

# EMC

IEEE EMC Society Newsletter

## INSIDE:

President's Message . . . . .	1	Practical Papers, Articles and Application Notes . . .	19
Letter from the Editor . . . .	2	EMC Directory 2000 . . . .	23
Chapter Chatter . . . . .	4	Book Review . . . . .	29
Call for Raconteurs . . . . .	12	Personality Profile . . . . .	31
Education Committee . . . . .	13	2000 Symposium News . . .	33
Newly Elected Members to the Board of Directors . . . .	15	BoD Activities . . . . .	34
Distinguished Lecturer Program . . . . .	17	Call for BoD Nominations . . . . .	37
TC-9 Computational EMC . . . . .	18	EMCABS . . . . .	41
		Calendar . . . . .	43



## President's Message

*Joe Butler – President, EMC Society*

### A New Millennium

In this first edition of the newsletter for new millennium, I am pleased to introduce myself as your new President. I look forward to serving the Society in this position for the next two years. As a way of introduction, I'd like to provide some insight as to my working relationship with the current Society officers who form what is referred to as the Executive Committee (EXCOM) of the EMC Society Board of Directors. Although I have participated in standards development for many different entities, I do not have quite the international exposure in the standards development area that perhaps Don Heirman, our VP for Standards, enjoys. However, I have actually visited his office where I have seen his one million linear feet of file storage! I have also visited our VP for Membership, Todd Hubing, in Rolla, Missouri, and I know where his barber-shop is located. I now serve alongside Kimball Williams, our VP for Technical Services, as a member of the Board of Directors of the National Association of Radio and Telecommunications Engineers (NARTE). Henry Ott, serving in the recently created position of VP for

Conferences, once had me make copies for him of a technical presentation he was giving to the Central New England EMC Chapter. I serve this chapter as chapter angel, sometime meeting host, and previously as chairman. Our VP for Communications, Len Carlson, with his years of experience on both our Board of Directors as well as on the IEEE Technical Activities Board (TAB), and I, have spent many hours together after BOD meetings debating issues affecting EMC Society governance. Warren Kesselman, our Treasurer, not only e-mails me weekly on a host of issues, but even takes the time to send me a Christmas card. Bill Gjertson, past President and current IEEE Division IV Director, leaves our EXCOM this year, but not without leaving fond memories of the Seattle symposium he chaired. My 10-year-old daughter had a great time in Seattle! Finally, the Society's Secretary and newsletter editor, Janet O'Neil, and I have collaborated on several marketing ideas for the many one-day EMC technical conferences that she organizes. In case you didn't know, I am the principal architect of where to locate the food and beverage table in relation to the exhibits.

In short, I think I have already established a good working relationship with the offi-

cers of the Society and believe I have their full support. I also especially acknowledge our outgoing President Dan Hoolihan for not only serving the Society well but for allowing me to be his confidant and sounding board on Society issues during his tenure as President these past two years. I am fortunate that Dan will remain on the Executive Committee for another year as past President.

Dan has certainly left his mark on our Society with his many accomplishments. Among these is the fostering of increased activities of the Board of Directors in international activities. During his term, the Board held one of its annual meetings at international locales, i.e., Rome in September 1998 and Tokyo in May 1999. As this newsletter goes to press, the board is in the process of drafting potential Memoranda of Understanding (MOU's) to detail our involvement in: IEEE EMC International

*Continued on page 3*



Photo by Dick Ford

**EMC Society Leadership Changes Helm.**  
*At the November 1999 meeting of the EMC Society Board of Directors, the gavel was officially passed from outgoing President Dan Hoolihan (L) to incoming President Joe Butler.*

<http://www.emcs.org>

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



# Letter from the Editor

Janet O'Neil – Editor, EMC Society Newsletter

## A New Look for the New Year!

With the advent of the year 2000, it seemed like an appropriate time to freshen up the look of the EMC Society Newsletter. In case you haven't noticed, we've revised the format of the Newsletter considerably. Most notably, the text is presented in three columns now, rather than in two. This change is significant as now more text can be printed on each page. (I trust you don't need to use a magnifying glass to read it

though!) The resulting savings for printing and mailing fewer pages were considerable. The savings were applied to providing color now throughout the issue – in all photos as well as graphs for the practical papers. I hope you enjoy the new, fresh look of the EMC Society Newsletter. Your com-

ments are most welcome. Please send your comments to [j.n.oneil@ieee.org](mailto:j.n.oneil@ieee.org) or call me at 425-868-2558. EMC



Photo by Dick Ford

*Newsletter Editor Janet O'Neil is flanked by EMC Society Board members Don Heirman (L) and Joe Butler at the annual Board dinner.*



Photo by Dick Ford

*Eager to begin their terms as new members of the EMC Society Board of Directors in the year 2000 are Jose Perini and Fred Heather (from left) and Larry Cohen (far right) with Joe Butler, newly elected President of the EMC Society. Not pictured are newly elected Board members Andy Drozd, Moto Kanda and Andrew Podgorski. For more information on the newly elected Board members, see page 15.*



Photo by Dick Ford

*Don Heirman, Vice-President of Standards, received this prestigious award from the IEEE to recognize his 17 years of Chairmanship of the Standards Committee. Outgoing EMC Society President Dan Hoolihan presented the award to Mr. Heirman at the November Board of Directors meeting. The EMC Society is one of the most active IEEE Societies in the Standards Association, largely due to Mr. Heirman's leadership. For more information on the Board of Directors activities at the November meeting, see page 34.*



Photo by Dick Ford

*Matt Chaney of Hargrove Exhibitor Services conducted a tour of the Hargrove facilities in Landover, Maryland for the 2000 IEEE International Symposium on EMC committee members. Enjoying the tour are (L-R) Matt Chaney, Penny Caran, Shelley Grandy and Bill Duff (Committee Chair). For more information on the 2000 EMC Symposium, please see page 33.*



## President's Message

continued from page 1

symposia in Tel Aviv, Israel (May 2003), Montreal, Canada (August 2001) and continuing technical cooperation for EMC symposia in Zurich, Switzerland (February 2001), Wroclaw, Poland (June 2000), and Brugge, Belgium (September 2000). Technical cooperation is also under consideration with several other international EMC symposia. During my tenure as President, I hope to continue to foster this increased globalization of our Society.

This past November, the Board of Directors met in Washington, DC, site of the upcoming EMC symposium. At this meeting, with the support of Dan Hoolihan, I orchestrated a long range planning session with the help of several of my associates on the Board. The session focussed on four key issues: globalization, organization and governance of the Society, membership, and communication. The results of our efforts were the identification of several initiatives, both short and long term, which will provide direction to the Board. As we review these ideas at our next Board meeting in Phoenix, we will begin to define tasks and identify resources to address the relevant issues. Globalization in all its composite parts will be a main thrust. Membership development, chapter development, and Board of Director representation from IEEE Regions 7, 8, 9, and 10, i.e., non-United States, will be focus areas.

As mentioned by Dan Hoolihan in the last EMC Newsletter, the five-year review of the EMC Society conducted by the IEEE during this past November's Technical Activities Board (TAB) meetings was very complimentary to us. Among the reviewer comments was the fact that they found it

interesting that the incoming president would be the chair of the long range planning activity and thus ultimately responsible for following through on the implementation of the plans. Most Societies have a separate long-range planning chair, or enlist the services of the past president. Using my interest in golf as a metaphor, could I have mismanaged my handicap negotiation even before I've teed off? I hope not, and I really don't think so - besides I have strong support for the issues from the Board. Better still, the Board developed the ideas!

I start my tenure with the financial health of the Society at an all time high. Our current net worth is approximately \$950K. The projected surplus from the Seattle symposium is \$150K and for Washington, DC is \$117K. The budget for 2000 shows a projected \$148K surplus. We are clearly in good shape financially to address new initiatives to foster our growth.

Looking ahead, the Board of Directors will meet in Phoenix, Arizona on March 24th, Montreal, Canada on June 9th, Washington, DC on August 20th and 24th, and finally in Tampa, Florida on November 16th. I look forward to meeting representatives of the local chapters at these locations as well as at other EMC symposia worldwide that I hope to attend. If you have any questions or comments regarding the Society's activities, please feel to stop and introduce yourself to me as I wander around the world, or call, fax, or e-mail me at the Chomerics Division of Parker Hannifin, 781-939-4267, 781-938-5071 (fax), [jbutler@parker.com](mailto:jbutler@parker.com). **EMC**

## NOTICE: BYLAWS CHANGE

The EMC Society Board of Directors, at its November 1999 meeting, approved a motion to delete the Society Bylaws paragraph 12.2 entitled "Typical Standing Committees." The "typical" content was general information and not a Bylaws procedural type statement. The deletion is an editorial change to simplify the Bylaws document. This change will become effective after approval by IEEE and publication of this notice.

## Newsletter Staff

### Editor

Jaeger Nichols O'Neil  
Lindgren RF Enclosures, Inc.  
22117 NE 10th Place  
Redmond, WA 98053  
Tel: 425-868-2558 Fax: 425-868-0547  
e-mail: [j.n.oeil@ieee.org](mailto:j.n.oeil@ieee.org)

### Editor Emeritus

Robert D. Goldblum  
ITEM Publications  
5 Union Hill Road  
West Conshohocken, PA 19388  
610-834-0400 fax: 610-834-7537  
e-mail: [rgoldblum@item.com](mailto:rgoldblum@item.com)

### Associate Editors

#### ABSTRACTS

Professor Osamu Fujiwara  
Dept. of Elec. & Comp.  
Engineering  
Nagoya Institute of Technology  
Gokiso-cho, Showa-ku, Nagoya  
466-8555 Japan  
+81-52-735-7421  
fax: +81-52-735-5442  
e-mail: [fujwara@odin.elec.nitech.ac.jp](mailto:fujwara@odin.elec.nitech.ac.jp)

#### BOOK REVIEWS

Reinaldo Perez  
c/o Lockheed Martin  
MS, 88700, P.O. Box 175  
Denver, CO 80201  
303-977-5845  
fax: 303-977-4306  
e-mail: [ray.perez@lmco.com](mailto:ray.perez@lmco.com)

J.L. Norman Vetter  
Violence Engineering Corp.  
120 East Broad St., Ste. B  
Falls Church, VA 22046  
703-532-1435  
fax: 703-538-3810  
e-mail: [enviet@msn.com](mailto:enviet@msn.com)

#### CHAPTER CHATTER

Todd Hubing  
Univ. of Missouri-Rolla  
120 Emerson Electric Bldg.  
Rolla, MO 65401  
573-341-6089  
fax: 573-341-4732  
e-mail: [t.hubing@ieee.org](mailto:t.hubing@ieee.org)

#### EMC PERSONALITY PROFILE

William G. Doll  
Computer Sciences Corp.  
Systems Support Div. Sec. 300  
5501 Backlick Road  
Springfield, VA 22151  
703-915-8450  
e-mail: [wcdoll@ieee.org](mailto:wcdoll@ieee.org)

#### EMC STANDARDS ACTIVITIES

Donald N. Heirman  
143 Jumping Brook Road  
Lincroft, NJ 07738-1442  
732-741-7725  
fax: 732-530-5695  
e-mail: [d.heirman@worldnet.att.net](mailto:d.heirman@worldnet.att.net)

#### IEEE EMC Society Newsletter Publication Schedule

Publication Dates	Editorial Deadlines
August	July 1
November	October 1
February	January 1
May	April 1

IEEE EMC SOCIETY NEWSLETTER is published quarterly by the Electromagnetic Compatibility Society of the Institute of Electrical and Electronic Engineers, Inc., 3 Park Avenue, 17th Floor, New York, NY 10016-5997. One dollar (\$1.00 USD) per member per year (included in the Society fee) for each member of the EMC Society. Periodicals postage paid at New York, NY and additional mailing offices. This newsletter is printed in the USA. Postmaster: Send address changes to IEEE EMC Society Newsletter to 445 Huer Lane, Piscataway, NJ 08854.

**COPYRIGHT PERMISSION** Permission to copy without fee all or part of any material without a copyright notice is granted provided that the copies are not made or distributed for direct commercial advantage, and the title of the publication and its date appear on each copy. To copy material with a copyright notice requires specific permission. Please direct all inquiries or requests to IEEE Copyright Office.





## Chapter Chatter

*Todd Hubing, Associate Editor*

**D**oublemint will probably be contacting Don Heirman and me after this year's symposium in Washington D.C. Have you seen those commercials that feature twins doing fun things while chewing Doublemint gum? After I get my Don Heirman haircut, they'll probably want to make a commercial showing Don and me playing golf, running on the beach or doing ESD tests.

As you may have heard, I volunteered to get my hair cut like Don Heirman's if at least \$10,000 is donated to the President's Memorial Award fund before the August EMC symposium. The President's Memorial Award is the Society's highest award. Each year, it honors a prominent deceased member of the EMC Society by providing scholarship money to support the education of a promising young student studying EMC. This award is supported entirely by contributions. Without the help of people like you and me, this important program will cease to exist.

I've received lots of email from people telling me they plan to contribute. Even people I've never met tell me they can't wait to see me with a Don Heirman haircut. The only person who's expressed any reservations at all is my wife. She thinks Don's hair looks pretty good on him, but she's quick to point out that Don has more hair to work with. Ever since my hairline started receding, I've been using the longer hairs in the middle of my head to hide the hairless areas on either side. With a Don Heirman haircut, there's no hiding anything. Nevertheless, I'm sure that when my wife sees me with my new haircut, the first words out of her mouth will be, "It looks great, Dear. I love it." I know this because over the years I've learned that this is the only acceptable way to react when your spouse comes home with a new hairstyle.

Speaking of the August symposium, I've noticed that exhibitors at the symposium often give away small items

The Presidents Memorial Award provides scholarship money to promising young graduate students studying EMC-related fields. The President's Memorial Award scholarships can only be awarded in years in which there are adequate resources available in the President's Memorial Award Fund. This fund is entirely dependent upon private and corporate donations. Tax-deductible donations to the President's Memorial Award Fund can be mailed to:

Warren Kesselman

Treasurer, EMCS

31 Hope Road

Tinton Falls, NJ 07724-3009

All money contributed is used to provide scholarships. There are no management or overhead charges. The President's Memorial Award Fund is independent of other IEEE accounts and cannot be used for any other purpose.

with company logos. It occurred to me recently that hats would be really neat give-away items. Don't you agree? I know that if I received a hat at the EMC symposium, I would want to wear it almost everywhere I went. This would be particularly true if it were a hat from a company that contributed to the President's Memorial Award Fund. Maybe the hats could say, "I support the President's Memorial Award!" Everyone would want a hat like that. Especially people who need to keep the Washington sun off the tops of their heads. Don and I could wear our hats when we make the Doublemint commercial. I hope I can learn to do an ESD test and chew gum at the same time.

### Atlanta

David Dennis, chair of the Atlanta chapter, reports that they had a meeting on December 2, 1999. Their guest speaker

was Mike Hopkins of KeyTek Instruments, and he delivered a presentation entitled "IEC Standards Update - October 1999: Changes to IEC Standards on ESD, EFT, Surge, PQF, RF Immunity and Emissions." Mike gave a basic overview of the EMC standards relating to these topics and he held an interactive discussion with the meeting attendees on the possible changes or revisions to the standards. Through Mike's firsthand involvement with the IEC Working Group responsible for development of basic EMC standards, he was able to provide valuable insight into what the future holds for these requirements and procedures.

### Beijing

Dr. Li Shufang reports that Prof. Gao Yougang, chair of the Beijing chapter, invited Mr. Elya Joffe, a Distinguished Lecturer of the IEEE EMC Society, to the Beijing University of Posts & Telecommunications. Mr. Joffe gave a brilliant two-part presentation on November 4th and 5th. The first part was titled, "Grounding Design in Printed Circuit Boards." Mr. Joffe introduced the basics of grounding design followed by many practical application examples. The second part was titled, "High Speed Signal Traces as Transmission Lines in PCBs." First Mr. Joffe proposed the idea of viewing power distribution networks as signal return paths. Then he discussed transmission line effects on PCBs and examples of typical transmission lines on PCBs as well as methods of controlling reflections. 52 researchers from universities, research institutes, and industries such as Beijing Univ. of Posts & Telecom., China Academy of Science, Shanghai Bell Telecommunication Company, Zhong-Xing Company, Hua-Wei Company among others were present. Over 20 IEEE members attended the research meeting. Mr. Joffe's lecture was very much appreciated by all of those in attendance. When he finished his presentation, the audience burst into thunderous applause. After the presentation, a heated discussion took place to the benefit of everyone involved. Many of those in attendance suggested that such wonderful presentations sponsored by the IEEE EMC Society should be held more frequently.



## Central New England

John Clarke, chair of the Central New England chapter, reports that three meetings were held in the fall of 1999. The September meeting was a joint meeting with the North East Product Safety Society. Kefeng Liu, of EMC Test Systems in Austin, Texas, spoke on the subject of "EMC Chamber Design and Measurement." The presentation addressed fundamental parameters involved in designing a large indoor shielded EMC chamber capable of making 10-meter radiated EMI tests. Key components such as RF absorbers and ground plane properties were discussed. Measurement accuracy of various RF instruments used was also addressed. Precision measurement of antenna factors and chamber Normalized Site Attenuation were covered. The use of various broadband antennas, Geometry Specific Antenna Factors and Free-Space Antenna Factors were also discussed. There were 25 people in attendance.

The featured speaker at the November meeting was Dr. Mirko D. Matejic of the Foxboro Company in Foxboro, Massachusetts. Dr. Matejic gave a presentation titled, "EMC Test Laboratory Assessment." On behalf of NVLAP and A2LA, Dr. Matejic has assessed over 100 EMC test laboratories. He discussed typical laboratories' strengths and deficiencies identified during on-site assessments. A credible way to determine EMC product compliance with applicable standards is to test the product at a competent accredited laboratory. All deficiencies must be well documented and referenced to either IEC/ISO Guide 25 or relevant technical specifications. If all deficiencies are resolved, the assessor recommends laboratory accreditation.

The topic of the December meeting was "Antenna Behavior, Design and Use." The speaker was Colin E. Brench of Compaq Computer Corporation in Maynard, Massachusetts. EMC Corporation staff conducted a tour of their new 10-meter semi-anechoic chamber. The facility tour was arranged by Boris Shusterman, a Principal Compliance Engineer at EMC Corp. This was followed by the technical presentation. Many of the differences between test facilities can be traced to antenna issues. Understanding antenna behavior during real measurements, site attenuation mea-

surements and calibration will largely explain discrepancies that result. The speaker discussed these issues and closed by describing the design of an antenna prepared for ANSI. There were 37 people in attendance at this meeting.

## Chicago

Derek Walton reports that the Chicago chapter continues to be busy. In December, 3-Com in Rolling Meadows was the venue for a presentation on signal integrity (SI) issues. Ray Lethental of 3-Com was the presenter, and Viewlogic provided an assortment of EMC/SI tools so that attendees could familiarize themselves with what can be simulated.

Election of the Chapter officers also took place at the December meeting. Each of the existing officers were reinstated, with the addition of three new positions. Clifford Kraft of Lucent Technologies has joined the program planning team while Carla Robinson of 3-Com and Frank Krozel of Electronic Instrument Associates have formed a new publicity team to help spread the news about our Chapter program.

The Chapter now has a formal website that is maintained by Frank Krozel. The location is: <http://www.ewh.ieee.org/soc/emcs/chicago/>. Feel free to browse the site, and perhaps join us at an upcoming event. This is also where you will find the latest information on our Mini-Symposium scheduled for May 22-23, 2000.

Sufficient interest was generated at the Chapter meeting discussing the ACIL inter-laboratory comparison that the Chapter has decided to perform its own version using a comb generator. Several test facilities have offered to perform a test and share the results. If any Chapter would like to perform a similar activity and share their data, please alert Clifford Kraft or Derek Walton. Contact information is on the chapter website.

## Dallas

*(Thanks to Bill Paschetag for submitting the following report on the activities of the Dallas chapter.)*

The October meeting of the Dallas EMC Society was held on October 19th at

KTL, Lewisville, Texas. The guest speaker was John Olivanti, Vice President of Technical Services at KTL, who spoke on "Telecom Regulatory and Testing Issues." Attendees were also given a tour of the KTL test facilities. There were 26 guests in attendance (12 IEEE members).

The November meeting of the Dallas EMC Society was held on November 15th, at Abbott Labs, Irving, Texas. The guest speaker was distinguished lecturer Don Heirman, Associate Director of the University of Oklahoma EMC Wireless Center, speaking on "Happenings at the University Center for the Study of Wireless EMC." Attendees were given a tour of the Abbott EMC test facilities. There were 27 guests in attendance (12 IEEE members). Nomination of Officers for 2000-2001 for the Dallas EMC Society chapter was held during the November meeting. Gary Shimko (Marconni Communications) was nominated for Chair, Bob Queen (Abbott Laboratories) was nominated for Vice-Chair and Bill Paschetag (SpectraPoint Wireless) was nominated for Secretary-Treasurer.

No technical meeting of the Dallas EMC Society was held in December, but instead a holiday social was held on December 21st at Enchilada's Restaurant in Dallas. Twelve people, including five guests, attended the social.

## Germany

Dr. Frank Gronwald reports that the German EMC chapter encountered a very special highlight when the "International Symposium on EMC" was held on October 5-7 in Magdeburg, Germany. About 150 participants joined the meeting and listened to 75 presentations, related to 10 main topics and covering most aspects of EMC. It was a scientific treat for the German chapter to



*Gary Shimko, Dallas EMC Chapter Vice Chair, Don Heirman, distinguished guest speaker at the November meeting and Mark Bushnell, Dallas EMC Chapter Chair.*



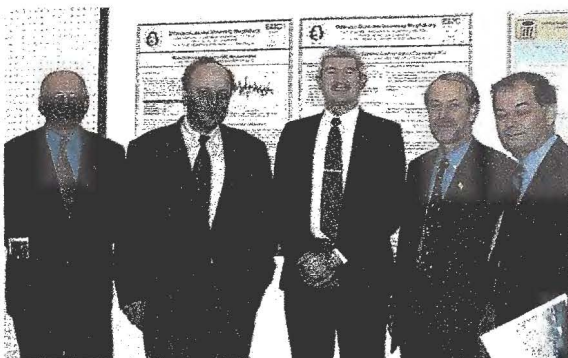
have international experts from the U.S., France, Sweden, and Russia present, among them Dr. C.E. Baum and Dr. F. Tesche. They stimulated a host of challenging discussions. In addition to the talks, two workshops on "European EMC Standards" and "EMC Threats" were conducted. In particular, the last topic sparked curiosity and the interest of the local TV and national press, which reported on the meeting.

The strength of the EMC community was clearly demonstrated when a historic experiment of Otto-von-Guericke (1602-1686) was performed during the symposium banquet. 14 EMC experts were required to separate two evacuated Magdeburgian half spheres of 20-cm diameter, tightly held to each other by the surrounding air pressure.

The organization of the symposium had been put into the hands of Professors Juergen Nitsch and Guenter Wollenberg who just established the Institute for Fundamental Electrical Engineering and EMC at the University Magdeburg.



*Everyone enjoys listening to the fanfare composed by Dr. C. E. Baum at the opening of the International Symposium on EMC in Magdeburg.*



*Two Chapter Chairs and the organizers of the EMC lecture series at the University of Magdeburg join speaker Elya Joffe following his presentation. Shown from left are Zbigniew A. Styczynski, Heyno Garbe (German EMC Chapter Chair), Elya B. Joffe (Israeli Chapter Chair), Juergen Nitsch and Guenter Wollenberg.*

Everybody agreed that they succeeded in not only assembling a meeting of high scientific value, but also in providing an enjoyable and relaxing atmosphere.

The 6th meeting of the German IEEE EMC Chapter took place on November 17 in Frankfurt. The main topics were the reports from the chair, from the "Numerical Field Calculation" Group and from the "Biological Effects" Group. The chairman, Professor Garbe, thanked the chapter members for their last year activities and presentations and congratulated Professor ter Haseborg on his appointment as the first Fellow in the German EMC Society. Altogether, Professor Garbe reported about 15 meetings in Berlin, Braunschweig, Hamburg and Magdeburg, which were organized by German IEEE members. He announced a presentation of Mr. Joffe dealing with "Transients and Electrical Overstress Protection in Electronic Systems." In November 1999, there was a special issue of the Transactions on EMC, organized by the German Chapter.

The German EMC Society was represented on two executive committee meetings and one chairman meeting by Professor Garbe. Mr. Mrozynski reported for the working group on "Numerical Field Calculation" which created 15 configurations and problems to benchmark different calculation tools. A complete list can be downloaded at <http://www-tet.uni-paderborn.de>. This benchmark catalog will also be part of a workshop at the IEEE EMC symposium in Washington, DC this year. The working group on "Biological Effects" was renamed "Human Security in Fields" to underline the electro-technical aspect. A new suggestion was the creation of a working group on "EMC and Defense-Devices" to help with the scientific interchange of information between civil and military developments. Professor Garbe reported also about a cooperation between the VDE and IEEE.

The German Chapter sponsored a very special event to start the new year. On January 12th, Distinguished Lecturer, Elya B. Joffe, who came all the way from Israel, contributed as



*First Fellow of the German EMC Society Chapter, Professor ter Haseborg (L), joined Chapter Chairman Professor Garbe at a recent chapter meeting.*

a speaker to the regular series of technical meetings at the University of Magdeburg. The Chairman of the 2003 IEEE International Symposium on EMC in Tel-Aviv shared his impressive practical expertise and spoke on "Transients and Electrical Overstress Protection in Electronic Systems." The audience of more than 30 participants was not only impressed by the two hour presentation, but also by the communication skills and enthusiasm of the distinguished guest. After the presentation, those present were invited to have some refreshing coffee, tasty cookies, and further discussion. Later, Mr. Joffe spontaneously gave two more colorful presentations in an accelerated mode. Besides the presentations, there was also time enough to tour the EMC facilities at the University of Magdeburg, in particular the reverberation chamber and the GTEM-cell. An interdisciplinary technology center, which will provide the home for a new anechoic chamber, is still under construction, but expected to be ready at the end of this year. The discussions in and outside the lecture hall not only conveyed a wealth of useful information but also further tightened the bond between the Israeli and German Chapters.

## Korea

The Korea Chapter of the IEEE EMC Society hosted a workshop and exhibition called "EMC Korea '99" with the cooperation of the Korea Electromagnetic Engineering Society (KEES). The event was held at the Seoul Education and Culture Center on





*Korea Chapter Chairman, Prof. Dong-Chul Park and speaker Mark Montrose pause in the exhibition hall to visit with Dr. Kyung-Chan Min at EMC Korea '99, hosted by the Korea EMC Chapter.*

September 30 and October 1, 1999. 140 attendees and 17 exhibitors attended the workshop. Mr. Mark Montrose, Montrose Compliance Service, Inc. (USA) and Prof. Shuichi Nitta, Tokyo University of Agriculture and Technology in Japan opened the workshop with two one-hour invited talks. The topics of their presentations were "EMI and PCB Fundamental Concepts and Design Techniques" and "The Practice and the Problems of Shielding by Metal Plates," respectively. The invited talks were chaired by Korea Chapter Chair, Prof. Dong-Chul Park and another 11 talks were successively presented by Korean EMC engineers and professors during the two days. The talks were organized to introduce practical EMC techniques to engineers and students. Topics included "PCB design for EMC compliance," "EMC considerations on semiconductor devices," "EMI suppression experiences in home-appliance products," "Electromagnetic shielding and absorbing tech-

niques," and "Regulations on EM hazards." A technical exhibition was also organized for the first time in Korea in the EMC area, and 17 booths were attended successfully. The Korea Chapter plans to hold this kind of technical workshop and exhibition annually.

## Melbourne

The inaugural meeting of the Melbourne, Florida chapter was held on 2 December 1999. The chapter was officially formed on 5 October 1999, and will serve EMC engineers working in

Central Florida. The meeting took place at the Indian River Brewing Company facilities in Melbourne, where the 18 attendees enjoyed pizza and cold drinks.

After Chapter Chair Bruce Crain welcomed everyone to the chapter and meeting, Ed Kirchner of Northrop Grumman presented the paper, "An EMC Design Approach for Integrating COTS Equipment into an Existing Military Platform." This paper, which was also given at the 1999 IEEE International Symposium on EMC in Seattle, described Northrop Grumman's experience in integrating COTS computing equipment into the E-8C Joint STARS aircraft. The paper generated an interesting group discussion about the growing use of COTS equipment and the various EMC challenges that result.

Attendees at this inaugural meeting were enthusiastic about the formation of the Melbourne chapter and we look forward to reporting our activities and plans in upcoming issues of "Chapter Charter!"



*Ed Kirchner discusses the integration of COTS equipment into the E-8C with other Central Florida EMC engineers.*

## Los Angeles

*(Thanks to Ray Adams, chair of the Los Angeles chapter, for submitting the following report.)*

Looking back on 1999, the Los Angeles Chapter had a good year but not as good as in years past. This can be attributed to changes at our old meeting facility. The officers of the LA chapter looked high and low in the area for an affordable and acceptable new meeting location. We had two meetings at the Ramada Inn Hawthorne prior to the summer

break and two after the break at our new location WEMS Electronics. The Ramada was no bargain and Vice-Chair Kaniaya Mahendra and WEMS' John O'Brien came up with the WEMS location for our next two meetings. We had the following speakers in Y2K-1:

In April, Bill Whitlock of Jensen Transformers spoke on "Practical Applications of 'Grounding' Home Theater and Stereo Systems." This was a pleasant change from the usual "grounding" talks. It was actually something we could use at home! Our chapter has looked at "grounding" from many different perspectives over the years: spacecraft, equipment, facility, lightning, and safety. This was new and appreciated territory to cover.

In March, Dr. Jason Chai of the Aerospace Corporation spoke on "A Lightning Data Survey and Parameters in Retest Criteria for Spacecraft." Dr. Chai's presentation was an analysis of the various re-test criteria such as distance from launch site to lightning strike that had been used by three contractors. Depending upon the distance/amplitude criteria set by the contractor, they could unknowingly penalize themselves thus delaying their preparations for launch.

In September, Dr. Scott Bennett gave a presentation titled, "The Basic Source of EMI — And The Key to EMC." Dr. Bennett used basic trigonometry and algebra to visualize the complex integrations required in electromagnetics.

The October meeting featured Dr. Richard Briet, who spoke on "The Verification and Validation of the Theory of Lightning Propagation and Lightning Protection: What it Means to the User and to the Supplier of Lightning Protection Systems." Dr. Briet's presentation was very interesting as it questioned the validity of current lightning protection practices. He had some real interesting photos of lightning strikes that seemingly defy physics or explanation.

Now that we have a stable meeting location, we are in the early stages of planning a full lineup of speakers for 2000. We have Steve Jensen coming to talk to us in January on "EMC War Stories: Tales From The Trenches" and have several others tentatively lined up for subsequent meetings. Y2K has the potential to be an excellent year for the Los Angeles Chapter.



## Montreal

Benoit Nadeau, chair of the Montreal chapter reports that they had two meetings this past fall. The October meeting featured a talk on "Unusual and Hidden Forms of Electrostatic Discharge" by Mr. Douglas C. Smith of Auspex Systems. The November meeting featured a presentation by Dr. Kok-Swang Tan of Health Canada. The topic of this presentation was "Susceptibility of Medical Devices to Electromagnetic Interference." Both presentations were very informative and well appreciated by the people who attended these meetings.

On another subject, the committee for organizing the 2001 IEEE EMC Symposium is busily preparing for the upcoming symposium in Montreal. The real work will begin following the Washington, DC Symposium this August.

## Nanjing

Prof. Wen Xun Zhang, chair of Nanjing chapter, reports that the Nanjing chapter successfully completed its schedule of technical activities in 1999. A total of 29 technical events were organized at Nanjing and Shanghai.

Two IEEE Distinguished Lecturer Programs were sponsored by the Nanjing chapter and also the Beijing chapter. Dr. Mark Gouker of MIT gave three presentations in May-June; Prof. Nader Engheta of the University of Pennsylvania also gave presentations on three topics in October and November. In addition, four experts from abroad were invited individually. Prof. O.P. Gandhi (USA) spoke on the topic of bio-electromagnetics. Dr. Y. H. Gu (USA) gave an interesting lecture on smart antennas. Dr. M. Zhang (Germany) spoke to the chapter on EM simulators. Dr. Z. X. Shen (Singapore) gave a presentation on modal expansion techniques. There was a pronounced academic environment present during the discussion between these speakers and the Chinese members and colleagues in attendance.

The chapter also co-sponsored a National Symposium on Antennas and chaired its technical program committee. The proceedings published included 310 pages (66 papers). Two local workshops were held on prediction models for mobile propagation and EM software, respectively. Ten normal lectures on a

wide range of topics were also arranged during 1999.

The accumulated attendance for the above activities was over 1600 (~1.5 times of that in 1998). About one third of the attendees were IEEE members. In addition to the technical meetings, a "Chapter Members Meeting" and sight-seeing program were held for the membership in Shanghai. The number of chapter members has increased from 95 to over 100 during the past year.

## Oregon and SW Washington

The Oregon and SW Washington EMC Chapter closed 1999 with a Christmas social. This was held at the "Amadeaus at the Fernwood" restaurant. (See pictures.) The event was held at this former mansion atop a hill overlooking the Willamette Valley: the perfect setting for socializing and getting away from those ever-present RF fields!

In October, Doug Smith turned the "static" subject of ESD into an electrifying educational and comedic adventure. Doug filled the house with over 40 people in attendance. The 12 large pizzas were just enough!

Henry Benitez, chapter chairman and also EMCS BoD Awards Chairman, took advantage of the occasion to present Doug with a belated award for his contributions to experiments and demonstrations at past EMC symposia. Also in attendance was Daryl Gerke, Phoenix chapter officer, who received an award for his contributions to the success of the '99 Arizona EMC Colloquium.

Mr. Ed Blankenship of Hewlett-Packard was a last minute guest speaker for our November chapter meeting. Ed did a fabulous job presenting his topic "Lloyd's Mirror - Interferometer and Comparison to Free Space, a.k.a. OATS."

The Oregon and SW Washington EMC Chapter has been committed to providing quality activities to its membership each and every month. With this goal in mind, the planned '00 program is just as impressive. Planned are talks from Mike Windler on C63.4 antenna and site calibration, Werner Schaefer on measurement instrumentation, Maqsood



Photo by Henry Benitez

*Oregon and SW Washington Chapter Officers present at the chapter's 1999 EMC Holiday Social are (L-R) Jerry Page of Northwest EMC, Ed Blankenship of Hewlett-Packard, and Charles Toblen, Henry Benitez and Ali Elmi, all of Tektronix.*



Photo by Henry Benitez

*Nicole Lockart-Rayner, the renowned guest pianist, provided entertainment at the Oregon and SW Washington Chapter Holiday Social. Great job Nicole!*



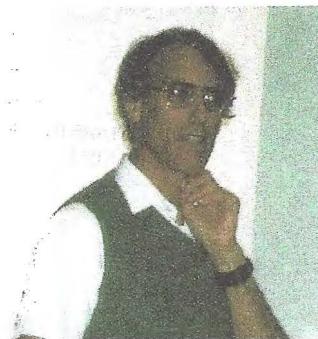
Photo by Henry Benitez

*Daryl Gerke (L) is presented with an award for his contributions to the success of the 1999 Phoenix Chapter Colloquium by Oregon and SW Washington Chapter Chairman and EMC Society Awards Chairman Henry Benitez.*





*It was a studious audience preparing itself for the October Oregon and SW Washington Chapter presentation by Doug Smith of Auspex Systems in Santa Clara, California.*



*Doug Smith, speaker at the Oregon and SW Washington Chapter meeting in October, is caught in a pensive moment. Is he pondering the real meaning of ESD?*

Mohd on the effects of lightning on equipment and humans, Elya Joffe on EMC troubleshooting, and Doug Smith's famous workshop on building high frequency probes. Continued speaker coordination with the Seattle chapter has been very rewarding.

Happy New Millennium!

## Phoenix

Harry Gaul, secretary/treasurer of the Phoenix chapter reports that their last meeting was held on November 4, 1999. Charlie Swiontek of Power-One (Camarillo, CA) entertained the audience with a well-received talk on "How to Meet the EC Harmonic Requirements." Most electronic systems create a certain amount of harmonic distortion to the AC powerlines. This harmonic distortion may be small on a product by product basis, but these harmonic effects become a very real problem when the entire AC power grid is considered. Charlie discussed the new legislation in Europe which will enforce the requirements of the EN61000-3-2 as of January 1, 2001, wherein all new electronic products sold in Europe with power requirements greater than 65 watts will be required to meet a new power line quality standard.

There is some confusion in the U.S. concerning whether the lower limit is 50 watts, 65 watts, or 75 watts. Charlie's response to this was that the Europeans generally design in power factor correction because it adds value to the product. They don't understand why Americans typically try to avoid meeting requirements by using a strict legalistic interpretation of applicability. Thus, it does-

n't matter to European manufacturers if the lower limit of applicability is 50 watts, 65 watts, or 75 watts. They will design and test their equipment for compliance with EN61000-3-2 regardless of the lower limit.

Charlie outlined various approaches possible for meeting the new legislative requirements and the costs associated with these approaches. The attendees learned that in some cases there may be no cost delta to add power factor correction (PFC) if done early in the design phase. Typically, the cost of a power supply will be higher by 10% when PFC is added. The usual approach is to add a second switcher, which operates on the AC side to smooth the current drawn over the entire sine wave cycle. Charlie also shared some "low budget" approaches where a 50-Hz resonant filter is built from two inductors with capacitors connected across each one. The cost delta of this approach is maybe 7 or 8% but it is usually used on low power products drawing less than 200 watts.

The Phoenix chapter was very fortunate to find such a dynamic speaker as Charlie. Other chapters may wish to have Charlie talk at their upcoming meetings. A copy of his PowerPoint presentation is available at <http://www.euh.ieee.org/r6/phoenix/phoenixemc/powerone.ppt>.

At the December meeting, Bob Dockey, an IEEE EMC Society Distinguished Lecturer, enlightened the Phoenix chapter about how a "good ground plane" on a circuit board can still produce common mode radiation, similar to a dipole. There were 25 attendees, 60% of which were IEEE members.

In 1993, Bob Dockey began investigating various means to reduce com-

mon mode radiated emissions from printed circuit boards (PCBs). During the course of Bob's research, he attached wires to opposite sides of a ground plane to simulate the attachment of shielded cables. He found that the radiated emissions tended to increase upon adding the wires due to the common mode current flowing along these wires. The emissions were caused by a small voltage gradient in the ground plane.

Research performed by Bob showed that the emissions can be reduced by decreasing the distance between the signal trace and the ground plane, by providing additional low-impedance paths for the signal current, and by placing an image plane above the PCB and connecting it to the ground plane around its periphery. Since Hewlett-Packard manufactures computer accessories such as ink-jet printers in great quantities, all of their EMC design rules for PCBs concentrate on minimal parts and inexpensive manufacturing costs. For example, HP strives to use PCBs that have no more than four layers. With a four-layer board, Bob recommends that the two inner layers be ground planes with a 62-mil separation. The two outer layers are for signal traces and they are separated from the ground layers by only seven mils of pre-preg. Ground vias connect the two ground planes wherever a signal via penetrates the ground planes. Also, guard traces are routed along side any high speed traces to reduce common mode radiation. In response to a question from the audience, Bob explained that they don't place the ground planes on





**Bob Dockey, EMC Engineering Group Manager for Hewlett Packard (Vancouver, WA), displays his circuit board that he used for investigating the phenomena of common mode radiation induced by return currents in a ground plane.**



**Mark Montrose displays the PCB that he used to research the effect of capacitor placement.**



**Over 100 engineers attended the Phoenix Chapter's January meeting with PCB expert and IEEE Distinguished Lecturer, Mark Montrose.**

the outside layers of the PCB due to manufacturing problems during the soldering process.

At the January meeting, the Phoenix chapter hosted a three-hour workshop with the EMC Society's Distinguished Lecturer, Mark Montrose. A total of 109 people attended this very popular event with 39 of them being IEEE members.

The workshop focused on designing printed circuit boards (PCBs) correctly from the start. According to Mark, "We're going to get the job done by using design rules. Let the others analyze it to death with Maxwell's equations solvers."

The attendees learned that the purpose of an autorouter is to maximize emissions, thereby ensuring job security for EMC Engineers. Mark outlined several important steps to successfully laying out a PCB:

1. Identify the "high threat" signals, which include reset, clock, audio, analog, video, high-speed digital and RF.
2. Manually route these signals to keep them short, direct, and separate from other high threat signals.
3. Protect these traces with the "protect" feature of the routing program.
4. Finally, allow the autorouter to route the remaining signals.

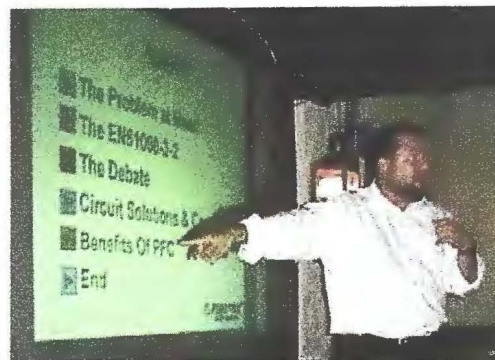
Mark also provided details on segmenting power and ground planes with moats and bridges to provide isolation for digital, analog, and I/O circuitry.

The workshop concluded with a special presentation of Mark's IEEE paper titled "Why Decoupling Capacitors Radiate." The results of his research showed that capacitor placement on a PCB is not critical, provided that each device and each decoupling capacitor has its respective VCC and GND pins tied directly to the power and ground planes with vias.

The Phoenix Chapter is sincerely grateful to Mark for sharing his expert knowledge on designing and laying out PCBs.

**Rocky Mountain Chapter**  
{Thanks to Lyle Luttrell, chair of the Rocky Mountain chapter, for submitting the following report.}

The Rocky Mountain chap-



**Charlie Swiontek of Power-One talks about the benefits of Power Factor Correction in consumer electronics.**

ter kicked off its fall program on September 28 with a highly amusing program "How to Design Digital Systems to Fail FCC & CISPR (in 20 easy steps)," presented by Daryl Gerke of Kimmel Gerke Associates, Ltd. 38 chapter members and guests enjoyed pizza sponsored by Criterion Technology then rolled along with Daryl for an interactive hour evening program. Starting with the advantages of "Design for Failure" (save component costs, gain management visibility and career mobility), Daryl provided RMC members with 20 easy to remember rules in three key design areas of components and circuit boards, cables and connectors and enclosures. Fundamentals included the keys to a strong transmitter and a good antenna. Daryl provided special tips on techniques, elaborating on using fastest components available, locating clock and I/O lines together, using long leads on caps, and providing slots in enclosures. He included secrets on how to ensure failure even when forced to use EMC control measures such as shielded cables, bypass caps or line filters. During the presentation, several chapter members offered enhancements to the techniques that product designers had demonstrated at their companies, which will remain anonymous. Daryl concluded the light-hearted look at EMC problems with the most important rule: never ask for help or advice.

The October 14 meeting featured Richard Charbonneau and Charles Grasso of StorageTek presenting "Embedded Capacitance - The Next Step in PWB Design." 21 members attended the evening session. The presentation started somewhat uniquely with Charles Grasso moderating an interactive discus-



sion with the audience. The interactive discussion centered on some decoupling engineering dogma. The presentation then moved to a discussion of the physics of power bus noise and an analysis of decoupling capacitor performance. The second part, presented by Rick Charbonneau, reviewed the details of the embedded capacitance project including; project members and mission statement, goals and objectives, the discovery process, test vehicle design, material considerations, electrical and qualification testing, modeling, deliverables, and timeline for the project. Part three, presented by Charles Grasso, reviewed some swept frequency response data taken on some of the PWB materials. A downloadable copy of the presentation is available at the chapter website.

On November 11, the chapter had another blockbuster turn out of 54 people to listen to Dr. Todd Hubing from the University of Missouri, Rolla discuss "PWB Power Structures - Theory and Design." The need for good, low impedance power distribution is vital to the performance of today's high-speed computing. It need not be said a great deal of lore is also involved especially in the area of decoupling. Following a pizza lunch, the meeting kicked off with Rick Charbonneau giving the attendees a brief overview of the NCMS Embedded Capacitance project. Dr. Hubing then presented a 3-hour tutorial that covered the theoretical aspects of power bus design and the seemingly contradictory nature of EMC engineers who might favor a lossy system and signal integrity engineers that demand a very low impedance distribution. Dr. Hubing also went

over some of the performance data taken at the UMR EMC laboratory and finally presented some design guidelines. A downloadable copy of the presentation is also available at the Chapter website.

The Rocky Mountain chapter web site is regularly updated with information on past and future programs with links to other sites of interest for EMC engineers. The meeting program schedule and downloads of recent meeting presentations are available on our web site at <http://www.ewb.ieee.org/r5/denver/rockymountainemc/>.

## Seattle

In October, the Seattle EMC chapter welcomed Doug Smith of Auspex Systems who responded to popular demand by presenting "Unusual Forms of ESD." That plastic bag of change that Doug carries around sure is getting a lot of mileage these days!

Doug began his presentation by stating the obvious: probably the main requirement a customer has for a piece of equipment is that it works. It can pass all of the IEC, CISPR, FCC, etc. tests, but if it does not work reliably, the customer will be unhappy. His entertaining talk covered some unusual and hidden forms of ESD that have caused many field problems for a number of companies and even government agencies. These forms of ESD are not described in any standard and can cause problems even if the equipment passes CE requirements. These hidden forms of ESD can result in hundreds of hidden ESD events per minute with band-



Photo by Janet O'Neil

*Intel showed up in force at the October Seattle EMC Chapter meeting. That's Leo Heiland, Mike Wyman and Chapter Chairman Gbery Pettit (L-R) all of Intel.*

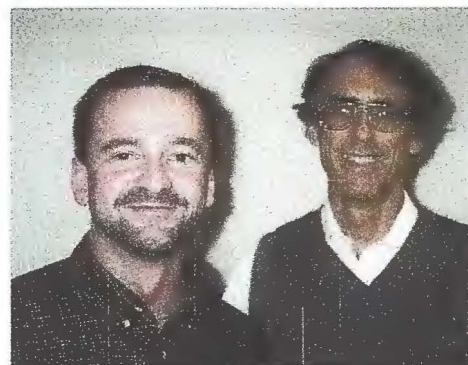


Photo by Janet O'Neil

*Joel Lachance of Microsoft (L) enjoyed the presentation by Doug Smith of Auspex at the October Seattle EMC Chapter meeting.*

widths to 20 GHz and beyond. It is not possible to prevent them by trying to control the environment (floor wax, wrist straps, etc.). Demonstrations of these ESD effects were shown – hence the plastic bag of change – and some general case histories were discussed.



*Todd Hubing enjoyed visiting with the Rocky Mountain Chapter officers following his presentation. Shown from left are Charles Grasso (Vice-Chair), Todd Hubing, Bob Reinert (Secretary) and Lyle Luttrell (Chairman).*



Photo by Stephen Simmac

*Seattle Chapter Chairman Gbery Pettit did double-duty at the November chapter meeting. He chaired the meeting AND was the dynamic speaker! He's shown presenting his "CISPR Update" material before an attentive audience.*





*Jim Muccioli of X2Y Attenuators spoke to a full house at the November meeting of the Southeastern Michigan Chapter.*



*Following the meeting, several Chapter members witnessed a live demonstration of the material Mr. Muccioli presented.*

Many of the case histories were very entertaining (at least to those not originally involved in the problem) and helped keep the talk on the light side. Upcoming standards activity that addressed ESD were discussed to round out the presentation.

At the November chapter meeting, Chairman Ghery Pettit was the local hero who filled in at the last minute for the originally scheduled speaker. Ghery rose to the occasion and presented an update on CISPR SC G proposed changes to CISPR Publication 22 and other documents. He addressed such topics as frequency range extension, ITE containing radio transmitters or receivers, limits over 1 GHz, user installation testing and ferrite clamps and tubes on radiated test sites, EMC requirements for multimedia equipment and EMC requirements for power line communication equipment. Ghery's unscheduled presentation was a surprise "hit." In the parking lot following the presentation, several chapter members were overheard to say, "Why haven't we asked him to speak before?" and "Boy,

was he a good speaker!" Everyone present was most appreciative of Ghery's pitch hitting as speaker for the evening.

### **Southeastern Michigan**

*(Thanks to Kimball Williams for submitting the following report.)*

The Wednesday, November 17, 1999 gathering of the Southeastern Michigan EMC chapter featured a lecture by James Muccioli of X2Y Attenuators discussing "Techniques for DC Automotive Motor Noise Suppression and Filtering of Common Mode and Differential Mode Noise." The lecture was held at 6 pm with refreshments and conversation beginning at 5:45 pm. 41 engineers and technicians attended the meeting from as far away as Holland, Michigan (i.e., the other side of the state!).

The lecture employed a live demonstration of the phenomenon. (Those of us that work constantly with electronic instrumentation can appreciate the tendency of such equipment to make us aware of here-to-fore undiscovered 'features' when we least expect it). All the



*Vice Chair Scott Lytle (on the left) presided at the event, and spent some time catching up on events with Ray Sasinowski, (on the right), the founder of the Southeastern Michigan Chapter.*

demonstrations were coaxed into full function and clearly showed the characteristics of noisy motors and of filter performance (both good and bad). By the time he was through, everyone was interested in the possibilities represented by an integrated, balanced filter structure. After the formal presentation, Jim and several members of the audience discussed the subject material in greater detail. **EMC**

## **Call for Raconteurs**

There will be a special session on EMC War Stories at the Y2K IEEE EMC Society Symposium in Washington, D.C. in August of 2000. The best and second best stories will be recognized at the awards banquet - assuming we get as many as two responses. They may even be published in the Society newsletter (no pseudonyms allowed).

Please submit a written version of your proposed war story - 500 to 2000 words - to the panel of judges (tom@7ms.com) on or before 1 May 2000.

The story should be about an EMC project in which you were involved. Like any good story, embellishments and exaggerations are expected, in fact encouraged. Oh yes. The story should have a kernel of truth. The chosen stories will be presented verbally at the symposium session by the authors (or their designee) and should be at least 10 minutes but not more than 20 minutes long. An overhead projector will be available for cartoons and notes so that you needn't write on your shirt cuffs. **EMC**



# EMCFest 2000

A Colloquium and Exhibition on  
**LOW COST, EASY TO USE,  
EMC DEVELOPMENT  
TEST METHODS**

**Tuesday, May 9, 2000**

**The Dearborn Inn  
Dearborn, MI**

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:*  
**Henry Ott & Doug Smith**

*Topics will include:*  
EMC Standards Update  
Inductance and EMC  
Signal Integrity and EMI  
EMC Troubleshooting Techniques  
Advanced EMC Issues

## Registration Fees:

\$150 prior to 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  
248-354-2845, k.williams@ieee.org  
Janet O'Neil: Co-Chair, Exhibits: 425-868-2558,  
j.n.oneil@ieee.org

<http://emc.eaton.com/emcfest2000.htm>

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



# IEEE EMC Society Education and Student Activities Committee

*Maqsood Mohd, Associate Editor*

I hope everybody had a bug-less Y2K beginning. Here at the Education and Student Activities Committee we have been busy putting together some wonderful activities for the 2000 IEEE International Symposium on EMC in Washington, DC. Also, just before the holidays, two EMC-S representatives (Andy Drozd and myself) attended a WEB-Education Seminar in the Washington, DC area. The attendees included education chairs or their associates from various Societies of the IEEE. I had the opportunity to talk to a few of them, including the representatives from the Antennas and Propagation and Microwave Theory and Techniques Societies. I must congratulate you, the members of the EMC-S, that your Board of Directors places high value on educational activities (and rightfully so). This is evident in the high level of funds they allocate for various activities of this Committee. They always are willing to support new and innovative ideas if it is going to bear better fruit than what we are accomplishing now. The other sister societies are not as lucky as we are in our EMC-S. Also, the educational activities (such as fundamental tutorials, experiment demos, student paper contest, and now student design contest) that we do at the annual symposia are by far more than any other IEEE Society does for its membership. I learnt this because each Society representative had to give a presentation about the current activities and future needs for their membership. Also, some other Society education Chairs or their representatives asked me during breaks how we are doing so many activities. There is one area however, that we lack seriously – that is in educational material such as video tapes, CDs, etc. We have a plan to improve this area. We are considering all options including dissemination through the World Wide Web. This is

the main reason why we attended that workshop. If you have any inputs, suggestions, comments, or even wish to take on this challenge, please contact me at (850) 729-6115 or send me an email at [mohammed@teas.eglin.af.mil](mailto:mohammed@teas.eglin.af.mil). If you want to see what happened at the web-education workshop you can view some of the highlights at <http://www.ieee.org/organizations/eab/webed-home.htm>. They will update the site periodically, so visit it again if you need to find out more.

## Plans for 2000 IEEE International Symposium on EMC

We have planned some exciting activities during this symposium. In the Monday Tutorial sessions, we have some outstanding speakers such as Professor VanDoren, Clayton Paul, and Henry Ott. So don't miss this exciting session and sharpen up your skills in the fundamentals. In the Experiments area, we have some unique experiments planned similar to last year. If you want to participate in this activity please contact Andy Drozd who is leading this activity (he is also the vice chair of Education and Student Activities Committee) at [andro1@aol.com](mailto:andro1@aol.com). We are planning a NARTE preparation workshop on Monday and the exam on Friday. Professor Whalen and Dave Case lead this activity. In the student activity area, we have excellent participation in the Student Paper Contest this year. An additional activity that we have introduced this year is the Student Design Contest. This idea was introduced to us by TC-7. We have struggled with the idea for a while and this will be our pilot year for this activity. This year will be a learning year for us. We may not be able to do everything just perfectly this year; we need help,



support, and understanding from every one of our EMC-S members. Ahmad Fallah is leading this activity. He can be contacted through email at [afallah@phoeintl.com](mailto:afallah@phoeintl.com). Some highlights of the competition are included in this article. Don't hesitate to provide some healthy feedback on this activity to Ahmad or to me.

### Highlights of Student Design Competition

These are some of the highlights provided as general awareness to the membership of the EMC-S. Student participants and their sponsors may obtain the detailed version from Ahmad Fallah at [afallah@phoeintl.com](mailto:afallah@phoeintl.com) or phone 701-277-6322. The last day to request a kit was February 18, 2000. Entries must be received prior to May 31, 2000. If the contest interests you and you did not hear about it before the deadline to request a kit, please consider participating next year. Read on to learn what you will need to do and start thinking about your entry for the 2001 symposium now!

### General Description:

The IEEE Student Electromagnetic Compatibility (EMC) Design Competition is a student competition sponsored by the IEEE Electromagnetic Compatibility Society (EMC-S), and is conducted by the Education and Student Activities Committee. The goal of this competition is to provide the Electrical and Computer Engineering students who are interested in the field of EMC an opportunity to exercise their knowledge and to gain hands-on experience.

### Objective:

The objective is to develop the best solution to a standardized broadband electromagnetic interference (EMI) problem while maintaining the capability to perform required electronic functions. A standard kit containing the required components for the broadband EMI circuit will be employed.

### Problem Description:

The problem involves the design, construction, evaluation, and documentation of the EMI mitigation techniques

for a prescribed electronic circuit. A diagram for a simple electronic circuit and a standardized kit containing electronic components are provided with each "design kit." The experimental evaluation will involve testing the completed circuit by measuring representative EMI quantities using simple laboratory techniques and equipment.

### Rules of Participation:

The competition is open to all undergraduate and first-year graduate students in an EE curriculum. All participants must have a faculty as a sponsor who will attest to their qualification. Teams are limited to three members, however, only one member will be invited to attend the EMC symposium if that entry is deemed to be the winner. The name of the principle author shall appear first in the author list of the final report. Design contestants shall provide the reviewing committee with the assembled and tested circuit board, all of the remaining parts from the kit, and a report containing all measurement results along with a description of how the solution was achieved.

### Entry Reviews:

The review committee will select three finalists during the first round by reviewing the measurement results provided by the competitors, and by making measurements on the actual design entries using a standard means of measurement technique. The finalist entries will be invited by the pre-screening committee to participate in the final competition to be held during the IEEE International Symposium on EMC. An all-expense-paid trip to the location of the EMC symposium will be a part of the prize for the top three design entries.

### Important Notes:

Proper packaging and delivery of the design entries are the responsibility of the contestants. The EMC-S Education Committee can not assume responsibility for entries that may be damaged or delayed during transportation. Participants should submit their best design (i.e., lowest emission levels) at the least cost. The committee shall deter-

mine the winning entry based on criteria listed in the descriptions provided herein. Adherence to the guidelines listed in this document is a necessary condition for qualification.

The variety and depth of activities that the Education and Student Activities Committee of the EMC-S undertakes is envy of other Societies in the IEEE. By the way, this just doesn't happen by chance. We are fortunate to have volunteers who are dedicated to excelling in their tasks and who are enthusiastic about what they do. I would like to express my personal thanks and appreciation for each of these volunteers who tirelessly work throughout the year to bring the very best in EMC education materials, workshops, demonstrations, and tutorials at every symposium and to all the members of the EMC profession throughout the year. When you email them, contact them, or see them during a symposium, please express your appreciation for volunteering their valuable time for the EMC-S and the Education and Student Activities Committee. **EMC**

IEEE STUDENT-GET-A-STUDENT MEMBER CAMPAIGN

## Spread the News!

Recruit a classmate to IEEE membership today – you may win a FREE membership for 2001!

For program information:  
[www.ieee.org/sgs/](http://www.ieee.org/sgs/)

Phone: 800-678-4333  
(US and Canada only)  
or 732-981-0060  
(worldwide)

Fax: 732-981-0225

Email: [new.membership@ieee.org](mailto:new.membership@ieee.org)





# 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, 2000.*

*Abbreviated biographies of these gentlemen are shown below.*



## **Jose Perini**

Prof. Jose Perini was born in Sao Paulo, Brazil, where he received the BS degrees in Electrical and Mechanical Engineering from Escola Politecnica de Sao Paulo in 1952. In 1961, he obtained the Ph.D. in EE from Syracuse University. He joined Syracuse University in 1962 as an Assistant Professor, moved through the ranks to Full Professor, and retired in 1991. He is now an Emeritus Professor of EE. He has taught in many different areas such as EMF, Antennas, EMC, Digital Signal Processing, Communications, Radar, Circuit Theory, Mathematics, and Computers. Prof. Perini has had continuous research support from the Navy, Air Force, Army, and industry, mostly in the EMC area, during his 29 years at SU. He is still active in the profession as a lecturer and researcher. As a Consultant he has done extensive work in the US and abroad. He has published and presented over one hundred papers in the US and overseas. He has given many invited papers, lectures, and tutorials. He was a Distinguished Lecturer for the EMC Society until 1998. He is an IEEE Fellow, and a certified NARTE EMC Engineer. He is a reviewer for the IEEE Transactions on EMC, AP-S, MTT, and Education.

Institute of Standards and Technology (formerly National Bureau of Standards) and served as group leader of the Fields and Interference Group for 15 years. Concurrently, he has served as an adjunct professor in the Department of Electrical and Computer Engineering at the University of Colorado, Boulder. Dr. Kanda is an IEEE Fellow, Life Member of the EMC Society and has been Editor-in-Chief of the IEEE Transactions on EMC for 12 years. He has been the leader of EMC research at NIST, has written over 100 archival papers, and has participated in the writing and editing of a number of EMC books and EMC standards for ANSI and IEEE Standards Committees. He was technical member, vice chair and technical program/paper committee chair of the 1981, 1989 and 1998 IEEE EMC Symposia in Denver, Colorado, respectively. He was elected to serve as Vice Chair from 1994 to 1996 and as chair of the International Commission A (Electromagnetic Metrology) of the International Union of Radio Science (URSI) from 1997 to 2000. He has received two Bronze Metals (1981 and 1992) and a Silver Medal (1989) from the U.S. Department of Commerce. He has received three EMC Transactions Best Paper Awards in 1982, 1989 and 1992. Dr. Kanda has been a leader in promoting EMC research and disseminating research results in the IEEE Transactions on EMC. His main goal has been to emphasize technical issues in EMC Society activities through the Technical Advisory Committee (TAC) and to upgrade the technical quality of the EMC Society publications.

## **Moto Kanda**

Motohisa (Moto) Kanda received the BSEE degree in 1966 from Keio University, Tokyo, Japan, and the MSEE and Ph.D. degrees from the University of Colorado, Boulder, in 1968 and 1971, respectively. From 1965 to 1966, he was a research technician at Keio University, and from 1966 to 1971 he was a research/teaching assistant at the University of Colorado. In 1971, he joined the staff of the Radio-Frequency Technology Division (formerly Electromagnetic Field Division), National



## **Andrew Podgorski**

Andrew Stan Podgorski has a MASc and Ph.D. degree from the Department of Electrical Engineering, University of Waterloo, Waterloo, Ontario, Canada. He has published over 100 scientific papers and over 30 classified and non-classified reports. He holds many patents

in the area of electromagnetics. Currently, he is President of ASR Technologies (Ottawa, Canada)—an independent Research and Engineering Company conducting research in the area of broadband electromagnetics. His scientific interest focuses on electromagnetic theory, microwave networks and antenna theory in application to measurements, modeling and generation of picosecond electromagnetic phenomena. For 15 years, he was a Group Leader of the EMI/EMC Group at the National Research Council of Canada and was involved in numerous programs of national significance for the Canadian Government and Industry. He has served on many international, inter-governmental military and civilian panels of experts representing Canada in USA, Europe, and Australia. For several years he was on the Board of Directors for the Electromagnetic Compatibility (EMC) Society of IEEE where he was the Treasurer and a "Distinguished Lecturer" for the Society. He is a Senior Member of IEEE and a Life Member of the IEEE EMC Society. Currently, he is a Chair of the Technical Activities Committee (TAC) of the IEEE EMC Society. Dr. Podgorski is a Registered Professional Engineer in the Province of Ontario and a member of the Association of Old Crows. His name is listed in the Canadian "Who's Who" Publication.



## **Andrew Drozd**

Andrew L. Drozd is President of and Chief Scientist for ANDRO Consulting Services, which is dedicated to work in the fields of EMC, CEM, and elec-

tromagnetic environmental effects (E3). He received a BS in Physics and Mathematics in 1977 and an MSEE specializing in Communications/Signal Processing in 1982, both from Syracuse University. His professional responsibilities include: systems engineering; EMC computer modeling, simulation and analysis; exploitation of innovative, expert system technologies for EMC/



CEM analytical applications; and EMC laboratory testing support including the design and conduct of experiments. Mr. Drozd continues to apply his over 23 years of technical and program experience in electromagnetics technologies primarily for the modeling and analysis of E3 effects, environments, and responses for government and commercial systems. Mr. Drozd is a Senior Member of the IEEE and an active EMC Society Member for over 15 years. He has completed his first three-year term as a Member of the EMC Society Board of Directors. He is involved in several important initiatives that cut across membership, technical, standards, and communications services for the Society. He is Vice Chair of the Education Committee and has organized the EMC Experiment Demonstrations for the annual IEEE EMC symposia since 1992. He is a Member of the EMC Society SDCOM and is the EMC Society senior liaison on the newly formed IEEE Intelligent Transportation System Technical Council. Mr. Drozd is the current EMC Chapter Chair for the IEEE Mohawk Valley Section and is a Member of the TC-9 Committee on Computational Electromagnetics. He is a Member of the IEEE Continuing Education Products Committee and has been actively involved in the IEEE sponsored Dual Use/Information Technologies and Applications Conference held annually in Upstate New York where he was responsible for establishing tracks that address EMC concerns in the information age. Mr. Drozd is also a NARTE certified EMC Engineer. He has authored and co-written approximately 100 technical papers, reports, and newsletter/journal articles on various EMC topics. Mr. Drozd continues to support the goals of the EMC Society on behalf of membership development, promoting education, standards development, and webmaster activities.



#### **Larry Cohen**

Lawrence S. Cohen was born in Washington, DC on December 20, 1948. He received a BSEE from George Washington University in 1975 and an MSEE from the Virginia Polytechnic Institute and State University in 1994. Mr. Cohen was involved in the integration of antennas for surface combatants while employed by the Naval Sea Systems Command from 1975 to 1987. From 1987 to the present, Mr. Cohen has worked in the Radar Division of the Naval Research Laboratory in Washington, DC where he has conducted research on mode-stirred chambers, enhanced radar absorption materials and T/R modules for future radar applications. Mr. Cohen is a past Chairman of the Washington, DC/Northern Virginia IEEE EMC Chapter and is presently a co-chairman for the EMC Society Education Committee's sponsored experiment demonstrations presented at the IEEE EMC Symposia. Mr. Cohen is the Technical Program Chair for the 2000 IEEE EMC Symposium in Washington, DC. Mr. Cohen is a NARTE Certified EMC Engineer.



#### **Fred Heather**

Fred Heather is a senior member of the IEEE and a 12-year member of the EMC Society. In 1993, he founded and currently serves as chairman of, the Southern Maryland Chapter of the Communications, Computers, and EMC Society. Over the past 20 years he has published several papers on EMC. In addition to his activities within the EMC Society, he has been a major participant with the SAE AE4 Committee. He served as chair on the AE4R High Intensity Radiated Fields (HIRF) Test and Analysis panel. Later he went on to supporting the

Electromagnetic Effects Harmonization Working Group (EEHWG). This international body was tasked with harmonizing the US and European HIRF documents into one common set of documents. He currently is chairman of the SAE AE4H subcommittee, chartered with specification, standards and technology for High Power RF Simulator and Effects. His professional certifications include NARTE, Senior Member, Certified EMC Engineer, and DWIA Certified in Systems Engineering and Test and Evaluation. He holds a BSEE degree from Rochester Institute of Technology granted in 1977. His professional career has been with the Naval Air Warfare Center, Aircraft Division, at Patuxent River, Maryland. During his 20-year career he has had responsibility for both major and minor aircraft development programs. He has conducted major Electromagnetic Environmental Effects (E3) tests on all the platforms for which he was responsible. His current position is E3 Technical Specialist and Consultant. In this position he is the Navy's E3 manager for the Joint Strike Fighter. He is the project manager for an OSD Test Technology and Demonstration Program on a Fiber Optic Microwave Transmission System and Project Director for another OSD program to develop a joint high power RF capability to simulate worldwide high power RF emitters. In his off time, he pursues his interests in the outdoors by providing adult outdoor training classes from basic camp training to advance backpacking as a volunteer member of the Girl Scout Council of the Nations Capital.

*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**

## **Sensor and Simulation Notes Now Available on CD ROM Years in the Making – Yours for FREE**

A collected edition of the Sensor and Simulation Notes (EMP 1) 1-422 complete (covering 1964-1998) is now available on a CD ROM courtesy of the Air Force Research Laboratory, Directed Energy Directorate, Dr. Carl E. Baum, Ed. Some of you who have shelves of these may wish to have this form instead. This is particularly suitable for libraries where people can search for particular notes in the word-searchable table of contents (index), peruse the note and then, if desired, print out a hard copy. You can also make additional copies of the CD for as many scientists/engineers who need it, provided you have a CD burner. Other series in the Notes on EMP and Related Subjects may someday be similarly available on CD ROM, but don't hold your breath.

To obtain a copy, send a request with full mailing address to:

Magdalena Lopez, AFRL/DEHP Bldg 909, 3550 Aberdeen Ave SE, Kirtland AFB, NM 87117-5776  
Phone: (505) 846-4101, Fax: (505) 853-3081, E-mail: [lopezmc@plk.af.mil](mailto:lopezmc@plk.af.mil)





## Two New Speakers and a Chairman for the Year 2000 Distinguished Lecturer Program

By Lee Hill, Chairman, Distinguished Lecturer Program

**W**erner Schaefer and Doug Smith recently began their two-year terms as the newest Distinguished Lecturers (DLs) of the IEEE EMC Society. They replace Don Bush and Bob Dockey whose terms expired on December 31, 1999. Our other three DLs, Elya Joffe, Michel Mardiguian, and Mark Montrose, are midway through their two-year terms.

At the end of August 1999, I volunteered to take over responsibility of DL Program from outgoing Chairman Scott Roleson. Under Scott's leadership, the IEEE EMC Society Distinguished Lecturer program has become a "must-have" resource for our members who seek expert speakers for local chapter meetings. Since Scott became chair in 1995, he has rallied support to increase the number of Distinguished Lecturers to five, including two new international speakers (Elya Joffe in Israel and Michel Mardiguian in France) especially for the benefit of our members in Europe. Please join me in extending a huge "thank you" to Scott for his service to the Society!

Here are our new Distinguished Lecturers:



**Doug Smith** is currently Manager of EMC Development and Test at Auspex Systems in Santa Clara, California. He received a BSEE degree from Vanderbilt University in 1969 and an MSEE degree from the California Institute of Technology in 1970. In 1996, he retired as a Distinguished Member of the Technical Staff at AT&T Bell Laboratories. Doug's interests include high frequency effects in electronic circuits, especially EMC, Electrostatic Discharge (ESD), Electrical

Fast Transients (EFT), and other forms of pulsed EMI. He has been granted over 15 patents, including several for measurement apparatus, has published over two dozen technical papers and articles, and has authored one book. Doug is a senior member of the IEEE. Doug's favorite topics to present are Unusual Forms of ESD (and War Stories), Signal Integrity Measurements and Probe-Building Workshop, and Common Signal/Noise/EMI Measurement Snafus. You can reach Doug at [doug@dsmitb.org](mailto:doug@dsmitb.org), telephone 1-408-356-4186.



**Werner Schaefer** is currently an EMC Technical Contributor at Agilent Technologies (formerly Hewlett Packard Company) in Santa Rosa, California. He received an MSEE in 1982 from the Technical University of Darmstadt, Germany, and an MBA from Hochschule für Berufstätige, Germany, in 1990. He has been active in EMC product design, marketing, and applications development at Hewlett Packard since 1983. He has published many papers on EMI and microwave measurements, and has co-authored one book. Werner is an active member of the IEEE, SAE, CISPR committee A, ANSI C63 subcommittees, VDE, and is a NARTE certified EMC Engineer. Werner's favorite topics to present include "Use of Scanning Receivers in EMI Compliance Measurements," "Understanding Impulse Bandwidth Specifications of EMI Receivers," and various aspects concerning the automation of radiated and conducted EMI measurements. You can reach Werner at [werner\\_schaefer@agilent.com](mailto:werner_schaefer@agilent.com), telephone 1-707-577-2817.

It is my pleasure and privilege to inherit a well-structured and well-established program that serves the technical needs of our members. My interest in EMC began back in 1985, when I picked a co-op job that had me spinning the dials and listening to the output of an EMC-25 analog EMC receiver! Since then I have completed an MSEE at the University of Missouri-Rolla's EMC Laboratory, and also served as a Distinguished Lecturer from 1994-96. The best place to find me is at my favorite place, the Experiments and Demonstrations area, during the annual IEEE EMC Symposium. So you see my personal label should be "EMC technical and education junkie." The DL program's charter to make expert speakers more accessible to our members seemed like a great place for me to help "give back" to the Society.

The EMC Society's Distinguished Lecturer Program provides speakers for Society chapter meetings and similar functions. Each Distinguished Lecturer (DL) usually can offer one of several pre-prepared presentations on various EMC topics. The EMC Society Board of Directors appoints DLs to two-year terms. Currently, the Society has five speakers serving on alternating terms.

Distinguished Lecturers may give up to six talks per year under the Program, which reimburses the DL for their approved traveling expenses up to a recommended limit of \$750 per US engagement, or \$1000 per international engagement. To provide as many opportunities to as many members as possible, the Society encourages hosting chapters whenever possible to absorb some part of the speaker's costs, such as by providing or paying for local transportation, meals, and lodging.

For more information about the EMC Society's Distinguished Lecturer Program, visit our web site at <http://www.emcs.org/lectur.html>. You can also contact me at 1-603-465-3920, or via email at [Lee\\_Hill@silent-solutions.com](mailto:Lee_Hill@silent-solutions.com). **EMC**





# TC-9 Computational EMC

## An Overview of EMC Modeling

By Colin E. Brench

For those new to the idea of applying computational electromagnetics (CEM) to solving EMC problems, two things become immediately apparent. First, there are a variety of numerical techniques available, each with unique strengths and weaknesses that need to be understood. Secondly, there is the question of how these techniques can be applied to a particular problem. These two issues create a tough barrier that must be overcome before further investigations of CEM are made. However, once these have been addressed it becomes easier to determine if CEM modeling will be a beneficial tool for any given situation.

The numerical techniques used in CEM are the means by which a set of equations is solved. For all EMC problems, it is Maxwell's equations that are being solved. However, in many cases the full set of equations is not necessary and constraints or simplifications can be applied. It is the addition of such constraints that result in the variety of techniques in use today for EMC modeling.

The three most common numerical techniques used in EMC modeling are the Finite Difference Time Domain (FDTD), the Finite Element Method (FEM), and the Boundary Element Method (BEM), more commonly though less accurately known as the Method of Moments (MoM). These techniques are all used for solving a variety of field problems. Other techniques include the Partial Element Equivalent Circuit (PEEC) method and

the Transmission Line Method (TLM). These two techniques were especially developed to provide a link between physical structures and circuit models.

The most general solution to an electromagnetic problem might well be obtained using the FDTD technique, as there are very few constraints required in formulating a practical EMC tool. The price to pay for the flexibility afforded by FDTD is the magnitude of computational resources required for a given problem. A more specific tool such as the Numerical Electromagnetics Code (NEC) uses the MoM. This tool was written to address a specific class of problems, namely antenna modeling. NEC has considerably more constraints within its code but because of this it runs much more efficiently. Different formulations, also using MoM, are written to address other specific tasks such as solving coupling problems.

The other numerical techniques mentioned have also been developed with the appropriate constraints to efficiently address a wide range of EMC related problems. This area is rapidly developing, with new customizations of these techniques being added frequently. Therefore, it is often equally important to consider what kinds of problems a tool is intended to solve rather than simply which technique should be used.

The application of numerical techniques to solving an EMC problem is the second hurdle to face. Some problems match so well to an easily implemented formulation of a particular numerical

technique that the electromagnetic problem and numerical technique have almost become synonymous. The antenna modeling tool, NEC, is a good example of this, where MoM has become so closely associated with NEC that many don't realize the wider range of applications that the MoM can be used to solve.

The creation of EMC models has much the same procedure as the preparation of a problem to be solved by any other means. The first three steps are to determine what is wanted from the model, what is known as a starting point, and what pieces of information might be missing. This information is then incorporated into the framework of the available modeling tools and the best method of solving the problem can then be determined.

While it is the clear goal of TC-9 to help develop all aspects of EMC modeling, the primary goal is to help EMC engineers understand the subject so that they can decide on its relevance to their particular problems. Not everyone will need EMC modeling, and EMC modeling is not needed to address every problem. While there is still much that can be done without the need to apply modeling, this is slowly changing. Design and analysis in the related discipline of signal integrity (SI) were once also performed by following rules and through the use of basic equations. However, as data rates increased and tools improved, SI modeling grew from occasional use to a mainstay in the field. It is to be expected that EMC design and analysis work will develop in the same manner. A more in-depth overview of several common numerical electromagnetic methods, listing of available commercial and public-domain codes, and a brief bibliography of CEM books is available at the web site <http://www.emclab.umn.edu/numer.html>.  
EMC

## ATTENTION ALL VENDORS OF EMC PRODUCTS AND SERVICES!

### ADVERTISE ON THE EMC SOCIETY WEBSITE IN 2000

As a service to its members, the EMC Society will launch an electronic directory of EMC related products and services in the year 2000. If your company provides EMC related products and services, consider having an electronic institutional listing and your company logo on the EMC Society website. Visitors to the EMC Society website ([www.emcs.org](http://www.emcs.org)) will soon see a "hot button" with the title "Directory of EMC Products and Services." Clicking on this hot button will lead viewers to a page of institutional listings (similar to that shown on the back cover this newsletter). Company logos will be shown and viewers that are interested in further information about a specific company can click on a company logo and be immediately linked to that company's website. The cost to post an institutional listing and company logo for one year is \$1,500. Those interested in taking advantage of this NEW advertising opportunity should contact the EMC Society Webmaster, Andy Drozd at phone 315-334-1163 or e-mail at [a.l.drozd@ieee.org](mailto:a.l.drozd@ieee.org).





# Practical Papers, Articles and Application Notes

Bob Rothenberg, Associate Editor

Two interesting papers are presented in this issue. The first, by Jim Muccioli of Jastech EMC Consulting, describes EMC measurements on dual line filters using a simple current injection test method. The second, by Scott Bennett, an EMC Consultant in Carr, Colorado, describes a useful and basic approach for minimizing fields from electrical circuits. The Bennett paper is an outgrowth of presentations he has given recently at EMC Society chapter meetings in Oregon/SW Washington and Seattle.

Practicing members of the EMC community are encouraged to share their experience-based knowledge by submitting articles or application notes for publication in this section of the Newsletter. Unlike *Transactions* papers, these works need not be theoretical, mathematical or archival. Test methods, measurement results and design approaches are particularly suitable. Maximum length is approximately 2000 words, plus up to 6-8 figures (depending on word count).

Submit articles for consideration to this Associate Editor via e-mail, fax or air-mail. Addresses and fax number are listed on page 3.

## A Low Cost Test Method for Making Dual Line Filter Measurements

by James P. Muccioli

### Abstract:

The purpose of this article is to present a test method for dual line filter measurements of common and differential mode noise using a small current probe. This test method is similar to the MIL-STD-461 "Current Injection Insertion Loss Measurement Method," however two lines are tested simultaneously and modifications are made to the probe and cable lengths for measurements up to 1000 MHz. Data is developed with several different types of filter configurations to characterize the test method.

### Introduction:

In today's EMC environment, where both common and differential mode noise need to be reduced, there are very few test procedures that measure the results of a dual line filter in its dynamic state. Typically, a dual line filter is tested in a static state, where one side is tested and then the other side, showing the insertion loss of each line but not both simultaneously. The author will describe a simple test methodology in which a spectrum analyzer with a tracking generator and a current probe is used for dynamic testing of the dual line filter.

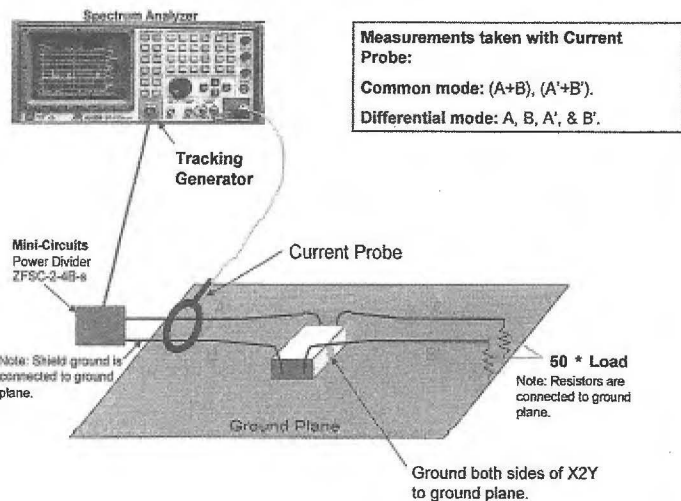


Figure 1. Measurement test setup.

### Test Configuration:

The test setup is shown in Figure 1. Three different dual line filter configurations are used for the device under test (DUT), as shown in Figure 2. The DUT is characterized using the tracking generator from the spectrum analyzer as the noise source for the before and after measurements. The tracking generator is connected to a power divider so both sides will receive equal amounts of noise. The actual test is conducted using a quart paint can to isolate the fields before and after the filter, as shown in Figure 3. The different filter configurations are attached to the top of the paint can and the wires protrude through the top of the paint can and terminate to a 50- $\Omega$  load. The small current probe is used to measure line A, line B, and then both lines A+B before the filter. Then the top is placed on the paint can and line A', line B', and lines A'+B' are measured.

### Test Methodology:

The purpose for using a miniature current probe (Fischer Custom Communications F-36-4) is to make quantitative measurements of the currents (magnetic fields) generated by the electrical noise from the tracking generator on the transmission lines. The current probe can be used in a non-shielded room because only the magnetic fields related to the electromagnetic radiation potential of the tracking generator affect the probe and it is relatively insensitive to stray electric fields. The windings of the probe are in a shield that reduces E-field pickup. Typical values of shielding from external E-fields vary from 60 dB below 100 MHz to greater than 30 dB at 450 MHz.

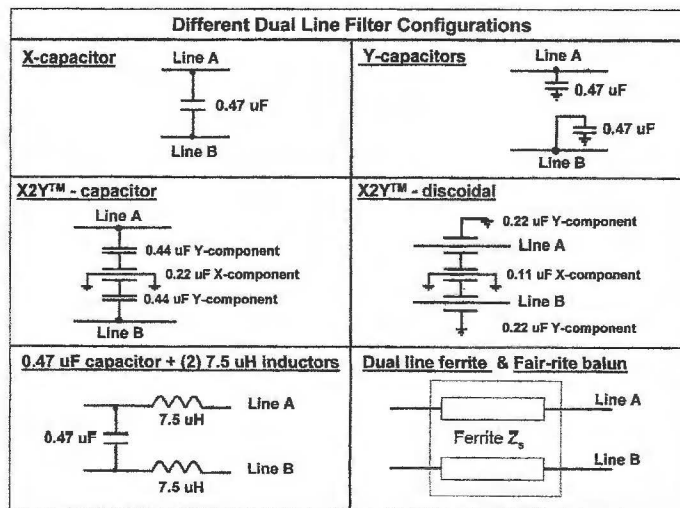


Figure 2. Three different dual line filter configurations.



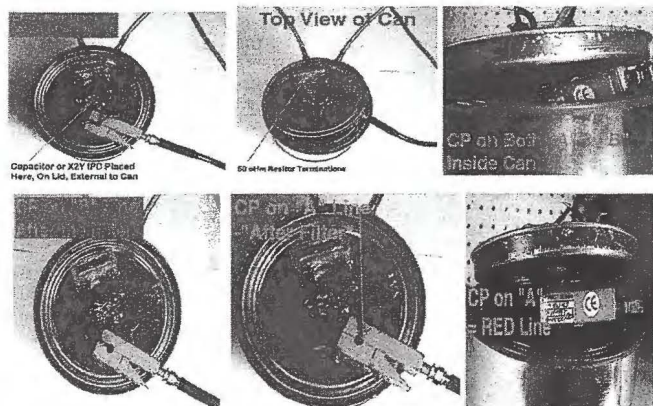


Figure 3. Pictures of test fixture.

The current probe has transfer impedance from 100 kHz to 1000 MHz, as shown in Figure 4. The transfer impedance  $Z_t$  is defined as the ratio of voltage developed across the output of the probe to the conductor under test. The current  $I_p$  in the conductor is calculated from the current probe output  $E_s$  in volts divided by the probe transfer impedance  $Z_t$ :

$$I_p = E_s / Z_t \quad (\text{Equation 1})$$

The spectrum analyzer used in this test is an IFR AN920 (9kHz - 2.9 GHz) and the frequency range is set from 100 kHz to 1000 MHz. The resolution is set to 120 kHz and the video bandwidth is turned off so that the spectrum analyzer does not filter the signals being analyzed.

### Test Results:

In Figures 5 through 10, the thin lines are the baseline references before the filter is introduced and the heavy lines are

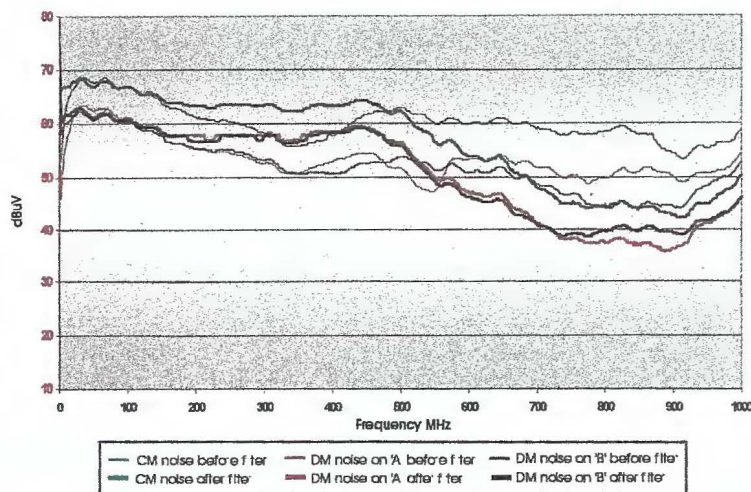
the measurements taken after the filter is in place. The delta between the baseline (before) and after filter measurements in these figures is the insertion loss in dBuV.

Figure 5 shows that a normal capacitor placed across lines A & B produces very little insertion loss over the frequency range. Below 150 MHz there is no insertion loss due to the filter. Between 150 MHz and about 500 MHz, there is a negative insertion loss (amplification of the noise). Finally, above 550 MHz, the data shows 2 to 15 dBuV of insertion loss.

Figure 6 shows the test results using a 3-pole capacitor filter. There is 10 to 40 dBuV of common and differential mode noise insertion loss, depending on frequency. A dip in the baseline values above 800 MHz is due to the wire length of 4.25 inches and movement of the wire to the side of the paint can, which causes resonance.

Figure 7 shows that the X2Y filter provides between 20 and 54 dBuV of

Figure 5. Capacitor filter.



insertion loss over the frequency range tested for both common mode and differential mode.

### Comparisons of Test Results:

In Figures 8, 9, and 10, the baseline data for both the 3-pole capacitor filter and the X2Y filter are very similar. The X2Y filter provides better common and differential mode insertion loss over the frequency range tested.

### Conclusion:

The test methodology used to measure the dual line filters is repeatable and easy to run. The current probe used in this test procedure was very effective in measuring both common mode and differential mode noise. However, the wire length of 4.25 inches needs to be reduced to eliminate high frequency resonance effects.

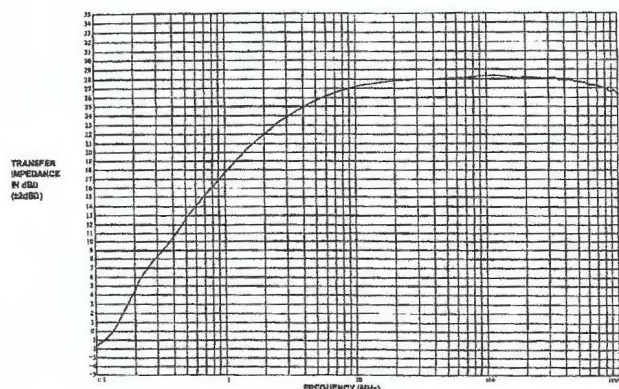


Figure 4. Current probe transfer impedance factor.

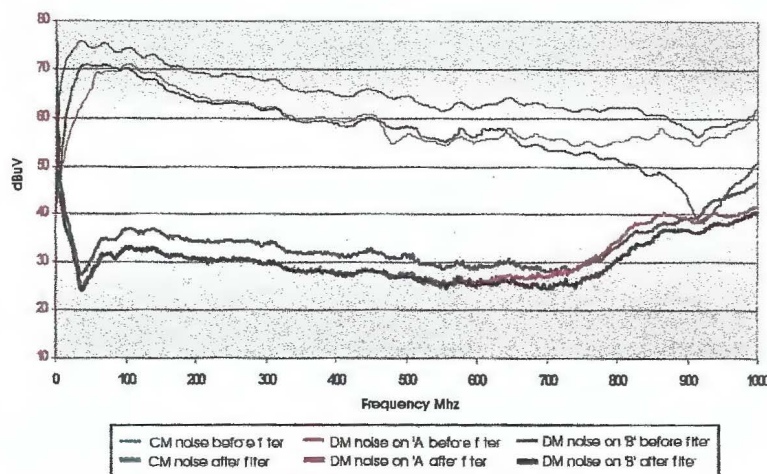


Figure 6. 3-pole capacitor filter.



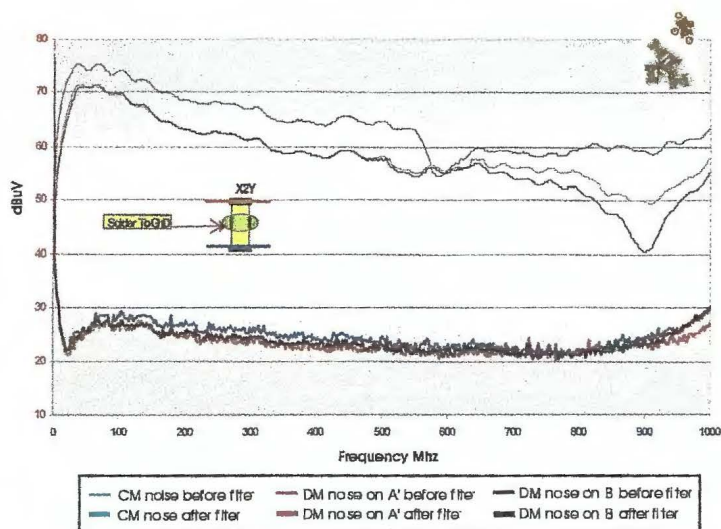


Figure 7. X2Y filter.

In summary, both the 3-pole filter and the X2Y device proved very effective in reducing common and differential mode noise. When EMC requirements are too stringent for normal capacitors, the X2Y device can provide added insertion loss.

This study was conducted with the filter values mentioned. The filtering can be improved by optimizing the filter value for any particular application. The load network in this test was built to 50- $\Omega$  impedance, but can be changed to meet any specific load requirements.

### Acknowledgements:

I would like to thank Joe Fischer from Fischer Custom Communications, Inc.

(<http://www.fischercc.com/>) for supplying the calibrated current probe used in the test setup. I would also like to thank Tony Anthony from X2Y Attenuators, LLC (<http://www.x2y.com/>) for supplying samples of the X2Y device manufactured by Syfer Technology Limited (<http://www.syfer.com/>).



James Muccioli is associated with Jastech EMC Consulting, LLC and X2Y Attenuators, LLC. He has extensive experience in EMC design, analysis, and testing. He is a NARTE certified EMC and ESD engineer, an active member of

SAE J-1113 and J-551 EMC committees, and chairman of the SAE Integrated Circuit EMC Task Force. He was selected as an IEEE Fellow in 1998 for contributions to integrated circuit design practices to minimize electromagnetic interference. Mr. Muccioli teaches seminars on EMC through his consulting firm, Jastech EMC Consulting, LLC ([www.Jastech-emc.com](http://www.Jastech-emc.com)) and an undergraduate course on EMC at the University of Michigan-Dearborn. He can be reached by e-mail at: [jastech@ameritech.net](mailto:jastech@ameritech.net). EMC

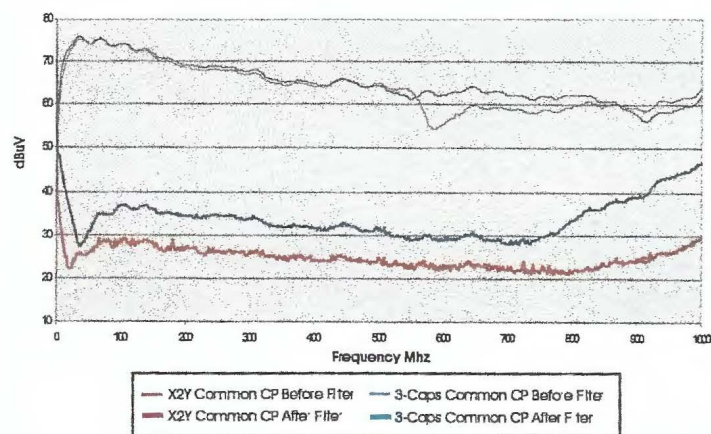


Figure 8. Common mode noise filtering of 3-pole capacitor filter compared to a X2Y filter.

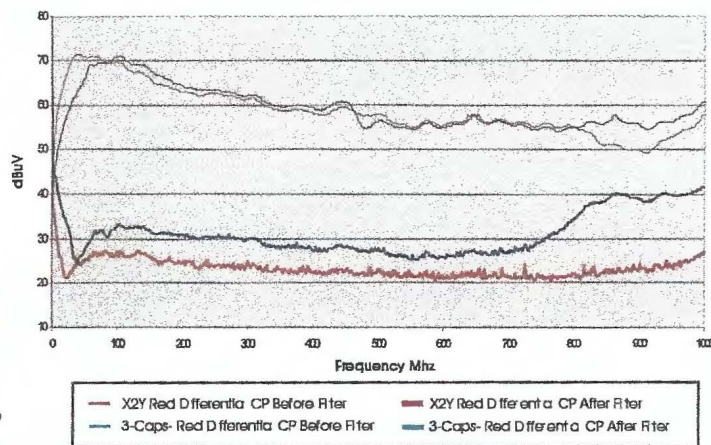


Figure 9. Differential mode noise filtering of line "A" with a 3-pole capacitor filter compared to an X2Y filter.

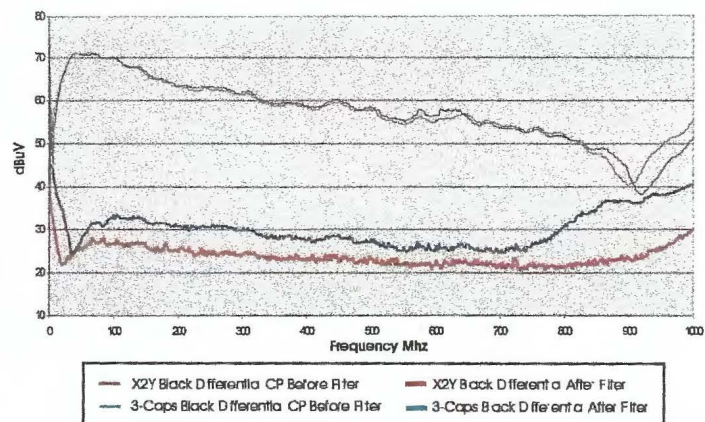


Figure 10. Differential mode noise filtering of line "B" with a 3-pole capacitor filter compared to an X2Y filter.



# THE KEY TO EMC

by W. Scott Bennett

**Abstract** - A simple, straightforward approach is described for minimizing the fields of any electrical circuit. The method is based on a study of the causes of the fields — circuit currents, and circuit geometries — rather than a study of the fields themselves.

## Introduction

The *current element* is a differential length of current that is assumed to be isolated in free space. Now, because of its assumed isolation, the current element is a *concept*; it is not something that can be physically realized. However, the current element is a very useful concept, because any circuit current can be accurately modelled as a superposition of its current elements. And, the electromagnetic fields of any circuit current will be equal to the superposition of the electromagnetic fields that each of its current elements would have [1-4]. Therefore, since unexpected electromagnetic fields of circuit currents are the sources of EMI, the current element is the *basic* source of EMI. And, the minimization of the fields of *all* current elements is obviously the *key* to EMC.

Now, as shown in Fig. 1(a) and (b), equal current elements with opposite directions would have equal, oppositely directed, electromagnetic fields at every corresponding point in space. This follows, because each field component of an

upwardly positive current element is directly proportional either to  $\sin \theta$ , or to  $\cos \theta$  [1-4]; and, if that current element is rotated  $180^\circ$ , those proportionalities become  $\sin(\theta + \pi) = -\sin \theta$ , and  $\cos(\theta + \pi) = -\cos \theta$ . As a result, if two equal, oppositely-directed current elements were placed closely parallel to one another, the sums of their fields would approach zero, as shown in Fig. 1(c). Therefore, if the oppositely-directed equal of every current element can be found in a circuit, and if all such equals can be positioned closely parallel to one another, the fields of that circuit current will approach zero.

In other words, EMC can be achieved by taking two steps: (1) be sure that every current element of a circuit has an oppositely-directed equal, and (2) place the current elements of each pair of oppositely-directed equals as close and as parallel to each other as possible.

## Circuit Currents

Now, an electric current is the flow of electric charge. For example, the charge flow that is the current in a metal conductor is the flow of electrons. Therefore, when the conduction current from a time-varying source increases, more electrons start to flow out of one source terminal and more electrons start to flow into the other source terminal. And, when that conduction current decreases at the source, fewer electrons start to flow out of one source terminal and fewer electrons start to flow into the other one. Also, in both cases, those changes in electron flow propagate away from the source and toward the load. In other words, one current component leaving the source propagates in the direction of positive current, and the other current component propagates in the opposite direction — one

clockwise, and one counterclockwise. As a result, when they come together, at any point in the circuit, both current components have the same positive direction and their sum is the total current at that point.

These current characteristics are illustrated in Fig. 2. In Fig. 2(a),  $i(t - t_c)$  is the clockwise propagating current component at the upper point shown, where  $t_c$  is its propagation time from the upper source terminal to that point. And,  $i(t - t_{cc})$  is the counterclockwise propagating current component at the lower point shown, where  $t_{cc}$  is its propagation time from the lower source terminal to that point. In these expressions,

$$t_c = \frac{d_c}{v_p} \quad \text{and} \quad t_{cc} = \frac{d_{cc}}{v_p}$$

where  $v_p$  is propagation velocity,  $d_c$  is the distance from the upper source terminal to the upper point, and  $d_{cc}$  is the distance from the lower source terminal to the lower point. After the additional propagation time,  $t_{pp}$ , from point to point, the total current at the upper point will be the sum of  $i(t - t_c)$  and  $\rho_L i(t - t_{cc} - t_{pp})$ . And, at the lower point, the sum of  $i(t - t_{cc})$  and  $\rho_L i(t - t_c - t_{pp})$  will be the total current. This is illustrated in Fig. 2(b). In these expressions,  $\rho_L$  accounts for the effect the load has on the amplitude of currents passing through it as a result of

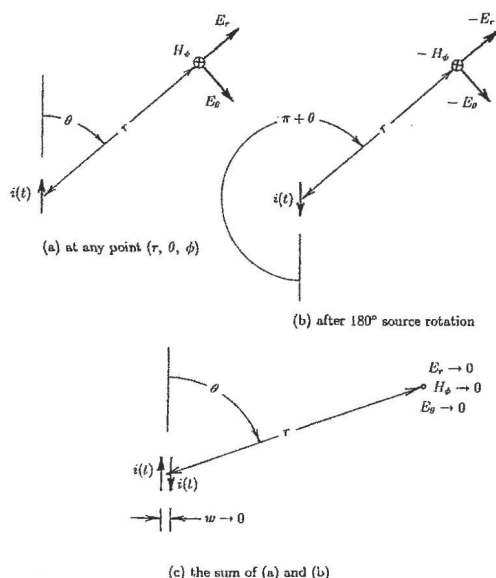


Figure 1. Current element fields.

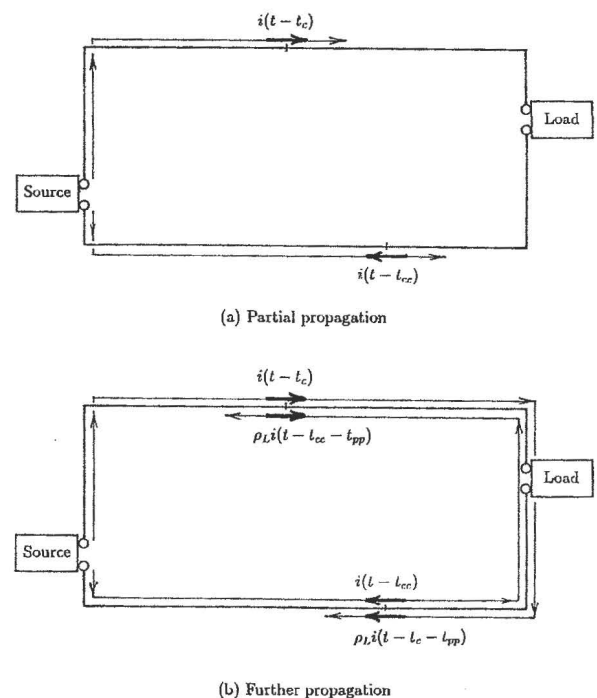


Figure 2. Circuit current components.



$i^2R$  losses, and  $t_{pp}$  includes any time change induced by the load as the result of capacitance or inductance. The effect of the load on current components propagating in either direction is the same, because the current components have the same positive direction as they pass through the load.

Thus, if the points in Fig. 2 are equidistant from the source, then  $d_c = d_{cc}$  and  $t_c = t_{cc}$ , and the total currents at those points will be equal. However, the total current in one conductor is positive in the direction from source to load, and the total current in the other conductor is positive in the direction from load to source. Therefore, if the conductors from a circuit's source terminals to its load terminals are given exactly the same length, every current element in one conductor will have an oppositely-directed equal in the other. And, the first step toward obtaining EMC for that circuit will have been taken.

### Circuit Geometry

As observed above, if both source-to-load conductors of a circuit have the same length, then every current element in that circuit will have an oppositely-directed equal. Therefore, to achieve EMC, all that remains to be done is to make the two members of each of those oppositely-directed current element pairs parallel and as close to one another as possible. A geometry that meets those requirements is illustrated in Fig. 3. As shown in that figure, the pairs need not form a straight line. However, by reducing the distance from source to load, the

circuit's fields would be further reduced, because the total number of current element pairs would be lessened.

### Other Observations

It should be noted that an alternate method of implementation to that of two individual conductors can be obtained with one conductor close to a ground plane. However, two things should be kept in mind if a ground plane is used: (1) the spacing between a current element and its oppositely-directed image in the ground plane is effectively twice the distance between the current element and the ground plane, and (2) there will be no fields on the opposite side of the ground plane from the current element with an ideal implementation. In other words, for a given spacing between two conductors, or between one conductor and a ground plane, there will be quite different results. On one side of the ground plane there will be considerably less field cancellation than that of a conductor pair with the same spacing, and on the other side of the ground plane there will generally be near-complete cancellation. However, for a given spacing, two individual conductors will, in general, be more effective than one conductor and a ground plane.

Finally, it should also be noted that complete cancellation of the fields of oppositely-directed, equal current elements is obtainable by making them

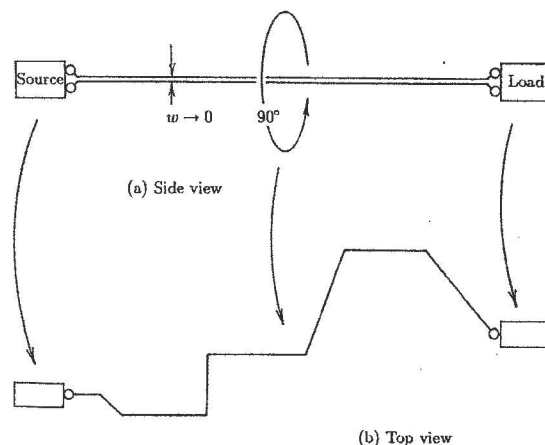


Figure 3. Typical circuit geometry for EMC.

coaxial. In other words, for the ultimate in EMC, a circuit's source-to-load conductor pair should be coaxial.

### References

1. Hayt, *Engineering Electromagnetics*, McGraw-Hill, 1981, pp. 479-482.
2. Jordan and Balmain, *Electromagnetic Waves and Radiating Systems*, Prentice-Hall, 1968, pp. 642-644.
3. Ramo, Whinnery, and Van Duzer, *Fields and Waves in Communication Electronics*, John Wiley & Sons, 1965, pp. 317-323.
4. Adler, Chu, and Fano, *Electromagnetic Energy Transmission and Radiation*, John Wiley & Sons, 1960, pp. 560-576.

Scott Bennett is an EMC Consultant, and can be reached at 7093 East County Road 74, Carr, CO 80612 (Tel: 970-897-2764) e-mail: w.scottbennett@juno.com.

EMC

© 2000 IEEE



## EMC Society Directors and Committee Chairs

### January 2000 Directory



### EMC SOCIETY DIRECTORS

#### SOCIETY OFFICERS

		Term
President	J Butler	(00-01)
Past President	D D Hoolihan	
Secretary	J N O'Neil	(99-00)
Treasurer	W A Kesselman	(99-00)
Vice President - Comm. Services	B L Carlson	(99-00)
Vice President - Member Services	T H Hubing	(99-00)
Vice President - Standards	D N Heirman	(99-00)
Vice President - Tech. Services	K Williams	(99-00)
Vice President - Conferences	H Ott	(99-00)

#### FUTURE EMC SYMPOSIA

2000 - Washington DC	21-25 August
2001 - Montreal	13-17 August
2002 - Minnesota	19-23 August
2003 - Israel	11-16 May
2003 - Boston	18-22 August
2004 - Santa Clara	
2005 - Chicago	

#### CHAIRMAN

W Duff
C Dube
D Hoolihan
E Joffe
M Matejic
F Gisin
D Walton



## DIRECTORS AT LARGE

Term Expires 12/00

H Benitez  
T H Hubing  
F P Mayer  
M I Montrose  
H W Ott  
D L Sweeney  
K Williams  
T Yoshino

Term Expires 12/01

D R Bush  
E T Chesworth  
E B Joffe  
D P Millard  
G S Pettit  
D C Smith

Term Expires 12/02

L Cohen  
A Drozd  
F Heather  
M Kanda  
J Perini  
A S Podgorski

EX OFFICIO (Without Vote)

Chapter Chairs  
Stdng Com Chairs  
R Schwartz, IEEE HQ  
M Ward-Callan, IEEE TAB  
W Gjertson, Division IV Director

### VICE PRESIDENT - COMMUNICATION SERVICES: B L Carlson

COMMITTEES:

Newsletter Editor  
Transactions Editor  
History  
Chapter Publicity  
IEEE Press Liaison  
Internet  
Public Relations

CHAIRPERSON:

J N O'Neil  
M Kanda  
C L Smith  
T Hubing  
H W Denny  
A Drozd  
H Benitez

### VICE PRESIDENT - MEMBER SERVICES: T H Hubing

COMMITTEES:

Awards  
Chapter Coordinator  
Membership  
Region 8 Membership  
Region 9 Membership  
Region 10 Membership  
Fellows Evaluation  
Fellows Search  
Constitution & Bylaws  
Nominations  
Distinguished Lecturer  
Survey  
PACE Coordinator  
Photographer

CHAIRPERSON:

H Benitez  
G Pettit  
A Drozd  
E B Joffe  
J Perini  
vacant  
W G Duff  
vacant  
W G Gjertson  
W G Gjertson  
L Hill  
R T Ford  
W McGinnis  
R T Ford

### VICE PRESIDENT - TECHNICAL SERVICES: K Williams

COMMITTEES:

Education and Student Activities  
Technical Advisory Committee (TAC)  
Electromagnetic Compatibility Management-TC1  
Electromagnetic Compatibility Measurement-TC2  
Electromagnetic Environment-TC3  
Electromagnetic Interference Control-TC-4  
High Power Electromagnetics-TC5  
Spectrum Management-TC6  
Nonsinusoidal Fields-TC7  
Electromagnetic Product Safety-TC8  
Computational EMC-TC9  
Representative Advisory Committee (RAC)  
Committee on Man and Radiation (COMAR)  
Energy Policy Committee  
Aerospace Research & Development

CHAIRPERSON:

M Mohd  
A Podgorski  
K Williams  
D N Heirman  
V Arafiles  
R Mohr  
L F Libelo  
A Chubujkjian  
G Bush  
M Marks  
J Drewniak  
D Case  
D D Hoolihan  
D P Millard  
B L Carlson

R & D Policy Committee

NARTE  
IEEE Metric Policy  
ACES  
ACIL  
Soc. Social Implications of Technology

R T Ford

D Case  
E Bronaugh  
T Hubing  
D Case  
R H Brook

### VICE PRESIDENT - STANDARDS: D N Heriman

COMMITTEES:

Standards Development Committee (SDCom)  
IEEE Stds Office Liaison  
IEEE Stds Board Liaison  
Standards Advisory and Coordination Committee (SACCom)  
CISPR Subcommittee A,E and G  
CISPR Subcommittee B  
EIA R1/R2 & G46  
SAE AE-4  
SAE Automotive EMI & EMR  
ASTM D09.12.14, E06.53  
ANSI ASC C63  
RTCA SC135,177  
Electrostatic Discharge Assoc  
ETSI TC ERM  
ISO TC22/SC3/WG3  
CENELEC 210A  
Standards Education and Training (SETCom)

CHAIRPERSON:

S Berger  
S Vogel  
D N Heirman  
E B Joffe  
D N Heirman  
D D Hoolihan  
vacant  
G Fenical  
K Williams  
D Peregrim  
D N Heirman  
E Borgstrom  
T J Ritenour  
R Storrs  
K Moy  
vacant  
H Denny

### VICE PRESIDENT - CONFERENCES: H W Ott

COMMITTEES:

International Conference  
Exhibits  
Regional Symposia

CHAIRPERSON:

B Wallen  
G Watkins  
J N O'Neil

### DISTINGUISHED LECTURERS

E Joffe (12/00)  
M Mardegian (12/00)  
M Montrose (12/00)  
D Smith (12/01)  
W Schaefer (12/01)

Please send all corrections and changes to Todd Hubing  
(t.hubing@ieee.org)

## EMC Society Chapters and Chapter Chairs January 2000

### ALBUQUERQUE

Joint AP/MTT  
Term: 1-1-96, 12-31-96  
Donald McLemore  
Phone: +1 505 889 7009  
mclmore-abq1@kaman.com  
ANGEL: Bill McGinnis

### ATLANTA

Term: 4-15-99, ?  
David Dennis  
Intertek Testing Services  
4317-A Park Drive NW  
Norcross, GA 30093  
Phone: +1 770 925 2444  
DDennis@itsqs.com  
ANGEL: Dave Millard

### AUSTRIA

Term:  
Mr. Dipl. Ing. Kurt Lamedschwandner  
Austrian Research Center Seibersdorf  
Division of Electronics  
Head of EMC Laboratory  
A-2444 Seibersdorf  
Phone: +43 2254 780 2800  
kurt.lamedschwandner@arcs.ac.at  
ANGEL: Elya Joffe



**BALTIMORE-ANNAPOLIS**

Term: 4-1-99, 3-30-00  
 Fred Kirby  
 fred@shore.intercom.net  
 ANGEL: Dick Ford

**BEIJING**

Term: 11-1-92, 12-31-95  
 Gao, You-gang  
 Beijing University  
 Posts & Telecommunications  
 Beijing 100088 China  
 (8610) 62282343 work/fax  
 lisf@bupt.edu.cn  
 ANGEL: Gene Cory

**BOSTON (CNEC)**

Term: 6/98, 6/99  
 John Clarke  
 24 Althea Drive  
 Yarmouthport, MA 02675  
 Phone: +1 508 362 7195  
 jclarke805@aol.com  
 ANGEL: Joe Butler

**CENTRAL TEXAS**

9/1/99 - 12/31/00  
 Richard Worley  
 Dell Computer Corporation  
 1404 Cedar Hills Blvd.  
 Cedar Park, TX 78613  
 Phone: +1 512 728 1081  
 Cell: +1 512 431 1084  
 Fax: +1 512 728 5278  
 richard\_worley@dell.com  
 Angel: Bill McGinnis

**CHICAGO**

Term: 4-1-99, 4-1-00  
 Derek N. Walton  
 12790 Route 76,  
 Poplar Grove, IL 61065  
 Work Phone: +1 815 637 3729  
 Home phone: +1 815 547 3467  
 lfresearch@ieee.org  
 ANGEL: Don Sweeney

**DALLAS/FORT WORTH**

Term: 6-30-97, 6-30-00  
 Mark E. Bushnell  
 821 Meadowgate Drive  
 Garland, TX 75040-3661  
 Phone: +1 903 457 6375  
 Fax: +1 903 457 7640  
 M.Bushnell@ieee.org  
 ANGEL: Bill McGinnis

**DAYTON (Inactive)**

Term:  
 Arturo Serrano  
 6160 Honeygate Dr  
 Huber Heights OH 45424  
 Phone: +1 513 667 4795  
 ANGEL: Ghery Pettit

**EASTERN NORTH CAROLINA**

Term: 10-7-98, 12-31-99  
 Jim Marley  
 Underwriters Laboratories  
 12 Laboratory Drive  
 Research Triangle Park, NC 27709  
 Phone: +1 919 549 1408  
 Fax: +1 919 547 6212  
 jim.marley@ieee.org  
 ANGEL: Ghery Pettit

**FRANCE**

Term: 1-1-92, 12-31-93  
 Prof Ferdy Mayer  
 President LEAD  
 12 avenue de la Republique  
 94700 Maisons-Alfort, France  
 0033 1 47343605 (phone/fax)  
 ANGEL: Elya Joffe

**GERMANY**

Term: 11-1-97; 10/31/00  
 Prof. Dr. Ing. Heyno Garbe  
 University of Hannover  
 Appelstrasse 9 A  
 D-30167 Hannover Germany  
 Phone: +05 11 7 62 37 60  
 Fax: +05 11 7 62 39 17  
 garbe@geml.uni-hannover.de  
 Heyno.Garbe@ieee.org  
 ANGEL: Elya Joffe

**HOUSTON**

Joint AP/MTT  
 Term: 1-1-91, 12-31-91  
 Jeff Williams  
 University of Houston  
 University Park  
 Dept of EE  
 Houston TX 77004  
 Phone: +1 713 743 4455  
 Fax: +1 713 743 4444  
 jwilliams@uh.edu  
 ANGEL: Bill McGinnis

**ISRAEL**

Term: 1-1-99, 12-31-00  
 Elya B. Joffe  
 KTM Project Eng., Ltd.  
 P. O. Box 264  
 KEAR Sava 44102, Israel  
 Phone: 011 972 8 9272997  
 Home Phone and  
 Fax: 011 972 9 7657065  
 eb.joffe@ieee.org  
 ANGEL: Ghery Pettit

**ITALY (Central and South Italy)**

Term: 11/1/97-10/31/98  
 Salvatore Celozzi  
 Electrical Eng. Dept.  
 University of Rome "La Sapienza"  
 via Eudossiana, 18  
 00184 Rome  
 Italy  
 Phone: +39 6 44585520  
 Fax: +39 6 4883235  
 celozzi@elettrica.ing.uniroma1.it  
 ANGEL: Ghery Pettit

**KOREA**

Term: 1/99 - 12/99  
 Professor Dong Chul PARK  
 Dept. of Radio Science and Engineering  
 Chungnam National University  
 Taejon, 305-764 Korea  
 Phone: +82 42 821 5665  
 Fax: +82 42 822 4334  
 dcpark@hanbat.chungnam.ac.kr  
 ANGEL: Ghery Pettit

**LONG ISLAND/NEW YORK**

Term: 6-30-92, 12-31-96  
 Bob Berkovits  
 P.O. Box 496  
 Huntington NY 11743-0496  
 Work Phone: +1 516 346 7782  
 Home Phone: +1 516 754 4095  
 Fax: +1 516 346 7823  
 ANGEL: Ghery Pettit

**LOS ANGELES**

Term: 9-1-93, 12-31-96  
 Ray Adams  
 Hughes Space & Communications  
 P.O. Box 92919  
 Los Angeles, CA 90009  
 Mail Station: SC/S25/C372  
 Phone: +1 310 662 7878  
 Fax: +1 310 416 3088  
 r.k.adams@ieee.org  
 ANGEL: Ghery Pettit

**MELBOURNE**

Term: 11-4-99, 12-31-00  
 Bruce R. Crain  
 Northrop Grumman  
 MS F06-221  
 2000 West NASA Blvd.  
 P.O. Box 9650  
 Melbourne, FL 32902-9650  
 Phone: +1 321 951 6395  
 Fax: +1 321 951 6388  
 crainbr@mail.northgrum.com  
 ANGEL: David Millard

**MOHAWK VALLEY**

Joint: REL  
 Term: 12-31-97, 12-31-99  
 Andrew L. Drozd  
 Andro Consulting Services  
 P.O. Box 543  
 Rome, New York 13442-0543  
 Phone: +1 315 337 4396  
 Alt. Phone: +1 315 334 1163  
 Fax: +1 315 337 4396  
 Alt. Fax: +1 315 334 1397  
 a.l.drozd@ieee.org  
 ANGEL: Ghery Pettit

**MONTREAL**

Term: 9-1-97, 8-31-99  
 Benoit Nadeau  
 Matrox  
 1055, boul. St-Regis  
 Dorval, Quebec, Canada H9P 2T4  
 Phone: +1 514 822 6000 x2475  
 Fax: +1 514 822 6275  
 bnadeau@matrox.com  
 ANGEL: Ghery Pettit

**NANJING**

Joint: AP/MTT  
 Term: 1-1-97, 12-31-98  
 Prof. Wen Xun Zhang  
 22-1001  
 2nd Suo-Jin-Cun  
 Nanjing Jiangs 210042  
 P.R. China  
 Home Phone: +86 25 5414002  
 Work Phone: +86 25 3792648  
 Fax: +86 25 5414002  
 wxzhang@seu.edu.cn  
 ANGEL: Ghery Pettit

**NEW JERSEY COAST**

Joint AP, VT  
 9-1-99; 8-31-00  
 William Drach  
 Celwave  
 Marlboro, NJ, 07743  
 Phone: +1 732 462 1880 x204  
 william.drach@celwave.com  
 ANGEL: Don Heirman

**NORTHWEST FLORIDA**

Term: 7-1-92, 6-30-97  
 Dr Maqsood A Mohd  
 4462 Parkwood Square  
 Niceville FL 32578  
 Phone: +1 850 729 6115  
 Fax: +1 850 729 6377  
 mohd@eglin.af.mil  
 ANGEL: Bill McGinnis

**ORANGE COUNTY**

Term: 8-1-98, 7-30-99  
 Randall Flinders  
 Emulex Corporation  
 3535 Harbor Blvd  
 Costa Mesa CA 92626-1437  
 Phone: +1 714 513 8012  
 Fax: +1 714 513 8265  
 r.flinders@ieee.org  
 ANGEL: Ghery Pettit



**OTTAWA**

Term: 12-18-99, 12-18-00  
 Gianluca Arcari  
 Product Integrity  
 Nortel Networks  
 PO Box 3511 Station C  
 Ottawa ON K1Y 4H7  
 Canada  
 Phone: +1 613 765 1552  
 Fax: +1 613 763 8091  
 gianluca@nortelnetworks.com  
 ANGEL: Ghery Pettit

**PHILADELPHIA**

Term: 10-01-93, 10-01-94  
 Michael Daniele  
 CSC  
 1301 Virginia Drive  
 Suite 100  
 Fort Washington PA 19034  
 Phone: +1 215 542 5409  
 Fax: +1 215 283 2507  
 Mdaniele@csc.com  
 ANGEL: Ghery Pettit

**PHOENIX**

Joint MTT, AP, ED, LEO  
 Term: 1-1-00; 12-31-00  
 Terence Donohoe  
 Honeywell  
 M/S M25A1  
 21111 N. 19th Ave  
 Phoenix, AZ 85027  
 Phone: +1 602-436-5974  
 terry.donohoe@honeywell.com  
 ANGEL: Daryl Gerke

**PIKES PEAK**

Term: 10-10-96; 10-10-97  
 Jim Youngman  
 Omnipoint Corporation  
 1365 Garden of the Gods Road  
 Colorado Springs, CO 80907  
 Phone: +1 719 548 1201  
 j.a.youngman@ieee.org  
 ANGEL: Ghery Pettit

**PORTLAND & SW WASHINGTON**

Term: 8-1-96, 7-1-00  
 Henry Benitez  
 3755 N.W. Columbia Avenue  
 Portland, Oregon 97229  
 Phone: +1 503 645 6613  
 Fax: +1 503 645 8056  
 h.benitez@ieee.org  
 ANGEL: Janet O'Neil

**ROCKY MOUNTAIN**

Term: 1-1-99; 12-31-99  
 Lyle Luttrell  
 Regulatory Agent/Component Engineer  
 Breece Hill Technologies  
 Phone: +1 303 664 8286  
 Fax: +1 303 449 1027  
 lluttrell@ieee.org  
 ANGEL: Henry Ott

**SAN DIEGO**

Term 1-1-97, 12-31-97  
 Dave Bernardin  
 TUV Product Service  
 10040 Mesa Rim Rd.  
 San Diego, CA 92121  
 Phone: +1 619 546 3999  
 Fax: +1 619 546 0364  
 d.a.bernardin@ieee.org  
 ANGEL: Ghery Pettit

**SANTA CLARA VALLEY**

Term: 7-1-99, 6-30-00  
 Zorica Pantic-Tanner  
 San Francisco State University  
 Phone: +1 415 338 7739

Fax: +1 415 338 0525

zpt@sfsu.edu

ANGEL: Janet O'Neil

**SEATTLE**

Term: 7-1-98, 6-30-99  
 Ghery S. Pettit  
 Intel Corporation  
 DP2-303, 2800 Center Drive  
 DuPont, WA 98327  
 Phone: +1 253 371 5515  
 Fax: +1 253 371 5690  
 g.pettit@ieee.org  
 ANGEL: Leonard Carlson

**SINGAPORE**

Joint AP, MTT  
 Term: 1-6-93, 1-6-94  
 Prof Leong Mook Seung  
 EE Dept/ Nar'l University of Singapore  
 10 Kent Ridge Crescent  
 Singapore 0511  
 ANGEL: Ghery Pettit

**SOUTHEASTERN MICHIGAN**

Term: 1-1-96, 12-31-96  
 Dennis Barberi  
 1567 Eason  
 Waterford, MI 48328  
 Phone: +1 810 825 8854  
 Fax: +1 810 825 4013  
 barberi@gdls.com  
 ANGEL: Kimball Williams

**SOUTHERN MARYLAND**

Term: 7-93, 12-94  
 Frederick W Heather  
 202 Bob's Court  
 Lexington Park MD 20653  
 Work Phone: +1 301 737 0303  
 Home Phone: +1 301 863 5782  
 Fax: +1 301 737 0305  
 ANGEL: Bill Duff

**ST. PETERSBURG (RUSSIA)**

Joint PES, AES, CS  
 Term: 1-99, 1-00  
 Alexandre Mikerov  
 Saint-Petersburg Electrical Engineering University  
 Head of the Electromechanics and  
 Electromechatronics Dept. P.O. Box 103  
 St.-Petersburg, 192286, RUSSIA  
 Home Phone: +7 812 172 68 96  
 Work Phone/Fax: +7 812 234 23 90  
 mick@emt.etu.spb.ru  
 ANGEL: Elya Joffe

**SWEDEN**

Term: 10-23-96, 10-23-97  
 Dag Bjorklof  
 SEMKO AB  
 P.O. Box 1103  
 S-164 22 Kista, Sweden  
 Phone: +46 8 7500455  
 Fax: +46 8 7500475  
 ANGEL: Elya Joffe

**SWITZERLAND**

Joint APS, MTT  
 Term: 1-1-99, 12-31-99  
 Prof. Dr. Ruediger Vahldieck  
 Chair for Field Theory  
 Swiss Federal Institute of Technology Zurich  
 (ETHZ)  
 Laboratory for Electromagnetic Fields and  
 Microwave Electronics (IFH)  
 ETH Zentrum, Gloriastrasse 35  
 CH-8092 Zuerich  
 Phone: +41 1 632 2742,  
 Secretary - 2810  
 Fax: +41 1 632 1198  
 vahldieck@ifh.ee.ethz.ch  
 ANGEL: Elya Joffe

**TAIWAN**

Term: 11-95, 12-31-96  
 Song-Tsuen Peng  
 National Chiao Tung University  
 Dept. of Comm. Eng.  
 1001 Ta Hsueh Road  
 Hsinchu 30050 Taiwan  
 ANGEL: Ghery Pettit

**TOKYO**

Term: 1-1-99, 12-31-00  
 Dr. Shuichi Nitta  
 Prof. Tokyo Univ. of Agri. & Tech.  
 2 24-16 Nakacho Koganei  
 Tokyo 184 JAPAN  
 Phone: +81 423 88 7096  
 Fax: +81 423 27 6692  
 nitta@cc.tuat.ac.jp  
 ANGEL: Ghery Pettit

**TORONTO, ONTARIO (CANADA)**

Joint MTT, AP  
 Term 8-1-99, 7-31-00  
 Ramesh Abhari  
 Department of Electrical & Computer  
 Engineering  
 University of Toronto  
 10 King's College Road  
 Toronto, Ontario, CANADA M5S 3G4  
 Phone: +1 416 978 4534  
 Fax: +1 416 978 4425  
 ramesh@waves.utoronto.ca  
 ANGEL: Ghery Pettit

**TUCSON (inactive)**

Joint MTT, AP  
 Term: 1-1-94, 12-31-94  
 Howard Kohlbacher  
 8532 E Appomattox  
 Tucson AZ 85710  
 Phone: +1 602 296 5578  
 ANGEL: Ghery Pettit

**TWIN CITIES**

Term: 1-1-98, 12-31-98  
 Roger Kuhn  
 3M  
 410 E. Fillmore Ave.  
 St. Paul, MN 55144  
 Phone: +1 612 778 6279  
 Fax: +1 612 778 6252  
 rdkuhn1@mmm.com  
 ANGEL: Dan Hoolihan

**UNITED KINGDOM & REPUBLIC OF IRELAND**

Term: 11-92, 11-93  
 Martin Green  
 International Interference Technology  
 The Corner House  
 Stainswick Lane  
 Shrivenham, Swindon,  
 England SN6 8DX  
 Work Phone: +44 793 782059  
 Home Phone: +44 793 782059  
 Fax: +44 1793 782 310  
 ANGEL: Elya Joffe

**WASHINGTON/NORTHERN VIRGINIA**

Term: 7-1-97, 6-30-98  
 Lawrence Cohen  
 11521 Sullnick Way  
 Gaithersburg, MD 20878-1032  
 Phone: +1 202 404 7726  
 ANGEL: Dick Ford

*The chapter chair directory is updated frequently.  
 You can find the most recent version on the web at  
<http://www.emcs.org/emcchaps.html>.*



# The IEEE EMC Society Directors and Committee Chairs

## January 2000 Directory

(please send all corrections to Todd Hubing at [t.hubing@ieee.org](mailto:t.hubing@ieee.org))

Arafiles, Virgilio (Vil)  
9542 Westwood Drive  
Ellicott City, MD 21042-3728  
Work Phone: +1 301 688 6276  
Home Phone: +1 410 465 0502  
Fax: +1 301 688 0056  
[vparafles@aol.com](mailto:vparafles@aol.com)

Benitez, Henry  
3755 N.W. Columbia Avenue  
Portland, Oregon 97229  
Phone: +1 503 645 6613  
Fax: +1 503 645 8056  
[h.benitez@ieee.org](mailto:h.benitez@ieee.org)

Berger, H S (Steve)  
Siemens  
2205 Grand Ave Pkwy  
Austin TX 78728  
Phone: +1 512 990 6147  
Fax: +1 512 990 6335  
[sberger822@aol.com](mailto:sberger822@aol.com)

Bogusz, Michael  
EMC Compliance Specialist  
Newbridge Networks Corporation  
600 March Road  
P.O. Box 1360  
Kanata, Ontario  
K2K 2E6 Canada  
Phone: +1 613 599 3600 x3319  
[m.bogusz@ieee.org](mailto:m.bogusz@ieee.org)

Bronaugh, Edwin L  
EdB EMC Consultants  
10210 Prism Dr  
Austin TX 78726-1364  
Phone: +1 512 258 6687  
Fax: +1 512 258 6982  
[Edwin.L.Bronaugh@siemenscom.com](mailto:Edwin.L.Bronaugh@siemenscom.com)

Brook, Robert H  
9 Ruey Place  
Plainview NY 11803  
Phone: +1 516 938 6991  
Fax: +1 516 938 4363  
[rbrook@worldnet.att.net](mailto:rbrook@worldnet.att.net)

Bush, Donald R.  
131 French Ave.  
Winchester, KY 40391-2520  
Phone: +1 606 744 8695  
Fax: +1 606 737 0747  
[d.bush@ieee.org](mailto:d.bush@ieee.org)

Butler, Joseph E  
Parker Chomerics  
77 Dragon Court  
Woburn MA 01888  
Work Phone: +1 781 939 4267  
Fax: +1 781 938 5071  
Home Phone: +1 978 468 0080  
[jbutler@parker.com](mailto:jbutler@parker.com)

Carlson, B Leonard  
NW Emetek Services  
516 W Snoq. River Rd SE  
Carnation WA 98014  
Phone: +1 425 222 5268  
Fax: +1 425 222 5268  
[l.carlson@ieee.org](mailto:l.carlson@ieee.org)

Case, David  
Aironet Wireless Comm., Inc.  
367 Ghent Road, Suite 300  
P.O. Box 5292  
Akron, OH 44333-0292  
Phone: +1 330 665 7396  
Fax: +1 330 665 7301  
[dcase@aironet.com](mailto:dcase@aironet.com)

Clarke, John  
24 Althea Drive  
Yarmouthport MA 02675  
508 362 7195  
[JClarke805@aol.com](mailto:JClarke805@aol.com)

Chesworth, E. Thomas  
Seven Mountains Scientific Inc.  
P.O. BOX 650  
Boalsburg, PA 16827-0651  
Phone: +1 814 466 6559  
Fax: +1 814 466 2777  
[tom@7ms.com](mailto:tom@7ms.com)

Chubukjain, Arto  
Industry Canada  
300 Slater Street, Room 1859C  
Ottawa Ontario Canada K1A 0C8  
Phone: +1 613 990 4717  
Fax: +1 613 991 3961  
[Chubukjian.Arto@ic.gc.ca](mailto:Chubukjian.Arto@ic.gc.ca)

Cohen, Lawrence  
Naval Research Laboratory  
Search Radar Div Code 53326  
4555 Overlook Drive  
Washington, DC 20375  
Phone: +1 (202) 404 7726  
Fax: +1 (202) 767 6172  
[cohen@radar.nrl.navy.mil](mailto:cohen@radar.nrl.navy.mil)

Dawson, Dr W Kenneth  
TRIUMF  
4004 Westbrook Mall  
Vancouver British Columbia  
Canada V6T 2A3  
Phone: +1 604 222 1047  
Fax: +1 604 222 8325  
[K.Dawson@ieee.org](mailto:K.Dawson@ieee.org)

Denny, Hugh W  
2528 LaVista Rd  
Decatur GA 30033  
Phone: +1 404 633 9363  
Fax: +1 404 894 7358  
[hugh.denny@etri.gatech.edu](mailto:hugh.denny@etri.gatech.edu)

Drewniak, James L.  
Department of Electrical Engineering  
University of Missouri-Rolla  
Rolla, MO 65401  
Phone: +1 573 341 4969  
Fax: +1 573 341 4169  
[drewniak@ee.umr.edu](mailto:drewniak@ee.umr.edu)

Drozdz, Andrew  
Andro Consulting Services  
P.O. Box 543  
Rome, New York 13442-0543  
Phone: +1 315 337 4396  
Alt. Phone: +1 315 334 1163  
Fax: +1 315 337 4396  
Alt. Fax: +1 315 334 1397  
[a.l.drozdz@ieee.org](mailto:a.l.drozdz@ieee.org)

Duff, Dr William G  
Computer Sciences Corp  
5501 Backlick Rd, Suite 300  
Springfield VA 22151  
Work Phone: +1 703 914 8450  
Home Phone: +1 703 250 2409  
Fax: +1 703 914 8499  
[w.duff@ieee.org](mailto:w.duff@ieee.org)

Fenical, Gary  
Instruments Specialties Co  
PO Box A  
Delaware Water Gap PA 18327-0136  
Phone: +1 570 424 8510  
Fax: +1 570 421 4227  
[gary\\_fenical@www.instr.com](mailto:gary_fenical@www.instr.com)

Ford, Richard T  
6 Westcot Place  
Falmouth VA 22405  
Work Phone: +1 202 767 3440  
Home Phone: +1 540 371 4008  
Fax: +1 202 404 4064  
[dford@radar.nrl.navy.mil](mailto:dford@radar.nrl.navy.mil)

Gjertson, William G  
Boeing Information, Space & Defense Systems  
PO Box 3999, MS: 8H-10  
Seattle WA 98124  
Work Phone: +1 425 393 2557  
Home Phone: +1 206 448 8675  
Fax: +1 253 773 4173  
[w.gjertson@ieee.org](mailto:w.gjertson@ieee.org)

Heather, Frederick W  
45870 Bob's Court  
Lexington Park MD 20653  
Work Phone: +1 301 342 6975  
Home Phone: +1 301 863 5782  
Fax: +1 301 342 6982  
[heatherf@ieee.org](mailto:heatherf@ieee.org)

Heirman, Donald N  
Don HEIRMAN Consultants  
143 Jumping Brook Rd  
Lincroft NJ 07738-1442  
Phone: +1 732 741 7723  
Fax: +1 732 530 5695  
[d.heirman@worldnet.att.net](mailto:d.heirman@worldnet.att.net)

Hill, Lee  
Silent Solutions  
20 Patch Road  
Hollis, NH 03049  
Phone: +1 603 465 3920  
Fax: +1 603 465 3921  
[Lee\\_Hill@silent-solutions.com](mailto:Lee_Hill@silent-solutions.com)

Hoeft, Lothar O. (Bud)  
9013 Haines Ave., NE  
Albuquerque, NM 87112  
Phone: +1 505 298 2065  
Fax: +1 505 298 2065  
[bud.hoeft@ieee.org](mailto:bud.hoeft@ieee.org)

Hofmann, H R (Bob)  
Lucent Technologies  
Room 2B-220  
2000 N Naperville Rd  
Naperville IL 60566  
Work Phone: +1 630 979 3627  
Home Phone: +1 630 355 2440  
Fax: +1 630 979 5755  
[hrhofmann@lucent.com](mailto:hrhofmann@lucent.com)



Hoolihan, Daniel D  
Hoolihan EMC Consulting  
PO Box 367  
Lindstrom, MN 55045  
Work Phone: +1 651 213 0966  
Fax: +1 651 213 0977  
d.hoolihan@ieee.org

Howard, John B.  
EMC Consultant  
1632 Grosbeak Avenue  
Sunnyvale, CA 94087 U.S.A.  
Phone: +1 408 736 2514  
Fax: +1 408 739 1461  
jhoward@emcguru.com

Hubing, Todd  
120 Emerson Electric Hall  
University of Missouri-Rolla  
Rolla MO 65401  
Phone: +1 573 341 6069  
Fax: +1 573 341 4532  
t.hubing@ieee.org

Joffe, Elya B.  
P.O. Box 264  
Kfar-Sava 44102, Israel  
Phone: +972 9 7657065  
Cell Phone: +972 52 783793  
Fax: +972 9 7657065  
eb.joffe@ieee.org

Johnson, W F  
Hamilton Engineering Inc  
2108 SW 152nd St  
Seattle WA 98166  
Work Phone: +1 206 244 0952  
Home Phone: 206 931 0372  
Fax: +1 206 243 0598

Kanda, Dr Motohisa  
Electromagnetic Field Div  
NIST  
M/S 813.07  
325 S Broadway  
Boulder CO 80303  
Phone: +1 303 497 5320  
Fax: +1 303 497 6665  
mkanda@boulder.nist.gov

Kesselman, Warren A  
31 Hope Rd  
Tinton Falls NJ 07724-3009  
Phone: +1 732 842 3207  
Fax: +1 732 530 9710  
w.kesselman@ieee.org

Kraemer, John G.  
Rockwell Collins  
M/S 106-183  
350 Collins Road, NE  
Cedar Rapids, IA 52498  
Work Phone: +1 319 295 4681  
Home Phone: +1 319 373 0125  
Fax: +1 319 395 5429  
jgkraeme@collins.rockwell.com

Libelo, Dr. Louis F  
US Army Research Lab  
2800 Powder Mill Road  
Adelphi, Maryland 20783  
Phone: +1 301 394 0782  
Fax: +1 301 394 2525  
llibelo@emsc5.arl.mil

Marks, Murlin  
Underwriters Laboratories  
1655 Scott Blvd  
Santa Clara, CA 95051  
Phone: +1 408 985 2400  
Fax: +1 408 556 6037  
marksm@ul.com

Mayer, Prof Ferdy  
7 Rue Paul Barruel  
75015 Paris, France  
phone/fax 0033 1 47343605  
FerdyMayerLEADFrance@compuserve.com

McGinnis, William  
Alexander Utility Engineering, Inc.  
975 W. Bitters Rd  
San Antonio, TX 78216  
Work Phone: +1 210 496 3200  
Home Phone: +1 210 684 2455  
Fax: +1 210 494 9987  
wmcginnis@ieee.org

Millard, David P.  
Georgia Tech Research Institute (GTRI)  
Georgia Institute of Technology  
Atlanta, Georgia 30332-0852  
Phone: +1 770 528 7600  
Fax: +1 770 528 3187  
david.millard@gtri.gatech.edu

Mohd, Maqsood A. Dr.  
Sverdrup Technology, Inc.  
TEAS Group  
Bldg. 260  
P.O. Box 1935  
Eglin Air Force Base, FL 32542  
Phone: +1 850 678 2001, x6115  
Fax: +1 850 729 6377  
mohammed@teas.elgin.af.mil

Mohr, Richard  
8 York Ct  
Northport, NY 11768  
Phone: +1 516 754 1142  
Fax: +1 516 754 1142  
rjmohr5@juno.com

Montrose, Mark I.  
Montrose Compliance Services, Inc.  
2353 Mission Glen Dr.  
Santa Clara, CA 95051-1214  
Phone and Fax: +1 408 247 5715  
mmontros@ix.netcom.com

O'Neil, Janet  
Lindgren RF Enclosures, Inc.  
22117 NE 10th Place  
Redmond, WA 98053  
Work Phone: +1 425 868 2558  
Fax: +1 425 868 0547  
j.n.oneil@ieee.org

Ott, Henry W  
Henry Ott Consultants  
48 Baker Rd  
Livingston NJ 07039  
Phone: +1 973 992 1793  
Fax: +1 973 533 1442  
hott@idt.net

Perini, Jose  
May-Sept Residence:  
34 Chardonway  
Ogdensburg, NY 13669-4221  
Phone: +1 315 393 4277  
Oct-April Residence:  
5207 South Atlantic Ave, Apt. 1221  
New Smyrna Beach, FL 32169-4558  
Phone: +1 904 426 5546  
jperini@syr.edu

Pettit, Ghety S.  
Intel Corporation DP2-303  
2800 Center Drive  
DuPont, WA 98327  
Phone: +1 253 371 5515  
Fax: +1 253 371 5690  
g.pettit@ieee.org

Podgorski, Dr Andrew  
332 Crestview Road  
Ottawa Ontario K1H 5G8 Canada  
Work Phone: +1 613 737 2026  
Home Phone: +1 613 737 6405  
Fax: +1 613 737 3098  
a.podgorski@ieee.org

Smith, Chester  
Harvey Consultants Inc  
2 Jonathan Lane  
Bedford MA 01730-1848  
Phone: +1 781 275 0598  
Fax: +1 781 280 0281

Smith, Douglas C.  
127 Wheeler Ave.  
Los Gatos, CA 95030-6246  
Phone: +1 408 356 4186  
Fax: +1 408 358 3799  
doug@dsmsmith.org

Svetanoff, Dale  
Sr. Electrical Engineer, EMC  
Rockwell Collins  
MS 106-183  
400 Collins Rd. NE  
Cedar Rapids, IA 52498  
Phone: +1 319 295 4928  
Fax: +1 319 295 0654  
dgsvetan@collins.rockwell.com

Sweeney, Donald L  
DLS Electronic Systems, Inc.  
1250 Peterson Dr  
Wheeling IL 60090  
Work Phone: +1 847 537 6400  
Home Phone: +1 847 724 3044  
Fax: +1 847 537 6488  
dsweeney@dlsemc.com

Traver, Dave  
Sony, M/S 5170  
16450 W Bernardo Dr  
San Diego CA 92127  
Phone: +1 858 942 2601  
Fax: +1 858 674 5967  
david.traver@am.sony.com

Ungvichian, Vichate  
Florida Atlantic University  
Electrical Engineering Dept.  
777 Glades Road  
Boca Raton, FL 33431  
Phone: +1 561 367 3465  
Fax: +1 561 367 2336  
ungvich@acc.fau.edu

Violette, J.L. Norman  
Violette Engineering Corp  
6927 Tyndale Street  
McLean, VA 22101  
Phone: +1 703 506 0528  
Fax: +1 703 506 0549  
enviolette@msn.com

Wallen, Barry  
Criterion Technology  
1350 County Road 16  
P.O. Box 387  
Rollinsville, CO 80474  
Phone: +1 303 682 6600  
Fax: +1 303 682 6610  
bwallen@criteriontech.com

*continued on page 30*





## Book Review

*Reviewed by Norm Violette, Associate Editor*

### Wireless Communications Design Handbook Aspects of Noise, Interference, and Environmental Concerns Volume II: Terrestrial and Mobile Interference

**Author: Reinaldo Perez**  
**Spacecraft Design**  
**Jet Propulsion Laboratory**  
**California Institute of Technology**  
**Academic Press, San Diego, CA 1998**

#### Introduction

This book is the second volume of a three-volume handbook series by the author titled: *Wireless Communications Design Handbook*. This five-chapter, 184-page Volume 2 is titled and addresses Terrestrial and Mobile Interference. Volume 1 of this series was reviewed in the EMC Society Newsletter, Summer 1999, Issue 182.

#### Chapter 1 - Base Stations, Mobile RF Communication Systems, and Antenna Interference

Mutual interference in today's telecommunication systems is considered directly related to the ITU frequency allocation. Types of potential mutual interference described among frequency sharing systems include: (1) interference between terrestrial stations; (2) interference between satellite-earth links; and (3) interference between terrestrial stations and earth stations.

Included among the factors that are linked to these interference situations are frequency spectra and planning, ground terminal location and positioning, transmitted signal power levels, antenna types (radiation patterns, gain, polarization, and orientation), satellite orbit utilization (such as low earth or geosynchronous orbit), propagation paths and spacing, and sharing of frequency bands. Technical means for protecting radio channels from interference are described. These techniques include means of interference cancellation.

Pager concepts, including pager loop antenna models and design techniques, are presented.

Basic cellular phone operation is described. Standards applicable to guide the design of cellular phones are identified and basic design techniques are described. The requirements for audio-to-cellular interface are presented. Analog and digital phone signal composition and processing, including basic TDMA architecture, are illustrated. Other topics addressed include coding and decoding, modulation techniques, filtering requirements, the effects of multipath phenomena, DSP applications, AD and DA conversions. Several illustrative figures are provided.

Antenna performance parameters and characterization for ground stations are described. The basic antenna parameter relationships between radiation patterns, gain, effective area, beamwidth, directivity, impedance, polarization, and beam area are summarized. Antennas considered suitable for use in wireless system base stations are described as falling into three basic groups: resonant, aperture, and phase array. The features of each group are described, including the parameters involved in antenna-to-antenna interference. Environmental factors in antenna selection are described. The performance of dipole arrays is analyzed and applications described.

Passive repeater technology for PCS systems is described. The objective is to provide adequate coverage in cell-based systems in handling the great number of new subscribers. The author describes how a passive repeater design could be placed in a covered zone to modify and shape the radiation pattern to reduce the losses due to multipath, diffraction, and shadow regions. The basic design, construction, and application of a device called a space lattice passive repeater (SLPR) are described and illustrated. The use of RF coaxial and optical distribution systems is also described.

IEEE MEMBER-GET-A-MEMBER CAMPAIGN

**EARN CREDIT**  
toward IEEE  
Products  
& Services!

## Spread the News!

**The time to be an IEEE member is NOW —**

and the best person to recruit new members for the IEEE is YOU! You already know the value of IEEE membership.

**Recruit a colleague to IEEE membership today — you may win a FREE membership for 2001!**

*For program information:*  
[www.ieee.org/mgm/](http://www.ieee.org/mgm/)

*For an IEEE member application:*  
Phone: 800-678-4333  
(US and Canada only)  
or 732-981-0060  
(worldwide)

Fax: 732-981-0225

Email: [new.membership@ieee.org](mailto:new.membership@ieee.org)

Internet:  
[www.ieee.org/join/](http://www.ieee.org/join/)

**WIN A FREE MEMBERSHIP**





The use of smart antennas is described to increase the coverage and capacity as well as signal quality. Basically, two kinds of smart antennas are described: switched beam and adaptive array systems. The capabilities and advantages of smart antennas over omnidirectional antennas are described including coverage of larger areas, lower transmitting power, and interference reduction such as reducing co-channel interference. Smart antennas are used in CDMA applications.

Propagation models are provided for simulating interference. The physical medium between antennas, referred to as the propagation channel, includes the different kinds of obstacles that could influence the propagation of electromagnetic waves such as mechanisms that can cause reflections, diffractions, and scattering. Models described include multipath interference, envelope fading, Doppler spread, time delay spread, path loss, co-channel and adjacent channel interference. The application of Rayleigh fading principles is presented.

## Chapter 2 - Space Environment Effects in Communications

The natural radio noise environment for frequencies up to 300 GHz is described including such noise sources as lightning, extraterrestrial sources, and atmospheric thermal emissions. Quantum noise and the effects of the ground on antenna temperature are considered. The concept of noise factor is defined. Relationships are presented tying noise power flux density, electric field strength, and effective antenna area.

The effects of temperature are discussed including defined distinctions between antenna temperature, sky noise temperature, and brightness temperature. Blackbody thermal radiation is briefly described. The characteristics are present-

ed of natural noise at the Earth's surface, atmospherics, and extraterrestrial noise.

The effects of the interaction of ions in the ionosphere and geomagnetic field lines are discussed. This section describes the variations of the quiet and disturbed plasmasphere and the impact on VLF whistlers and other wave propagation. Also, space storms, including solar activity (solar wind and sunspots), are described along with their effects on satellites.

## Chapter 3 - Electromagnetic Interference and Receiver Modeling (Non-average Power Sensitivity Receptor Modeling)

This Chapter provides detailed developments of the concepts of the applications of deterministic and stochastic waveforms as applied to receiver modeling. The details discuss waveform parameters of total energy, peak current (and voltage), and rise time. The discussion is in terms of the electromagnetic interference (EMI) margin for each of these parameters that preserve the important features of the average power margin. Interference models are developed for deterministic and stochastic waveforms.

## Chapter 4 - Nonlinear Interference Models

Detailed mathematical derivations are provided of several nonlinear models. The basis of these derivations is the modified nonlinear transfer function, which is discussed in great detail, with particular emphasis on its derivation from an approach based on the more general Volterra series. The mathematical theory of functionals and functional expansion (proposed by Vito Volterra in 1930) is presented in detail and used to develop the modified nonlinear transfer

function approach. Limitations of the approach are discussed, and the response of a weakly nonlinear system is developed for sinusoidal steady-state and two-tone sinusoidal inputs.

Receiver desensitization, gain compression and expansion, intermodulation, cross modulation, and spurious responses, are described. Included is a discussion of transmitter intermodulation products.

## Chapter 5 - Propagation Effects on Interference

This chapter describes interference problems that can arise between terrestrial systems, between terrestrial and space systems, and between space systems. Potential interference situations are described. The signal-to-noise and signal-to-interference ratios are defined and described. Communications over long distances and transhorizon propagation related to interference are presented, including the troposcatter propagation technique. The effects of ducting and rain scatter are discussed.

The analysis of the problem of interference to or from an earth station is described based on determining a coordination area surrounding the earth station. This approach is described in detail based on great circle propagation and for scattering by rain. Interference between space and surface stations is described and detailed procedures for interference analysis are presented.

A discussion is presented on the permissible level of interfering emissions. Other topics include link communications systems design (digital and analog systems), allocations of noise and signal-to-noise ratio, and diversity reception.

The end of the book includes a comprehensive list of references and an index.  
**EMC**

## Society Directors and Committee Chairs

*continued from page 28*

Whalen, James  
State University of New York  
Bonner Hall - Room 215B  
Buffalo, NY 14260 U.S.A.  
Phone: +1 716 645 2422, x1210  
Fax: +1 716 645 5964  
jjw@ubvms.cc.buffalo.edu

Williams, Kimball  
Eaton Corporation  
PO Box 766  
26201 Northwestern Hwy

Southfield MI 48037-0766  
Phone: +1 248 354 2845  
Fax: +1 248 208 2018  
k.williams@ieee.org

Yoshino, Takeo  
Fukui University of Technology  
The Radio Physics Research Lab  
2-36-22 Zempukuji, Suginamiku  
Tokyo, Japan, 1670041  
Phone and Fax: +81 3 3397 5577  
yoshinot@nisiq.net

You-Gang, Gao  
Beijing University  
Ports & Telecommunications  
Beijing 100088 China

*This directory is updated frequently.  
The most recent version is on the web at  
<http://www.emcs.org/chairs.html>.  
Please send all corrections to Todd Hubing  
at [t.hubing@ieee.org](mailto:t.hubing@ieee.org). **EMC***





## Personality Profile

*Bill Duff, Associate Editor*

Mark I. Montrose, has an unusual background that involves two paths. These paths bounced between becoming a professional musician and an electrical engineer.

His first significant exposure to engineering was when a high school teacher asked if he wanted to get an amateur radio license at age 16. This he achieved easily, progressing from Novice to Extra Class in the course of two years. His current call sign is K6WJ, having changed it from its original issue. He set up a radio shack in his bedroom with an ARC-5 crystal control transmitter and a BC-348 receiver. Every time he keyed the transmitter, the lights dimmed in the house and caused the TV to go into inverse video - a definite EMC effect. He had no knowledge about EMC at that time, except it was driving his family crazy. He also had no idea what he did to his neighbor's TVs.

While his interest in electronics was increasing, so was his music talent as a student. He became an accomplished musician playing tenor saxophone in both high school and college. He has performed in Carnegie Hall (New York), Constitution Hall (Washington D.C.), Royal Albert's Hall (London), plus other famous concert locations throughout Europe.

When it came time for college, he had to flip a coin between becoming a music major or electrical engineer. Engineering won.

For college, Mark selected California Polytechnic State University, San Luis Obispo. At Cal Poly, he double majored in Electrical Engineering and Computer Science, receiving two Bachelor of Science Degrees simultaneously in 1979. He spent two years as a co-op student working first at Mare Island Naval Air Station for six months and then 1-1/2 years at Vandenberg Air Force Base. While at Vandenberg, he was responsible as the primary design engineer for six modules used in a new control console for the Telemetry Integrated Processing System

(TIPS) to support dual unmanned satellite launches. This system replaced a patch-panel, Honeywell/RCA analog system that had to be manually configured for each launch.

After graduation, Mark moved to the Silicon Valley in Northern California and began work as a digital designer, including work in the field of product engineering. He earned a Masters Degree in Engineering Management from the University of Santa Clara in 1983.

In 1980 while at Zilog, the FCC had issued a Docket that mandated compliance with CFR 47, Part 15. As with most EMC engineers, he was assigned the task of FCC engineer, because when he acknowledged to management that he had an amateur radio license, and that he knew what the letters RF meant, "tag, your-it" occurred. This started his career within the field of regulatory compliance. His experience as a product engineer became valuable as he learned how to design systems and make them compatible with other assemblies and their operating environment, while performing FCC/VDE, UL, CSA and TÜV submittals.

After working at several other companies, he joined MIPS Computer Systems as principal compliance engineer, specializing in EMC. It was here that he was introduced to several world-class EMC consultants. These experts took the time to train and educate him in advanced EMC related to system design and PCB layout. This training set the stage for his current position as an independent EMC consultant in Santa Clara, California.

When Silicon Graphics purchased MIPS, Mark went independent, forming his own company where he is owner and principal consultant of Montrose Compliance Services, Inc. At MIPS, he recognized that there was little information available to the general engineering community regarding EMC and applied techniques. He started to document information that he learned from the

experts into a design manual. This manual ended up becoming a book, which was not the original intent of this project. The book, *Printed Circuit Board Design Techniques for EMC Compliance*, published by IEEE Press has become one of the all-time best sellers for the IEEE.



*Mark I. Montrose*

As his consulting business developed, Mark started teaching seminars and public workshops. He was professionally trained and received classroom accreditation by the State of California Council for Private Postsecondary and Vocational Education in Printed Circuit Board Technology. He is an adjunct professor for several private training schools. He also teaches in-house seminars privately for client companies in addition to public workshops around the world.

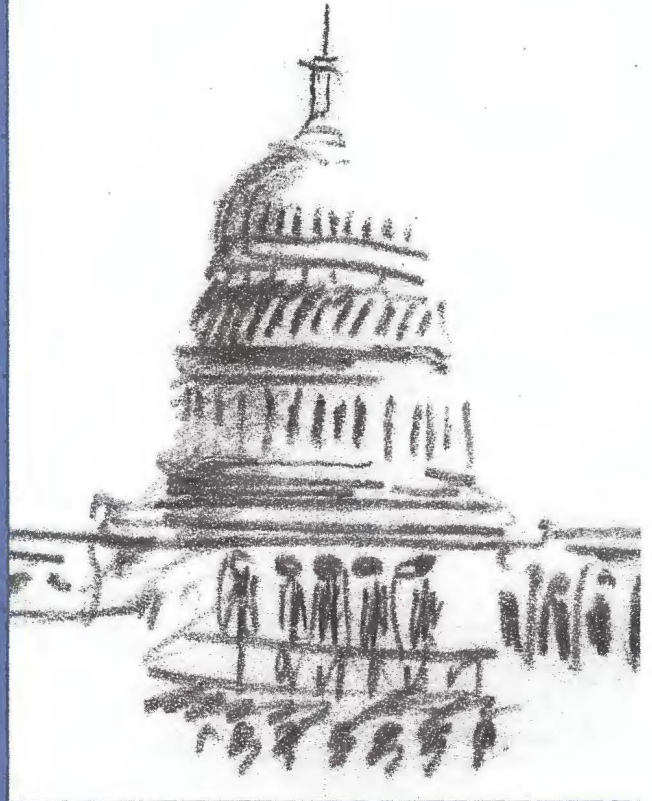
After becoming successful as a consultant and lecturer, he authored another specialty book *EMC and the Printed Circuit Board - Design Theory and Layout Made Simple*. He is also a contributing author for the *Electronics Packaging Handbook*, a joint publication of CRC and IEEE Press.

Currently, Mark is a senior member of the IEEE and sits on the Board of Directors for the EMC Society. In addition, he is a Distinguished Lecturer for the Society, a member of the dB Society, a member of TC-8, Electromagnetic Product Safety, and a life member of the American Radio Relay League (ARRL). In addition to his affiliation with the IEEE, he is assessed by a European Competent Body as a Test Laboratory to ISO Guide 25, performing in-situ testing of industrial products.

Mark is married with two children, an 11-year old boy and 14-year old daughter (another accomplished tenor saxophone player in the family). There are two items not related to EMC that Mark has an interest in: scouting and martial arts. He is still affiliated with the scouting program as an assistant scoutmaster for his son's troop. He enjoys monthly activities that include hiking, camping and backpacking. In regards to the martial arts that he is still active in today, Mark is black belt level in Shotokan Karate. **EMC**



# WHERE WILL YOU BE IN AUGUST, 2000?



Join your hosts, the IEEE EMC Society, as engineering professionals from all over the globe meet in Washington DC at the 2000 IEEE International Symposium to discuss the news and views on the World of EMC, the challenges facing the EMC engineer in the government, commercial and military arenas, trends in standards and regulations, changes affecting product and system design, new ideas and challenges for the decade ahead. The spectrum of challenges for EMC is changing, ensure you're a part of the future at the 2000 IEEE International Symposium on EMC.

- Keynotes and Perspectives on the Decade Ahead
- Exhibits, Exhibits, Exhibits
- Demonstrations
- Industry Networking and Socializing
- Great Sightseeing, Shopping and Scenery in the Nation's Capital

**Mark your calendar now for the  
2000 IEEE International Symposium  
on Electromagnetic Compatibility:  
*A Spectrum of EMC Challenges  
for the Next Millennium.***

**August 21 - 25, 2000**

**Washington Hilton, Washington, DC**

For more information contact:  
Technical Program - Larry Cohen  
202-404-7726, [cohen@radar.nrl.navy.mil](mailto:cohen@radar.nrl.navy.mil)  
Exhibits - Penny Caran  
804-897-5334, [pcaran@TechIntl.com](mailto:pcaran@TechIntl.com)  
Attendee Info - IEEE Conference Services  
800-810-4333, [d.catapano@ieee.org](mailto:d.catapano@ieee.org)

**[www.dcemc2000.org](http://www.dcemc2000.org)**







## Chairman's Message

by Dr. William G. Duff

### Highlights of the 2000 IEEE International Symposium on EMC in Washington, DC

As Chairman of the 2000 IEEE International Symposium on Electromagnetic Compatibility, and on behalf of the EMC Society, the Washington/Northern Virginia EMC Chapter and the Symposium Committee, I invite you to attend this special EMC event. The theme of the symposium is "A Spectrum of EMC Challenges for the Next Millennium." The symposium will highlight numerous EMC challenges that must be addressed in the future and will, hopefully, provide some solutions. The symposium will be held during the week of August 21-25, 2000 in Washington, DC at the Washington Hilton and Towers Hotel.

We plan to have a great technical program with thirty-six technical sessions featuring two hundred papers on the latest developments in EMC technology. There will be an open forum session where attendees can interact directly with the authors of selected papers. To take advantage of the unique opportunities that Washington, DC has to offer, we are planning to have six organized sessions that will address some of the specific "EMC Challenges" that the regulatory community and various government agencies will have to address in the new Millennium. The "EMC Challenges" sessions will be of particular interest to local government agencies and contractor personnel. These sessions may be attended by individuals with a limited registration (which is available at a significantly reduced fee). The limited registration will only provide admission to the "EMC Challenges" sessions. Tickets to Social Events or a Symposium Record may be purchased separately.

Exhibits of EMC products and services will supplement the technical program. Approximately two hundred exhibitors will participate in the symposium.

The latest developments in EMC technology will be on display and the exhibitors will be happy to describe how their products or services may help you with your EMI problems. Individuals that are interested in the "Exhibits Only" will be admitted for a nominal fee. I encourage you to visit the exhibit area and take advantage of the opportunity to learn about the latest in EMC products and services.

Our social program will begin on Tuesday evening with a reception at the Air and Space Museum - the most visited museum in the world! The Wednesday evening gala will include an Exhibitors Reception followed by a Moonlight Tour of the Washington Monuments. On Thursday, we will have the Awards Luncheon. These social events will provide an opportunity for attendees to interact informally.

I would like to thank the symposium committee, attendees, exhibitors, presenters, companions and volunteers that are involved in making this symposium a huge success.

EMC

### "EMC Challenges Sessions"

#### Presented at the 2000 IEEE International Symposium on EMC

The "EMC Challenges Sessions" will address some of the specific EMC issues that the regulatory community and various government agencies will have to address in the new Millennium. These sessions may be attended by individuals with a "Limited Registration" or a "Regular Registration."

#### Tuesday Morning

*"EMC Challenges" - Providing Spectrum for Use by the Private Sector*

Chairperson - Julius Knapp - Federal Communications Commission

- Meeting the Spectrum Needs for New Satellite Services
- Providing Spectrum for Third Generation Mobile Services
- Spectrum Requirements for Fixed Services
- The New Spectrum Management Paradigm - Auctions and Flexibility
- Government/Non - Government Spectrum Sharing
- Impact of New Technologies in Spectrum Management

#### Tuesday Afternoon

*"EMC Challenges" - Providing Spectrum for Use by the Federal Government*

Chairperson - TBD

- A Wireless World and New Spectrum Dependent Technology
- Federal Government Requirements for Spectrum
- How NTIA Will Meet the Challenges
- Optimum Utilization of the Spectrum - Spectrum Sharing
- Spread Spectrum Systems
- DSP and Error Detection and Correction Coding

#### Wednesday Morning

*"EMC Challenges" - E3 and Spectrum Support to the Warfighter*

Chairpersons - Bill Lenzi and Steve Caine - Joint Spectrum Center

- The Warfighter's Requirements for Spectrum
- How the JSC Will Meet these Requirements
- Incorporating E3/SC in Acquisitions
- Utilization of Ordinance in Future Joint Operations
- Standardizing Spectrum Information Systems
- Siting Mobile Service Providers on DOD Property

#### Wednesday Afternoon

*"EMC Challenges" - Dealing With EMI Problems in the Transportation Industry*

Chairperson Andy Drozd - Andro Consulting Services

- Intelligent Transportation Systems and Potential EMC Concerns
- Transient Protection of Transportation Equipment
- Aircraft Protection Requirements for High Intensity Radiated Fields
- Measurement Methods and Application of EMC Regulatory Limits to Government and Commercial Transportation Systems
- Spread Spectrum Communications and Control Systems in Modern Transportation and Traffic Control Applications
- Practical Techniques to Minimize EMI in Commercial Vehicles
- Space Transportation Systems Spectral - Orbital Congestion

#### Thursday Morning

*"EMC Challenges" - Using COTS Equipment for Military/Critical Applications*

Chairperson Dave Dixon - Naval Undersea Warfare Center

- The Guides EMC Specification/Platform Requirement Matrix and Some Navy COTS Issues
- Harmonization of Military and Commercial EMC Specifications
- The Difficulty in Comparing Military and Commercial EMC Standards
- Proliferation of EMC Standards
- A Comparison of Commercial and Military High Level EM Susceptibility Requirements

#### Thursday Afternoon

*"EMC Challenges" - Impact of EMC Metrology on Specifications and Standards*

Chairperson Dr. Motohisa Kanda - National Institute of Standards and Technology

- EM Shielding Measurement Methods and Techniques
- Application of EMC Measurement Methods and Techniques to Cables
- EMC Measurement Methods and Techniques for PCBs
- EMC Measurement Methodology for Lightning and ESD
- Radiation Hazard Measurements
- EMC Measurements and Modeling
- Neural Networks



# Board of Directors Activities

Washington, DC

November 19-20, 1999

## Call to Order

President Hoolihan called the November 19, 1999 meeting of the EMC Society Board of Directors to order at 9:00 am. A round of introductions was made. Board members present included H. Benitez, D. Bush, J. Butler, L. Carlson, T. Chesworth, A. Drozd, W. Duff, R. Ford, W. Gjertson, D. Heirman, D. Hoolihan, T. Hubing, E. Joffe, W. Kesselman, D. Millard, M. Montrose, J. O'Neil, H. Ott, G. Pettit, D. Smith, D. Sweeney, N. Violette, K. Williams and T. Yoshino. Board members absent were F. Mayer, W. McGinnis, and D. Traver. Several guests were also present.

The agenda was presented. Bill Gjertson was asked to report on the recent TAB meeting. Warren Kesselman was asked to report on the IEEE Millennium Awards. Discussion on the selling of IEEE Intellectual Property was added. The topic of an EMC BoD Administrator was added. The Survey Report was moved to "Unfinished Business." The Vice-Presidents were asked to present a short summary of their respective areas of responsibility. The agenda was approved with these additions.

## President's Report

President Hoolihan reported on the recent IEEE meetings in Salt Lake City. The Society review occurred at this meeting. Generally speaking, the review was very favorable for the EMC Society since membership growth has been steadily increasing, as has symposia attendance. Likewise, income from the symposia has remained strong. We continue to develop, update, and publish standards at an above average rate. The fastest growing membership regions are 8, 9 and 10. President Hoolihan shared some of the view graphs he presented for the formal review. The IEEE will issue a written report summarizing the review. Bill Gjertson reported on the IEEE Board of Directors meeting on November 12 in Salt Lake. He discussed the branding issues - the IEEE logo currently used will remain in place. The IEEE 2000 budget was approved; how-

ever, \$1.7 million in initiatives were defeated. Warren Kesselman summarized the Millennium Awards activity. The list of candidates and status of balloting was presented. These awards will be presented during the 2000 IEEE EMC Symposium in Washington, DC.

## Treasurer's Report

Treasurer Warren Kesselman presented his report. The year-end budget net for the EMC Society is expected to be \$100,000. Cash on hand as of September 30, 1999 was \$360,190 and the long-term investment value was \$693,920. Regarding the 2000 budget, the IEEE increased the surplus of \$38,000 by \$15,000 for a total 2000 budget surplus of \$53,000. Mr. Kesselman's report included a breakdown by line item of the 2000 EMC Society budget and a summary of IEEE activity since 1967 related to finances. Regarding the IEEE's new financial model, in the worst case scenario, Mr. Kesselman expects that the reserves of the EMC Society may be "taxed" by 3%.

## Secretary's Report

Janet O'Neil presented the minutes from the Board meeting held August 1 and 5, 1999 in Seattle, Washington. Two changes were required. The minutes were approved as amended.

## Membership Services Report

Todd Hubing, Vice-President for Membership Services, distributed his report. The Transactions Best Paper Award cash prize was increased from \$50 to \$1000 for the year 2000 and beyond. New chapters have been established in Melbourne, Florida and St. Petersburg, Russia. There will be an IEEE Chapters Coordinator meeting in New Orleans in February 2000. Henry Benitez will attend from the EMC Society. Regarding the Distinguished Lecturer (DL) program, there have been 21 DL presentations to date this year and at least three more are planned. Five of the 24 were in



*Board members Jose Perini (L) and Mark Montrose enjoyed the annual November Board dinner in Washington DC following the EMC Society Board of Directors meeting. This was Jose's first meeting as a newly elected Board member.*

Region 8 and three were in Region 10. Doug Smith and Werner Schaefer were approved as the new DL candidates for two-year terms, respectively, starting in the year 2000. Membership Chairman Andy Drozd advised that there are currently 5,189 members of the EMC Society. He is working with the Washington, DC Symposium committee to reserve two booths for the EMC Society. The membership booth display needs to be replaced and he is investigating projected costs. He is working with Elya Joffe to establish contacts in the Middle East to facilitate the 2003 Israel EMC Symposium. The new Region 8 membership chair is Elya Joffe and Jose Perini agreed to be the new Region 9 membership chair.

## Technical Services

Kimball Williams, Vice-President for Technical Services, reviewed the goals and objectives for Technical Services. Regarding the activities of the Education Committee, the University Grant RFP has been issued. The committee is coordinating with the Washington DC symposium committee for space for the tutorials and demonstrations. The line item budget for 2000-2003 was reviewed. There is a new chair, Ahmad Fallah, for the Student Design Contest Committee. They are mailing design kits to students now and the hope is to schedule the contest during the Washington DC symposium.



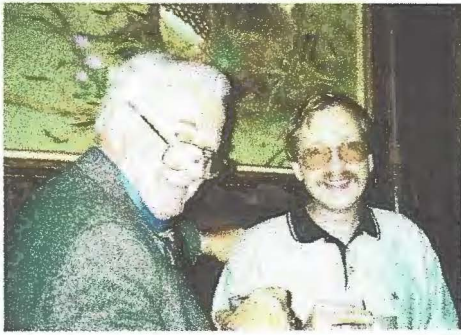


Photo by Janet O'Neil

*Veteran Board member Len Carlson (L) shared some "Board tips" with newly elected Board member Fred Heather at the annual Board dinner.*

Greg Schneider and Mike Hatfield have joined Andy Drozd on the Experiments Committee. Regarding video production, Dick Ford advised that he does not have the time to work with Empire Video for creating the video of the EMC demonstrations. However, the committee took a video of Clayton Paul performing a demonstration at the Seattle symposium. The Washington DC committee will use this to promote attendance at the symposium by distributing this to local universities and colleges. President Hoolihan requested that Kimball Williams investigate the IEEE's Nano Technology Committee and report on this at the next Board meeting. Andy Drozd reported on the recent ITS Council Symposium in Japan. It was well attended and posted a \$30,000 sur-



Photo by Janet O'Neil

*Current Board member Takeo Yoshino presented a welcoming toast to newly elected Board member Larry Cohen (L) at the annual Board dinner, a traditional event where newly elected members are "officially" introduced and outgoing members are sincerely thanked for their service.*

plus. Mr. Drozd recommends continuing the EMC Society's involvement in this Council. There will be a joint Representative Advisory Committee (RAC) luncheon scheduled with the SACCom during the Washington DC symposium. Three new membership organizations have been approached. RAC also wishes to connect with other EMC symposia and conferences worldwide. Dave Case, RAC Chair, will present a paper at the Biological Effects of EMC conference in Crete, Greece next year. In the absence of Technical Activities Committee (TAC) Chair Andrew Podgorski, Kimball Williams discussed the EMC symposia paper review process. Electronic review of the proposed symposia papers was discussed. The committee would like to review the papers 100% electronically.

### Standards Services

Don Heirman, Vice-President for Standards Services, presented his report. This included an organizational chart of the three committees reporting to Standards. The committee is working on development of their website with a hot link to the Society's website. The IEEE is providing the web site services. Regarding the SDCCom (Standards Development Committee), as a result of the elections held at the last meeting, Steve Berger is the new Chairman of the Standards Committee, Dave Traver is the new Vice-Chairman and Hugh Denny is the new Secretary. There are five active standards. Hugh Denny is the chairman of SETCom (Standards Education and Training Committee). This committee desires to enhance the awareness of the EMC standards process by conducting training seminars for working groups. They also want to educate the broader community to show how standards can be implemented. They are planning a Standards Development workshop for the Washington, DC symposium. IEEE Policies and Procedures will be reviewed. Guidelines for running and managing an effective working group will be provided. Finally, how to review and track an actual document will be presented. Bob Hofmann has stepped down as chairman of SACCom (Standards Advisory and Coordination Committee). A replacement is being sought. Volunteers interested in this



Photo by Dick Ford

*During the November Board meeting, a tour was led of the 2000 IEEE International Symposium on EMC hotel facilities by (L-R) Bill Duff, Symposium Steering Committee Chairman, Shannon Byrne, Conference Center Manager of the Washington Hilton and Towers, Larry Cohen, Symposium Committee Technical Program Chair, Dan Hoolihan, outgoing EMC Society President, and Joe Butler, incoming EMC Society President.*

position should contact Don Heirman at [d.heirman@worldnet.att.net](mailto:d.heirman@worldnet.att.net).

### Tour of Washington Hilton and Towers Hotel Facilities

Bill Duff, Chairman of the Washington, DC EMC Symposium, introduced Shannon Byrne, Conference Center Manager for the Hilton Hotel, to the Board. Together they showed the Board the areas of the hotel that will house the exhibits, where the demonstrations will be located, and where the technical sessions will be held. The Washington, DC EMC Symposium will be held at the Washington Hilton and Towers Hotel.

### Vice-President Reports

Each Vice-President gave a brief report on their respective activities for the benefit of the new members of the Board present at the meeting. It is expected that each new Board member will volunteer to work under one or more of the Vice-Presidents.

### Long Range Planning

Joe Butler, President-Elect, presented a report on Long-Range Planning. The Board then broke into four separate groups to formulate goals and objectives



for the next five years. Each breakout group focused on one of the four following topics: globalization, membership benefits, communications, and organization/governance. Mr. Butler also distributed a copy of the IEEE Strategic Plan as a reference document for the planning exercise.

The meeting then adjourned for the day at 5:00 pm.

*The Board reconvened and President Hoolihan called the November 20, 1999 meeting to order at 9:00 am.*

## Communication Services

Len Carlson, Vice-President for Communication Services, presented his report. This summarizes the recent Society review related to Periodicals, including the Transactions and Newsletter. Mark Montrose reported for Hugh Denny, chair of the IEEE Press committee. He advised that significant revenue has been raised. The Society's return on investment in the IEEE Press has been good. The books have generated \$30,000 in income with \$3,000 in expenses. Janet O'Neil, Editor, reported on the Newsletter. The budget for next year has been increased to cover the increasing page length as well as the increasing use of color for cover photos and graphs/figures that accompany some of the practical papers. Andy Drozd reported on the activities of the EMC Society web pages. He has reviewed the content and operating functions of several

EMC Society websites. The goal is to ensure each site works properly, has current and correct information, and projects a professional image for the EMC Society. Mr. Drozd acknowledged the efforts of David Southworth who has been very helpful in setting up and maintaining websites for various EMC Society committees. Mr. Drozd attended the recent IEEE web page education workshop held at IEEE headquarters. Approximately 18 Societies participated in the workshop. The issues addressed included web page development, policies and procedures, and special programs.

## Conference Services

Henry Ott, Vice-President for Conference Services, presented his report. He reviewed the financial surpluses realized at the various EMC symposia held annually since 1991. The average surplus of these symposia as a percentage of revenue is some 20%. The Denver 1998 Symposium committee was fined \$300 by the IEEE for not having their books closed within one year. Mr. Ott advised that the books need to be closed to avoid additional new fines. Treasurer Kesselman advised that the IEEE has implemented these fines due to pressure from the IRS. Bill Duff reported as chairman of the 2000 IEEE International Symposium on EMC in Washington, DC. Regarding the technical papers, 254 have been received and are being evaluated. 245 exhibit booths and 29 tables have been sold. Ads have been placed in various magazines and press releases have been issued. There will be no increase in registration fees from last year. The issue of single sponsors for symposium promotional opportunities was discussed. President Hoolihan asked the symposium committee chaired by Barry Wallen to address this issue.

## Unfinished Business

Dick Ford presented a report on the symposium survey. Overall the Seattle symposium received a good rating in terms of the presentation quality, hotel, registration, and social.

## New Business

Janet O'Neil presented a proposed policy for website advertising that was approved

as modified. Russ Carstensen, Executive Director of NARTE, presented a report on NARTE activities. NARTE is the only known entity that certifies individuals as competent EMC engineers. He would like to see the organization establish a formal relationship with the IEEE EMC Society. Most importantly, they would like to formally recognize the EMC Society as containing the body of knowledge defining EMC. He requested the assistance of four to five Board members to create a Memorandum of Understanding (MOU) to describe this relationship. The intent is to present the draft MOU to the Board

for approval at the March 2000 Board meeting. President Hoolihan requested that Kimball Williams, as Vice-President for Technical Services, form the task force to address this issue and present the draft MOU at the March meeting. Don Heirman, Dick Ford, Ghery Pettit, Tom Chesworth, Don Sweeney, Joe Butler, and Elya Joffe volunteered to be on this task force.

## By-Laws

Warren Kesselman recommended amending the by-laws to delete paragraph 12.2 "Typical Standing Committees." The Board agreed.

## Angel Program

Dick Ford suggested renaming the EMC Chapter "Angel" program the "Haislmaier Angel" program in memory of Robert Haislmaier, a longtime member of the Board. The Board agreed.



*During the November Board meeting, the EMC Chapter's popular "Angel Program" was officially renamed the "Haislmaier Angel Program" in honor of the late Robert Haislmaier, past member of the EMC Society Board of Directors and long-time champion of the EMC Chapters.*



Photo by Janet O'Neil

*Joe Butler, incoming President of the EMC Society (L), presented an engraved crystal clock to outgoing President Dan Hoolihan at the annual Board dinner. The Board gave Dan a round of applause for his leadership during his two years as President.*





Photo by Janet O'Neil

*Board members Don Bush (L) and Doug Smith enjoyed relaxing at the Board dinner following the two-day November Board meeting in Washington, DC.*

### EMCS Administrator

The Board renewed its contract with Warren Kesselman as the Society's part-time paid administrator for the year 2000.

### "War Stories" Special Session

Tom Chesworth advised that he will chair a special session entitled "War Stories" at the Washington DC, Symposium. Special

recognition prizes will be presented for the 1st and 2nd best war stories presented at the symposium. Todd Hubing accepted the action item from President Hoolihan to establish a task force to address this as an ongoing special session at each symposia, assign an official name to the committee, create the recognition and/or prize, etc.

### Board Meeting Schedule for 2000

Joe Butler reviewed the schedule of meetings for the year 2000. The new schedule of meetings will be distributed to the Board in the near future.

### Planning Committee

The four separate breakout groups reconvened to rank their respective goals and objectives. The leader of each group then reported out on the group's activities. Mr. Butler subsequently summarized this reporting.

### Action Item Review

Secretary O'Neil reviewed the status of open action items from previous meet-

ings and summarized the action items presented at the current meeting.

### President's Closing Remarks

President Hoolihan recognized and thanked the outgoing Board members, including those present Norm Violette, Dick Ford, Andy Drozd and Bill Gjertson. He also thanked the Board for their support over the last two years and voiced his support for the incoming new President of the EMC Society, Joe Butler. The gavel was then passed to Mr. Butler who acknowledged the fine leadership of the EMC Society by Mr. Hoolihan and presented him with a past President's pin.

Since there was no further business, the meeting adjourned at 4:45 pm.

Janet O'Neil  
Secretary,  
EMC Society Board of Directors  
EMC

## Call for BoD Nominations



**N**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, 2001. Attendance at the last meeting of the 2000 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 sum-

mary 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, 2000. 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 Typed Copy

III. SIGNATURES: (Minimum of 15 names.) We, the undersigned, all of whom are current IEEE Electromagnetic Compatibility Society (EMCS) members in good standing, nominate the above-mentioned person to serve on the EMCS BoD for a three-year term beginning January 1, 2001.

MEMBER'S NAME (PRINT)	SIGNATURE	MEMBERSHIP NUMBER
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____
7. _____	_____	_____
8. _____	_____	_____
9. _____	_____	_____
10. _____	_____	_____
11. _____	_____	_____
12. _____	_____	_____
13. _____	_____	_____
14. _____	_____	_____
15. _____	_____	_____





**IEEE**  
Networking the World™

# 2000 Membership Application

Please complete this application, typing or printing clearly in capital letters. Sign and return to:

## IEEE Admission and Advancement

445 Hoes Lane  
PO Box 459  
Piscataway, NJ USA 08855-0459

Telephone: 800-678-IEEE (4333)  
(US/Canada) or 732-981-0060 (worldwide)  
Fax: 732-981-0225  
Email: [new.membership@ieee.org](mailto:new.membership@ieee.org)

Please attach  
your business  
card here

Or complete the web application at: [www.ieee.org/join/](http://www.ieee.org/join/)

## 1 PERSONAL INFORMATION

Please provide all information requested; incomplete applications cannot be processed.

Enter your name as you wish it to appear on your membership card and all correspondence. Please circle your last/surname as a key identifier for the IEEE database. Do not exceed 40 characters or spaces per line. Please use English language characters and abbreviate as needed.

Title First/Given Name Middle Last/Family/Surname

### Home Address

Street Address

City State/Province

Postal Code Country

Home Phone

Date of Birth Day MONTH Year ☐ Male ☐ Female

Are you now or were you ever a member of the IEEE? ☐ Yes ☐ No If yes, please provide, if known:

MEMBERSHIP NUMBER

GRADE Year MEMBERSHIP EXPIRED

## 2 EDUCATIONAL INFORMATION

► A baccalaureate degree from any of IEEE's Reference List of Educational Programs assures assignment of "Member" grade. Information regarding your initial technical degree is vital to proper grade assignment.

**A** First Professional Degree Received Program/Course of Study

College/University Campus

State/Province Country Month/Year Received

**B** Highest Technical Degree Received Program/Course of Study

College/University Campus

State/Province Country Month/Year Received

## 3 BUSINESS/PROFESSIONAL INFORMATION

You may attach a resume to provide additional information for IEEE membership grade determination.

Company Name

Department/Division

Title/Position Years in Current Position

Years in the Profession Since Graduation ☐ PE/PEng State/Province

### Business Address

Street Address

City State/Province

Postal Code Country

Office Phone Office Fax

Email Address

Please send all IEEE mail to my: ☐ Home Address ☐ Business Address  
If not indicated, mail will be sent to home address.

To better serve our members and supplement member dues, the IEEE mailing list is released to other engineering and carefully selected organizations to provide you with information on technical products and services related to your profession. Please check box if you do not wish to have your name included. ☐

## 4 SIGNATURE OF APPLICANT

I hereby make application for IEEE membership and agree to be governed by the IEEE Constitution, Bylaws, and Code of Ethics.

SIGNATURE

DATE

► Application must be signed.

Over Please



## 5 AUDIT INFORMATION

This information is used by IEEE magazines to verify their annual circulation. Please refer to the audit codes and indicate your selections in the space provided.

A. What is your employer's primary line of business at your location? If you do not work for an employer, please identify your line of business.

1. Computers
2. Computer Peripheral Equipment
3. Software
4. Office and Business Machines
5. Test, Measurement and Instrumentation Equipment
6. Communications Systems & Equipment
7. Navigation & Guidance Systems & Equipment
8. Consumer Electronics/Appliances
9. Industrial Equipment, Controls & Systems
10. IC's & Microprocessors
11. Semiconductors, Components, Sub-Assemblies, Materials & Supplies
12. Aircraft, Missiles, Space & Ground Support Equipment
13. Oceanography & Support Equipment
14. Medical Electronic Equipment
15. Original Equipment Manufacturers Incorporating electronics in their end product (not elsewhere classified)
16. Independent & University Research, Test & Design Laboratories & Consultants (not connected with a uni. co.)
17. Government Agencies & Armed Forces
18. Companies Using &/or Incorporating any Electronic Products in their Manufacturing, Processing, Research or Development Activities
19. Telecommunications Services, Telephone (including cellular)
20. Broadcast Services (TV, Cable, Radio)
21. Transportation Services (Airlines, Railroad, etc.)
22. Computer/Communications & Data Processing Services
23. Power Production/Generation/Transmission & Distribution

24. Other commercial Users of Electrical/Electronic Equipment & Services (not elsewhere classified)
25. Distributor (Reseller, Wholesaler, Retailer)
26. University, College/Other Educational Institutions, Libraries
27. Other (please specify below)

B. What is your principal function?

1. General/Corporate Management
2. Engineering Management
3. Project Engineering Management
4. Research & Development Management
5. Design Engineering Management-Analog
6. Design Engineering Management-Digital
7. Research & Development Engineering
8. Design/Development Engineering-Analog
9. Design/Development Engineering-Digital
10. Hardware Engineering
11. Software Design/Development
12. Computer Science
13. Science/Physics/Mathematics
14. Engineering (not elsewhere specified)
15. Marketing/Sales & Purchasing
16. Consulting
17. Education/Teaching
18. Retired
19. Other (please specify below)

C. What is your principal responsibility?

1. Engineering or Scientific Management
2. Management other than Engineering
3. Engineering Design
4. Engineering
5. Software Science/Management/Engineering
6. Education/Teaching
7. Consulting
8. Other (please specify below)

D. What is your title?

1. Chairman of the Board/President/CEO
2. Owner/Partner
3. General Manager
4. VP Operations
5. VP Engineering/Div. Engineering
6. Chief Engineer/Chief Scientist
7. Engineering Management
8. Scientific Management
9. Member of Technical Staff
10. Design Engineering Manager
11. Design Engineer
12. Hardware Engineer
13. Software Engineer
14. Computer Scientist
15. Dean/Professor/Instructor
16. Consultant
17. Other Professional/Technical (please specify below)

## 6 2000 MEMBERSHIP RATES

IEEE member dues and regional assessments are based on where you live and when you apply. Please check the appropriate box. Membership is based on the calendar year from 1 January through 31 December. All prices are quoted in US dollars.

RESIDENCE	16 AUG 1999 - 29 FEB 2000 PAY FULL YEAR ONLY	1 MAR 2000 - 15 AUG 2000 PAY HALF YEAR ONLY
United States.....	\$113.00 <input type="checkbox"/>	\$56.50 <input type="checkbox"/>
Canada (includes GST)*.....	\$107.00 <input type="checkbox"/>	\$53.50 <input type="checkbox"/>
Canada (includes HST)*.....	\$114.00 <input type="checkbox"/>	\$57.00 <input type="checkbox"/>
Africa, Europe, Middle East.....	\$ 97.00 <input type="checkbox"/>	\$48.50 <input type="checkbox"/>
Latin America.....	\$ 90.00 <input type="checkbox"/>	\$45.00 <input type="checkbox"/>
Asia, Pacific.....	\$ 91.00 <input type="checkbox"/>	\$45.50 <input type="checkbox"/>
Proceedings of the IEEE.....	\$ 23.00 <input type="checkbox"/>	N/A <input type="checkbox"/>

\* IEEE Canadian Business No. 125634188

Subscriptions to IEEE Spectrum (\$11.50/year) and The Institute are included in membership dues.

## PAYMENT METHOD

You may pay for membership by:

- American Express, Visa, MasterCard, Diners Club, Eurocard
- Check - Payable to the IEEE on a bank in the USA or in acceptable local currency
- Bank Drafts/Money Orders - Payable on a bank in the USA or in acceptable local currency
- UNESKO Coupons
- Wire Transfer -  
To: First Union Bank, 530 Broad Street  
Newark, NJ 07102, USA  
ABA #031201467, Account #201130673841-6  
Add \$15.00 for bank fees  
Send bank verification and transfer number, confirming fund transfer, with this application.

Local Currency Payments

The local currencies accepted by IEEE (in the equivalent amount of US dollars) without additional fees or charges are: The Australian dollar, CFA franc, Deutsche mark, East Caribbean dollar, Euro, French franc, Swiss franc, Norwegian krone, pound sterling or yen, as well as the local currencies of these countries:

Argentina	Colombia	Indonesia	Mexico	Portugal
Austria	Cyprus	Ireland	Morocco	Singapore
Bahamas	Denmark	Italy	Netherlands	Solomon Is.
Belize	Dominican Republic	Jamaica	Netherlands	South Africa
Belgium	Finland	Kuwait	Antilles	Spain
Bermuda	Gibraltar	Luxembourg	New Guinea	Sweden
Bolivia	Greece	Malawi	New Zealand	Tanzania
Burundi	Guatemala	Malaysia	Panama	Thailand
Canada	Hong Kong	Maldives Rep.	Paraguay	Tunisia
Cayman Isl.	Iceland	Mauritius	Peru	Turkey
Chile			Philippines	Zambia

Minimum Income Provision

Applicants who certify that their prior year's income did not exceed US \$8,600 or equivalent are granted a 50% reduction in: full year dues, regional assessment and fees for one IEEE Society. Please submit written certification with application and payment. Student members are not eligible. ☐ I certify I earned less than \$8,600 (US dollars) in 1999.

Your bank may charge a significant additional fee to your account at the time of collection of funds.

## 8 PAYMENT AMOUNT

Please total the Membership dues from above and any Society dues from the side panel.

IEEE Membership Dues \$ \_\_\_\_\_

Society/Standards Assn. Membership dues (optional) \$ \_\_\_\_\_

Proceedings of the IEEE \$ \_\_\_\_\_

Canadian residents pay 7% GST or 15% HST  
Reg. no. 125634188 on Society payment(s) and publications only TAX \$ \_\_\_\_\_

Amount Paid TOTAL \$ \_\_\_\_\_

☐ Check ☐ VISA ☐ M/C ☐ E ☐ DISC ☐ AMERICAN EXPRESS

CHARGE CARD NUMBER \_\_\_\_\_

MONTH \_\_\_\_\_ YEAR \_\_\_\_\_

CARDHOLDER'S SIGNATURE \_\_\_\_\_  
(BILLING STATEMENT ADDRESS) USA ONLY

NAME AS IT APPEARS ON CARD \_\_\_\_\_

SIGNATURE \_\_\_\_\_

## 7 SOCIETY/STANDARDS ASSOCIATION INFORMATION

As an IEEE member, you are encouraged to join any Societies that support your technical/professional interests. Each Society membership includes a personal subscription to the core journal, magazine or newsletter of that Society. All prices are quoted in US dollars.

SOCIETIES	16 AUG 1999 - 29 FEB 2000 PAY FULL YEAR	1 MAR 2000 - 15 AUG 2000 PAY HALF YEAR
Aerospace and Electronic Systems	AES010 20.00 <input type="checkbox"/>	10.00 <input type="checkbox"/>
Antennas and Propagation	AP003 12.00 <input type="checkbox"/>	6.00 <input type="checkbox"/>
Broadcast Technology	BT002 15.00 <input type="checkbox"/>	8.00 <input type="checkbox"/>
Circuits and Systems	CAS004 7.00 <input type="checkbox"/>	4.00 <input type="checkbox"/>
Communications	COM019 23.00 <input type="checkbox"/>	12.00 <input type="checkbox"/>
Components, Packaging, and Manufacturing Technology	CPMT021 10.00 <input type="checkbox"/>	5.00 <input type="checkbox"/>
Computer*	CO16 33.00 <input type="checkbox"/>	17.00 <input type="checkbox"/>
Consumer Electronics	CE008 22.00 <input type="checkbox"/>	11.00 <input type="checkbox"/>
Control Systems	CS023 15.00 <input type="checkbox"/>	8.00 <input type="checkbox"/>
Dielectrics and Electrical Insulation	DEI032 15.00 <input type="checkbox"/>	8.00 <input type="checkbox"/>
Education	ED25 15.00 <input type="checkbox"/>	8.00 <input type="checkbox"/>
Electromagnetic Compatibility	EMC027 15.00 <input type="checkbox"/>	8.00 <input type="checkbox"/>
Electron Devices**	ED015 5.00 <input type="checkbox"/>	3.00 <input type="checkbox"/>
Engineering Management	EM014 28.00 <input type="checkbox"/>	14.00 <input type="checkbox"/>
Engineering in Medicine and Biology	EMB018 26.00 <input type="checkbox"/>	13.00 <input type="checkbox"/>
Geoscience and Remote Sensing	GRS029 34.00 <input type="checkbox"/>	17.00 <input type="checkbox"/>
Industrial Electronics	IE013 20.00 <input type="checkbox"/>	10.00 <input type="checkbox"/>
Industry Applications	IA034 17.00 <input type="checkbox"/>	9.00 <input type="checkbox"/>
Information Theory	IT012 15.00 <input type="checkbox"/>	8.00 <input type="checkbox"/>
Instrumentation and Measurement	IM009 18.00 <input type="checkbox"/>	9.00 <input type="checkbox"/>
Lasers and Electro-Optics	LEO036 18.00 <input type="checkbox"/>	9.00 <input type="checkbox"/>
Magnetics	MAG033 30.00 <input type="checkbox"/>	15.00 <input type="checkbox"/>
Microwave Theory and Techniques***	MTT017 8.00 <input type="checkbox"/>	4.00 <input type="checkbox"/>
Nuclear and Plasma Sciences	NPS005 15.00 <input type="checkbox"/>	8.00 <input type="checkbox"/>
Oceanic Engineering	OEO22 12.00 <input type="checkbox"/>	6.00 <input type="checkbox"/>
Power Electronics****	PELO35 5.00 <input type="checkbox"/>	3.00 <input type="checkbox"/>
Power Engineering	PE031 22.00 <input type="checkbox"/>	11.00 <input type="checkbox"/>
Professional Communication	PC026 22.00 <input type="checkbox"/>	11.00 <input type="checkbox"/>
Reliability	RL007 25.00 <input type="checkbox"/>	13.00 <input type="checkbox"/>
Robotics and Automation	RA024 20.00 <input type="checkbox"/>	10.00 <input type="checkbox"/>
Signal Processing	SP001 20.00 <input type="checkbox"/>	10.00 <input type="checkbox"/>
Social Implications of Technology	SIT030 22.00 <input type="checkbox"/>	11.00 <input type="checkbox"/>
Solid-State Circuits	SSC037 14.00 <input type="checkbox"/>	7.00 <input type="checkbox"/>
Systems, Man, and Cybernetics	SMC028 9.00 <input type="checkbox"/>	5.00 <input type="checkbox"/>
Ultrasonics, Ferroelectrics, and Frequency Control	UFFC020 15.00 <input type="checkbox"/>	8.00 <input type="checkbox"/>
Vehicular Technology	VT006 15.00 <input type="checkbox"/>	8.00 <input type="checkbox"/>

\*If you are currently an ACM member and wish to join the Computer Society, you may deduct \$5.00 from your full year dues, or \$2.50 from your half year dues.

\*\*Pay \$25.00 for "permanent" EDS membership.

\*\*\*Pay \$40.00 for "permanent" MTT membership.

\*\*\*\*Pay \$40.00 for "permanent" PEL membership.

IEEE Standards Association IEEE-SA 10.00 ☐ N/A

TRACKING CODE

110355

PROMO CODE

REPOM2K

Member-Get-A-Member Recruiters: For MGM credit, please complete at time of application.

MEMBER RECRUITER NAME \_\_\_\_\_

IEEE RECRUITER'S MEMBER NUMBER (required for MGM) \_\_\_\_\_





# 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.hunter@ieee.com*

Sha Fei, EMC Research Section, Northern Jiatong University, Beijing, China

*emclab@center.njtu.edu.cn*

Ferdy Mayer, L.E.A.D., Maisons, Alfort France

*FerdyMayerLEADFrance@compuserve.com*

Maria Sabrina Sarto, Department of Electrical Engineering, University of Rome, Italy

*sarto@elettrica.ing.uniroma1.it*

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

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

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

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

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

**EMCABS: 01-2-2000**

#### A ZERO-CURRENT-SWITCHING PWM FLYBACK CONVERTER WITH A SIMPLE AUXILIARY SWITCH

H. S-H Chung+, S.Y.(Ron) Hui + and W-H Wang++

+Dept. of Electronic Engineering, City University of Hong Kong, Hong Kong, ++Dept. of E.S., University of Sydney, Sydney, Australia.

IEEE Transactions on Power Electronics, March 1999, pp. 329-342.

**Abstract:** It is well known that Switch Mode Power Supplies (SMPS) that use "soft switching" generate less conducted emissions than the "hard switched" units. A simple modification, an auxiliary winding, a switch and a small capacitor, converts a conventional isolated flyback PWM circuit to a ZCS (Zero-Current Switching) circuit with several advantages, including reduced conducted emissions. The analysis in the paper is complemented with measured data on a multi-output 80 W circuit. A simplified design procedure is shown by an example.

**Index terms:** Conducted emission reduction, soft-switching flyback SMPS

**EMCABS: 02-2-2000**

#### A STUDY ON THE OPTIMIZATION OF A 60 GHz WIRELESS LAN INSTALLATION ENVIRONMENT

Tomoya KUBO, Masafumi KIMURA and Risaburo SATO, Electromagnetic Compatibility Research Laboratories Co., Ltd., 6-6-3, Minami-Yoshinari, Aoba-ku, Sendai, 989-3204 Japan

Proceedings of 1999 Asia Pacific Microwave Conference, Singapore, November 30 – December 3, pp.178-181

**Abstract:** This paper describes the conditions for placing electromagnetic absorbers to control the delay waves appearing in a 60 GHz band wireless LAN installation environment. It was found that absorbers located at the reflection points of the waves, which were calculated using a ray-tracing method simulation, could suppress the delay waves effectively, and the level of delay waves could be controlled by the size of the absorber.

**Index terms:** Wireless LAN, absorber location, ray-tracing method, computer simulation

**EMCABS: 03-2-2000**

#### CALCULATION OF LOAD EFFECT PRODUCED BY FERRITE CORE ATTACHED TO WIRE ABOVE A GROUND PLANE

Al Zaher Samir and Osamu Fujiwara, Faculty of Engineering, Nagoya Institute of Technology, Showa-ku, Gokiso-cho, Nagoya 466-8555 Japan, Phone: +81-52-735-5421, Fax: +81-52-735-5442, E-mail: fujiwara@odin.elcom.nitech.ac.jp

Proceedings of 1999 Asia Pacific Microwave Conference, Singapore, November 30 – December 3, pp.182-185

**Abstract:** Ferrite cores are commonly attached to a cable/wire to reduce the electromagnetic noise emission from digital information equipment. In this paper, an equivalent circuit for the load effect produced by a ferrite core attached to a wire above a ground plane was considered. A practical method for determining the equivalent circuit parameters was presented, and the resultant load effect was calculated. The validity was confirmed by measurements of scattering transmission parameters for the wire with attachment of a commercially available ferrite core above a ground plane.

**Index terms:** Wire above a ground, ferrite core, load effect, equivalent circuit

**EMCABS: 04-2-2000**

#### RISE TIME EFFECTS ON CROSSTALK IN HIGH-SPEED MICROSTRIP TRANSMISSION LINES

Settapon Malisuwat and Vichate Ungvichian, Chulachomklao Royal Military Department of Electrical Engineering Academy, Nakhon-Nayok, Thailand, Department of Electrical Engineering EMI R&D LAB, Florida Atlantic University, Boca Raton, Florida, USA

Proceedings of 1999 Asia Pacific Microwave Conference, Singapore, November 30 – December 3, pp.202-205

**Abstract:** Effects of a high-speed pulse with rise time (quadratic-linear-quadratic transition) on crosstalk along microstrip transmission lines are investigated. Closed form analysis equations for coupled microstrip lines have been used to calculate the crosstalk transfer function. The substrate loss, line loss, line thickness correction factor, and cover plate correction factor are included in the calculation. The simple closed form expressions of crosstalk in this paper are given in a form such that they can be implemented easily on a desktop computer or a programmable pocket calculator.

**Index terms:** Microstrip lines, rise time, crosstalk, closed form analysis

**EMCABS: 05-2-2000**

#### MEASUREMENT FOR ELECTROMAGNETIC SUSCEPTIBILITY OF THE ELECTRONIC MEDICAL EQUIPMENT

Han-Kil Bae and Jong-Heon Kim, Dept. of Radio Sci. and Engr., Kwangwoon Univ., 477-1 Wolgye-dong, Nowon-ku, Seoul 139-701, Korea

E-mail: ihkim@daisy.kwangwoon.ac.kr



**Abstract:** In this paper, the electromagnetic immunity of electronic medical equipment was tested by employing a standard test method for medical equipment. In addition, the electromagnetic interference to the medical equipment caused by two different types of portable transceivers have been studied. In this study, 20 medical equipments of 14 different types were investigated. There are a patient monitor, an infusion pump, a neonatal incubator and so on. In the case of the EMS test, interferences were detected for seven medical products of four different types (53.3%) such as the patient monitor. For the two portable transceivers, 16 medical equipments of 11 different models (80%) were affected. The experiment results show that the malfunction of the electronic medical equipments is dependent upon the frequency range and the electric field strength of the mobile phones.

**Index terms:** Medical equipment, portable transceiver, malfunction, electromagnetic immunity test

---

EMCABS: 06-2-2000

**FORMATION OF HOT SPOTS IN THE HUMAN EYE FOR PLANE WAVE EXPOSURES**

A. Hirata, G. Ushio, and T. Shiozawa, Department of Communication Engineering, Osaka University, Yamaoka-2-1, Suita-shi, Osaka, 565-0871, Japan  
Proceedings of 1999 Asia Pacific Microwave Conference, Singapore, November 30 – December 3, pp.477-480

**Abstract:** The interaction between the human eye and EM waves in the hot spot frequency range is investigated with the aid of the FDTD method. Numerical results show that hot spots appear in a certain frequency range, and the location and number of hot spots depend upon the frequencies of the incident wave. In particular, hot spot formation is found to be mainly caused by the resonance due to the geometrical structure of the eye. Additionally, temperature rises in the human eye are calculated to assess the possibilities of microwave-induced cataract formation. The numerical estimate shows that the EM wave with the power density  $22 \text{ mW/cm}^2$  induces a temperature rise of 3.0 degrees centigrade, the threshold temperature rise for cataract formation.

**Index terms:** Human eye, electromagnetic wave exposure, FDTD method, temperature rise, hot spot formation

---

EMCABS: 07-2-2000

**DEPENDENCE ON ANTENNA OUTPUT POWER OF TEMPERATURE RISE IN HUMAN HEAD FOR PORTABLE TELEPHONES**

Jianqing Wang, Takahiro Joukou and Osamu Fujiwara, Department of Electrical and Computer Engineering, Nagoya Institute of Technology Gokiso-cho, Showa-ku, Nagoya 466-8555, Japan, E-mail: wang@odin.elcom.nitech.ac.jp  
Proceedings of 1999 Asia Pacific Microwave Conference, Singapore, November 30 – December 3, pp.481-484

**Abstract:** Since biological hazards due to RF exposure are caused mainly by a temperature rise in tissue, the localized specific absorption rate (SAR) should be related to the temperature rise in the human head for portable telephones. Although the SAR is known to be directly proportional to the antenna output power of portable telephones, the dependence of temperature rise on the antenna output power remains unclear. In this paper, the relationship between the peak temperature rise in a human head and the antenna output power is investigated by using the finite-difference time-domain (FDTD) method. It is found that the peak temperature rise is approximately proportional to the antenna output power below 1 W and also that the peak temperature rise in the brain can be estimated from its blood-flow and heating potential.

**Index terms:** Portable telephone, human head, FDTD method, antenna input power, SAR, temperature rise

---

EMCABS: 08-2-2000

**SAR INDUCED IN A MULTILAYERED SPHEROIDAL HEAD MODEL BY THE EM FIELDS IRRADIATED FROM A CELLULAR PHONE**

X.K. Kang, L.W. Li, M.S. Leong, P.S. Kooi and T.S. Yeo, Communications & Microwave Division, Department of Electrical Engineering, National University of Singapore, 10 Kent Ridge Crescent, Singapore 119260.  
Proceedings of 1999 Asia Pacific Microwave Conference, Singapore, November 30 – December 3, pp.485-488

**Abstract:** The recent development of cellular phones has resulted in an increasing public concern about the biological effects of electromagnetic (EM) fields on the human head. This paper presents the computation of the specific absorption rate (SAR) distribution inside a multilayered prolate spheroidal model of human head exposed to a GSM dipole, using spheroidal vector wave functions.

**Index terms:** Cellular phone, multilayered spheroidal head model, SAR, theoretical analysis

---

**CALCULATION OF CURRENT IN A HUMAN MODEL INDUCED BY LOW FREQUENCY MAGNETIC FIELD**

Boonchai Techaumnat, Shoji Hamada and Tadasu Takuma, Kyoto University, Kyoto EMC-Japan meeting at Kyodai-Kaikan, Kyoto, December 3, 1999, EMC-99-1

**Abstract:** The paper describes the calculation result of induced current in a human model due to a 50 Hz uniform magnetic field. The calculation method is the boundary element method using a human model composed of the second order curved elements. Maximum current density was calculated at each z-plane in the human model. The overall maximum induced current was determined for the magnetic field in the horizontal direction from back to front and in the vertical direction. In the case of the horizontal magnetic field, five internal organs were simulated with ellipsoids and their maximum induced current was calculated.

**Index terms:** Numerical calculation, boundary element method, ELF magnetic field, human model, induced current

---

EMCABS: 10-2-2000

**TEST METHOD OF ELF MAGNETIC SHIELDING EFFECTIVENESS USING MAGNETIC FIELD EXPOSURE METER**

Kenichi Yamazaki+, Hideaki Yazaki++, Hiroyuki Satake+++ and Yasuo Okazaki+++  
+ Central Research Institute of Electric Power Industry, ++ Tokyo University of Agriculture and Technology, +++ Gifu University  
EMC-Japan meeting at Kyodai-Kaikan, Kyoto, December 3, 1999, EMC-99-2

**Abstract:** A new test method for evaluation of ELF (extremely low frequency) magnetic shielding effectiveness was proposed. A cubic shielding box without any apertures and a magnetic field exposure meter, which contains a data storage function and placed in the center of the box, were used to characterize shielding effectiveness of several shielding materials. A procedure, an experimental setup and data formats of the proposed method are shown.

**Index terms:** ELF magnetic field, magnetic shielding, magnetic field exposure meter

---

EMCABS: 11-2-2000

**ELF MAGNETIC FIELD MITIGATION NEAR ELECTRIC POWER LINES USING AUXILIARY CONDUCTOR LOOP**

Hideaki Yazaki+, Yuzo Takahashi+, Kenichi Yamazaki++ and Tadashi Kawamoto++  
+ Tokyo University of Agriculture and Technology, ++ Central Research Institute of Power Industry  
EMC-Japan meeting at Kyodai-Kaikan, Kyoto, December 3, 1999, EMC-99-3

**Abstract:** Some investigations regarding ELF (extremely low frequency) magnetic field mitigation for the overhead power line were conducted. We focused on a mitigation method using an auxiliary conductor loop installed near the phase conductors. In this paper, the effect of the existence of conductor sag was investigated, for both passive and active loop methods. In addition, the concept of the current dipole moment was rewritten by a simple formula and some optimal conductor arrangements for effective active loop mitigation were shown.

**Index terms:** ELF magnetic field, passive loop, active loop, current dipole moment, conductor sag

---

EMCABS: 12-2-2000

**STUDY ON A LOCATING SYSTEM OF A PARTIAL DISCHARGE OCCURRENCE POSITION FOR POWER DISTRIBUTION LINE**

Hiroyuki Okamura+, Takamu Genji+, Makoto Kawasaki++ and Kiyoshi Oku+++  
+ The Kansai Electric Power Co., Inc., ++ Kansai Tech Co., Inc.  
EMC-Japan meeting at Kyodai-Kaikan, Kyoto, December 3, 1999, EMC-99-6

**Abstract:** Equipment trouble may be caused by the partial discharge phenomenon that has its root in deteriorated insulation or contact. Besides the partial discharge pulse may generate an obstruction on television screen in area of low electric field strength. Under present condition we have to inquire poles one by one to specify that source. Since it is very inefficient, we developed the system mounted on a car, which analyze phase difference of pulse signals from partial discharge by receiving the signal on four antennas. The system can locate a partial discharge occurrence position in a short time. In this paper, the causes of location deviation in process with development of this system are reported.

**Index terms:** Partial discharge pulse, spatial phase difference method, antenna, global positioning system



# Calendar

## EMC Related Conferences & Symposia

### 2000

#### May 3-7

Co-Sponsored by the IEEE  
Communications Society  
SECOND ASIA-PACIFIC  
CONFERENCE ON  
ENVIRONMENTAL  
EMC -CEEM '2000  
Shanghai, China  
Prof. Gao Yougang  
Fax: +86.10.6606.9587  
Phone: +86.10.6228.2343  
e-mail: [lisf@bupt.edu.cn](mailto:lisf@bupt.edu.cn)

#### May 9

Sponsored by the Southeastern  
Michigan EMC Chapter  
(see ad on page 13)  
EMC FEST 2000: A COLLOQUIUM  
AND EXHIBITION ON LOW COST,  
EASY TO USE, EMC DEVELOP-  
MENT TEST METHODS  
With Henry Ott and Doug Smith  
The Dearborn Inn, Dearborn, MI  
Kimball Williams, 248.354.2845  
[k.williams@ieee.org](mailto:k.williams@ieee.org)

#### May 14-19

CONFERENCE ON PRECISION  
ELECTROMAGNETIC MEASURE-  
MENTS (CPEM - 2000)  
Technical Forum and Trade Exhibition  
Sydney Hilton, Australia  
Barry Inglis, Conference Chairman  
[cpem2000@tourbosts.com.au](mailto:cpem2000@tourbosts.com.au)  
<http://www.tourbosts.com.au/cpem2000>

#### May 17-19

Sponsored in Cooperation with the  
German Section of the IEEE Computer  
Society  
4th IEEE WORKSHOP ON SIGNAL  
PROPAGATION ON  
INTERCONNECTS  
Parkhotel Herrenkrug,  
Magdeburg, Germany  
<http://www.tet.uni-hannover.de/SPI>

#### May 22-23

Sponsored by the Chicago  
EMC Chapter  
Y2K CHICAGO EMC  
MINI-CONFERENCE  
Holiday Inn, Itasca, IL  
Frank Krozel, 630.924.1600  
[www.ewh.ieee.org/soc/emcs/chicago](http://www.ewh.ieee.org/soc/emcs/chicago)

#### May 22-23

Sponsored by the Università di  
Cagliari and European Union COST  
Action 261  
CAGLIARI EMC WORKSHOP 2000  
UE COST 261 WORKSHOP ON  
COMPUTATIONAL ELECTROMAG-  
NETICS FOR COMPLEX AND DIS-  
TRIBUTED SYSTEMS (in English)  
Plus "A Premise on Electromagnetic  
Pollution" (in Italian) on May 20  
Prof. Maurizio Migliaccio  
Fax: +39.070.6755900  
Phone: +39.070.6755871  
e-mail: [migliaccio@diee.unica.it](mailto:migliaccio@diee.unica.it)  
[www.diee.unica.it/cost261.html](http://www.diee.unica.it/cost261.html)

#### July 5-14

PROGRESS IN ELECTROMAGNET-  
ICS RESEARCH SYMPOSIUM  
(PIERS 2000)  
Royal Sonesta Hotel  
Cambridge, MA  
Hsiu C. Han  
515.294.5320  
<http://www.piers.org/piers2k>

#### September 11-15

EUROPEAN EMC SYMPOSIUM  
(formerly EMC ROMA)  
Brugge, Belgium  
Prof. Johan Catrysse  
Fax: (059) 70.42.15  
e-mail: [johan.catrysse@kb.khbo.be](mailto:johan.catrysse@kb.khbo.be)

#### October 23

Sponsored by the Eastern North  
Carolina EMC Chapter  
A ONE DAY EXHIBITION AND  
TUTORIAL ON "THE  
FUNDAMENTALS OF EMC"  
by Dr. Clayton R. Paul  
The Radisson Governors Inn  
Research Triangle Park, NC  
Jim Marley, 919.549.1408  
[james.r.marley@us.ii.com](mailto:james.r.marley@us.ii.com)

## EMCS Cooperating Symposia

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

## EMCS Symposia Schedule

- 2000 Washington, DC  
August 21-25  
Washington Hilton  
Bill Duff  
703.914.8450
- 2001 Montreal, Canada  
Montreal Convention Center  
Christian Dube  
514.653.6674
- 2002 Minneapolis/St. Paul  
Hyatt Regency, Minneapolis  
Dan Hoolihan  
651.213.0966  
E-Mail: [d.hoolihan@ieee.org](mailto: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  
Bob Hofmann  
630.979.3627

## IEEE EMC Society Board of Directors Meetings

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

March 24, 2000  
Phoenix, Arizona

June 9, 2000  
Montreal, Canada

August 20 and 24, 2000  
Washington DC

November 16, 2000  
Tampa Bay, Florida



# Institutional Listings

The IEEE Electromagnetic Compatibility Society is grateful for the assistance given by the firms listed below and invites application for Institutional Listings from other firms interested in the electromagnetic compatibility field.

## AMPLIFIER RESEARCH

160 School House Road, Souderton, PA 18964-9990 USA Telephone (215) 723-8181 Fax (215) 723-5688 Website: [www.ar-amps.com](http://www.ar-amps.com)

Broadband RF power amplifiers, 1 W to 50 kW, dc to 40 GHz; Antennas and accessories for RF susceptibility testing; broadband E-field monitors and interference generators for IEC automotive and telecom applications.

## ARA

11317 Frederick Avenue, Beltsville, MD 20705-2088

Telephone (781) 937-8888 Fax (781) 932-9359 e-mail: [emc@ara-inc.com](mailto:emc@ara-inc.com)  
Website: <http://www.ara-inc.com>

Innovative products and solutions for pre-compliance and compliance EMC testing including EMC test equipment (emission/immunity, GTEM...), Individually Calibrated Antennas, Sensors and Accessories (masts, turntables, LISNs...)

## CKC LABORATORIES, INC.

Seven Locations in California, Oregon, and Washington

Toll Free (800) 500-4EMC Fax (209) 742-6133 e-mail: [ckclabs@ckc.com](mailto:ckclabs@ckc.com)  
Global EMC and Safety compliance testing, design consultation and seminar services, DAR EN45001 and A2LA Accredited. Visit our Website at <http://www.ckc.com>

## EMC TEST SYSTEMS (ETS)

2205 Kramer Lane, Austin, TX 78758

Telephone (512) 835-4684 Fax (512) 835-4729 e-mail: [info@emctest.com](mailto:info@emctest.com)  
Website: <http://www.emctest.com>

Absorber, Antennas, Anechoic Chambers, Broadband E-field Probes, Current Clamps, GTEM cells, LISNs, RF Shielded Doors, Shielded Rooms, Towers, Turntables and much more.

## FAIR-RITE PRODUCTS CORP.

P. O. Box J, One Commercial Row, Wallkill, NY 12589 Toll Free: (888) 324-7748 Telephone (914) 895-2055 Fax (914) 895-2629

e-mail: [ferrites@fair-rite.com](mailto:ferrites@fair-rite.com) Website: <http://www.fair-rite.com>  
Ferrite Cores for EMI Suppression, Multilayer Chip Beads, Surface Mount Beads, Connector Suppressor Cores and Tile Absorbers.

## LEHMAN CHAMBERS

5800 Cumberland Hwy., Chambersburg, PA 17201 Telephone (717) 264-2265 Fax (717) 264-9178 Website: [www.lehman-inc.com](http://www.lehman-inc.com)

Design and Build of Anechoic Chambers; Chamber Retrofits; Chamber Relocations; RF Shielded Enclosures, RF Shielded Doors and Components, RF Absorbers

## LINDGREN RF ENCLOSURES, INC.

400 High Grove Blvd., Glendale Heights, IL 60139

Telephone (630) 307-7200 Fax (630) 307-7571 e-mail: [lrfe@interserv.com](mailto:lrfe@interserv.com)  
Website: [www.LindgrenRF.com](http://www.LindgrenRF.com)

EMI/RFI Shielded Rooms; RF Shielded Doors and Components; Anechoic Chambers and Absorber Materials; High Performance Power, Signal, Data and Telecomm Line Filters from ELMAG Division (561) 881-9292

## PATTON & ASSOCIATES

82 Wildwood Drive, Prescott, AZ 86301-5093

Telephone (520) 771-2900 Fax (520) 771-2990  
e-mail: [patton@patton-assoc.com](mailto:patton@patton-assoc.com) Website: <http://www.patton-assoc.com/>  
Telecommunications Consulting, Design and Type Approval for Europe, North America and the Pacific Rim

## SCHAFFNER EMC, INC.

9B Fadem Road, Springfield, NJ 07081

Telephone (973) 379-7778 or (800) 367-5566 Fax (973) 379-1151  
<http://www.schaffner.com>

EMC Filters, EMC Immunity Test Instruments, Automatic Test Systems for EMC and Power Supply Testing

## TEXAS SPECTRUM ELECTRONICS, INC.

9110 Autobahn Dr., Dallas, TX 75237

Telephone (972) 296-3699 Fax (972) 296-7881 e-mail: [Texasspec@aol.com](mailto:Texasspec@aol.com)  
Website: [www.Texasspectrum.com](http://www.Texasspectrum.com)

Custom EMI Filters, Miniature EMI Filters, Telecom Power Filters, Filter Arrays, and Filter Suppressor Networks. RFI Commercial Filters, Filtered D-sub and Filtered Telephone Jacks. High Current Filtered Terminal Blocks and High Voltage Feed-thru Capacitors

*An Institutional Listing recognizes contributions to support the publication of the IEEE EMC SOCIETY NEWSLETTER and the IEEE TRANSACTIONS ON ELECTROMAGNETIC COMPATIBILITY. Minimum rates are \$500.00 for four consecutive issues of each publication during one calendar year (each publication is distributed quarterly). The above Institutional Listings represent those contracted for 2000. Institutional Listings for 2001 will be solicited in December 2000. No agency fee is granted for soliciting such contributions. For inquiries related to Institutional Listings, please contact Janet O'Neil, Editor, phone 425.868.2558, e-mail [j.n.oneil@ieee.org](mailto:j.n.oneil@ieee.org).*

\*\*\*\*\* 3-DIGIT 550  
02934594 27N 254348 B0034  
DANIEL D HOOLIHAN  
PO BOX 712  
LINDSTROM MN 55045-0712