything including 0 dB. Therefore common mode and not differential mode is mainly producing EMI. The equipment is hardly never going to be an impedance match. Additionally, PVC installation cable by their insulation display much more path loss than telecom cables. 60 dB over 100 m at 20 MHz are not unusual. Even on one particular floor there is a lot of difference in attenuation, because outlets are installed in various locations, using different feeder systems of various phases and forming subs. The effective PLC signal transmission in the short wave range (3 MHz to 30 MHz) is perturbed by the legally nec-

essary radio interference protection of the RFI bypass capacitors in the line filters of the associated equipment. These capacitors cause RF short circuits. For these obvious reasons low voltage networks have not been put into the group of telecom networks.

On the other hand, radio transmitters have to go through national approval. This has not changed much with the introduction of TTE and R+TTE directive by the EU, because frequency spectrum use and frequency allocation have historically grown differently in the various countries. A change over night is impossible, harmonization will take time. It is also worth mentioning the duty of the national telecom authorities to ensure a certain transmission quality in the spectrum. Consequently this leads to the right of the German RegTP to control also the situation below 30 MHz along conductors, maintaining a peaceful coexistence of the various services. This may be, among others, public broadcasting, security services, the military, secret service and amateur radio. That is the coordination under the German frequency management plan, which is in its final draft version presently. In former days there was basically no EMC conflict



measured magnetic outdoor field strength 8m from the building wall when the real stimulation current is replaced by the new CISPR 22-limits, measures with HFH2Z2, H-field strength given in

E-field units (derived by addition of 51,5db

Fig. 2: Values of field strength measured with a loop antenna at 8 m distance from a three-story building. dotted line: ambient emission; thin continuous line: field strength generated by injection of the commonmode current equivalent to the CISPR22/EN55022 emission limit into the telecommunication network of the building; bold line: minimum useable field strength for radio planning. HFH2-Z2: R&S active loop antenna 9 k to 30 MHz. (Source: Measured data received from the German RegTP)

between cable systems and wireless applications. Unfortunately this has changed a lot with the introduction of cable TV systems and high-speed digital signal transmission. In spite of using coaxial cables in the TV distribution systems there is a lot of shield leakage, based on technical imperfections and aging. Catastrophic emissions in the aeronautical security bands are jamming Germany. LANs and WANs are growing increasingly, adding to this critical situation.

The German telecommunication act (TKG §45 part 2) regulates the use of frequencies in and along conductors. There is not much of a choice for PLC user. They either use low power spread spectrum systems with limits well below the EMC standards for ITE or apply for a national approval according to TKG, if they intend to use high power systems.

The fight over the last mile to the end customer in modern deregulated telecom and electricity markets requires solutions for wide spread networks on harmonized European level. This is presently happening under ETSI and CEPT/ERC, standardizing functional and EMC parameters more or less under one roof.

An important EMC compromise has been reached in CISPR 22 (EN55022 1998). This led to a relaxation for telecom ports under class B of about 10 dB conducted common mode emission between 6 and 30 MHz. This is, however, a temporary solution, which may have to be revised within the next 3 years, based on interference complaints.

The German standardization subcommittee DKE UK 676.17 has founded a PLC working group in the forth quarter of 1999, closely cooperating with ATRT. The DKE represents the national committee of Germany, dealing with ETSI, CENELEC, CISPR and IEC. Of particular importance is presently CENELEC TC 205A, spanning the frequency range from 3 kHz to 30 MHz. Most PLC interested parties follow the high power approach with subdivisions in various unoccupied short wave windows and creating a product specific standard. This attempt, however, is problematic, due to international frequency allocations at the ITU in Geneva.

On the German side the RegTP under the ministry of economic affairs has issued a decree NB 30 - 1999. This contains the following 3 m limits: 1. 0.009 to 1 MHz

40 dB(µV/m) - 20 log10 (f / MHz) 2. >1 MHz to 30 MHz

40 dB(µV/m) - 8.8 log10 (f / MHz)

 3. >30 MHz to 1 GHz
 27 dB(μV/m) equivalent to an effective radiated power 20 dBpW

- 4. > 1 GHz to 3 GHz
- 40 dB(μV/m) equivalent to effective radiated power 33 dBpW

The detailed measurements follow the procedure RegTP 322 MV 05.

4. Public's Response and PLC Alternatives

Shortly before CEBIT 99, the consortium RWE Ascom announced in a big PR campaign a fundamental breakthrough in PLC. The Ascom stocks rose sharply. However, PLC technical details were never published. It was interesting to watch the reaction of the other consortia in immediately launching their own success stories for projects, which were not even close to finished. Putting the pressure on the consortia in ATRT, clearly demonstrated these experts were not in the position or willing to speak about technical details. Even the presentation of the inventor of the NOR.WEB PLC, Dr. Brown, was only partly covering technical details. How can one standardize a proprietary black box PLC technology? It became finally clear by walking around at the CEBIT 99, that the whole PLC show was marketing driven. Only RWE Ascom demonstrated live. This, however, was not much more than ISDN quality. The show was accompanied by numerous protests of short wave users. The strongest opponents proved to be the RegTP licensed radio amateurs. Their club (DARC) with more than 60,000 members stated correctly PLC to be a lethal threat to the amateur radio service. This was demonstrated in various PLC field trials.

Security services like police, military and intelligence service (BND) contradict the assumption of the PLC activists, regarding the existence of many empty frequency windows. Naturally, these secret windows are not publicly listed, while at the same time radio and TV community was worried about potential increase of the noise floor throughout Germany. It was emphasized, that the introduction of digital broadcasting, leading to less radiation hazards, will only work if the transmitter power is reduced maintaining the same background noise. The more sophisticated the modulation type, the higher the signal noise ratio has to be.

The proof for the premature push of PLC into the standardization becomes evident by analyzing the majority of the symposia, dealing with PLC at that time. Here it was mostly the business case highlighted, but the technical feasibility not to mention EMC was hardly discussed in detail. Services like video on demand, super fast Internet access and Internet telephony kept the project manager's dreaming. This is partly supported by the observation of power network engineers, starting a new telecommunication career. In the mean time German universities started Ph.D. PLC work, which naturally will take 3 to 5 years.

It is important, however, to recognize there are many competing technologies of either conducted or wireless nature outside the field of PLC. There is tough competition in the race to the last mile. The broad band cable TV system can nowadays offer several 10 Mbit/s in about 100 MHz bandwidth at reasonable price. Bi-directional systems with the corresponding modems are commercially available for private homes with charges similar to cellular phones. The provider Netcologne is offering 52 Mbit/s without having to reserve a rented extra line.

The German Telekom is offering ADSL with approximately 1 Mbit/s expanding the old ISDN capabilities. This technology has less EMC problems, due to the symmetrical nature of the telecom lines. Fiber optic links are well known, but normally too costly to connect the end customer.

Wireless LANs today reach 1 to 10 Mbit/s at 20 dBm (100 mW) bridging several 100 m in 2.4 GHz and 5.8 GHz ISM bands. Long distance tests of up to 7.5 km at 2 Mbit/s and 100 mW have already successfully been conducted. Lately 155 Mbit/s have been achieved by wireless loops.

Looking at these advanced alternative technologies, the introduction of PLC within a relatively small window of 1 to 2 years is critical, knowing the PLC community is trying to catch up with the low side of the other high-speed data rates.

5. Withdrawal of Most RegTP Field Trial Licenses

After the presentation of the short wave propagation study by Ascom at the end of 1998 it was clear, -40 dBm/Hz PLC transmission level might increase the natural background noise in Germany by as much as 10 dB. The ionosphere would then mirror this effect into overseas regions. Short wave radio communications could therefore be seriously affected.

Amateur radio PLC simulations in the U.K. proved the effectiveness of Milliwatt powers for European wide radio traffic by using typical PLC and even symmetrical, buried cables. These tests were under the supervision of EMC professionals like competent bodies and EMC test labs.

Concern was also expressed by the German armed forces, the BND, the ministry of internal affairs and local federal government state agencies. Telecom experts in the worldwide embassy radio link system also expressed concern. A similar situation was found in the broadcasting over long, medium and short waves. The often-stated argument, this can all be covered by Internet is complete nonsense.

Many serious PLC studies and simulations in academia do not make the author believe PLC could shortly be implemented on a nation wide base.

30 dB to 40 dB in excess of the RegTP NB 30 decree in well-monitored field trials of the consortia, accompanied by accredited test labs and the RegTP, speaks for itself. These results, initially classified, are now publicly available in the minutes of the ATRT PLC meeting from 24 Sept. 1999.

Based on intensive discussions the RegTP has now withdrawn the granted licenses. Another sensational news was: NOR.WEB is pulling out of the PLC business, mainly for economical reasons!

6. Summary

The PLC results, in particular regarding EMC, did by far not meet the expectations. The time pressure in the market place by competing technologies is enormous. The consortia were unable to deliver adequate technical and normative drafts. ATRT, however, was able to input international normative requests for well coordinated PLC standardization. The first working groups are successfully acting. The author assumes that in the near future there is only a chance to introduce PLC technology by using spread spectrum and keeping well below the EMC limits. This, however, will lead to more repeaters along the line. EES Germany has conducted positive pre-investigations. The EMC act with the higher limits, compared to the TKG limits, may have to be reconsidered in view of system and not only box requirements.

To probe further, here are some EU PLC links in English and German language:

http://www.PLCforum.com http://www.ptf.de http://www.ipcf.org http://www.ascom.ch http://www.siemens.com/plc The latest news comes from the national association of radio and telecommunications engineers, Inc. (NARTE) USA issue vol 18 No 3 Fall 2000 with a citation of a recent article from the Wall Street Journal, where again German PLC promoters discuss marketing but rather not EMC aspects.

Biographical Note



Dr.-Ing. Diethard Hansen is founder and president of EES Switzerland and Germany, specializing in international consulting, high tech marketing, training, innovative EMC test products, accredited

testing and R&D. Further areas: LVD, radio, automotive and medical. He is holding a BS/MS in electrical engineering from Germany and a Ph.D. degree from TU Berlin. More than 20 years of industrial EMC/EMP experience, 35 patents (GTEM, EUROTEM, Poyntor sensor) and 140 professional publications as well as chairmanships are assigned to him. He was the manager of the EES Competent Body and acted as board member of European Competent Bodies ACB - Brussels. Memberships: IEEE/EMC, CENELEC, ETSI and IEC. He is the RegTP ATRT PLC chairman and a lead auditor for EMC labs and Competent Bodies in the German DAR accreditation system. Since 1990, Dr. Hansen is a senior EMC engineer under USA NARTE accreditation.



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Inter-Society Activities



COMAR Report

By Dan Hooliban, COMAR Representative on the IEEE EMCS Representative Advisory Committee (RAC)

INTRODUCTION

The EMC Society has been associated with the Committee on Man and Radiation (COMAR) for a number of years. COMAR is presently a technical committee under the Engineering in Medicine and Biology (EMBS) Society of the IEEE. For many years, COMAR has labored to produce scientific responses to many of the unsubstantiated claims of health hazards to humans from sources of electromagnetic energy. This article will describe some of the latest activities of COMAR and a closely-related Web page.

COMAR

In general, COMAR meets twice a year for business meetings and to discuss the latest developments in the world of Electromagnetic Fields, Electrophobia, and Non-Ionizing Radiation.

The latest meeting was held in November (1999) in San Antonio, Texas. Specific topics addressed at the meeting included: Electrophobia and Consumer Exploitation, Medical Applications (it was reported that an article entitled "Medical Aspects of Radiofrequency Overexposure" was rejected by the New England Journal of Medicine so other publications will be approached), Microwaves and RF, 60-Hz Power Lines, Heaters and Sealers, and Standards.

Other activities included a status report on a book of article reprints; Dr. Eleanor Adair reported that four of eight sections are finalized, three sections are being revised and are almost completed, and one section remains for revision. The complete book is scheduled for submission to the IEEE Press near the end of the year. A COMAR response to an IEEE Spectrum Speakout article by Robert Ashley was discussed; the COMAR response was published in the September Spectrum and it appeared this all worked out OK.

A new Technical Information Statement (TIS) on Magnetic Resonance Imaging (MRI) exposures was discussed. It appears that MRI machines, which are currently generally at 1.5 Tesla and 67 MHz, are moving toward 4 Tesla and 400 MHz. Also, a new draft "Consumers' Guide to Specific Absorption Rates (SAR)" for cellular phones was discussed, however, this is not directly related to Government labeling requirements for cellular phones.

A second new TIS on Cellphone Protective Devices was discussed; this will address hands-free devices for cellphones (which may increase the EM radiation) and shielding devices (which cite 2 dB of shielding) and most people do not realize what that means.

"A pair of excellent summaries has recently been published on cell phone radiated emissions and their health impact on brain tumors. The good news was that neither report showed any association between cell phone usage and brain tumors."

Two additional issues discussed included issuing a pamphlet on environmental exposure to RF, especially on broadcast sites. The second was a technical discussion of "electrical sensitivity" in people and what this is.

The next meeting date for COMAR is Saturday June 9, 2001 at 7:00 PM in St. Paul, Minnesota.

WWW REFERENCE

There has recently been published in the literature a pair of excellent summaries on cell phone radiated emissions and their health impact on brain tumors. These articles are discussed on the Web Page: http:/www.mcw.edu/gcrc/cop/cellphone-health-FAQ/toc.html. The good news was that neither report showed any association between cell phone usage and brain tumors.

This Web Page is coordinated by Professor John Moulder of the Medical College of Wisconsin. It includes frequently asked questions about the whole topic of Cell Phone Antennas (Base Stations) and Human Health. If you ever had a brother, sister or other relative ask your opinion on the issue of cell phones and health hazards, this is the web site to send them to.

Topics covered are summarized as answers to 25 questions. These questions include the following:

- 1. Are there health hazards associated with living, working, playing, or going to school near a cellular phone or PCS base station antenna?
- 2. Do the differences between cell phones, PCS phones, and other types of portable phones matter when evaluating the potential impacts of base station antennas on human health?
- 3. Do cell phone and PCS base station antennas produce radiation?
- 4. Is there a scientific basis for these radiofrequency safety standards?
- 5. Does the U.S. have safety guidelines for mobile phone base stations?
- 6. What siting criteria are required to ensure that a cellular phone and PCS base station antenna will meet safety standards?
- 7. Does everyone agree with the current RF safety standards?
- 8. Will cellular phone or PCS base station antennas affect heart pacemakers, cause headaches, etc?
- 9. What do the most recent scientific studies of radiowaves and human health show?

The Web page is updated periodically and should be an excellent resource for cell phone and health questions. For more information on COMAR activities, contact Dan Hoolihan of Hoolihan EMC Consulting at phone 651-213-0966 or e-mail at d.hoolihan@ieee.org. **EMC**

Personality Profile



Bill Duff, Associate Editor

Introducing Larry Cohen from Washington, DC

Larry Cohen, a native Washingtonian, was born on December 20, 1948. He grew up in the Silver Spring, Maryland area. Larry put himself through college at George Washington University by working as an auto parts salesman at a nearby Sears and Roebuck. He graduated with a BSEE in 1975. Larry served for six years with the Maryland Army National Guard which included six months active duty training as an infantry soldier at Fort Polk, Louisiana.

Upon graduation from GWU, Larry went to work for the Naval Ship Engineering Center (NAVSEC) in Hyattsville, Maryland where he was involved with the design of the Combat Suite for the SSN-688 Class attack submarines. By 1978, NAVSEC had merged with the Naval Sea Systems Command

(NAVSEA) where Larry went to work in the Topside Antenna Integration Group for Preston Law. This was Larry's introduction to the pandemic problems caused by electromagnetic radiation on a ship's topsides and the importance of good EMC practices. During his tenure in the Topside Integration Group Larry was responsible for the arrangement of antennas and EMC for amphibious, auxiliary and destroyer classes of ships. Larry was mentored by Preston Law, Jim Garrett and Dick Ford in attempting to optimize antenna performance against the backdrop of EMC and structural considerations.

By 1986, Larry became deeply involved in the use of radar absorption material (RAM) in order to mitigate problems involving reflections of RF energy on a ship's topsides. During this time, Dick Ford invited Larry to apply for employment at the Naval Research



Larry at work in his Advanced Technology Chamber (Mode Stirred) at the Naval Research Lab.

Laboratory (NRL) in Washington, DC. Larry began his service at NRL on April 1, 1987 working for Dick Ford. Larry decided that working at NRL required additional technical insight so he enrolled in the Masters program in Electrical Engineering at the Virginia Polytechnic Institute and State University, specializing in communications theory and signal processing. Larry became heavily involved in the design of RAM for shipboard EMC applications. With Dick Ford, Larry performed isolation testing as part of the UAV Pioneer Program, with RAM aboard the Battleship USS Iowa.

During this time Larry began his association with Professor Jose Perini of Syracuse University. Professor Perini provided Larry with technical insight on how RAM performance could be optimized for angle of incidence and frequency considerations. As a result of this effort Larry played a significant role in the development of a numerical model that allowed optimization of RAM design parameters as well as a RAM specification for NAVSEA.

In 1993, Dick Ford became interested in Mode Stirred Chamber technology and directed Larry to secure funding for a chamber to be built at NRL. Larry spent the next three years investigating ways of optimizing chamber test performance.

In April of 1994 Larry received his MSEE from Virginia Tech.

In 1997, a result of the Navy's interest in active array technology, Larry became interested in potential EMI related problems, including the generation of intermodulation products, as a result of the use of transmit/receive (T/R) modules which populate active array antennas. Larry gave a series of talks alerting the DOD EMC community on potential problems that could result through the use of T/R modules.

During the 1987-1997 time period, Larry was afforded the opportunity to represent US Navy EMC interests at various international meetings and forums. He was appointed by Steve Caine of SPAWAR as a US Navy representative to the Information Exchange with the UK Royal Navy.

For the past three years Larry has continued work on mode stirred chambers investigating the use of non-mechanical electronic methods for stirring modes. Larry has recently been involved with assessing the EMI related effects between US Navy shipboard radars and wireless communications.

In 1999, Larry was elected to the EMC Society Board of Directors and was the Technical Program Chairman for the 2000 IEEE International Symposium on EMC held in Washington, DC.

In his spare time Larry enjoys playing golf, bicycling, hiking and reading. EMC

EMCFest '2001

A Colloquium and Exhibition on Practical Control of Inductance in PCBs, Cables, Connectors and Motors

Monday, April 23, 2001 Dearborn Inn Dearborn, Michigan 7:30 am-8:30 am Registration & Continental Breakfast 8:30 am-5:00 pm Technical Sessions 5:00 pm-6:30 PM Reception, Exhibits & Demonstrations

Featuring Industry renowned speakers: Lee Hill & Jim Muccioli

The focus of this colloquium will be on practical methods of controlling the inductance at the PC board and system level. This will include connectors, cables and devices under the control of the electronic system.

Registration Fees: \$150 prior April 1 \$175 after April 1 and at the door Non-IEEE attendees, add \$25 ATTENDANCE IS LIMITED *** Register early ***

Fees include one copy of the colloquium record, continental breakfast, a 'networking' lunch and a "Happy Hour" reception immediately following the Technical Sessions.

Hands on participation during the demos Vendor tabletop exhibits of the latest EMC related products and services.

For further information:

Kimball Williams: Co-Chair Technical Program Ph: 248-354-2845 e-mail: k.williams@ieee.org Janet O'Neil Co-Chair Exhibits Ph: 425-868-2558 e-mail: j.n.oneil@ieee.org Home page: http://emc.eaton.com/emcfest2001.htm

Sponsored by the Southeastern Michigan Chapter of the IEEE Electromagnetic Compatibility (EMC) Society.

Al Gross, Prominent Member of EMC Society, Dies

"World Class Engineer" and Pioneer in Personal Communications Fondly Remembered by American Radio Relay League (ARRL) 1918-2000

The man who brought the world such indispensable wireless communications concepts and devices as the walkie-talkie, pager and cordless telephone has died. Al Gross, W8PAL SK (silent key), of Sun City, Arizona, passed away on December 21, 2000. He was 82.

Gross obtained his Arnateur Radio license in 1934 at the age of 16. His early interest in Arnateur Radio helped set his career choice while he was still a teenager.

Gross pioneered the development of devices that operated in the relatively unexplored VHF and UHF spectrum above 100 MHz. His first invention was a portable hand-held radio transmitter-receiver. Developed in 1938 while he was still in high school in Cleveland, he christened it the "walkie-talkie." The device caught the attention of the US Office of Strategic Services, the forerunner of the Central Intelligence Agency. The OSS recruited Gross,

"Al was my office mate for a year when I worked at Westinghouse. You don't meet too many people like Al in a lifetime. To a great extent, the reason why we're doing what we're doing is due to his inventions and effort. One person can make quite a bit of difference in this world!" – Harry Godlewski, Crown Castle USA, Inc.



secured several patents for various portable

and cordless telephone devices. In September 1958, Gross Electronics received FCC type approval for mobile and hand-held transceivers for use on the new Class D 27-MHz Citizens Band. "If you have a cordless telephone or a cellular telephone or a walkie-talkie or beeper, you've got one of my patents," Gross once said.

He added that if his patents on those technologies hadn't run out in 1971, he'd have been a millionaire several times over.

Over the years, Gross worked as a communications specialist for several large companies. Since 1990 and until his death, he was a senior engineer for Orbital Sciences Corporation.

Gross received numerous awards and honors during his distinguished career, including the 1992 Fred B. Link Award from the Radio Club of America and the 1999 Edwin Howard Armstrong

and this led to the invention of a twoway air-to-ground communications system used by the military behind enemy lines during World War II. The system allowed OSS agents to communicate with high-flying aircraft.

After World War II, Gross set up Gross Electronics, Inc. to design and build various communications products, some of them under government contracts. He also launched Citizens Radio Corporation to design, develop and manufacture personal wireless devices.

Cartoonist Chester Gould asked if he could use Gross' concept of a miniaturized two-way radio in his Dick Tracy comic strip. The result was the Dick Tracy twoway wrist radio.

During the 1950s and 1960s, Gross

Achievement Award from the Institute of Electrical and Electronics Engineers.

As his IEEE biography put it: "It is clear that Mr. Gross was a true pioneer and helped lead the way to today's wireless personal communications revolution." Gross is survived by his wife, Ethel. A burial mass was held December 27 in Sun City.

Editor's Note: This material was reprinted from The ARRL Letter, Vol. 19, No. 50, December 29, 2000. The EMC Society is grateful to Harry Godlewski (Harry.Godlewski@crowncastle. com) and Bill Duff (w.duff@ieee.org) for providing this information for publication in the EMC Society Newsletter. Al Gross was an active member of the EMC Society. He was a past Chairman of the Phoenix EMC Chapter and was instrumental in its formation. EMC

Board of Directors Activities

Tampa, Florida Thursday, November 16, 2000

CALL TO ORDER

President Butler called the last Board meeting of the year 2000 to order at 8:30 am. A round of introductions was made. Board members present included H. Benitez, D. Bush, J. Butler, L. Carlson, T. Chesworth, L. Cohen, A. Drozd, F. Heather, D. Heirman, D. Hoolihan, T. Hubing, E. Joffe, W. Kesselman, D. Millard, M. Montrose, J. O'Neil, H. Ott, A. Podgorski, J. Perini, G. Pettit, C. Sartori, D. Smith, D. Sweeney, K. Williams and T. Yoshino. Guests present included B. Crain, W. Duff, D. Ford, and J. Muccioli. Ferdy Mayer was the absent Board member. President Butler welcomed the newly elected Board members and acknowledged those who would be leaving the Board. He requested that the newly elected Board members solicit existing Board members to see how they can contribute to Board activities. Every Board member is expected to contribute to one of the working committees under each Vice-Presidency. The agenda was then presented. Several items were added which would be addressed later in the meeting. The agenda was approved as amended.

TREASURER'S REPORT

Treasurer Warren Kesselman presented his report. As of September 30, 2000, total liabilities and net worth for the EMC Society is \$1,445,350. Mr. Kesselman's report also included an EMCS cost center summary (as of October 31, 2000) and year-end forecast. The total expected year-end income for 2000 is \$1,902,500, expenses are \$1,669,100, with a net of \$233,400. Mr. Kesselman advised that the Society is healthy financially. The Board accepted the Treasurer's report.

SECRETARY'S REPORT

Secretary Janet O'Neil presented the minutes from the Board meetings on August 20 and 24, 2000. The minutes were approved as amended.

MEMBER SERVICES REPORT

Todd Hubing presented the report of membership services. He reported for Lee Hill, chair of the DL program. Two new lecturers need to be appointed for terms beginning in 2001. Mr. Hill will propose these candidates for an electronic vote by the Board. DL activity is at an all time high. Henry Benitez reported on Awards. The awards nomination process needs to be revised. Don Sweeney volunteered to create a template for each award category. The Board was encouraged to seriously consider candidates each year for the Society's most prestigious awards especially. Mr. Benitez agreed to set a timeline for the milestones of the awards process. Mr. Hubing requested assistance from the Board to form an ad hoc committee to assist Mr. Benitez with this effort. Don Bush, Larry Cohen, Don Sweeney, Tom Chesworth, and Dick Ford volunteered to be members of this committee. Mr. Hubing advised that this committee will present their revised awards proposal at the next Board meeting. Regarding Chapter activities, Ghery Pettit advised that there are two new potential chapters. One is a joint chapter in Georgia (part of Soviet Union) which wishes to add the EMC Society to their charter. There is also a new chapter in Turkey which is in the process of being formalized by IEEE. Elya Joffe reported that there is interest in Greece to form a chapter. He is assisting them with this effort. Elya Joffe presented his Region 8 report. He attended the Brugge EMC conference and staffed the IEEE EMC Society membership booth. He encouraged Prof. Johan Catrysse to start an EMC chapter. Two new IEEE and EMCS members were recruited, one new EMCS member was recruited, and interest was generated in others. As a result of the recruiting efforts at this conference, another Israeli attendee successfully recruited five new IEEE and EMCS members a few weeks after the conference. Mr. Joffe feels that the price of IEEE membership is a deterrent to recruiting new members in some countries. He also manned the booth at the EMC Millennium Workshop in Greece and recruited one new IEEE and EMCS



Recently elected Board members Jim Muccioli of Jastech EMC Consulting and Carlos Sartori (L-R) with the Escola Politecnica da Universidade de Sao Paulo Brasil enjoyed the Annual Board Dinner following the November Board meeting.

member. The distribution of the Seattle EMC Symposium records and CDs were well received. All were distributed free of charge to the workshop attendees. It was suggested that the EMC Society pursue student engineers to attract new members in these countries. In 2001, Mr. Joffe plans to take the booth to Zurich in the spring, summer in St. Petersburg, and in the fall to Torino, Italy for their respective EMC conferences. Mr. Joffe attended the IEEE Region 8 Section meeting in Paris in October and represented the EMC Society. Jose Perini verbally reported on EMC activities in Region 9. He is planning to visit Brazil next year. Carlos Sartori reported that he is assisting the EMC engineers in Sao Paulo in forming an EMC chapter. Dan Hoolihan advised that he spoke with IEEE about offering free memberships in the EMC Society to those who joined the IEEE during 2001 and 2002. Mr. Sartori thought this would be well received. Takeo Yoshino reported on EMC activity in Region 10. He showed a map of China which outlined the areas of EMC activity, including Beijing, Shanghai, Nanjing, Wuhan, Shenzhen, and Chendu. The area of Shenzhen is developing the most quickly with growth in industry and electronics. Mr. Yoshino has made contact with several EMC leaders in these areas to assist them in developing IEEE activity. He noted that the incomes of these EMC engineers is very low and must be taken into account when recruiting new members. He is trying to recruit corporate and/or university IEEE memberships as a result. Regarding the Survey Committee, Dick Ford advised that 100 surveys were





The Annual Board Dinner provides a unique opportunity for the spouses of Board members to get to know the company their husbands are keeping. Myrthes Perini gets to know Board member Henry Benitez of Intel. Her husband Jose Perini just finished bis first year on the Board.

collected at the Washington, DC symposium. His report covered survey results from the Santa Clara to Washington, DC symposia. Overall, the DC symposium scored well. The negative comments largely concerned the social aspects of the symposium. There was a very good response to the question asking if registrants/exhibitors were planning to attend Montreal. The Board thanked Mr. Ford for his work on the survey. Andy Drozd presented his report on membership. He advised that we will have two booths at the Montreal EMC Symposium and the booth will have a new banner. He is working with the German EMC chapter to provide various IEEE membership material for their chapter recruiting activities. The IEEE is conducting a telemarketing campaign to contact members in arrears and promote their membership renewal. Currently there are 5,162 active members of the EMC Society, a 5% increase. However, in this total there are

283 student members (a 10% decline over the past six months). Mr. Drozd has been working with the chapter chairmen to ensure that their respective websites are up and running. Regarding the Fellows Search Committee, Tom Chesworth reported that he has contacted the chapter chairmen to solicit their assistance in nominating candidates for the Fellow Award. He received several names for candidates which he will turn over to Bill Duff. The problem lies with filling out the detailed forms required for the Fellow application.

No one seems interested in tackling this considerable paperwork. Dan Hoolihan presented his report on by-laws. He suggested a change to the bylaws in order to revise scheduling dates for the Board of Directors elections and a change to notify each candidate for the Board who does not get elected. The first suggestion extends the time to return the ballots (see page 2 of this newsletter for the formal posting of the proposed bylaw change). In the second suggestion, the candidate shall receive a letter from the Society President which includes advising the candidate of the number of votes received and the number of votes required to win a spot on the Board. The Board agreed that these were good suggestions.

STANDARDS SERVICES

Don Heirman, Vice-President of Standards presented his report. It was noted that the webpage (http:// grouper.ieee.org) for EMC Standards is now operational. Standards activity covers three major areas: The Standards Education and Training Committee (SETCom) chaired by Hugh Denny, the Standards Advisory and Coordination Committee (SACCom) chaired by Elya Joffe and the Standards Development Committee (SDCom) chaired by Steve Berger. Regarding the SDCom, all standards are currently active. Regarding SACCom, Elya Joffe presented his report. Several new members have joined the committee including Dave Traver (liaison with EIA R1/R2), Noel Sargent (liaison with TC20 and SC 14 Space Systems), Steve Berger (liaison with RRSNA) and Arnold Greenspan (liaison with IEEE SCC



(L-R) Dave Millard of the Georgia Tech Research Institute welcomes newly elected Board members Bruce Crain of Northrop Grumman in Melbourne, Florida and Dick Ford from the greater Washington, DC area to the Annual Board Dinner.

20). There are currently still openings for representatives to the following three organizations: CENELAC, ASTM C09.12.14 (shielding effectiveness) and ASTM E06-53 (reusable structures). Mr. Joffe's report included a complete roster of the representatives and their e-mail contact information as well as compilation of their respective reports. Contact Mr. Joffe at eb.joffe@ieee.org if you are interested in participating in the SACCom. The Standards meetings scheduled for 2001 include March 13 in Hilton Head, NC in conjunction with the IEEE Standards Association, August in Montreal in conjunction with the IEEE EMC Symposium, and November in conjunction with the EMCS Board of Directors meeting.

CONFERENCE SERVICES

Henry Ott, Vice President for Conference Services, presented his report. He advised that the papers for TC-9's special session were inadvertently not included in the Washington, DC symposium record. They will be included in the Montreal symposium record and the EMC Society will fund this expense. The Board then held a general discussion upon commercialism within the symposium papers. The Board agreed to follow and enforce current policy concerning commercialism. Next followed several reports on upcoming EMC symposia: 2000 Washington, DC: Bill Duff reported on this symposium. The expected net surplus is approximately \$260,000. The Board thanked Mr. Duff and the members of the Washington, DC symposium steering committee for organizing a wonderful symposium; 2001 Montreal: Henry Ott reported that everything is under control

> with this symposium. They have received over 300 papers. They have over 160 booths sold to date; 2002 Minneapolis: Dan Hoolihan reported that the symposium will be held at the Minneapolis Convention Center with the main hotel being located across the street. He showed a preview of their committee logo. The committee has contracted with ITCMS to manage the symposium; 2003 Israel: Elya Joffe reported that they now have a fully operational symposium steering committee. The MOU with the EMCS is being negotiated. The call for papers will

distributed at the be Montreal EMC symposium and will be mailed to all EMCS members. The website is now available (www.ortra.com/ emc2003). They have invited the EMCS Education committee to participate in and support their symposium. This includes having the experiment demonstrations during the symposium. Elva Joffe then presented his report as session during the Petersburg EMC symposium,

June 19-22, 2001. Jose Perini volunteered to chair an ad hoc committee to put together this program. He will work with Elya Joffe on this. The Board requested a report on the program at the next Board meeting. The Board also approved the suggestion for President Butler to organize a presentation on IEEE EMCS activities at the St. Petersburg EMC symposium. Regarding the Beijing EMC symposium, Mr. Joffe advised that he had received a letter from the organizing committee about their misuse of the EMC logo. He will draft an outline for the process of obtaining technical cosponsorship from the EMC Society with foreign conferences. This will be posted to the EMCS website. The Board approved the request to be recognized as a technical co-sponsor of the 2002 Beijing EMC symposium. Regarding the EMC Europe conference in September 2002, this will be held in Sorrento, Italy. The Board approved the request to be recognized as a technical co-sponsor of the 2002 EMC Europe conference in Sorrento.

COMMUNICATION SERVICES

Len Carlson, Vice-President for Communication Services, verbally presented his report. He reported for Professor Marcello D'Amore, Transactions Editor-in-Chief. Prof. D'Amore has set up a new editorial board which will be detailed on the inside front cover of the next issue of Transacations. Regarding the Newsletter, Editor Janet O'Neil presented her report. Bob Rothenberg has retired



the EMCS Global Symposia Election of the Board Officers for 2001-2002 is a cause for celebra-Coordinator. The Board tion at the Annual Board Dinner. Celebrating his re-election as agreed to organize an EMCS Vice-President for Technical Services is Kimball Williams of Eaton sponsored workshop/technical Corporation (center), his wife Mary Lou, and Board member Ghery session during the St. Pettit of Intel.

as Associate Editor for Practical Papers. Bob Olsen of Washington State University in Pullman is doing a fine job as the new Associate Editor for Practical Papers. The last issue for 2000, the Fall issue, featured the Washington DC symposium and is 48 pages, the longest issue yet since Ms. O'Neil has been editor. It features four pages of color photos of various symposium activities. Regarding Public Relations, Tom Chesworth advised that there is no activity to report since the last meeting. He requested ideas from the Board on what we need to do in the area of public relations. He suggested the Board consider placing ads in related trade magazines and other related IEEE Society newsletters to promote membership in the EMCS. It was suggested that the EMCS brochure be updated. Mr. Chesworth advocated for a more proactive approach to



Don and Marilyn Sweeney enjoyed their last Annual Board Dinner in Tampa, Florida. Don just completed his three-year term as a member of the Board and he was duly thanked for his service. They can now devote more time to their company, DLS Electronic Systems in Wheeling, Illinois.

public relations. IEEE EMCS Webmaster Andy Drozd reported on his recent activity with the EMCS website. Most of the TCs have updated their websites. He has provided guidelines to the TCs on material they should consider posting to the web-0,Ne site. He is in the final stages of implementing the EMCS anet website advertising policy. Mr. Drozd wrote an article for the EMCS Newsletter about the website activities. He then showed actual pages of the website so the Board could view the graphics, layout used, etc. Mark Montrose next presented his report as IEEE press

liaison. There are eight EMC books. There are five books that are permanently out of stock. Royalties received up to December 31, 1999 were \$5,587.54. The amount of total royalties accrued so far for 2000 will not be available until March 2001. Mr. Carlson then closed his report by presenting a financial statement for the proposed new EMCS magazine. He needs to present the magazine for approval at TAB at their January meeting. For the magazine proposal to be approved, he feels a \$5 membership dues increase is necessary. The Board approved raising EMC Society dues from \$15/year to \$20/year effective in 2002 to support launching the technical magazine.

TECHNICAL SERVICES

Kimball Williams, Vice-President for Technical Services, presented his report. His report included a budget forecast through 2006 for Technical Services. Regarding the Technical Activities Committee, a status report for each TC was provided. Dan Hoolihan is the new chairman of TC-1 (EMC Management), Graeme Strauss is the new chairman of TC-3 (EM Environment), and Bob Scully is the new chairman of TC-4 (EMI Control). Mr. Williams then reported for Magsood Mohd, Chair of the Education and Student Activities Committee. He provided a status report of the various subcommittees, including the Student Design Competition which is a fairly new subcommittee. The first design competition award was presented during the Washington, DC symposium. It has been

advertised in the Newsletter for the 2001 symposium in Montreal. The Demonstrations subcommittee is working now to formalize the process to schedule a demostration during the symposium week. The Education Committee remains dedicated to its outreach efforts to expand EMC education. Mr. Williams then reported for Dave Case, Chairman of the Representative Advisory Committee (RAC). The annual RAC/SACCom (Standards Advisory and Coordination Committee) jointly organized luncheon was held on August 21 at the Washington, DC symposium. Over 30 people attended the luncheon. RAC also sponsored a special session during the symposium on RF Exposure that was attended by approximately 200 people. Some 65 people attended the two NARTE workshops. It was noted that NARTE plans to expand its current programs by adding certification programs in avionics, satellite broadcast, and wireless communications in the next several years. Mark Montrose reported on the Nanotechnology Council. He commented that the TAB committee on Nanotechnology has made remarkable progress to date with the limited membership and volunteers available. The IEEE will hold related workshops in 2001 at Rutgers University, New Jersey in January and in Hawaii in October. Mr. Montrose is the EMCS liaison to this council. Andy Drozd reported as the EMCS Representative to the Intelligent Transportation Systems (ITS) Council. The annual conference was held October 1-3 in Dearborn, Michigan. This new council launched their first issue of Transactions and their Newsletter in 2000. Council officers were elected for 2001. The Council is currently represented by 17 member Societies, including the EMC Society. Mark Montrose remains the alternate EMC Representative to ITS.

OLD BUSINESS

The following items were discussed under "Old Business":

TC-8 Update: Mark Montrose pre-

sented an update on the activities of TC-8 (Product Safety). This is a very active committee. The goal of the committee is to become its own Society in accordance with IEEE guidelines. The Board approved encouraging the Product Safety group to form their own Society within the IEEE.

TC-10 Update: Mark Montrose presented a report on this proposed new technical committee on Signal Integrity. He described the need for a new technical committee. The Board agreed to officially recognize the need for TC-10 and to allow the members to proceed in creating this as an interim technical committee.

NEW BUSINESS

The following items were discussed under "New Business":

Elections: Dan Hoolihan presented the nomination slates for the Board officer positions. After voting for each officer, the election results included Todd Hubing as the winning candidate for the office of President-Elect, Len Carlson as the winning candidate for the office of Vice-President for Communication Services, Don Heirman as the winning candidate for the office of Vice-President for Standards Services, Kimball Williams as the winning candidate for the office of Vice-President for Technical Services, Andy Drozd as the winning candidate for the office of Vice-President for Membership Services, Henry Ott as the winning candidate for the office of Vice-President for Conference Services, Janet O'Neil as the winning candidate for the office of Secretary, and Warren Kesselman as the winning candidate for the office of Treasurer.

IEEE TAB Web Liaison: Joe Butler advised that the IEEE has requested assistance from an EMCS Board member to review technical websites and provide guidance for improving websites. Doug Smith agreed to work with the IEEE on this.

Zurich EMC Special Technical Session: Don Heirman reported on the special technical session that the EMCS is holding during the EMC Zurich conference. Topics covered include measurements above 1 GHz, measurement uncertainty and measurement techniques, among others.

50th Anniversary Celebration: Dan Hoolihan advised that the anniversary ad hoc committee is looking at a special archival issue of Transactions for the anniversary year. They are working closely with the IEEE on how to promote this since there are several societies which will be celebrating their 50th anniversary within the next 5 years.

Paid Administrative Assistant: President Butler advised that it is time to renew our agreement with Warren Kesselman as the Society's paid administrator for 2001. The Board approved Warren Kesselman as the Society's paid administrator for 2001.

Past Symposium Records: President Butler requested the report of Don Bush who chaired an ad hoc committee to propose a recommendation on what to do with our excess inventory of Seattle symposium print records, CDs, and items stored at Applied Microimage. Various ideas were discussed. President Butler requested that Andy Drozd take on this activity as the new Membership Services Vice President and report at the next meeting in Zurich.

November 2001 Board Meeting: The Fall Standards/Board meetings will be November 12 (Standards) and 13 (Board) in San Diego, California.

ACTION ITEM REVIEW

President Butler reviewed the action items discussed during the meeting.

ADJOURNMENT

There being no further business, the meeting then adjourned at 5:15 pm.

Janet O'Neil Secretary EMC Society Board of Directors

EMC

2001 IEEE EMC Symposium August 13-17, 2001 Montréal It is with great pleasure that

It is with great pleasure that we ask you to come to our International Rendez-Vous for Electromagnetic Compatibility to be held on the 13th to 17th of August, 2001 at the Palais des Congrès in Montréal, Québec, Canada.

Summer in Montréal is a most beautiful setting for engineering professionals, their families and friends attending and participating in the 2001 IEEE EMC Symposium. The Symposium will include technical speakers, exhibits, and workshops.

You are invited to enjoy our unique city, fine dining and experience our renowned "joie de vivre".

We are looking forward to seeing you.

The 2001 IEEE EMC Committee

For further information please contact: IEEE EMC 2001 Symposium Secretariat - JPDL 1555 Peel, Suite 500 Montréal, Québec, Canada, H3A-3L8 Tel: (514) 287-1070 • Fax: (514) 287-1248 Email: emc2001@jpdl.com Web Site: http://www.2001emcmtl.org



Photographs: Tourisme Montréal

Introducing Members Newly Elected to the EMC Society Board of Directors

The following members began a three-year term on the Board effective January 1, 2001. Abbreviated biographies of these gentlemen are shown below.



Henry Benitez

Henry Benitez is an EMC Laboratory Manager at Intel Corporation in Hillsboro, Oregon. He received a BSEE electrical engineering degree from the

University of Portland and is a NARTE Certified EMC Engineer. He has over 20 years experience in the field of EMC. He is Chairman of the IEEE Oregon Chapter of the EMC Society and is presenting serving his first term on the Board of Directors for the IEEE EMC Society. He has taken responsibilities as IEEE EMCS Public Relations Chair and Awards Chair. He is a contributor to the IEEE Standards Advisory and Coordination Committee (SACCom). He has been an active member of the Information Technology Industry Council (ITI) TC-5 EMC committee. He has participated in ECMA TC 20, ANSI C63, CISPR B US TAG, and IEC US TAG EMC committees. He participated as a member of the ANSI U.S. technical delegation chartered to discuss mutual recognition agreements with the European Commission. He contributed to the development of IEC61326 (EN61326) product family standard for control, measurement, and laboratory equipment via the joint TC 66 WG1/SC65 WG4 international committee. Mr. Benitez has published numerous EMC papers in engineering magazines, IEEE publications, and EMC conference records since 1984. He has presented papers at EMC conferences throughout the world. Mr. Benitez was awarded an IEEE Millennium Medal for his contributions to the Oregon IEEE Section.

1984. In 1989, he received the MS degree in Electrical Engineering from Florida Institute of Technology in Melbourne, Florida. In 1998, he received the Ph.D. in Electrical Engineering from the Georgia Institute of Technology in Atlanta, Georgia. Dr. Crain is currently with Northrop Grumman Corporation in Melbourne, Florida, where he is the technical lead of the Electromagnetic Environmental Effects (E3) group. During his 15-year career in the EMC field, Dr. Crain has worked for several aerospace companies in addition to Northrop Grumman, including Lockheed Martin in Marietta, Georgia, Harris in Melbourne, Florida, Alenia Spazio in Turin, Italy, and Matra Marconi Space in Tolouse, France. Dr. Crain's primary technical interests are EMI design of aerospace hardware, EMC design of aerospace vehicles, and protection of aerospace vehicles against external electromagnetic threats such as lightning and HIRF. His current interests are computational electromagnetic methods for electromagnetic analysis of aerospace platforms. Dr. Crain has been a member of IEEE for 16 years and currently holds the grade of Senior Member. He recently started a new chapter of the EMC Society in Melbourne, Florida, and holds the office of Chairman. He served as the Chairman of the EMC Society Chapter in Atlanta during 1996-1998, and was the Publicity Chairman for the 1995 IEEE International Symposium on EMC in Atlanta. Dr. Crain is a NARTE certified EMC engineer and is registered as a Professional Engineer in the states of Florida and Georgia. Dr. Crain has been authorized by the FAA to act as a Designated Engineering Representative (DER) in the areas of EMI/EMC, HIRF and Lightning.

Bruce Crain

Bruce Crain was born in Pittsburgh, Pennsylvania, where he received the BS degree in Electrical Engineering from Carnegie Mellon University in



Dick Ford

Richard (Dick) Ford, NCE, is the owner and principal engineer of 4D Associates, Inc. He received his BSEE from Northeastern University, Boston, MA, USA in 1964 and undertook post graduate work at Virginia Polytechnic Institute, American University, BYU and University of Colorado.

Dick Ford has over 30 years experience in the EMC fields. Over his nearly 40 year's professional experience, he's been employed at MIT's Draper Lab, Sylvania, GE, Interference Control Technologies, the Navy's Surface Weapon's Center/ Dahlgren and the Naval Research Laboratory where he currently works part time as an annuitant. In 1973 he cofounded the US Navy's Shipboard EMC Improvement Program (SEMCIP) which by 1983 had grown to be the US DoD's largest and most successful EMI Fix-It program. He was a Congressional Fellow assigned as military technology advisor to Senator Hatch in 1982-83 where he contributed a key background paper on the EMP aspects of the movie "The Day After" when it received US Congressional Review. In 1983-84 he was Technical Editor of EMCT, at the time, our industry's world leading bi-monthly magazine (70,000 circulation). He has taught EMC to about a thousand students in commercial and government sponsored short courses both nationally and internationally since 1983. After retiring from NRL in 1998, he formed his own company and continues to work as an EMC consulting technologist. He holds two US patents on EMC measurement technology. He's a certified EMC Engineer (NARTE - 1989 to present). His hobbies are solar energy and carpentry. Mr. Ford has been an IEEE member for over thirty years. He's been an EMC Society BoD member/officer/committee chair continuously since 1986. He was EMCS BOD Treasurer from 1986 to 1994, EMC Society Photographer from 1994 to present, Liaison to the IEEE USA's R&D Policy Committee from 1991 to present, Chair of the Society's Survey & Analysis Committee from 1994 to present, and 2000 IEEE International Symposium on EMC committee member and treasurer from 1999 to present. He received several EMC Society Awards

including the Laurence G. Cumming Award 1992 and Honorary EMCS Life Member 1994. He's a strong proponent of the Society's international out-reach initiatives, as well as the Institute's national initiatives both in the US and, in the future, worldwide (based on the experiences of IEEE/USA). He's voted for more open and democratic processes with the Society's BoD and specifically feels that the Society's president-elect should be directly elected by the Society members.



Mark I Montrose

Mark I. Montrose, S'72-M'79-SM'93, graduated from California Polytechnic State University, San Luis Obispo, California with a Bachelor of

Science Degree in Electrical Engineering and a Bachelor of Science Degree in Computer Science, both in 1979. He received a Master of Science Degree in Engineering Management from the University of Santa Clara, Santa Clara, California in 1983. Mr. Montrose is the owner of Montrose Compliance Services, Inc., specializing in international regulatory compliance with an emphasis on applied EMC engineering, printed circuit board design and layout, signal integrity and product safety. Technical and professional experience includes over 20 years of applied EMC engineering and consulting. This involves extensive design, test, and certification of Information Technology Equipment plus Industrial, Scientific and Medical products, both at the system and component level. Before becoming a consultant, Mr. Montrose was the principal EMC engineer and manager of regulatory compliance departments at Whittaker Communications, Hughes LAN Systems, MIPS Computer Systems, Alcatel Information Systems, Corvus Systems, and ZILOG. He is assessed by a European Competent Body as an EMC laboratory for in-situ CE approvals to the EMC Directive, and is also accredited as a test laboratory by NARTE. Currently, he is an adjunct professor for the University of Wisconsin (Madison) in addition to a professional training organization located in Hong Kong, Malaysia and Singapore. He is a certified instructor, accredited by the Council for Private Postsecondary and Vocational Education in California, pre-

senting EMC seminars internationally for client companies. Mr. Montrose is the author of two best selling EMC books published by IEEE Press, Printed Circuit Board Design Techniques for EMC Compliance-A Handbook for Designers, 1st ed.-1996/ 2nd ed.-2000, and EMC and the Printed Circuit Board-Design, Theory and Layout Made Simple, 1999. Both books are sponsored by the IEEE EMC Society. In addition, he is a contributing author to The Electronic Packaging Handbook, 2000, co-published by CRC and IEEE Press. Mr. Montrose's professional affiliations and activities include being a current member of the IEEE EMC Society Board of Directors, a Senior Member of the IEEE EMC Society, a Distinguished Lecturer of the Society, IEEE Press Liaison, and member of the dB Society. He is affiliated with TC-4 (EMI Control), TC-8 (Product Safety Technical Committee) and is an officer in the Santa Clara Valley Product Safety Chapter. He has received the EMC Society's Certificate of Achievement for outstanding contribution to the international arena of EMC, based upon his educational activities and technical publications. He is on the editorial review board for the ITEM publication and is a frequent contributor to the EMC Society's Newsletter in addition to other professional publications. Mr. Montrose is a life member of the American Radio Relay League (ARRL) with the Amateur Extra Class license of K6WJ. Professional activities include promoting EMC education using a simplified approach, performing EMC research on PCB layout techniques, presenting technical papers on various aspects of EMC, and conducting demonstrations related to hands-on, applied EMC engineering, including signal integrity, at IEEE International EMC Symposiums, Conferences and Colloquiums in North America, Europe and Asia. In 1991 and 1994, Mr. Montrose was co-chairman of the technical program session at the Santa Clara Valley EMC Colloquiums.



James P. Muccioli

James P. Muccioli is Senior Vice-President of Technology & Testing at X2Y Attenuators, LLC. He received his bachelor's and master's degrees in

electrical engineering from the University

of Michigan. Mr. Muccioli is a NARTE certified EMC and ESD engineer. His background includes 18 years of specialized EMC systems experience at X2Y Attenuators, Daimler-Chrysler, and United Technologies. He is an active member of the SAE J-1113 and J-551 EMC committees and is chairman of the SAE Integrated Circuit EMC Task Force. He has co-authored articles published in the IEEE Transactions on Electromagnetic Compatibility ("The Electromagnetic Environment of an Automobile Electronic System," August 1987, and "Measuring the Radiated Emissions From a Family of Microprocessors Using a 1-GHz TEM Cell," May 1999). Other published papers were included in the 1990 IEEE International Symposium on Electromagnetic Compatibility ("Radiated Emissions of Very Large Scale Integrated Circuits") and the 1991 IEEE International Symposium on Electromagnetic Compatibility ("An Electromagnetic Immunity Diagnostic Tool for Electronic Circuits"). Mr. Muccioli is inventor or co-inventor of seventeen granted U.S. and international patents and is inventor or co-inventor of many other pending patent applications. Mr. Muccioli was a contributing author ("Part 6: Electromagnetic Interference and Compatibility") for the Automotive Electronics Handbook (Ronald Jurgen, Editor-in-Chief, McGraw-Hill, Inc., 1995, 1999). He taught an undergraduate course ("Noise Reduction Techniques") at Lawrence Technological University and the University of Michigan. He also teaches continuing education seminars in EMC through his firm Jastech EMC Consulting, LLC. Mr. Muccioli was a member of the Board of Directors of the IEEE EMC Society (1993-1998) and was selected as an IEEE Fellow in 1998 for contributions to integrated circuit design practices to minimize electromagnetic interference. He served as EMC Society Technical Services Chairperson for Student Vice-Activities (1990-1996) and Chairperson of the Education Committee (1993-1996).



Henry W. Ott

Henry W. Ott is President of Henry Ott Consultants, an EMC training and consulting organization. Prior to starting his own consulting company, he was with AT&T Bell Laboratories, Whippany, New Jersey, for 30 years, where he was a Distinguished Member of the Technical Staff. At Bell Labs, he worked on projects relating to missile guidance systems, nuclear effects instrumentation, analog and digital tape recorders, telephone transmission and signaling systems, microprocessors, and acted as a consultant on Electromagnetic Compatibility. He is the author of the book Noise Reduction Techniques in Electronic Systems, published in 1976 and 1988, by Wiley Interscience. The first edition was translated into Japanese, Russian, Bulgarian, and Polish, and the second edition has been translated into Italian and Japanese. Mr. Ott is a Fellow of the IEEE. He is Vice President-Symposia/Conferences of the IEEE EMC Society. He is also a member of the ESD Association and is a NARTE certified Electrostatic Discharge Control Engineer. He also holds an amateur radio operator's license with the call sign WA2IRO. Mr. Ott is the holder of four patents, and author of numerous technical papers. He is a past Distinguished Lecturer for the EMC Society, and lectures widely on the subject of EMC. He received his BSEE degree from New Jersey Institute of Technology in 1957, and his MSEE degree from New York University in 1963.



Takeo Yoshino

Professor Takeo Yoshino received his B.E degree in 1953 from the University of Electro-Communications (U.E.C.), Tokyo, Japan. In 1953, he

joined the Department of Electronic Engineering of the U.E.C. Since 1973, he was a Professor of the Department and the Graduate school of UEC. He retired from UEC in 1995 and joined the Fukui University of Technology as the Professor of their Graduate School. Since 1970 he has been the Director of Sugadaira Space Radio Observatory of U.E.C., and he was concurrently professor and research contractor of the Institute of Space and Aeronautic Science (ISAS), National Institute of Polar Research (NIPR) and the Nobeyama Radio Observatory of the National Astronomical Agency until his retirement. From 1958 to 1960, he stayed at Syowa Station in Antarctica as a wintering party member of the third Japanese

Antarctic Research Expedition, and from 1975 to 1977, he was at Syowa Station again as the leader of the 17th Expedition. In Antarctica, his main field of interest was the analysis and investigation of the auroral phenomena by the natural VLF radio wave emissions observed by the ground, rockets and satellites. His research interests are as follows: The investigation of emission mechanism of electrostatic ion-cyclotron waves and VLF auroral hiss over auroral oval by satellite observations, the observation study of earthquakes and volcano eruptions by means of the seismogenic emission phenomena, the bio-effects of radio emission phenomena and VDT in EMC fields, and the observation and development of burst VLBI system in the millimeter band radio astronomy. Professor Yoshino received the IEEE-AP Best Paper Award in 1967, and a Distinguished Service Award on EMC from the Polish EMC Symposium in 1992. He is a member of IEIEC, SGEPSS and ASJ (Japan), IEEE and AGU (USA), URSI, IAGA and COSPAR, an advisory board member of the Zurich EMC Symposium, the Wroclaw EMC Symposium, and the Lowell Observatory.



Carlos A. F. Sartori Carlos A. F. Sartori was born in Botucatu, State of São Paulo, Brazil, on January 5th, 1959. He received the

B.Sc., M.Sc., and the

Ph.D. degrees from Escola Politécnica of University of São Paulo (EPUSP), in 1983, 1994, and 1999, respectively, each in Electrical Engineering. From 1982 to 1984, he worked at Main Eng. S.A., a consulting engineering company, where he was introduced to some aspects of electromagnetic compatibility related to transmission line designs. In 1984, he joined the National Commission on Nuclear Energy CNEN/IPEN-SP, and, in cooperation with the Brazilian Navy Research Institute in São Paulo CTMSP, since 1991, he has been the technical person responsible for the CTMSP EMC Group. After 10 years working as an engineer, he started teaching. Thus, although in different subjects and at different educational levels, he followed a familiar tradition; where many

of the members of his family are teachers, including his parents who are retired high school teachers and his sister that is a professor at a medical school at the São Paulo State University. Concerning his academic life, he has been a lecturer and a researcher at the Postgraduate Program of the Department of Energy and Automation Engineering of the Escola Politécnica since 1991, and since 1999 an invited Professor, where he teaches Electromagnetic Compatibility. He is also an Assistant Professor at the Catholic University of São Paulo where he held a position as a Member of the Council, and he was the Vice-head of the Department of Electrical Engineering in 1997 and 1998. At Catholic University of São Paulo, he Electromagnetism teaches and Principles of Communication. In 1994, he received the Best M.Sc. Work Award from EPUSP and, in the same year, due to his academic performance, the "Unibanco Award." He is involved with many EMC cooperation programs. Among them are the ones developed at Lmag "Applied Electromagnetics Laboratory of EPUSP" with collaboration of power companies, automotive industries, medical instrumentation industries and hospitals, nuclear and aerospacial research institutes, and research councils and foundations. An additional motivation to his carrier is given by the relationship and exchanged experiences with some outstanding University EMC groups. One of these experiences was in the winter of 1999, in which he spent one month at the Universities of L'Aquila and Rome, Italy. As Carlos always jokes, despite the attempt of Professor Orlandi to "freeze" him, he survived, and he had a whale of a time, learning and visiting in such a beautiful region. His active research interest in EMC is quite vast. At the beginning, the main interest was focused on grounding systems, time-domain modeling of EMC problems regarding lightning; evaluation of electromagnetic environment, field coordination and optimization of Lightning Protection Systems. Currently, it includes some additional interesting subjects concerning transmission lines coupling, EMI in automotive systems, EMI in medical devices, new measurement techniques,

and biologic effects. Mr. Sartori joined the IEEE in 1991, and, in July of 2000 he was appointed Director of the EMC Society for the 2000-2002 term. He is also a member of the IEEE Education Society, IEEE Magnetics Society, International Compumag Society, and equivalent Brazilian organizations. He is the Vice-president of the Brazilian Society on Electromagnetics. In 1998, he was the Technical Chairman of the Cbmag – Brazilian Congress on Electromagnetics. Mr. Sartori is married and has two sons in high school. Although he is a mediocre soccer player, he likes, as all Brazilians, very much this sport, and, of course, the beaches, the caipirinha, a native Brazilian beverage, and, as an Italian descendant, he loves red wine. We wish the newly elected members of the Board of Directors success and thank all candidates for their willingness to serve and for permitting their names to be included on the ballot. EMC

Call for BoD Nominations



ominations are now being accepted for candidates for the IEEE EMC Society Board of Directors. In accordance with the Bylaws, nominations may be made by petition or by the Nominations Committee. Petitions shall carry a minimum of 15 names of Society members in good standing (dues paid), excluding those of students. Nominees should possess professional stature and significant technical skills in electromagnetic compatibility. They must have adequate financial support outside the Society and have the approval of their organizations or employers to actively participate. Duties include attendance at three of four Board meetings a year and participation on committees, both of which require telephone, fax, mail and e-mail communications. Nominees must be full members of the IEEE and members of the EMC Society. Elected Directors must serve a three-year term starting January 1, 2002. Attendance at the last meeting of the 2001 year is also desirable. No member can serve more than two consecutive three-year terms, including partial terms. All nominees are required to submit a biographical summary to the Nominations Chairman for inclusion on the ballot. The summary must not exceed a one-half typewritten page and must be in the following format:

First paragraph Name, title, place of employment, educational background

Second paragraph Technical and professional experience

Third paragraph IEEE service and activities including offices, committees, etc.

Please submit petitions and biographical summaries to the Nominations Chairman:

Dan Hoolihan Hoolihan EMC Consulting PO Box 367 Lindstrom, MN 55045 phone: (651) 213-0966 fax: (651) 213-0977 d.hoolihan@ieee.org

Submissions must be postmarked no later than May 31, 2001. Information can be obtained from Mr. Hoolihan or any member of the BoD.

NOMINATION PETITION ELECTROMAGNETIC COMPATIBILITY SOCIETY BOARD OF DIRECTORS

(Nomination guidelines given on preceding page.)

I. NOMINEE'S NAME:		
MEMBERSHIP NUMBER:		
ADDRESS:		
PHONE:		
II. BIOGRAPHICAL SUMMARY: Attach	Туред Сору	
III. SIGNATURES: (Minimum of 15 IEEE Electromagnetic Compatibility above-mentioned person to serve on	names.) We, the undersigned Society (EMCS) members in the EMCS BoD for a three-year t	l, all of whom are current good standing, nominate the erm beginning January 1, 2002.
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CALL FOR PAPERS!



Next meeting of the Reverberation Chamber, Anechoic Chamber, and OATS Users Scheduled for June 4-6, 2001

The next meeting of the Reverberation Chamber, Anechoic Chamber, and OATS Users will be June 4-6, 2001 at the Hyatt Regency Hotel in Bellevue, just east of Seattle, Washington. The meeting sponsors include Boeing, Underwriters Laboratories, Inc., ETS-Lindgren and the Seattle Chapter of the IEEE EMC Society. Papers are solicited which address reverberation chamber, anechoic chamber and OATS test methodology. Abstracts should be submitted via e-mail to Mike Hatfield at HatfieldMO@NSWC.NAVY.MIL no later than April 15.

PROGRAM: This June meeting will begin on Monday afternoon, June 4 with an optional half-day tutorial/workshop. Tuesday and Wednesday, June 5 and 6, will feature two full days of technical presentations. An awards banquet will be held on Tuesday evening. On Wednesday, the Seattle EMC Chapter has organized a table-top show in the area adjacent to the technical presentations. Vendors who specialize in EMC products and services will be on hand the entire day. Immediately following the presentations on Wednesday, the Seattle EMC Chapter and vendors will host a farewell "Happy Hour" reception.

VENDOR TABLE TOPS: To reserve a table top display for June 6, please contact Janet O'Neil at 425-868-2558, j.n.oneil@ieee.org.

REGISTRATION: Registration fees are \$200 by April 15, \$225 by May 15 and \$275 thereafter and at the door. Registration fees include admission to the workshop and all technical presentations, a copy of the meeting record, continental breakfast, lunch, and afternoon breaks on June 5 and 6, the gala awards banquet on June 5, and the reception on June 6. To register, contact Heidi Scheuer of Underwriters Laboratories, Inc. at 847-272-8800 x42750 or e-mail at Heidi.Scheuer@us.ul.com. Hotel reservations may be made by calling the Hyatt hotel directly at 425-462-1234. Call by the May 18 cut-off date and reference "IEEE OATS Users Meeting" to obtain the group rate of \$179 USD plus tax for single occupancy, \$189 USD plus tax for double occupancy.



EMC Standards Activities

Don Heirman, Associate Editor

As your Society's Vice-President for Standards, I oversee three subcommittees devoted to Standards activity. One commit tee is the Standards Development Committee (SDCom) which is chaired by Steve Berger. Steve and I appreciate the artic cle provided by Elya Joffe as below on recent committee activities. And, we appreciate the editing support for this articl provided by Hugh Denny, chair of the Standards Education and Training Committee (SETCom). We reiterate Elya' call for volunteers to assist us with Standards, whether as a member of the SDCom, SETCom, or the last of my three subcommittees reporting for Standards, the Standards Advisory and Coordination Committee (SACCom), chaired by Elya Joffe. Get involved and make a difference!

Revision of IEEE Standard 473: IEEE Recommended Practice for an Electromagnetic Site Survey (10 kHz to 10 GHz)

By Elya B. Joffe, Member – Standards Development Committee (SDCom)

A. IEEE Standard 473:1991 at a Glance

IEEE STD 473 describes a systematic approach for performing an EM site survey, commencing from preparation of the planning of the test until completion, data analysis and documentation of the measurement results. The Standard outlines procedures and information regarding the methods for conducting EM site surveys particularly for EMR Bio-effects and equipment effects applications. The Standard is due for reaffirmation or revision in 2001. It is proposed that the Standard be revised to reflect current needs and applications, emerging technologies and available measurement techniques and instrumentation.

B. Why the Need for Revision?

Inasmuch as the Standard extensively covers a broad spectrum of considerations in conducting EM site surveys, a detailed review indicates that an extensive revision is necessary. The following are some examples of developments which merit revision of the Standard:

- 1. Increased density of radio sites, with an overwhelming number of transmitters collocated on site.
- 2. Expanded radio services have been assigned higher frequency bands, due to lack of available spectrum. Thus, the maximum frequency applied of the Standard (10GHz) appears to be non-representative of current and future spectrum usage.
- ISM (industrial, scientific and medical) applications render environments, once at ambient levels, highly "EM polluted," posing potential problems to radio services.

- Communication, command and control sites are often located near pulsed sources. In addition, many communication services utilize pulsed waveforms. The proposed revision, therefore, will:
- 5. Expand the scope of the Standard
- 6. Reflect modern test and measurement equipment and procedures
- 7. Incorporate techniques to measure time domain characteristics of pulsed waveforms, spread spectrum signals, etc.
- 8. Update the information data base as necessary

(1) Revise/extend the scope of the Standard

Currently, the Standard's scope covers EMR Bio-effects and EM environment for electronic equipment, but little focus is given to the most serious problem in dense RF areas, namely: antenna to antenna coupling. As the transmitter sites become more and more crowded, the need for site compatibility becomes ever increasing. However, performing an EM site survey for site compatibility considerations requires that specific parameters such as modulation waveforms, signal bandwidth, spectral distribution, signal waveform characteristics, field polarization, etc, be measured. The existing Standard addresses these parameters only to a limited extent.

Due to recent changes in frequency allocations, the upper frequency range needs to be extended from the current 10GHz to 40GHz.

(2) Updating the Test Equipment and Test Methods

The test techniques are based on test

equipment available two decades ago. For example:

- The current Standard refers primarily to "E-Field Strength Meters." This limits significantly the spectral data that can be extracted from the measurements.
- "Saving" data is still specified using... paper (plotters) rather than magnetic media (e.g. floppy disks...).
- No time domain measurement equipment is specified. In particular – the use of digital oscilloscopes, proper detectors and LNAs, etc, is not incorporated.
- Measurement equipment needs and usage limitations in high ambient field levels are not addressed.

Additional issues which need to be updated include:

- Antenna/sensor related issues:
 - ► Field strength probes vs. conventional antennae
 - ► Use of directional antennas for spatial resolution of interference
 - ➤ Use of both horizontal and vertical polarization measurements or circular polarization in order to obtain full data
 - Calibration of the antenna for correct survey
 - ➤ Use of monopole antennas (not only loop antennas) for lower frequency measurements (in the HF/shortwave band)
- Procedure related issues
 - ➤ Addition of proper warnings and procedures for performing measurements in high ambient environments, and safety precautions for the same, e.g., warnings regarding avoidance of overload or saturation conditions which may be detrimental to measurement results and often

fatal for the equipment performance, etc.

- > Procedures for selecting sweep rates, considering time domain characteristics of the RF sources
- Methodology for full-system calibration of test equipment

(3) Incorporate measurement techniques for time domain characteristics of pulsed waveforms

With the increased use of high power pulsed RF sources, e.g., cellular base stations, radar emitters, etc. in the near vicinity of communication, command and control facilities, for either commercial or military applications, the extraction of the time domain characteristics becomes crucial for completion of the RF compatibility analysis. Suppose that an EM site survey is to be conducted in order to investigate the possibility of installation of a new pulsed radio communication service in an existing radio communications facility. The communication system is a TDMA (time division multiple access system) operating at a low duty cycle, with a high immunity to interference (error correction

encoding, etc). Having completed the survey, it is found that the dominant source is a radar at a nearby airport, the spectrum of which almost completely overlaps the frequency band allocated to the new system.

Normally, two approaches are employed in this case:

- Frequency culling, where the frequency overlap (in and out of band) is considered. If no overlap is observed, the probability of interference is, obviously, reduced.
- Amplitude culling, where the amplitude of the signal coupling into the receiver from the radiating source, is performed. This analysis considers also the path losses, the front end characteristics of the receiver, etc. Obviously, whenever there is some frequency overlap, either directly or due to spurious signals, some interference may be probable.

In the discussed case, having reviewed the spectral data obtained by measurement on site, it was found that a significant frequency overlap ("frequency culling") existed. Therefore, amplitude culling was conducted, and it was found that the RF interference signal at the input of the receiver was 30-40dB above its sensitivity level. Based on the measured spectral data alone, the radar, being a broadband emitter, could have potentially blocked the receiver. This would have caused a severe degradation to the receiver performance. In many "normal" cases, this would have prohibited the installation of the equipment on site.

Thus, a major objective of the proposed effort is to incorporate time domain measurements. Such data will enable the performance of "statistical culling," in other words, a statistical analysis of the probability of interference between the system on site is performed. Of course this process has benefits only where pulsed systems are concerned, but today, in the "digital age," this is, in fact, the reality. Such measurements were not possible in the past, but can reliably be conducted with modern test equipment.

(4) Need for a format for site survey documentation

In the performance of site surveys, one of the most important issues is the proper documentation of the survey results. A

continued on page 41

CONGRATULATIONS

to the following members of the EMC Society who were elected to Senior Member grade at recent meetings of the IEEE Admission and Advancement Panel. The IEEE Section Affiliation follows each name.

Flavio G. Canavero, North Italy Carlos Ferrari, Argentina Robert G. Georgerian, Denver See Kye Yak, Singapore Akhlesh Lakhtakia, Central Pennsylvania Murlin Marks, Santa Clara Valley Wayne B. Mieth, San Diego Cesar Monzon, Dallas Terry North, Southeastern Michigan David Osborn, Boston Wayne Owen, North Jersey Akira Sugiura, Tokyo Keith Whites, Lexington Eyal Zadok, Israel



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Book Review



Reinaldo Perez, Associate Editor

Mobile Antenna System Handbook

Editors: K.Fujimoto and J.R. James; Publisher: Artech House, 1994, 617 pages

Some of our readers may be familiar with the many antenna books presently on the market. The EMC membership is very familiar with antennas since it is part of our technology and industry. Why do we want to review an antenna book? Basically, for two reasons: 1) Antenna technology for mobile wireless communications systems is expected to evolve significantly within the next 10 years as the wireless personal communications revolution continues, and 2) This is not a book on antenna theory and methods for analysis and is not a book on computational analysis techniques for antennas, rather, the book is a timely account of the state of affairs of antenna techniques relating to communications, radar, and navigation with emphasis on systems. This book is intended for readers who are interested in knowing what is going on in the wireless telecommunications world. Many EMC engineers are already in this mode.

The book covers the areas of interest in land, maritime, satellite, and aeronautical mobile systems. The chapters in the book are organized by classification for application. The main chapters separately address land, maritime, satellite, and aeronautical mobile systems. The final chapter, a glossary, gives a large classification and other details that have a strong coordinating role in the book. For each chapter, attention is paid to design factors concerning propagation problems, operational requirements, and environmental conditions. The most important of the propagation problems, fading and the delay time effects caused by multipath propagation, are discussed in great detail. Discussion includes the relevance of various system parameters in antenna design such as communication

zone, modulation schemes, frequency spectrum, interference, system signal-tonoise ratio, and bit error rate. The environmental conditions which affect mobile system performance directly are also discussed. Finally, proximity effects, which are caused by the interaction between the antenna and the body of the equipment, front-end circuits, and human operator, are also addressed since they are important factors that must be included in any antenna design.

The book is organized in eight chapters and one appendix. Chapter 1 titled "General View of Antennas in Mobile Systems," presents an overview of antenna systems, including some historical perspectives on mobile communications and related antenna technologies, trends, and antenna design concepts in modern mobile systems. Chapter 2 titled "Essential Techniques in Mobile Antenna System Design," discusses techniques applied specifically to mobile systems. The chapter discusses background material on technology, propagation, and antennas to support subsequent chapters. Problems related to propagation, radio transmission, choice of frequencies, communication zones, and interference are treated. This is followed by the requirements for antenna systems, discussion of proximity effects, and the evaluation of antenna performance in a mobile environment.

Land mobile systems are divided into three chapters. Chapter 3 titled "Land Mobile Antenna System I" covers fundamental issues and techniques concerning land mobile antenna systems, such as propagations, the design and application of antennas for both base and mobile stations, and diversity systems. Chapter 4 titled "Land Mobile Antenna Systems II" covers pagers and portable phone systems. The first part discusses the fundamentals and performance for different antennas in paging receivers. Antenna design for different kinds of paging receivers, with shapes such as the conven-

sented. In the second part of the chapter, antennas for portable phones are described. The last part of the chapter describes safety issues for portable mobile antenna systems. Of special interest to the computational electromagnetic community is the treatment, in Chapters 3 and 4, of the method of moments and finite difference time domain approaches for analyzing and designing mobile antennas. The material presented is only application oriented, which means that no discussions are made of these techniques, but instead the application of such techniques in designing these antennas is reviewed. Chapter 5 titled "Land Mobile Antenna Systems III" addresses antenna systems for different kinds of land mobile systems concerned with broadcast reception in a car, and communication in train and city bus systems. The design of a diversity antenna system for car broadcast reception requires the same technology as other mobile antenna systems. The challenge of receiving a TV broadcast from a moving vehicle is also addressed. In the chapter discussions are also made of how ferrite antennas can be used not only for receiving but also for transmitting.

tional box, pencil, and credit card is pre-

Chapter 6 is devoted to mobile satellite systems embracing vehicle, shipborne, and broadcast applications. In the first half of the chapter, antenna systems deployed in satellites such as Inmersat are covered by introducing structure, performance, and characteristics of such antennas. The material is of introductory nature only. In the second part of the chapter antenna systems for trains and cars to communicate with satellites are discussed.

Finally, in Chapter 7 an introduction is presented of a wide variety of airborne antenna systems for communications and navigation (slot, spiral, microstrip patch, helical, and dipole). This book can be recommended as a reference in mobile antenna design. **EMC**



EMCABS

EMC Abstracts

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.bunter@ieee.org 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, you can 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.

The abstracts of papers from EMC Japan are now available on the web-site: http://www.tc.knct.ac.jp/EMCJ/ index-e.html, which has been provided by the IEICE EMC Japan Technical Committee and the EMC-S Japan Chapter with the aid of Professor Yoshifumi Shimoshio, Kumamoto National College of Technology. Most of the papers are available in Japanese only, while the abstracts are clearly identified. In each abstract the author's address or e-mail is given below the article title. You can directly contact the author(s) of your interested article and request the copy. In case you cannot reach the author(s), please feel free to contact Prof. Shimoshio via e-mail at *yshimo@tc.knct.ac.jp* He will assist in routing your request to the author(s), but he will not translate the papers.

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. **EMC** MEASUREMENT OF NOISE SOURCE IMPEDANCE OF OFF-LINE CONVERTERS

Dongbing Zhang+1, Dan Y. Chen+2, Mark J. Nave+3, and Dan Sable+4 +1 National Semiconductor, Santa Clara, CA; +2 Virginia Polytechnic Institute and State University, Blacksburg, VA; +3 Network Appliance, Sunnyvale, CA; and +4 Virginia Polytechnic Institute and State University, Blacksburg, VA

IEEE Transactions on Power Electronics, Septembet 2000, pp. 820-825

Abstract: The conducted noise emissions of Switch Mode Power Supplies operated off-line require line filters for their reduction to meet EMC regulations. The design of a line filter of predictable performance requires a knowledge of the noise source impedance of the SMPS involved using the insertion loss method. The measurement techniques for determining both common mode and differential mode source impedances are developed and compared with measured data. The attenuation of the line filter is then predictable.

Index terms: Design of line filters for off-Line SMPS, noise source impedance measurement, insertion loss method.

EMCABS: 02-2-2001

ANALYSIS AND SPECTRAL CHARACTERISTICS OF A SPREAD-SPECTRUM TECHNIQUE FOR CONDUCTED EMI SUPPRESSION K. K. Tse, Henry Shu-Hung Chung, S. Y. (Ron) Hui. And H. C. So

Department of Electronic Engineering, City University of Hong Kong, Hong Kong

IEEE Transactions on Power Electronics, March 2000, pp. 399-410.

Abstract: Frequency Modulation (FM) and Random Carriet Frequency (RCF) techniques have been applied to reduce conducted emissions of Switch Mode Power Supplies (SMPS). What has been lacking were analytic methods for comparing these techniques to the Pulse Width Modulation (PWM) scheme. For example, how much randomness is desirable for RCF dc-dc converter? This paper describes methods that permit the analytic predictions, hence comparisons, of the spectrums of conducted noise produced by the three converter methods. The analysis, confirmed by experiment, shows that RCF method is superior to FM and permits exploring the degree of randomness that is desirable.

Index terms: Spread spectrum in SMPS, random carrier frequency in SMPS, frequency modulation in SMPS, PWM converters, conducted EMI suppression in SMPS, random noise circuit hence comparison.

EMCABS: 03-2-2001

MEASUREMENT OF COMPLEX TRANSFER IMPEDANCES OF SHIELDED MULTICONDUCTOR CABLES WITH SHIELD INHOMO-GENEITIES INSIDE CABLE BUNDLES

Lorenz Jung, Jan Luiken ter Haseborg

Hamburg University of Technology, Dept. of Measurement Engineering /EMC, Harburger Schloss Strasse 20, D-21071 Hamburg, Germany

Proceedings of 4th European Symposium on Electromagnetic Compatibility, Brugge, Belgium, September 11-15, 2000, pp. 83-88.

Abstract: The determination of the complex transfer impedances and transfer admittances of shielded multiconductor cables is the prerequisite for calculating disturbing currents on the inner wires of the cable. This paper shows a measurement procedure based on the improved triaxial measurement set-ups using multiconductor transmission line theory for evaluation. With this method of evaluation it is possible to determine individual transfer impedances and admittances for each inner conductor of a shielded multiconductor cable over a broad frequency range. In this paper the measurement method is extended to cables which are located inside a cable bundle.

Index terms: Shielded multi-conductor cable, complex transfer impedance, measurement, multi-conductor transmission line theory.

OPTIMAL UTILIZATION OF A REVERBERATION CHAMBER

Frank B.J. Leferink, Thomson-CSF Signal,

Environmental Competence Centre, P.O. Box 42, 7550 GD Hengelo, The Netherlands

leferink@signaal.nl

University of Twente, Faculty of Electrotechnical Engineering,

Telecommunication Engineering, P.O. Box 217, 7500 AE Enschede, The Netherlands

leferink@cs.urwente.nl

Wim C. van Etten

University of Twente, Faculty of Electrotechnical Engineering,

Telecommunication Engineering, P.O.Box 217, 7500 AE Enschede, The Netherlands

etten@cs.utwente.nl

Proceedings of 4th European Symposium on Electromagnetic Compatibility, Brugge, Belgium, September 11 -15, 2000, pp. 201-206.

Abstract: The impact of the structure of a reverberation chamber, as used for electromagnetic compatibility testing, on spatial uniformity, isotropicity and quality factor are described. A new reverberation chamber with varying angles between wall, floor and ceiling and with vibrating walls is presented. Inside this Vibrating Intrinsic Reverberation Chamber (VIRC) a diffuse, statistically uniform electromagnetic field is created without the use of a mechanical, rotating, mode stirrer. This chamber results in a better homogeneity and increased field strength compared to conventional mode stirred reverberation chambers (MSC). Test results obtained in the VIRC are presented. *Index terms*: New reverberation chamber, vibrating walls, EMC test.

EMCABS: 05-2-2001

RADIATED EMISSION OF AN ELECTRICAL CIRCUIT INSIDE A PENETRABLE SHIELDED ENCLOSURE: A NUMERICAL TIME-DOMAIN APPROACH

Mauro Feliziani, University of L'Aquila, Department of Electrical Engineering,

67040 Poggio di Rio, L'Aquila, Italy

Francescaromana Maradei, University of Rome "La Sapienza," Department of Electrical Engineering, Via Eudossiana 18, 00184 Rome, Italy

Proceedings of 4th European Symposium on Electromagnetic

Compatibility, Brugge, Belgium, September 11 -15, 2000, pp. 227-232.

Abstract: The electromagnetic field radiated by an electromagnetic source inside a shielded enclosure with penetrable walls is calculated by a numerical procedure based on the mixed Finite-Difference/Whitney-Elements Time-Domain (FD/WETD) method. The domain inside the enclosure is modeled by the WETD method, while the exterior domain is modeled by the FDTD method. The two methods are interfaced on the surfaces of the shielded enclosure by the impedance network boundary conditions (INBCs), which couple the tangential components of the electric and magnetic fields on both shield surfaces. The solution scheme of the resulting equation system is implicit-explicit. The proposed method is applied to analyze the radiated emission produced by an electrical circuit with lumped parameters placed inside the penetrable shielded enclosure adopting the formulation of the circuit-oriented WETD method.

Index terms: Electromagnetic source, penetrable shielded enclosure, radiated emission, numerical time domain approach.

EMCABS: 06-2-2001

EMC EFFECTS CAUSED BY RADIATED AND CONDUCTED ESD FIELDS

Francescaromana Maradei, University of Rome "La Sapienza," Department of Electrical Engineering, Via Eudossiana 18, 00184 Rome

maeadei@elettrica.ing.unitoma1.it

Marco Raugi, Dept. of Electrical Systems and Automation, University of Pisa, Via Diotisalvi 2, 56126 Pisa

raugi@dsea.unipi.it

Proceedings of 4th European Symposium on Electromagnetic

Compatibility, Brugge, Belgium, September 11 -15, 2000, pp. 339-344.

Abstract: In this paper a scattered field finite-difference time-domain (FDTD) formulation is proposed to analyze an electrostatic discharge (ESD) event. Analytical expressions for the field radiated during the ESD discharge phase are determined and considered as incident fields during the current discharge phase. In order to take into account the electromagnetic field penetration through shielding structures, the conductive panels are efficiently modeled in the FDTD by the impedance network boundary conditions (INBCs), which are suitably formulated in terms of scattered field. The method is applied to carry out the analysis of ESD events in some configurations.

Index terms: Electrostatic discharge, radiated and conducted fields, shielding structure, filed penetration, analysis.

EMCABS: 07-2-2001

INFLUENCE OF MICROWAVE OVEN DISTURBANCE ON SPREAD SPECTRUM SYSTEM

Takeshi Kowada, Takashi Shinozuka and Risaburo Sato

Electromagnetic Compatibility Research Laboratories Co., Ltd.

6-6-3 Minami-Yoshinari, Aoba-ku, Scndai, 989-3204 JAPAN

Proceedings of 4th European Symposium on Electromagnetic Compatibility, Brugge, Belgium, September 11 -15, 2000, pp. 381-385.

Abstract: We have been examining the influence of electromagnetic disturbance that invade spread spectrum communication system. In these experiments, the amplitude probability distribution (APD) of the electromagnetic disturbance and the bit error rate (BER) of the communication system were measured and the relation between the two was evaluated quantitatively. Evaluation using the APD measurements was compared with the methods proposed by CISPR (peak measurement) and their respective noteworthy points were investigated. In addition, we will report together with communication quality evaluation results with microwave ovens on the market. Index terms: Spread spectrum system, microwave oven, electromagnetic dis-

Index terms: Spread spectrum system, microwave oven, electromagnetic disturbance, statistical measurement, CISPR measurement.

EMCABS: 08-2-2001

MODELING OF GRIDS BY USING THE METHOD OF EQUIVALENT DIPOLES

Koen Vervoort, Alcatel Bell, Francis Wellesplein 1, B-2018 Antwerpen (Belgium)

Kathleen De Jongh, Ronald De Smedt,

Alcatel Bell, Francis Wellesplein 1, B-2018 Antwerpen (Belgium)

Proceedings of 4th European Symposium on Electromagnetic Compatibility, Brugge, Belgium, September 11 -15, 2000, pp. 465-470.

Abstract: The shielding effectiveness of a grid in an infinite screen is determined by replacing the apertures by equivalent dipoles. The results correlate well with those obtained with a more rigorous simulation tool based upon the method of moments. The advantage of the present method is the capabiliry to handle much larger grids. The key factor to characterize a grid is the polarizable density. As application, it is shown how the total air surface can be increased while keeping the same shielding effectiveness.

Index terms: Shielding effectiveness, grid, infinite screen, equivalent dipoles, rigorous simulation tool.

EMCABS: 09-2-2001

VARIABLES OF SE MEASUREMENTS PERFORMED IN MODE-STIRRED CHAMBERS

W.Kürner, A.Schwab

Institut für Elektroenergiesysteme und Hochspannungstechnik, Universität Kahlsruhe

Engesserswasse 12, Gebäude 30.36 D-76131 Kahlusruhe, Germany

Telephone: +49 721 608 2520/2521 Fax: +49 721 69 52 24

(Key contact: kuemer@ieh.etec.uns-karlsruhe.de)

Proceedings of 4th European Symposium on Electromagnetic Compatibility, Brugge, Belgium, September 11 -15, 2000, pp. 499-503.

Abstract: Shielding effectiveness (SE) measurements in Mode-Stirred Chambers include many unknown variables concerning the operation mode of the chamber and the evaluation of measurement data. This paper aims at determining the best operational mode – e.g. mode-tuned or mode-stirred mode - and the minimum number of test samples. The obtained results from SE measurements are compared to measurements carried out in an anechoic chamber. It is shown that both measurement environments are comparable concerning the average shielding effectiveness of an EUT.

Index terms: Shielding effectiveness, mode-stirred chamber, operation mode, measurement.

EMCABS: 10-2-2001

A SIMPLE METHOD FOR REPRESENTING PCBS IN EQUIPMENT ENCLOSURES

A Denton*, D W P Thomas*, T KonefaI+, T M Benson*, C Christopoulos*, J F Dawson+,

A C Marvin+ and J Porter+

*The University of Nottingham, UK and +The University of York, UK Proceedings of 4th European Symposium on Electromagnetic Compatibility, Brugge, Belgium, September 11 -15, 2000, pp. 509-513.

Abstract: In this paper we show a simple method for representing printed circuit boards (PCBs) within an enclosure, allowing the shielding effectiveness (SE) of the loaded enclosure to be assessed with only a limited amount of information. A number of measurements of the SE of an enclosure loaded with PCBs are presented, showing the range of values of SE that can be obtained by loading the enclosure with different PCBs.

Index terms: Printed circuit board, enclosure, shielding effectiveness, measurement.

EMCABS: 11-2-2001

ELECTROMAGNETIC FIELDS PRODUCED BY PCB STRIPLINE AND MICROSTRIP INSIDE A SCREENED RECTANGULAR ENCLOSURE: A CIRCUIT APPROACH

T. Konefal, J.F. Dawson, A. Denton*, T.M. Benson*, C. Christopoulos*, A.C. Marvin,

S.J. Porter, D.W.P. Thomas*

EMC Standards Activities

continued from page 37

methodology for recording the data, organizing it, and finally interpretation of the data, are necessary in order to effectively complete the site survey.

An appendix outlining the recommended format for the site survey documentation will be added to the Standard.

C. Call for Volunteers

Would you be interested in being involved in this activity? If you are

- involved in RF site studies
- experienced in running "on site" RF measurements
- familiar with statistical analysis techniques
- or simply have interest in this issue

and would like to contribute to this activity, please do not hesitate to let us know of it.

Our goal is to prepare a useful, up to date standard. Would you like to be part of it?

For further information, please contact Elya B. Joffe at: eb.joffe@ieee.org EMC

University of York, UK and the *University of Nottingham, UK Proceedings of 4th European Symposium on Electromagnetic Compatibility, Brugge, Belgium, September 11 -15, 2000, pp. 587-592.

Abstract: The problem of radiation from a PCB microstrip or stripline trace inside a rectangular enclosure is addressed. A circuit approach is taken whereby the PCB trace couples into the enclosure by a mutual inductance and capacitance. The enclosure is treated as a superposition of transmission lines (one for each waveguide mode) short circuited at each end by the enclosure walls. The technique allows the rapid solution of complex field problems.

Index terms: Printed circuit board, rectangular enclosure, electromagnetic fields, circuit approach.

EMCABS: 12-2-2001

PRINTED CIRCUIT BOARD POWER BUS DECOUPLING USING EMBEDDED CAPACITANCE

Todd Hubing, UMR Electromagnetic Compatibility Laboratory

University of Missouri-Rolla, Rolla, MO 65409 USA

M. Xu, I. Chen, I. Drewniak, T. Van Doren and A. DuBroff

UMR Electromagnetic Compatibility Laboratory

University of Missouri-Rolla, Rolla, MO 65409 USA

Proceedings of 4th European Symposium on Electromagnetic Compatibility, Brugge, Belgium, September 11 -15, 2000, pp. 639-642.

Abstract: The purpose of decoupling capacitors on printed circuit boards is to meet the instantaneous current demands of high-speed active devices while minimizing power bus noise. Embedded capacitance is an alternative to discrete decoupling capacitors and is achieved by taking advantage of the natural capacitance between the power and ground planes. This paper investigates the electrical properties of boards manufactured with four different kinds of embedded capacitance. These boards have power-ground plane pairs separated by very thin materials with high dielectric constants. It is shown that some kinds of embedded capacitance work significantly better than standard decoupling schemes using discrere decoupling capacitors.

Index terms: Printed circuit board, power bus noise, decoupling capacitor, embedded capacitance. EMC



3RD Annual Chicago EMC MiniSymposium

Tuesday May 22, 2001 Holiday Inn - Itasca, IL 860 West Irving Park Rd.

The Chicago IEEE EMC Society Chapter is presenting our third MiniSymposium.

http://www.ewh.ieee.org/soc/emcs/chicago/

exhibits.... contact Frank Krozel at 630-924-1600

Chapter Chatter

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Seattle

In October, the Seattle Chapter participated in "Milwaukee Night" at IEEE Northcon/2000 in Bellevue. The meeting was held at the Meydenbauer Center. "Milwaukee Night" is a unique event where several IEEE Society chapters hold their meetings concurrently. Participating chapters included those representing the EMC, Computer, Circuits and Systems, Power Engineering and Power Electronics Societies.



Jim Muccioli of Jastech EMC Consulting was the speaker for the November Chapter meeting. He explained the new capacitive technology introduced by X2Y Attenuators. Tony Anthony (L) invented the technology and was there to lend support to Jim's presentation. He was joined by Don Harris (R), also of X2Y Attenuators.

Each chapter had their respective speakers present their material twice in one night with a break in between. That meant attendees could sit in on one chapter's presentation, take a break, and then sit in on another chapter's presentation. You could conveniently attend two Society chapter meetings in one night! The Seattle EMC Chapter's program featured "Techniques for the EMI Evaluation of VLSI Devices" by Kevin Slattery of Intel Corporation in Hillsboro, Oregon. Kevin explained that at the heart of almost every EMI/EMC problem is what to do about the source of emissions. These emissions may be causing problems in the surrounding environment through direct radiated interference or they may show

themselves by creating functional problems within the module circuitry itself. In all cases, the designer needs a method for identifying and then characterizing these emissions. Kevin's presentation described three methods for accomplishing this. It was concerned primarily with emissions generated by VLSI devices such as microprocessors, ASICs and other large scale devices that use high-speed clocks. Two of the methods described were essentially similar, but differed in the frequency range that they address. The third method was complementary to the first two in that, once having characterized the spectrum of concern, the designer can use this method to investigate the geometry of the emissions at the device package and die level. Kevin Slattery is presently employed by Intel in the Desktop

Architecture Lab in Oregor where he works on EMI at th silicon level. Previously, h worked at Daimler Chrysler i: Hunstville, Alabama, where h performed EMC testing and analysis for Chrysler automotive electronics. He moved to the great Pacific Northwest two years ago. Kevin says he loves i here, he enjoys the rain, and he doesn't miss the heat o Alabama. He also likes the fine Pinot Noirs from the Oregor wineries.

In November, the technical program featured "New X2Y Filter Technology Emerges as Single Component Solution for Noise Suppression" by James P.

Muccioli. Jim showed how a new capacitive technology introduced by X2Y Attenuators LLC, Erie, Pa., can overcome the limitations of currently available signal-integrity solutions by reducing parts count while enhancing performance. He also showed how it opens the door to multi-source solutions and explained that X2Y technology is not a capacitor per se, but rather an architecture that can be used to manufacture a variety of devices, including capacitors, decouplers, transient voltage suppressors, and filters. Jim Muccioli is associated with Jastech EMC Consulting, LLC and X2Y Attenuators, LLC. His talk was guite entertaining and informative. The chapter members asked many penetrating questions throughout the presentation which clearly indicated their interest in the topic.

Jim can be reached by e-mail at jpmuccioli@telocity.com if your interest is piqued. This meeting was held at CKC Labs in Redmond who treated the Chapter to pizza and soft drinks before the presentation. Thanks Pat!

Visit the IEEE Seattle Section website at www.ieeeseattle.org/ for more information on the Seattle EMC Chapter's current and future activities. **EMC**



Seattle Chapter Vice-Chairman Pat Andre of CKC Labs and Bill Hall of William P. Hall Contract Services (L-R) picked up a CD of Jim Muccioli's presentation which also included related technical papers and articles on the X2Y technology.



Dr. Lynne Green of Innoveda asked for clarification of one point in Jim Muccioli's presentation. Mr. Muccioli was happy to oblige!

Calendar

EMC Related Conferences & Symposia

2001

May 13-16

Sponsored by the IEEE Computer Society Test Technology Technical Council (TTTC) 5th IEEE Workshop: Signal Propagation on Interconnects Union Lido Park Hotel Venice (Cavallino) Italy Flavio G. Canavero Canavero@polito.it http://www.tet.uni-hannover.de/SPI

June 4-6

Sponsored by the IEEE Seattle EMC Chapter, Underwriters Laboratories, The Boeing Corporation and ETS-Lindgren The Reverberation Chamber, Anechoic Chamber and OATS Users Meeting The Hyatt Regency Hotel in Bellevue Greater Seattle, WA area Michael O. Hatfield Phone: 540.653.3451 HatfieldMO@NSWC.navy.mil (See ad page 35.)

June 19-22

IV International Symposium on EMC and Electromagnetic Ecology St. Petersburg State Electrotechnical University "LETI" Russia Prof. D.V. Puzankov, Chairman Phone: +812.346.46.37 Michel Ianoz, Vice-Chairman Phone: +4121.6932664 E-mail: michel.ianoz@epfl.ch emc2001@eltech.ru http://www.eltech.ru/EMC2001

October 21-26

Sponsored by the Antenna Measurement Techniques Association (AMTA) AMTA Annual Symposium Denver, CO Mike Francis Phone: 303.497.5973 francis@boulder.nist.gov http://www.amta.org/AMTA2001

EMCS Cooperating Symposia

U.K.: Biannually, even years, in SeptemberZurich: Biannually, odd years, in FebruaryWroclaw: Biannually, even years, in June

EMCS Symposia Schedule

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2001	Montreal, Canada
	Montreal Convention Center
	Benoît Nadeau
	514.822.6000 x2475
2002	Minneapolis/St. Paul
	Hyatt Regency, Minneapolis
	Dan Hoolihan
	651.213.0966
	E-Mail: d.hoolihan@ieee.org
2003	Tel-Aviv, Israel
	(International IEEE)
	Elya Joffe
	Fax: 972.9.765.7065
2003	Boston, MA
	Sheraton Boston
	Mirko Matejic
	508.549.3185
2004	Santa Clara, CA
	Franz Gisin
	408.495.3783
2005	Chicago, IL
	Derek Walton

815.637.3729

IEEE EMC Society Board of Directors Meetings

(For information on all meetings, contact Janet O'Neil, 425.868.2558)

June 15, 2001 Minneapolis, Minnesota

August 12, 2001 Montreal, Canada

November 13, 2001 San Diego, California

IEEE EMC Chapter Colloquium and Exhibition "Table-Top Shows"

2001

April 23

Southeastern Michigan EMC Chapter, contact Kimball Williams 248.354.2845 (See ad page 24.)

May 22

Chicago EMC Chapter, contact Frank Krozel, 630.924.1600 (See ad page 41.)

June 4 Portland EMC Chapter, contact Henry Benitez, 503.696.2284.

June 6

Seartle EMC Chapter, contact Janet O'Neil, 425.868.2558 (See ad page 35.)

June 8

San Diego EMC Chapter, contact Dave Bernardin, 858.678.1422

http://www.emcs.org

This newsletter is online! Visit the web page address above and click on the "Newsletter" button.

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