IEEE

Electromagnetic Compatibility Society

Newsletter

ISSUE NO. 141 145 SPRING 1990 (ISSN 0164-7644) EDITOR: ROBERT D. GOLDBLUM

CALL FOR NOMINATIONS

Nominations 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. The petition shown shall carry a minimum of 15 names of Society members, excluding those of students. Nominees should possess professional stature and significant technical skills in electromagnetic compatibility. They should have adequate resources and/or backing so as to be able to contribute actively to the Board of Directors, handling committee activities, correspondence, telephone calls, etc. Nominees must be full members of IEEE and members of the EMC Society. No member can serve for more than six consecutive years, including partial terms. All nominees are required to submit a biographical summary to the Nominations Chairman. The summary must not exceed one-half typewritten page and must be in the following format:

1st paragraph	Name, title, place of employment, educational background
2nd paragraph	Technical and professional experience
3rd paragraph	IEEE service and activities including offices, committees, awards, etc.

Petition forms and information can be obtained from the Nominations Chairman.

Please submit petitions and biographical summaries to the nominations chairman. Submissions must be postmarked no later than May 30, 1990.

Donald E. Clark
Nominations Chairman
Electronic Research Bldg.
Georgia Tech Research Institute
Atlanta, GA 30332
Telephone: (404) 894-4315
FAX: (404) 894-3906

Nomination petition is printed on page 31.

NEW BOARD MEMBERS

The following candidates have been elected to the IEEE Electromagnetic Compatibility Society for three-year terms, beginning January 1, 1990.

Joseph E. Butler
Patricia L. Coles
Warren A. Kesselman
David M. Staggs
Donald A. Weber

Congratulations and best wishes to these newly elected members.

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COMMITTEE FOR EVALUATING TESTING OF EMI GASKETS

A committee of EMC engineers will be organized to perform testing and studies for the purpose of generating a standard or set of standards for testing EMI gaskets.

The committee will evaluate the three presently used methods of testing the shielding quality of EMI gaskets and three other proposed methods. These 6 methods are as follows:

- MIL-STD-285
- Modified MIL-STD-285 per MIL-G-83528
- SAE, ARP 1173
- Proposed IEEE Standard P-509
- Dual TEM cell Stir Mode chamber method
- Modified MIL-STD-285 (using a gasketed slot in the middle of the plate)

The committee will meet on Monday evening, August 20th, between the hours of 7:00 and 9:00 p.m. during the IEEE, EMC Symposium in Washington, DC. The meeting will be open to anyone interested in participating in the study. The room to be used for the meeting will be listed in the Symposium Schedule.

PRESIDENT'S MESSAGE

OUR OWN BOOTSTRAPS

Edwin L. (Ed) Bronaugh,
President EMC Society

There is an old saying about a person who "pulled himself up by his own bootstraps" which characterizes many people we have known. People who, with much effort and on their own, have achieved fame, fortune, or more importantly, provided outstanding and much needed service to humankind. Some of these people have been members of organizations and have done what they could to help the whole organization "pull itself up by its own bootstraps," and we have all known such a person or benefited from his or her efforts. Organizations such as IEEE and our own EMC Society are successful and thrive only through the efforts of volunteers, some of whom help us to "pull ourselves up by our own bootstraps."

The EMC Society has been in existence almost 32 years -- serving the electronics industry, our government, and society in general, and now many of our key people either are nearing retirement or have already retired. When I look around the room during meetings of our various boards and committees, I see mostly seasoned people who have already put forth a sustained effort to make and keep the EMC Society viable; I see very few young, energetic people who have many years of service yet to perform. But, new, younger people are needed to carry on the vitally important work of the EMC Society and the IEEE.

The time is now to "pull ourselves up by our own bootstraps." We need our newer, younger members to get involved in running our EMC Society. We can go on the way we are for a while, but when we are all gone the Society will fall into the laps of its younger members, few of whom have been groomed to take over and continue to build on the work already done. The result will very likely be the loss of our "corporate memory" and the wasting of much of the good efforts of all those who have put so much into the Society. I'm reminded of another cliche about reinventing the wheel. What we must do is to get our newer, younger members heavily involved in the operation of the EMC Society.

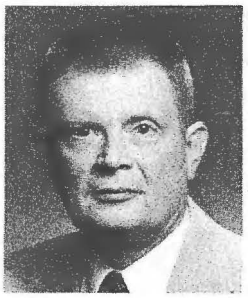
To those of you who have been sitting on the sidelines, you must understand that you get out of anything no more than you put in. Every engineer and scientist understands this principle when it is applied to electronics and machinery, but many seem not to understand it when it is applied to people and their organizations. Many business and government entities also seem not to understand this principle. They will (almost grudgingly) let an older member of their organization go to the annual EMC Symposium as a reward for long, industrious service, but they should be encouraging *all* of their engineers and scientists to get involved, and support that involvement!

In the Fall 1989 Issue (No. 143) of this EMC Society *Newsletter*, our immediate past president, Don Clark, told us about "Professional Activities and Practices." In that message, he mentioned taking responsibility for your own career. This part of his message cannot be overemphasized. Getting involved in the technical and professional operation of your Society, the EMC Society, will help you develop your career through new knowledge you can gain, through a "network" with your peers, and through establishing your reputation, company-wide and nationwide. It is an excellent way to avoid "engineering obsolescence" and increase your value to your present employer and any future employer. Of course, for the EMC Society and the IEEE, your involvement will be important to keeping it viable, "on-course" and productive.

I ask you, I beg you, I implore you, serve on the boards and committees of our EMC Society; help us "pull ourselves up by our own bootstraps."

BOD ACTIVITIES

BOARD OF DIRECTORS MEETING IN DALLAS, TX



by Donald N. Heirman

The first meeting of 1990 of the EMC Society Board of Directors was held between 1 and 6 p.m. on February 21, 1990 at the Dallas-Fort Worth Airport Marriott in Dallas, TX. The meeting was part of a week long series of EMC meetings including two ANSI-Accredited Committee C63 meetings – Subcommittee One and S/C 1 Working Group on Electrostatic Discharge, the EMC-S Standards Committee, and the Dallas EMC-S chapter. Board members present included: Al Mills, Gene Knowles, Herb Mertel, Bob Haislmaier, Chester Smith, Dan Hoolihan, Dave Staggs, Don Heirman, Pat Coles, Warren Kesselman, Dick Ford, Joe Butler, Walt McKerchar, Ed Bronaugh, Bob Hofmann, and Janet O'Neil. Members absent: Charlotte Tyson, Don Weber. Others present: Gene Cory, Steve Berger, Bob Brook, Moto Kanda, and Ed Vance.

President Ed Bronaugh presided over his first meeting and welcomed the continuing and newly-elected Board members and guests. He then sought and received approval of the agenda which was structured to increase the efficiency of Board deliberations by moving all motions to either new or old business and thus leaving the other portion of the meeting to succinct reporting.

Secretary Janet O'Neil then reviewed the minutes of the November 13, 1989 meeting. After minor changes, the minutes were approved. The Board expressed its thanks for the high quality and accuracy of the minutes.

Treasurer Dick Ford indicated that as of January 1, 1990, our Society's net worth was $286.8 K. He indicated that our reserves per member was at $78, which is in the top 10 of the IEEE Societies. The treasurer's report was approved.

Reports were given by all four directors:

1. Director Bob Haislmaier (Communications Services) announced that Bob Goldblum (Newsletter Editor) has appointed two Newsletter Associate Editors -- Reinaldo Perez and Norm Violette. Moto Kanda (Transactions Editor) reported on his plans to meet with associate editors at the Washington Symposium this year. Gene Cory reviewed the future symposia status. The Board approved, in principle, San Antonio as the site for the 1997 EMC Symposium.
2. Director Don Heirman (Technical Services) presented the following reports. As standards committee chairman, he indicated that PARS 1140 (Near field E and H measurements) and 1190 (LISN calibration) are being revitalized. Dheena Moongilan, (201) 834-1806, was named chairman of P1140 Working Group, replacing Rick Tell. Dave Staggs resigned as chair of P1190; he is seeking his replacement. Standard-299 (shielding effectiveness measurements) was sent to ballot with a due date of the end of March. The revisions of Standards 140 (Mitigation of emissions from RF Heating Equipment) and 187 (Measurement of Emissions from TV and FM Broadcast Receivers) are complete and the submission to the IEEE Standards Board for approval is imminent.
3. Don then presented Dr. Clayton Paul's annual report for 1989. Clayton indicated that, in 1989, 7 lectures were presented by the present 6 Distinguished Lecturers. Typical responses from the evaluation forms show that 90% of the attendees rated the presentations good to excellent. To date, $5,300 has been spent supporting this program. A special article by Clayton on the "Establishment of a University Course in EMC" was recently published in the IEEE Transactions on Education. This was written to increase the visibility of EMC in the university arena. Finally, work is progressing in the EMC-S participation in the IEEE Engineering Skills Assessment Program (ESAP) with the cooperation of Technical Committee 1, chaired by Russ Carstensen. For more information, call Clayton on (606) 257-1644.
4. Don also presented Wilf Lanber's report (Technical Advisory Committee). Wilf announced that John Kellas was named chairman of TC-6 on spectrum management (not Paul Vaccani as previously reported). For the Washington, DC symposium, the TC s reviewed 167 and accepted 144 papers. Three tutorials will be presented at the symposium: TC-2 (Basic EMC Measurement Principles), TC-6 (Spectrum Authorization and Licensing), and TC-8 (Electric Shock -Means of Providing Protection in the Design of Electrical Products). For more information, contact Wilf on (613) 998-2377.
5. Director Dan Hoolihan (Member Services) presented his report. The EMC Society has 3706 paid members as of 1/31/90. This represents an annual growth rate of 8.7% which is quite a bit above the IEEE membership increase of 3.5%. We now have 5 chapters outside of the United States: one in Austria, India, Spain, Sweden, and Canada. Dan then indicated that there will be a special 3-hour chapter chairperson session on Thursday afternoon, 23 August 1990, at the symposium

in Washington, DC. The purpose is to have the Board discuss items of mutual interest among the chapters and to see where Board help can be provided. Each Director and the President will discuss their roles with the chapters. Special programs such as the Angel Program and Distinguished Lecturer Program will also be discussed. For more information and final details, call Dan on (612) 583-3322. Finally, Jim Mucciolli (student activities) is reviewing special incentives to produce a quality student paper contest.

6. Director Walt McKerchar (Professional Services) gave his report. The EMC-S logo contest had over 30 entries. Janet Zach is now collecting Board votes to determine the winners who will be presented a $100 award at the Washington symposium. Al Mills (PACE) handed out a letter he sent to each United States EMC Chapter chairperson containing PACE information for each chapter member. There is much activity in this area. Contact your local chapter chairperson for a copy of the letter. Herb Mertel (Transnational Committee) presented his report that 6 new society members were signed up the IEEE booth at the Nogoya Symposium last year. He also noted that he has corresponded with the IEE in the United Kingdom and that symposium records from the York EMC Symposium, 11-13 September 1990, will be exchanged with records from our 1990 EMC symposium. He is also negotiating for an "International EMC Societies" booth at York to foster and advertise future EMC Symposia. Finally, Bob Brook (SSIT) presented his report on the activities of the Society of Social Implications of Technology. He indicated that there will be a special session on the socio-economic aspects of EMC at the Washington Symposium. For more information, call Bob on 516-595-3136.
7. Under old business, 3 motions were passed by the Board affecting symposium operations.

   A. Each symposium financially sponsored by the EMC Society shall budget for a surplus of not less than 20% of gross income.
   B. The symposium booth assignment procedure for EMC-S sponsored symposia shall be as follows:

      1. Every effort will be made to accommodate the exhibitor's preference for location.
      2. Booth assignments will be made on the basis of prior participation in IEEE EMC-S symposia as follows:
         a. For those exhibitors whose contract and deposit/payment have been received on or before the first booth assignment date (usually six months prior to the symposia as specified by the local symposium committee), booths will be assigned on a point system priority basis. One point will be allowed for each year exhibited during the past ten years. One additional point will be allowed for each booth taken over one during each of those years.
         b. Applications received after the booth assignment date will be assigned space in the order received.
      3. The local symposium committee reserves the right to alter this procedure to maximize exhibit area harmony or to accommodate special requirements.

   C. That the local EMC symposium committee be authorized to delete papers from the symposium if a presenter has not pre-registered by the suspense date for the printing of the final program.

   In addition Gene Cory and Bob Haislmaier were asked to prepare a Board policy statement for pricing exhibitor spaces. For 1990 and 1991, Gene will deal directly with the symposium committee treasurers.
8. Other BoD approved items under old business were:

   a. The local symposium committee shall reserve a booth for the IEEE EMC-S and a booth for other international EMC symposia at no cost to the EMC Society.
   b. The EMC-S shall cooperate with the 1991 Zurich EMC Symposium as we have in the past.
   c. An advance of $5,575 to R & B Enterprises to produce the *EMC-S NEWSLETTER.*
   d. A one-time use of the EMC-S mailing list at the EMC-S rate to send a copy of the Navy's "Program for EMC Excellence" Newsletter to EMC-S members.
   e. The EMC-S will fund the IEEE - authorized expenses for the winner of the student paper award for 1990 to attend the Washington, DC Symposium.

9. Under new business, President Bronaugh reviewed the need for EMC-S representatives at various instrumental EMC conferences. He asked for volunteers to staff the EMC-S booths. Any interest, call Herb Mertel on (619) 578-1480.
10. Various TAB reports were presented by Bob Hofmann. For details, call Bob on (708) 979-3627. (Note new area code for Chicago suburbs.)
11. President Bronaugh adjourned the meeting at 5:30 p.m. and indicated that there will be 3 more BoD meetings in 1990. The next meeting will be 19 May at The Hyatt Cherry Hill Hotel in Cherry Hill, NJ -- the site of the 1991 EMC Symposium. The 20 August meeting will be in Washington, DC at the symposium. The 16 November meeting in either San Diego, Phoenix, or Tucson. Contact Secretary Janet O'Neil for more details on (213) 870-9383.

Respectfully submitted,
Don Heirman
Associate Editor, for BoD Activities

CHAPTER CHATTER

Charles F. W. Anderson
Associate Editor

CENTRAL NEW ENGLAND

On March 20, the Chapter sponsored a meeting on the topic "Pulse Effects - Their Mitigation and Testing." Speakers were A. Peter Krickhuhn and Wade Selph of Maxwell Labs (San Diego). BoD Member/Chapter Secretary/Treasurer Joe Butler will address the April meeting on "Lightning Susceptibility of EMI Gaskets." A May meeting is also being planned. Thanks to John Clarke (Chapter Vice Chair) for the above.

NEW JERSEY COAST

Guess who walked off with first prize at the Chapter's annual holiday party in December -- none other than Don Heirman! He is now the owner of a fancy radar detector.

James W. Beck (GE Astro-Space Div.) spoke at the Chapter's January meeting. His topic was "The Future Look in Commercial Communication Satellites." As Systems Program Manager for AT&T's next generation Telstar 4 satellite, he discussed power budget, on-board control sophistication and reconfigurability, T/R electronics, and multihorn antennas, which are the design drivers of the fourth-generation commercial satellites.

The March 20 meeting was addressed by Anatoly Tsaliovich (Distinguished Member, Bell Labs Technical Staff, Holmdel). He spoke on "Radiated Field Patterns of Electronic Systems." He described the methods used to establish relationships between system design, configuration and EMI potential. Models developed are being used to synthesize and analyze electronic systems radiated fields.

Gene Barber continues to do a fine job as editor of the EM/VT/AP Chapter Newsletter.

SANTA CLARA VALLEY

Bob Cowdell spoke at the Chapter's February meeting. The title of his talk was "MIL-STD-461C: The Inside Story." His presentation included such topics as how to use 461C; meanings of the new tests; design impacts of new requirements; new trends in technology; and problem areas not covered by the documents.

The March meeting was addressed by Henry Ott, whose topic was "The Changing Regulatory Environment." Hank discussed the rationale behind the FCC's revision of Part 15 covering digital devices, the changes made and the impact which these changes will have on the industry. He ended with a bit of "crystal-ball-gazing" with regard to future regulatory trends in Europe and the U.S. (I think that Chapter Secretary John Howard is the one who sends me the meeting announcements but I'm not sure.)

TOKYO CHAPTER

Just too late to make the deadline for the Winter issue, came a letter from Japan enclosing abstracts of the papers presented at the October, November and December meetings. Brief summaries of some of the papers which would seem to be of special interest follow. Only the dash numbers of the papers are given -- they are all prefixed by EMJC89.

-47: Baba/Fujimura (Tohoku U.), "Measuring Method of the Electric Properties of Dielectrics by Time-domain Reflectrometry." Authors state method is useful for characterizing absorbing and shielding materials.

-51: Endo/Numata/Sasqaki/Ootawara (Iwate U.), "The Analysis of the Electromagnetic Noise from a Moving Car." Reports results of experimental work using a laboratory model of a typical ignition system.

-56: Matsuoka/Miyazaki/Watanabe/Sano (Jemco Corp.), "A Consideration on the Broad-band Antennas used for the Measurement of Radiated Emissions from Information Technology Equipment." Correlation of 1/2-wave dipole and broadband antenna measurements.

-57: Shimayama (Fuji Electronic Ind. Co.), "Problems about RF Noises which Disturb Electronic Devices." A restudy of continuous and damped oscillations; including a discussion of the CISPR measuring techniques, RFI in distributed constant circuits, merit/demerit of X-Y capacitor suppression, and frequency of recurrence of disturbances.

-59: Takahashi (Takusyoky U.)/Yasuda (Omron Tateishi Electn. Co.)/Shibuya & Ito (same university), "Measurement of the Radiated Emission from the Printed-wiring Board." Calculated and measured levels of PWB EMI reported. Common-mode current was used as the basis for calculations and good agreement was observed in experiments with PWBs.

-60: Sato/Yamamoto/Kuramoto (NTT Telecommunications Networks Lab.), "A Study on Central-office Grounding Methods for Reducing Conductive Noise from AC Power Mains and Rectifiers to Telecommunications Equipment." Comparison of separated and integrated signal and protective grounds in reducing lightning-surge transient voltages.

-63: Chino/Yamamoto (National Defense Academy), "Painting Method for Microwave Absorbers. Describes two types of double-layer absorbers using $BaTi0_3$ ceramics and ferrite-

loaded paints. 10 dB/absorption bandwidth of 2550 MHz was obtained at 10 GHz!

-66: Anzai/Ogawa/Yamada/Kikuma/Inagaki (Nagoya Inst. of Tech.), "Direction-of-arrival Estimation of Indoor-Multipath Waves by Rotary Scanning of Antenna using MUSIC Algorithm." Reports results of tests which were to define some of the problems encountered in implementing indoor RF communications systems.

-69: Ishihara/Twasaki/Ikeda (Nagoya Inst. of Tech.), "The Noise Radiation Characteristics of Powerline with Earthing Conductor." Reports results of tests of 3-pole connector conducted EMI using various types of filters.

-71: Amemiya (Chiba Inst. of Tech.)/Yamaguchi (Kanazawa Inst. of Tech.), "A Method for Deriving Shielding Effectiveness for Plane Waves from Data Measured at Small Shielding Samples." Correction factors for shielding effectiveness were derived for obtaining plane-wave shielding effectiveness from measurements in cylindrical test configurations.

-74: Kuramoto/Sato/Yamamoto (NTT Telecommunication Network Lab.), "A Study on Surge-current Distribution in Buildings Caused by Direct Lightning." Reports results of computations of building structure impedances, a surge-current measurement method using external conductors, and comparison of the calculated current/voltage distributions versus building scale-model experiments (probably related to their **-60** paper -- see above).

WASHINGTON/NORTHERN VIRGINIA

Before anything else, I should report that Bob Haislmaier underwent surgery just a few days before this writing. At the March 22 meeting (see below), I talked with Flo, Bob's charming wife, who reported that everything was going along fine and that Bob might even be home by March 24 or 25.

On January 25, the Chapter's luncheon meeting was addressed by J. Brueggeman (Grumman Space Station Program Support). He presented a review of the Space Station Freedom EMC approaches covering such matters such as EMC/EMI requirements; document approval problems; international aspects (ESA, Japan and Canada are participants); and some of the difficulties with having **four** primary contractors. A new series of requirement documents, all prefixed "SSP," will govern EMC for the program. (As one who participated in the early phases of the LEM part of the Apollo Program, it will be interesting to see what changes have taken place in NASA systems EMC philosophy over the years.

The March 22 meeting featured Michael Barge (Locus, Inc. p/o NRL's EMC group) speaking on "A Compendium of Bioelectromagnetic Effects." His talk illuminated the many highly controversial aspects of exposure to EM energy from such sources as radio-frequency generating devices, 60-Hz powerlines and video terminals. He stressed the harm done by media distortion and over-reaction, citing the flaws in New Yorker Magazine's Brodeur articles and a number of radio and TV programs. Michael placed great emphasis on the EMC community's role as responsible engineers to try to counteract some of the harm done by those who do not have the background to understand this problem area. As he pointed out, risks are perceived to be greater if they are not understood. (Incidentally, Michael Barge will be presenting a paper on the subject at the August Symposium).

Footnote: Symposium planning by Tom Doeppner and his committee is progressing nicely -- by the time this issue of the *Newsletter* reaches you, the Advance Program mailing should already be in your hands. Hope to see many of you in DC this summer!

EMC MEMBERSHIP NEWS

Charlotte Tyson, EMC Society Membership Chairman

The EMC Society has enjoyed excellent growth during the 1980's, demonstrating the continuing increase in the importance of Electromagnetic Compatibility in a world that depends on electronics more than ever. The EMC Society has grown from approximately 1900 members in 1980 to over 3700 members at the end of 1989. The Society has been one of the five fastest growing societies in the IEEE for the last several years, and had a yearly growth rate in 1989 of 9.6%.

In December, 1988, the IEEE reached the 300,000 mark in membership. The first person to join the EMC Society after the passage of this membership mark was Dr. Siraj M. Khan, a physicist with Harry Diamond Labs in Adelphia, MD. Dr. Khan received his M.S. in Physics from the University of Illinois, and his PhD in Solid State Physics from the University of Maine. After serving as a professor at various universities, Dr. Khan joined the Department of Defense where has been involved in research, development, and program management in the area of nuclear survivability. His particular interest is in EMP, and he has organized a workshop on shielding from EMP in cooperation with the Washington, DC EMC Society Chapter. He joined the IEEE and the EMC Society for exposure to the latest research and development efforts in the area of electromagnetics.

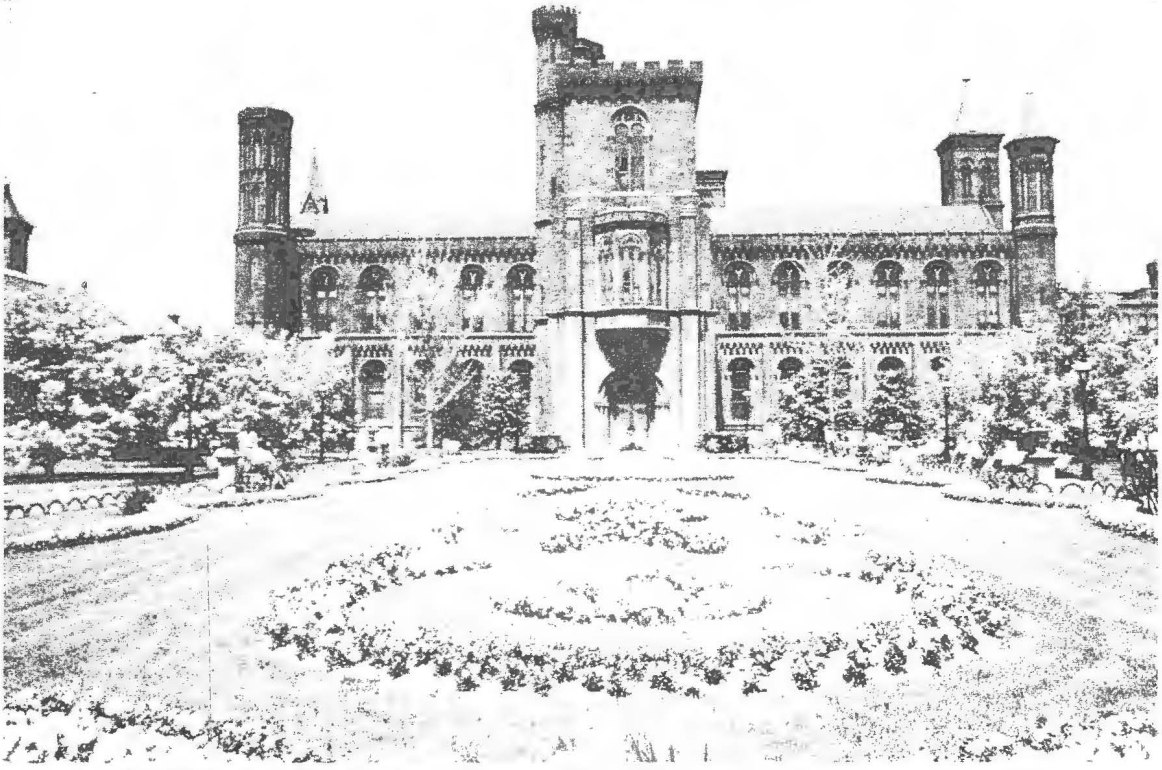
People with a broad range of backgrounds have joined the EMC Society, and each of you has an important part in making the Society what it is, and representing it to others. The society continues to develop and update standards, host annual technical symposia, support chapters across the United States and abroad, and work to improve university level EMC education, as well as many other activities.

Help continue to make the EMC Society strong, and encourage the non-members you know within the EMC community to join today! Membership applications and the new EMC Society brochure, are available from Charlotte Tyson, EMC Society Membership Chairman, 1213 Twin Peaks Circle, Longmont, CO 80503. Telephone (303) 924-8197.

A SPECTRUM OF EMC ISSUES FOR THE NINETIES

WASHINGTON HILTON, WASHINGTON, DC

AUGUST 21-23, 1990



Smithsonian Castle, courtesy of the Washington, DC Convention and Visitors Association, 1212 New York Ave., NW, Washington, DC.

1990 IEEE INTERNATIONAL SYMPOSIUM ON EMC

P.O. BOX 19342, WASHINGTON, DC 20036

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PRODUCT SAFETY

TECHNICAL COMMITTEE REPORT

John McBain
Associate Editor

The Product Safety Technical Committee (TC-8 or PSTC) has a peculiar situation for a technical committee. It has certain responsibilities within the EMC Society, the same as every technical committee. But because of its origin and its stated objectives (see *EMC-S NEWSLETTER*, issue 140, Winter 1989), it has assumed additional responsibilities. Several of its efforts are directed towards fulfilling these: publishing the Product Safety Newsletter; promoting regular local area meetings with technical presentations on product safety topics; and encouraging interested members from all IEEE Societies to participate in PSTC activities. Because of all these activities, some confusion has arisen about what it means to be a member of the PSTC.

PSTC MEMBERS

A fine distinction can be made between members of the PSTC and participants in PSTC sponsored activities, the most widespread of which is subscribing to the Product Safety Newsletter. As with other EMC Society Technical Committees, the members of the PSTC are confirmed by the Board of Directors (BoD) of the EMC Society, and must be members of both the IEEE and the EMC Society. Presently, the PSTC has nine members. However, there are scores of participants at local area technical meetings and hundreds of subscribers to the Product Safety Newsletter. The participants are not necessarily members of the EMC Society or even the IEEE, although we encourage joining both and have generated a number of new members.

How can we say that some individuals have joined the IEEE or the EMC Society because of the PSTC? Because they told us on their "Reader Surveys" that we asked all subscribers to the Product Safety Newsletter (PSN) to fill out and return. If you have not yet done so, you probably have not been seeing recent issues of the PSN in your mailbox. But more about that later.

So, even if you have been receiving the PSN or attending local area meetings you may be a subscriber or an attendee but, technically speaking, you are not a member of the PSTC. You may be a member of the IEEE and the EMC Society, but only if the BoD approves are you a member of the PSTC. Now that you have heard the bad news, here is the good news. You can still participate in the activities of the PSTC! You can receive the PSN, attend local meetings, volunteer to help out (or is that part of the bad news?), write articles, give presentations, and so on. And if you really want to become an official member of the PSTC as well, just keep volunteering -- it is practically inevitable.

READER SURVEY

This survey has several purposes besides the obvious one of finding out who wants to keep subscribing to the PSN. Some initial results available now (March 1990) are worth describing. One of the main purposes of the survey is to establish the proportion of readers who are actually IEEE or EMC Society members. This information was requested by the EMC-S BoD because of their financial backing of the PSTC, which allowed the PSTC to continue publishing and mailing the Product Safety Newsletter during 1989. Although a long-term objective of the PSTC is to become a Technical Council, which means seeking support from other IEEE Societies as well, the EMC-S BoD unilaterally was willing to "start the ball rolling" (or "start the wavefront propagating?"). Their initial sponsorship arose from several technical and non-technical common interests between the EMC Society and the previously independent Product Safety Society (see *EMC-S NEWSLETTER*, Issue 141, Spring 1989). But serving the interests of EMC Society members remains the highest priority, so knowing their proportion among PSN readers is important.

Reader Survey results can be summed up roughly as follows. From a mailing list of approximately 1300 names, we have had so far about 50 percent of the surveys returned. Of these, about 50 percent are already IEEE members, and

(Continued on page 10)

POINT AND COUNTERPOINT

MIL-STD-461/2/3 REVISIONS

Anthony G. Zimbalatti
Associate Editor

The Tri-Service MIL-STD-461/462/463 Revision Working Group should consider several basic technical issues and working practices.

The establishment of an additional set of STD-461 limits is needed. The purpose of these additional limits is to prevent unreasoned contamination of the electromagnetic environment (EME) by equipment emanating electromagnetic emissions exceeding the permissible levels delineated in 461. These additional limits, called EME Protection Limits, delineate maximum radiated and conducted emission levels that equipment are permitted to manage. Adopting EME Protection Limits will prevent two EME contamination sources. First, it will prevent the present design practice which permits tailoring of 461 emission types and levels, including unlimited relaxation of these emissions! Relaxation is permitted for emissions that are determined to be benign. Second, it will prevent granting of waivers that permit unlimited out-of-spec emissions. Waivers are granted if emissions prove benign when equipment operate compatibly in their system configuration. Before adopting EME Protection Limits, several issues require consideration. For example: is there a need for different EME Protection Levels dependent on equipment or system usages, types and locations? Are EME Protection Limits cost-effective? Buyers and designers of equipment and systems will state that minimum product cost goes with unlimited equipment emission levels. Many persons will state that EME Protection Limits are indeed cost-effective for the following reasons: achieving electromagnetic compatibility among equipment deployed in an environment contaminated by unlimited, unnecessary emissions is costly; unlimited contamination increases the likelihood of causing interference not only in the equipment and system undergoing design, but in other equipment or systems.

Concomitant with adopting EME Protection Limits, the establishment of Equipment Susceptibility Minimum Limits is needed for two reasons. First, present 461 tailoring practices allow unlimited relaxation of 461 susceptibility limits. Second, the cost for attaining electromagnetic compatibility among equipment will most likely be minimized if equipment share minimum susceptibility and maximum emission burdens.

A tailoring guide describing how, what and when to tailor is also needed. This guide should include the rationale for each tailored specification requirement and the supporting data, analysis, or other evidence.

Finally, a basic working practice is needed which identifies and documents the rationale and supporting data for every proposed or approved revision. This would help others in uncovering loopholes unforeseen by the committee. Also, it would create a paper trail for specification users and improve usage of 461/462/463 and later revisions.

Perhaps this column will stimulate others to identify matters that the 461 committee should consider. No doubt I will hear from the "I gotcha" counterpoint gang for identifying the need for Equipment EME Protection and Minimum Susceptibility Limits, which is controversial. After all that's what this column is about.

Product Safety *(Continued from page 9)*
around 50 percent of IEEE members are also EMC Society members. This means that we will be cutting the mailing list in half as we start 1990 (remember, if you didn't send in your survey, we warned you!), although we expect it will grow rapidly throughout the year. About one quarter of the names will be members of the EMC Society and about half members of the IEEE. It is interesting that Product Safety Newsletter readers include members from at least 27 IEEE Societies, including especially the Reliability, Engineering Management, Industry Applications, and Dielectric and Electrical Insulation Societies. On the other hand, over 30 percent of the respondents who are IEEE members do not belong to any Society.

Not being an expert on statistics, I cannot say exactly how significant our results may be. It seems as if interest in product safety is quite widespread within the IEEE and the idea of a Technical Council for Product Safety may have broad appeal. The PSTC still needs some assistance from the EMC Society, but, hopefully, other Societies interested in product safety will become co-sponsors. I welcome any comments or suggestions from you about that.

EDUCATION COMMITTEE NEWS

The Education Committee is interested in assisting universities in the establishment of an undergraduate/graduate course in EMC at their institutions. The last survey taken by the Education Committee, which was several years ago, revealed only 5 universities offered such a course. I receive calls from other universities asking for help in setting up such a course. I usually send them the course syllabus and other material for the EMC course that I offer at the University of Kentucky. (This semester I have 35 enrolled, which is considerably more than the usual 10-15 for a senior elective course.) We need to help and encourage other institutions to establish such a course if we ever expect to change the usual cycle of the student getting on the job and, to his/her dismay, discovering the deficiency in their basic knowledge base. I am requesting that any of our members who have knowledge of, or are offering, such a course in EMC at a college/university to please send me a note about any details of the course. We would like to build our knowledge base of other offerings so that we can "network" our common interests. So please send any information you may have on

1. Universities that offer an EMC course (along with a contact name),
2. Any details of that course, and
3. What you think should be in such a course.

Please respond by sending this to:

Professor Clayton R. Paul
Dept. of Electrical Engineering
University of Kentucky
Lexington, KY 40506

An article written by me entitled "Establishment of a University Course in Electromagnetic Compatibility (EMC)" was delayed but has appeared in the February issue of IEEE Transactions on Education, which is a special issue on "Teaching Electromagnetics."

The EMC Experiments Booklet has been printed. An additional printing of 250 spiral bound copies will be available at the Washington symposium. We still desperately need more experiments to be submitted for inclusion if this booklet is to become a useful tool in achieving its objectives. Anyone who has an experiment in mind that they would like included should submit that experiment to Clayton Paul, Department of Electrical Engineering, University of Kentucky, Lexington, KY 40506. Please help us by submitting experiments.

The Distinguished Lecturer Program is a viable program with four lecturers: Scott Bennett, Don Heirman, Joe Fischer and Ed Bronaugh. We encourage you to make use of this program. Anyone interested in having a Distinguished Lecturer speak at a chapter meeting or other gathering should contact the lecturers directly or through the program director, Dave Hanttula, at Grid Systems, Fremont, CA (415) 656-1661, ext. 249.

Kimball Williams is converting the EMC Bibliography to ASCII format for incorporation on diskettes. This is intended to be a compact and localized source of reading material germane to the subject of EMC. We expect this to be completed by the end of March.

Russ Carstensen has volunteered his TC-1 committee for the trial participation in the Engineering Skills Assessment Program (ESAP). Three groups from other societies have volunteered for a trial run in this IEEE-wide experiment to help those who wish to change fields to assess their deficiencies and help them in remedial work. The program consists of a Field Specific Knowledge Inventory (FSKI), which is a complete list of specific things that an engineer in that job function would be expected to know and perform, along with a Professional Self Assessment Evaluation (PSAE), which is a test that is intended to be a diagnostic tool.)

Clayton Paul
Chairman, EMCS Education Committee

CALL FOR PAPERS

The Journal of Electromagnetic Waves and Applications is planning a special issue on wave interaction with chiral and complex media, to be published in late Fall 1990. Original contributions in this area are now being accepted for review. Topics of particular interest include (but are not limited to):

- Fundamentals of chiral materials and electromagnetic chirality
- Electromagnetic modeling of chiral microstructures
- Scattering and diffraction in chiral media
- Guided waves in chiral media and applications
- Antennas in chiral media and radomes
- Optics of chiral materials
- Analytical and numerical techniques
- Applications of chiral materials to optical and microwave devices
- Anisotropy and chirality

Prospective authors are requested to submit three copies of their manuscripts by **June 1, 1990** to Professor Nader Engheta, Guest Editor, JEWA Special Issue, Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, PA 19104-6390 U.S.A.

EMC PERSONALITY PROFILES

William G. Duff
Associate Editor

ROBERT "BOB" MAYHER

Robert "Bob" Mayher began his career in 1958, after graduating from MIT, by working for the Philco Corporation, Research Division, in Philadelphia, PA, on both the analysis and implementation of a new jam resistant, spread spectrum communication system. During this project he acquired valuable experience in applying theory to a new concept, designing hardware to perform a specified function and the testing of a communication system under jamming conditions. Throughout his career he has continued to analyze and measure the effects of undesired signals on the performance of receiving systems while only changing the description of the undesired signals from jamming to interference.

In 1962, he left Philco to become one of the first technical staff members at the Electromagnetic Compatibility Analysis Center (ECAC) in Annapolis, MD. The center was just beginning and much work was needed on interference analysis. He continued the work he had begun at Philco and wrote a number of reports on the analysis of interference to receiving systems and on the derivation of signal-to-interference protection ratios.

In 1972, the Office of Telecommunications (OT) of the Department of Commerce (DOC) was just beginning to organize a spectrum management division and Bob transferred positions to use his previous experience and broaden his background in the field of "Spectrum Management." The OT performed various technical tasks for the newly formed "Office of Telecommunication Policy" (OTP). During the early years, these two offices addressed many new approaches to efficient spectrum management, and much time was spent coordinating these offices. During this period, Bob investigated a potential interference problem for the airborne command post that led to an extensive measurement and analysis program and proved that a serious problem could exist if this system was not carefully planned. This led to the development of one of the first large scale computer analysis programs to operationally frequency plan a band. During this period, he also developed a handbook dealing with the "Performance Degradation Analysis of Communications/Electronics Receiving Systems."

Soon after joining OT, Bob was asked by Dick Kirby to write a report for the next meeting of the CCIR. Dick Kirby has subsequently become director of the CCIR and Bob has continued to produce many reports for the CCIR and to chair national and international meetings. In 1978, he proposed and is still chairman of the CCIR Interim Working Party (IWP) on "Spectrum Management and Computer-Aided Techniques." This highly successful IWP has produced a handbook on spectrum management that is well known throughout the world. Bob is also Vice Chairman of Study Group 1, that, following the long-range plan he developed, has changed its focus and name to "Spectrum Management."

During the 1970's Bob was heavily involved in the 1979 WARC activities, chairing the U.S. Government Technical Committee preparing for the WARC and participating in the Special Preparatory Meeting (SPM) and the 1979 WARC.

In 1982, Bob was promoted to Chief of the Spectrum Engineering and Analysis Division of the National Telecommunications and Information Administration (NTIA). In this position, he directed technical program activities and developed technical and policy alternatives for government spectrum management.

(Continued on page 30)

PCs FOR EMC

Edmund K. Miller
Associate Editor

The past few columns have had more-or-less theme topics. This time, I'll be going through the mailbag as well as choosing from a variety of PC/computer topics that might be of general interest.

A COMMENT ON SOFTWARE REVIEWS

From time to time, this column discusses various specific software, either commercially available or from a private developer. Unfortunately, a complete review of these products is not possible. As an alternative to doing either a full review or nothing, I have chosen instead to include what I have called "mini-reviews" or what amounts to a software description. These descriptions range from simply mentioning a program that has come to my attention to summarizing it based on information provided from other sources, including the developer. It's important that readers understand that these descriptions usually are not based on my own personal experience in running a given program. A "hands on" review would be more valuable to readers, and if any are willing to share their experience with others by way of writing a review for inclusion in this column, I would be most appreciative. But, in lieu of actual reviews, I will continue to include software descriptions as the most viable alternative.

READER INPUT

Wes Brodksy, Medford, MA

As readers might know from past issues of this column, the question of what kind(s) of language(s) are most productive for engineering and scientific applications is a topic of particular interest. We have had defenders and proponents of FORTRAN, FORTH, BASIC, Pascal, C, and APL. While having their distinct advantages as well as limitations, most of us would agree that we can be more productive and accurate using such higher-level languages than would be the case if we had to write in machine and/or assembly language. Nevertheless, further improvements are possible and needed. One approach is to construct programs using block diagrams and schematics in a manner analogous to how engineers develop circuits and systems. Object-oriented programming is a promising example, giving the user a more visual environment, one in which many of the details normally needing attention are handled by the language itself.

One step on the way to more truly "user friendly" languages are various general-purpose mathematics packages such as *PC-Matlab* and *Mathematica*, which might be regarded as taking languages like FORTRAN a logical next step further. In a recent letter, Wes Brodksy of Medford, MA summarized his experience with *PC-Matlab*, which he describes as "an excellent middle ground" between a general-purpose language such as APL and other special-purpose software. Mr. Brodsky observes that "it has the interactive form and vector-matrix/array processing power of APL, without the funny symbols. Plus it included FFT, Inverse FFT, filter generation functions, numeric integration, and numerical analysis. The ease of use with complex numbers (they are treated just like real numbers) almost by itself makes the software worth the price. Plotting routines are also included." Mr. Brodsky concludes that *PC-Matlab* is available from: The MathWorks, Inc., 20 North Main Street, Suite 250, Sherborn, MA, Telephone (617) 653-1415.

R. P. Haviland, Daytona Beach, FL

Some time ago, Mr. Haviland was kind enough to provide me a review copy of a PC software package he has developed for antenna applications titled "Practical Antenna Design and Analysis," but unfortunately, I had misplaced the package. The material is not very time sensitive however, so I hope that you'll find this "mini-review" useful. Mr. Haviland notes in an accompanying letter that, "These programs are aimed at the more advanced of the amateur radio fraternity, and are tailored to their frequency range and normal antenna usage. At the same time, an attempt has been made to simplify less common techniques for amateur use. As far as professional use is concerned, the material is probably at the 'preliminary design choice' level. However, I do not know of another set of programs with this breadth of coverage."

An excerpt from the flier Mr. Haviland included in the package begins, "Basic antenna types included are the di-

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EMC CERTIFICATION AND ACCREDITATION

PROGRESS REPORT

Russell V. Carstensen
Associate Editor

We are entering the home stretch! As of January there were more than 220 certified EMC engineers on the rolls at NARTE. The period for certification qualification by eminence ends 17 May 1990. From that point on, in addition to satisfying the other requirements for education, experience and peer endorsement, candidates for certification will be required to pass an eight-hour examination.

To help get the word out, NARTE sent a twenty-page bulletin on certification and accreditation in March to the EMC community. Titled "A View Toward EMC Excellence," the bulletin was more than a reminder to apply; it covered the Navy's focus and where certification and accreditation fit into the larger context of third party accreditations. It contained experiences by a candidate lab that was assessed in the laboratory accreditation process. The bulletin also covered common errors encountered by NARTE in the applications.

Assembling a solid mailing list for the EMC community is not a simple task. Resources and restrictions make assembly of a list for the potential certification and accreditation candidate difficult at best. There are special purpose lists and there are commercial lists, but none of them efficiently selects those in charge of EMC engineering and technical support and those involved or responsible for laboratory operations. NARTE did the best they could, but they may still have missed some very important people. If you did not get a copy of the NARTE bulletin titled "A View Toward EMC Excellence" call NARTE at (503) 581-3336 and have them send you one.

The IEEE has an Engineering Skills Assessment Program (ESAP) to provide guidance for members seeking to evaluate their skills in an electrical engineering field. ESAP is the logical starting point for professional development to help engineers advance their career objectives. In electrotechnology, careers are affected by rapid technological change, requiring engineers to update constantly what they learned in college.

ESAP consists of three components; an inventory of knowledge elements, a self assessment test, and guidance information. The knowledge inventory, called a field specific knowledge inventory (FSKI) consists of those elements which are deemed important by successful incumbents. It was developed by volunteers. The self assessment test is a multiple-choice test prepared and validated against the FSKI by standard statistical methods. The test and answers are released in Society publications for members' use at their discretion.

At one of the EMC certification and accreditation working group meetings, one of the participants said that the group was doing more than developing certification criteria; they were defining the body of EMC technology. He was right. The EMC certification effort parallels ESAP. I have volunteered to head the EMC Society to convert the wealth of knowledge gained by the certification working group to ESAP standard format. Through Technical Committee 1-EMC Management, I anticipate that it will take about nine months to have the EMC ESAP ready for community review.

With respect to laboratory accreditation, there are more than ten labs in the accreditation pipeline. NIST is very sensitive to lab image and does not discuss which labs have applied or which ones are proceeding to final accreditation. I have heard that labs which have been visited by assessor teams are pleasantly surprised at the level of competence and professionalism demonstrated by the assessors. They did not expect to see such high quality assessors. We have carefully screened assessors into the program. It is a testament to their experience to be so well-received.

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BYLAWS
IEEE ELECTROMAGNETIC COMPATIBILITY SOCIETY (S-27)
MARCH 1990

1.0 These Bylaws provide detailed guidance for the supervision and management of the EMCS affairs, in accordance with the Society Constitution. Amendments may be made by means of the procedures described in Article IX, Section 2, of the Constitution.

Suitable Bylaws, and amendments thereto may be adopted by a two-thirds vote of the Board of Directors in meeting assembled, provided that notice of the proposed Bylaw, or amendment, has been sent to each member of the Board of Directors at least 15 days prior to such meeting; or a Bylaw, or amendment, may be adopted by a two-thirds mail vote for the members of the Board of Directors, provided a 30-day period is provided for such responses. In either event, the proposed Bylaw, or amendment, shall be published in the Society *Transactions* or *Newsletter*. No Bylaw, or amendment, shall take effect until it has been published and it has been mailed to the Technical Activities Secretary of the IEEE, and he has obtained approval of the General Manager. Editorial changes in the Bylaws which clarify the meaning, structure or operation of the Board of Directors shall require only the approval of the Board of Directors.

2.0 ***Membership:*** There shall be only one grade of Society membership available to all IEEE members, based on the payment of the annual fee prescribed in IEEE Bylaw 109.

2.1 ***Member:*** Membership shall be based on payment of annual IEEE and Society dues and upon acceptance of formal application by IEEE Headquarters.

2.2 ***Honorary Life Members:*** Such membership, exempt of the payment of the annual fee, shall be based on the recommendation of the Society Awards Committee, the endorsement of the Society Board of Directors, and the approval of the General Manager of IEEE.

2.3 ***Affiliates:*** Affiliation may be based on membership of other IEEE-approved Societies that have been recognized for affiliate purposes by specific action of the Board of Directors. A list of approved societies will be maintained by the Technical Activities Secretary of the IEEE. Further, affiliates may join in accordance with any other provision that may be incorporated in the IEEE rules and regulations.

A Society Affiliate may not serve in elective office in the Society or in a Chapter or vote for candidates for these offices; however, an Affiliate may serve in any appointive office in the Society or a Chapter of the Society. A Society Affiliate is entitled to receive notices of all meetings sent to Society members, may receive copies of publications of the Society, may attend and participate in any function of the Society by payment of IEEE member charges, and may receive any award bestowed upon him by the Society. A Society affiliate may not receive any IEEE benefits that are derived through IEEE membership except as approved by the Executive Committee of the IEEE.

2.4 ***Student Members:*** An exception to the annual fee shall be made for students, as prescribed by IEEE Bylaw 109. Transferring to full membership shall be in accordance with the same Bylaw.

2.5 ***Life Members:*** Fees are suspended for Life Members as prescribed in IEEE Bylaws 102 and 109.

2.6 ***Special Membership:*** Special reduced fees for retired members, those unemployed due to involuntary termination of employment and are seeking reemployment, and those whose annual income falls below the minimum income level in his region may become a special member as described in IEEE Bylaw 109.

2.7 ***Special Provisions:*** Special members (life, retired, unemployed, or other honorary) and affiliates of the Society on (date of adopting the new Bylaws) may continue even though their respective attainment of such special membership or affiliation was by a means other than as defined above.

3.0 ***Board of Directors:*** The Board of Directors shall consist of Directors-at-Large and Executive Directors with vote plus elected and appointed Ex-officio Directors without vote. Over fifty percent of the voting members shall constitute a quorum and all voting members shall have an equal vote.

3.1 ***Directors-at-Large:*** There shall be 18 Directors-at-Large elected by the Society membership. Their term of office shall be three years with 6 Directors-at-Large elected each year. No Directors-at-Large can serve for more than 6 consecutive years, partial terms included.

3.2 ***Executive Directors:*** The President, Vice President, Secretary, Treasurer, immediate past President, and the four Technical Directors shall be Executive Directors. These are elective offices by the process contained in Section 5.0.

3.3 ***Ex-Officio Directors:*** Chapter chairpersons, standing, technical and ad hoc committee and subcommittee chairpersons, editors of society publications, subsociety officers, symposium officers and other appointed or elective positions as designated by the President with the consent of the Board of Directors shall be Ex-Officio Directors. Ex-Officio Directors are nonvoting members of the Board of Directors.

3.4 ***Continuation and Appointment to Board of Directors:*** In order to ensure a continuously active Board of Directors, elected Board of Director members who in the absence of extenuating circumstances miss three consecutive meetings will be dropped from membership. Vacancies thus or otherwise created (member fails to accept office or is disapproved by IEEE Headquarters) shall be filled by the appointments for the unexpired terms by the President with the consent (simple majority) of the Board of Directors.

3.5 ***Rules of Order:*** Roberts Rules of Order (Newly-Revised) shall govern conduct of the Board of Directors meetings on all matters not otherwise specified in these Bylaws or the Constitution.

3.6 ***Board of Directors Financial Support:*** The Board of Directors shall be able to provide monetary support for the services of outstanding individuals to serve in advisory or nonelective position for a period to be specified in the appointment. Board of Directors approval by a 2/3 majority is needed.

4.0 ***Nomination and Election of the Board of Directors:*** The Nominating Committee shall be reconstituted by the President on or before April 1st of each year. The Nominating Committee shall consist of a chairperson and four or more members of the Society, not more than half of which may be members of the Board of Directors. No member of the Nominating Committee shall be concurrently nominated for election to the Board of Directors.

4.1 The Nominating Committee shall immediately upon being formed, or no later than 15 April mail notices for the solicitation of nominations for membership as Directors-at-Large on the Board of Directors to existing Board of Directors members and to Chapter Chairpersons. There shall also be published in the first Newsletter of the year a call for nominations for the Board of Directors. Such nominating petitions shall be received by the Chairperson of the Nominating Committee by 30 May. Persons nominated and elected to the Board of Directors should possess significant technical and professional stature in Electromagnetic Compatibility and should have adequate resources and/or backing to be able to attend meetings and actively contribute to the Board of Directors, including committee activities, correspondence, telephone calls, etc.

4.2 A nominating petition shall carry a minimum of 15 names of Society members, excluding students, for the nominee to be placed on the slate.

4.3 The Nominating Committee may make nominations for the Board of Directors in addition to those nominated by petition.

4.4 In the preparation of the slate of nominees, consideration shall be given to both geographical representation and technical interests. In the event the 2/3 Board of Directors carry-over members into the following year and the nominations received by petition do not include members and nominees from IEEE regions one through six, the Nominating Committee will contact Society members in these unrepresented regions (who are qualified for Board of Directors membership, and who are willing to serve in that capacity if elected) and submit their names in the slate of nominees on or before 30 June.

4.5 On or before 30 June, the Chairman of the Nominating Committee shall mail to IEEE Headquarters the slate of at least 12 nominees for election to the six offices to be filled on the Board of Directors.

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

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

4.8 During the first meeting following election, the newly elected members of the Board of Directors will be introduced to their new duties and will participate in the election of the new Board of Directors officers.

5.0 ***Election of Officers of Board of Directors:*** At the first meeting following the election of the incoming Directors-at-Large, the Board of Directors comprised of the newly elected members and all current Directors-at-Large and Executive Directors shall nominate and elect from among the Directors-at-Large, a President and Vice President and, from the Society membership, a Secretary, Treasurer and four Technical Directors who will occupy those respective offices for the succeeding year. Election shall be by secret ballot and when a quorum is not present, by mail balloting. The first meeting shall be prior to 1 January if at all possible.

5.1 ***Terms of Office:*** The term of office for the President shall be one calendar year with re-election to a second successive term of one year allowed. The President, whether serving one or two years, shall not again be eligible for election to the Presidency until a lapse of three years. The Vice President may hold office for not more than two consecutive one year terms. Vice President eligibility is restored after a lapse of one year. There is no restriction on the successive terms of office of the Technical Directors, the Secretary, and the Treasurer. It is of benefit to the Society that both the Secretary and the Treasurer be encouraged to serve at the request of the Board of Directors for terms of not less than three years in order that the expertise developed by these officers not be lost to the Society by early replacement. All officers shall continue to serve until their successors take office.

5.2 ***Secretary and Treasurer Understudies or Assistants:*** It is recommended that the Secretary and Treasurer each recruit from the Society membership, qualified understudies or assistants who will be in a position to assume the duties of these respective offices upon request of the Board of Directors in the event of the unavailability of either of these elected officers to continue in their position.

[Section 5.2 was deleted]

5.3 ***Presidential Duties:*** The President shall supervise the affairs of the Society and shall speak for the Society on all matters not specifically delegated to others.

5.4 ***Vice Presidential Duties:*** The Vice President shall fulfill the duties of the President if the President is absent, incapacitated or requests a temporary replacement. The Vice President shall also fulfill such other functions as the President of the Board of Directors may from time to time direct.

5.5 ***Secretarial Duties:*** The Secretary shall be responsible for keeping the records of the Board of Directors in the areas commonly ascribable to secretarial functions. The Secretary shall prepare and distribute reports, notices or such documents as may be required by the President and the Board of Directors.

5.6 ***Treasurer's Duties:*** The Treasurer shall act as liaison with IEEE Headquarters on all financial records of the Society in the areas commonly ascribable to treasurer functions. The Treasurer shall prepare vouchers for withdrawal of Society funds for payment to officers or members of the Society; certify bills to be paid by IEEE Headquarters direct to suppliers; make a report at each Society business meeting covering the current financial status of the Society; prepare the Society budget; and perform such other financial duties as may be assigned by the President.

5.7 ***Technical Director's Duties:*** The Technical Directors shall supervise and coordinate the activities of the Standing Committees and Technical Committees assigned to them.

6.0 ***Subsocieties:*** Subsocieties are voluntary associations of a significant portion of the total Society membership and hence differ from Standing Committees, which are appointive. The affairs of the subsocieties shall be supervised by the Board of Directors.

6.1 ***Chapters:*** Chapters are subsocieties organized on a geographical basis. This subject is fully treated in the IEEE Bylaws and the Society and Section Manuals.

6.2 ***Technical Subsocieties:*** A Technical Subsociety may be organized to cover a specific portion of the field of interest of the Society. Each Technical Subsociety may be governed by a Technical Committee. Subsocieties may be governed by a Technical Committee. Subsocieties may organize sessions at a Society Symposium or Technical Conference, and may organize separate specialized symposia. Subsocieties may organize special issues of the *Transactions* or a special section in an issue. Any service or Subsociety members, beyond those provided all Society members, must be paid for by the Subsociety and the amount must be endorsed by the Board of Directors and approved by the General Manager of IEEE. Where possible, the Subsociety shall limit its scope to an area under the cognizance of one technical committee.

7.0 ***Publications:*** The Society shall sponsor such publications as are recommended by the Technical Committee for Communications Services and are approved by the Board of Directors. The Presi-

dent, in consultation with the appropriate Technical Directors and with the advice and consent of the Board of Directors, shall appoint an editor for each publication.

7.1 ***Editors Terms of Office:*** An Editor may serve indefinitely, subject to mutual agreement with the President and the appropriate Technical Director.

7.2 ***Editor's Duties:*** Each Editor shall implement the approved publications program. In accordance with the guidance provided, and general IEEE rules and regulations, the Editor shall designate associate editors, special guest editors and manuscript reviewers.

7.3 ***Editor's Compensation:*** Compensation for an Editor may be considered by the President in consultation with the appropriate Technical Director with the advice and consent of the Board of Directors.

7.4 ***Editorial Expenses:*** Editorial expenses shall be subject to review and approval of the Board of Directors. The Treasurer shall review the expenses to determine adherence to the Society's budget.

8.0 ***Society Funds:*** The Society may raise funds as specified in Article IV of the Constitution and in the IEEE Bylaws and rules and regulations.

8.1 The annual society fee shall be determined by action of the Board of Directors. Failure of a Society member to pay the annual Society fee will not render him liable to dismissal from the IEEE, but any Society member who fails to pay such fee before March 31 of each year will be automatically dropped from the Society membership.

8.2 IEEE Headquarters shall act as bursar for all Society funds, except as specified thereunder. Billings and receipt of the annual fee shall be via the IEEE Membership and Fiscal Departments. All other fiscal affairs shall be handled through the office of the Technical Activities Secretary.

8.3 The general committee for a symposium or technical conference may, with the advice and consent of the Board of Directors, authorize the symposium treasurer or fiscal officer to open an account to be used for the deposit and disbursement of funds related to the symposium. In each case, the Board of Directors shall be advised of the name of the bank, the anticipated size of the account, the names of the account signatories, and of arrangements for insurance and bonding by the IEEE. Symposia jointly sponsored with other technical societies are excluded from bank, account size, account signatories and insurance/bonding information if a charter of operations with those societies is approved by the Board of Directors and the IEEE.

8.4 For other special circumstances, such as co-sponsorship of a symposium, the Board of Directors shall make prudent arrangements to safeguard the Society's funds that may be involved.

9.0 ***Society Business:*** The President and officers shall conduct the Society's affairs subject to the advice and consent of the Board of Directors, except where other authorization is specified.

9.1 No Board of Directors meetings shall be held for the purpose of transacting business unless each member shall have been sent notice of the time and place of such meeting at least 30 days prior to the scheduled date of the meeting.

If less than a quorum attend a duly called meeting, tentative actions may be taken which will become effective upon subsequent ratification, either at a meeting or by mail, by a sufficient number of members as to constitute a majority. Minutes of such meetings shall be mailed by the Secretary to each Board member who shall register his disapproval of any actions taken at such meetings, within 15 days after receiving said minutes, or he shall be deemed to have ratified.

9.2 The Society shall sponsor at least one symposium each year. The symposium shall be held, when at all possible, in the fall of the year.

9.3 The annual meeting of the Society shall be the last meeting of the year. The annual meeting, where possible, should coincide with the annual symposium. It is intended that at the annual meeting all Society business for the year shall be brought to a close or formally extended to the following year.

[Section 9.3 was deleted]

10.0 ***Technical Committees:*** A Technical Committee, which may organize a subsociety if desired, functions in a specific technical area as directed by the appropriate Technical Director with a scope to be approved by the Board of Directors. In carrying out the Committee responsibilities, the Technical Director shall be assisted by the Technical Advisory Committee.

10.1 ***Appointment:*** Officers of the Technical Committees shall be appointed by the appropriate Technical Director with approval of the Board of Directors. Members shall be appointed by the officers of the Technical Committee.

10.2 ***Terms of Appointment:*** Technical Committee officers and membership shall be appointed with the following terms:

a. Committee membership - three years
b. Committee officer - two years

The President with the consent of the BoD, may extend the terms for a longer period.

[The word "President" was changed to Technical Director, and after the last word "period" the words "of time" were added.]

10.3 ***Functions:*** Each Technical Committee shall promote activities in its field and shall provide the expert knowledge and assistance to:

a. Receive, generate, and review papers within its scope in cooperation with the *Transactions* Editor and/or the Technical Papers Committee.
b. Organize and operate sessions at meetings of the IEEE at all levels and at meetings of other organizations with which the Society is desirous of cooperating, in accordance with the rules in effect at such meetings.
c. Arrange through appropriate editors for publishing pertinent papers in IEEE publications.
d. Generate and develop appropriate standards in its field for processing by the IEEE Standards Committee, through the Society Standards Committee and otherwise in accordance with institute policies.
e. Evaluate "state of the art" in the area of committee interest.

10.4 ***Operations:*** The operation of each Technical Committee requirements shall be one annual meeting to formulate a report to be presented to the Board of Directors indicating the status of committee work.

[Section 10.5 was added. It read as follows:]

10.5 ***Committees:*** *The Technical Committees may include, but are not limited to, the following areas of interest:*

EMC Management - TC1

EMC Measurement - TC2
EM Environment - TC3
EM Interference Control - TC4
EM Pulse - TC5
Spectrum Management - TC6
Sequency Union - TC7
EM Product Safety - TC8

11.0 ***Executive Committee:*** The Executive Committee consists of the President, immediate past President, Vice President, Technical Directors, Secretary and Treasurer. These officers, who are also identified as Executive Directors, are elected officials in accordance with paragraph 5.0. The functions of the Executive Committee will be to:

a. Act for the Board of Directors in emergency situations wherein time is not available to call a special meeting of the Board of Directors.
b. Assist the incumbent President and Vice President as necessary.

12.0 ***Standing Committees:*** Standing Committees shall be appointed by the President with the advice and consent of the Board of Directors. It will be discretionary with the President to appoint any part or all of any Standing Committee, or to appoint the chairperson only of a Committee, and request the latter to appoint additional members. Such appointments shall be for a period of one year unless waived by the Board of Directors. Each Standing Committee will be assigned to the appropriate officer for overall supervision.

[Section 12.0 had a change and addition. It reads as follows:]

12.0 ***Standing Committees:*** *Standing Committees shall be appointed by the President with the advice and consent of the Board of Directors. It will be discretionary with the President to appoint any part or all of any Standing Committee, or to appoint the chairperson only of a Committee, and request the latter to appoint additional members. Such appointments shall be for a period of three years with one-third appointed each year unless waived by the Board of Directors. Each Standing Committee will be assigned to the appropriate officer for overall supervision.*

12.1 ***Standing Committee's Duties:*** The specific duties of each Standing Committee shall be as recommended by the President, after consultation with appropriate officers, and approved by the Board of Directors.

12.2 ***Typical Standing Committees:*** The Standing Committees may include, but are not limited to, the following:

a. Administrative Committees
(1) Constitution and Bylaws
(2) Nominations and Appointments
(3) Planning

b. Technical Service Committees
(1) Education
(2) Spectrum Studies
(3) Standards
(4) Technical forecasting and Assessment
(5) Walsh Functions
(6) Representative Advisory

[Section 12.2.b was changed to the following:]

b. Technical Service Committees
(1) Education
(2) Distinguished Lecturer
(3) Standards
(4) Technical Advisory
(5) Representative Advisory

c. Professional Services Committees
(1) TAB Committee Participation
(2) Public Relations
(3) Government Relations
(4) Employment Analyses
(5) Inter-Society Relations

[Section 12.2.c was changed to the following:]

c. Professional Services Committees
(1) TAB Committee Participation
(2) Public Relations
(3) Government Relations
(4) Employment Analyses
(5) Inter-Society Relations
(6) PACE
(7) Transnational

d. Member Services Committees
(1) Awards and Fellows
(2) Chapters
(3) International Affairs
(4) Membership
(5) Student Activities

[Section 12.2.d was changed to the following:]

d. Member Services Committees
(1) Awards
(2) Chapters
(3) Fellows
(4) Membership
(5) Student Activities

e. Communications Services Committees
(1) Information Retrieval
(2) Meetings
(3) Newsletters
(4) Symposium
(5) Transactions

13.0 ***Special or Ad Hoc Committees:*** Special or ad hoc committees may be created by the Board of Directors. For each case, the Board of Directors shall specify the number of members the committee shall have and how the members are to be selected and the terms of the members if other than for the life of the committee. Special or ad hoc committees shall automatically be dissolved after two years unless the Board of Directors sets an expiration date. Each special or ad hoc committee shall report the status of its work at a Board of Directors meeting within one year of its formation or prior to completion of its activity, whichever is sooner.

PRACTICAL PAPERS, ARTICLES, AND APPLICATION NOTES

by Edwin L. Bronaugh

We are indeed fortunate to have a timely paper on a model for the site attenuation on open area test sites. Mr. McConnell has suggested a model for site attenuation at antenna separation distances of 3, 10 and 30 m for both horizontal and vertical polarization. Following a somewhat different approach, ANSI ASC C63 has just recently revised the model used in C63.4 for normalized site attenuation between horizontally polarized tuned dipoles at a test distance of 3 m. The results of both models now agree. Ordinarily, I do not like to put highly theoretical papers with many equations in this department, but Mr. McConnell has done an exemplary job of explaining in plain English what the equations mean and what his results are.

AN IMPEDANCE NETWORK MODEL OF THE OPEN FIELD RANGE

Roger A. McConnell, CKC Inc.

At CKC we have been working for several years on mathematical modeling of the open field range using resonant dipoles. Several papers describing these earlier modeling efforts have appeared in the National and International EMC Symposium records, and while the models for horizontal polarization produced good correlation with data from our seven ranges, they lacked mathematical rigor at several points. In particular, a good model for vertical polarization was lacking.

Recently we have developed a mathematically rigorous model in which the range is represented as an impedance network. In this model, the site attenuation is entirely a function of the self and coupled impedances of the dipoles and their terminating impedances.

The open field range is modeled as two dipoles located over a perfectly conducting ground plane, with two image antennas or reflections located below the ground plane. The image antenna technique is used to more easily portray the geometry of the direct and reflected paths between the transmit and receive dipoles, and also permits the calculation of the total coupled impedance effects of three antennas in the model acting upon the fourth antenna by calculating the coupled impedances between pairs of dipoles taken two at a time.

The model demonstrates a unification and continuity of the radiated near and far fields, and explicit far field and pattern expressions are not required. The self and coupled impedances contain magnitude and phase information which, when incorporated into the network equation, yield attenuation, gain, and pattern at both small and very large distances. The pattern information is particularly useful in the vertical model in which the antennas are staggered rather than centered on each other.

The model applies to either vertical or horizontal polarization, and to either the exact half wave dipole or the slightly shortened resonant dipole. The change from vertical to horizontal polarization is accomplished by changing the algebraic sign of three of the four coupled impedances.

Several assumptions lie behind the model. First, the ground plane is assumed to be of infinite conductivity and extent. Second, in the computation of coupled impedances, the dipoles are assumed to be infinitely thin and to have a sinusoidal distribution of current along their lengths.

The derivation of the site attenuation equation from the impedance network diagrams is straight forward, as will be shown. The network equation, however, contains the total coupled impedances resulting from the interactions of all the antennas, and the coupled impedances between the transmit and receive dipoles on both the direct and the reflected paths. The computation of these coupled impedances requires a large number of lengthy equations.

The model will be described in several steps: The network representation will first be developed. Next, the method of calculating the coupled impedances will be briefly outlined. Finally, comparisons between this model and other theoretical models and measurements from a number of open field ranges will be presented.

THE OPEN FIELD RANGE

In Figure 1 the open field range is shown. The transmit dipole is identified as Antenna 1, the receive dipole is Antenna 2, the image of the transmit dipole is Antenna 3, and the image of the receive dipole is Antenna 4.

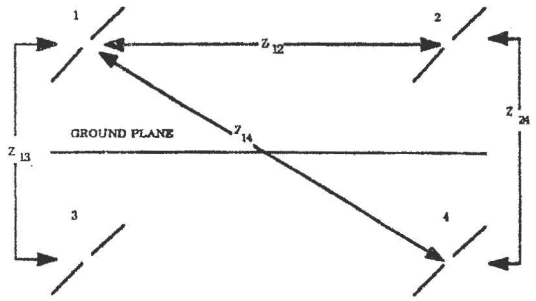


FIGURE 1 - THE OPEN FIELD RANGE

The coupled impedance paths are shown in Figure 1. The subscripts conform to the antenna numbering system. Thus, Z_{12} is the coupled impedance between Antenna 1 and Antenna 2, and Z_{14} is the coupled impedance between Antenna 1 and Antenna 4, which is equal to the coupled impedance on the reflected path between Antenna 1 and Antenna 2. Z_{13} is the coupled impedance between Antenna 1 and Antenna 3, and Z_{24} is the coupled impedance between Antenna 2 and Antenna 4.

In both horizontal and vertical polarizations, the tangential E-field at the ground plane must be zero. This means that in horizontal polarization the image of the transmit antenna is assumed to be driven 180^0 out of phase from the transmit antenna, whereas in vertical polarization, to achieve the zero tangential E-field, the transmit antenna and its image must be driven in phase. These considerations affect the algebraic sign of some of the coupled impedances. In horizontal polarization any coupled impedance associated with an image antenna has a negative sign. In vertical polarization any coupled impedance associated with an image antenna has a positive sign.

THE NETWORK MODEL

The network diagram of the transmit antenna and its driving source is shown in Figure 2. The signal generator produces a voltage V_S through its internal impedance, R_S. This voltage is applied to the transmit dipole which has a self impedance Z_{11}, and a coupled impedance Z_{M1}. Z_{M1} is the total effect on Antenna 1 of the coupled impedances from the three other antennas in the system.

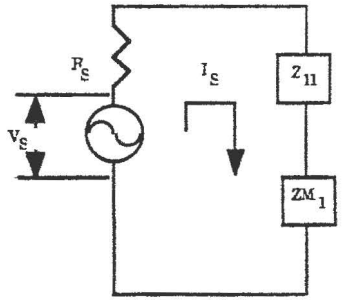


FIGURE 2 - THE TRANSMIT ANTENNA CIRCUIT

If all the impedances in this circuit are known, the current at the input terminals of the transmit antenna can be found:

$$I_S = \frac{V_S}{R_S + Z_{11} + Z_{M1}} \qquad (1)$$

At this point a careful consideration of the several coupled impedances is required. All of the coupled impedances between the various pairs of dipoles contribute to an alteration in the center impedance of both the transmit and the receive antennas. However Z_{12} and Z_{14} have, in addition, another role. These two coupled impedances relate the open circuit voltage produced on Antenna 2 to the current flowing in Antenna 1.

In Figure 3, the transmit antenna circuit is shown in slightly modified form. The coupled impedances Z_{12} and Z_{14} have been separated from the total coupled impedance Z_{M1}. The current calculated in Equation (1) flows through (Z_{12} - Z_{14}), producing V_{OC}, the open circuit voltage generated at the receive antenna. For horizontal polarization, Z_{14} is subtracted from Z_{12}. For vertical polarization Z_{14} is added to Z_{12}. For the horizontal case:

$$V_{OC} = I_S (Z_{12} - Z_{14}) \qquad (2)$$

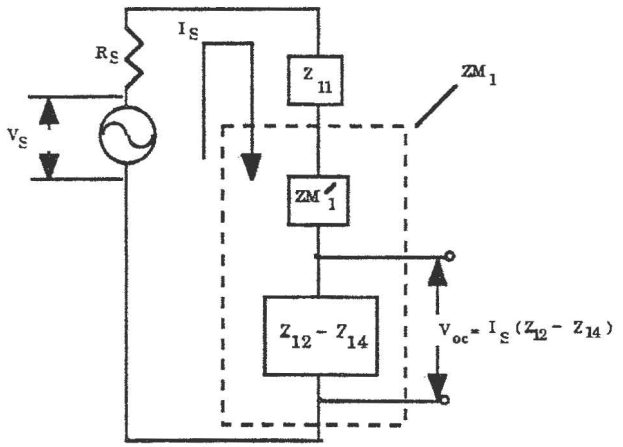


FIGURE 3 - THE MODIFIED TRANSMIT ANTENNA CIRCUIT

In Figure 4 the circuit of the receive antenna is shown. The coupled impedance (Z_{12} - Z_{14}), with current I_S flowing through it, has been replaced by the open circuit voltage, V_{OC}. At the receive antenna V_{OC} is connected to a series circuit consisting of Z_{22}, Z_{M2}, and R_L, where Z_{22} is the self impedance of Antenna 2; Z_{M2} is the total effect on Antenna 2 of the coupled impedances from the three other antennas in the system; and R_L is the load resistance of the spectrum analyzer or other measurement instrument connected to the receive antenna.

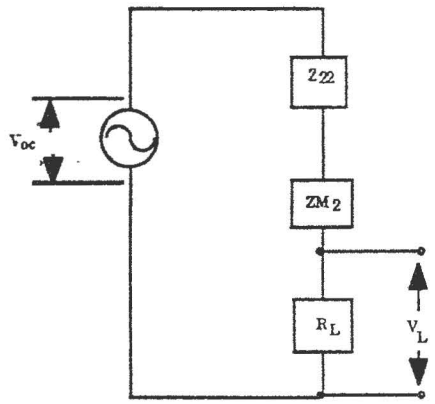


FIGURE 4 - THE RECEIVE ANTENNA CIRCUIT

The voltage, V_L, developed across the load resistance, can be found by voltage division:

$$V_L = \frac{V_{OC}\ R_L}{(R_L + Z_{22} + Z_{M2})} \quad (3)$$

SITE ATTENUATION

Site attenuation can be defined as the ratio of the voltage developed across the receive antenna load resistor to the voltage developed across the same load resistor when the signal generator is connected directly to it. In actual practice, the signal generator and the spectrum analyzer are connected with lengths of cable and baluns to their respective antennas. When the system is calibrated, the two baluns are disconnected from the antennas and are connected directly together. A measurement is then made of the voltage developed across the load resistor. Next, the signal generator is connected directly to the load resistor, and a measurement of the voltage is again taken. A comparison of the two readings gives the cable and balun losses. These losses, taken separately at each measurement frequency, are subtracted from the subsequent antenna range measurements for comparison to the lossless network model.

When the signal generator is connected directly to the receive load resistor, with no intervening cables and baluns as shown in Figure 5, the calibration voltage developed across the load is:

$$V_{CAL} = \frac{V_S\ R_L}{R_S + R_L} \quad (4)$$

Combining Equations 1, 2 and 3, and dividing by Equation 4 produces the site attenuation equation:

$$SA = \frac{(Z_{12} - Z_{14})\ (R_S + R_L)}{(R_S + Z_{11} + Z_{M1})\ (R_L + Z_{22} + Z_{M2})} \quad (5)$$

Expressed in decibel form:

$$SA = -20\ \text{Log}\ \frac{(Z_{12} - Z_{14})\ (R_S + R_L)}{(R_S + Z_{11} + Z_{M1})\ (R_L + Z_{22} + Z_{M2})} \quad (6)$$

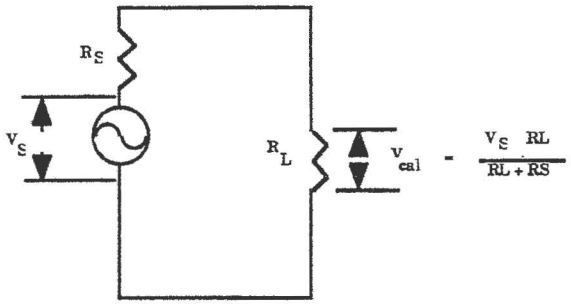


FIGURE 5 - THE VOLTAGE CALIBRATION CIRCUIT

If the source and load impedances are complex, R_S and R_L are replaced in Equations (1) through (6) by Z_S and Z_L.

CALCULATION OF COUPLED IMPEDANCES

A complete review of the methods of calculating the coupled impedances is too lengthy for presentation here. We hope to give a more complete description of the network model and its computer program, including all the details of the coupled impedance calculations, in a longer paper which is to be submitted for possible publication in the EMC Transactions or at the 1990 Washington EMC Symposium. A brief outline will be given here.

The coupled impedances for pairs of dipoles can be calculated using the methods developed by King[1], with a modification given by Ramo, Whinnery and Van Duzer[2].

King gives solutions for coupled impedances of dipoles whose longitudinal axes are parallel, but which otherwise can have any geometric relationship to each other, and may be of any length less than a half wavelength. Ramo, Whinnery and Van Duzer give a similar solution but include a factor $1/[\text{Sin}(\beta L_1)\ \text{Sin}(\beta L_2)]$, which represents a current normalization for dipoles shorter than a half wavelength. This factor is equal to 1 for half wave dipoles and is nearly equal to 1 for shortened resonant dipoles.

King's approach results in 18 sine and cosine integrals for the resistive part of the coupled impedance between a pair of parallel dipoles, and another 18 sine and cosine integrals for the reactive part. A further set of equations, involving sine and cosine integrals and logarithmic terms, is required for the coupled impedances of collinear dipoles, for the case of vertical polarization. All of King's equations, as shown in Reference [1], with the modification mentioned above, have been incorporated into a computer program of the network model.

It is necessary to consider not just the coupled impedance between pairs of dipoles, but also the total coupled imped-

ance from three dipoles in the site attenuation model acting upon a fourth dipole.

Smith, German and Pate[3] have derived the total coupled impedances in terms of Z, and the expansion of these impedances into their resistive and reactive components is given in Reference [4].

COMPARISONS WITH OTHER MODELS AND DATA

The network model produces site attenuation values which are in excellent agreement with the models of Sugiura[5] and Bennett[6]. The agreement with the ANSI C63.4 model is also quite good, except at the lowest frequencies and closest distances. In Figures 6 through 13 comparisons of various models and data are shown.

Figure 6 is a plot showing site attenuation as a function of frequency for a 3 meter range with horizontal polarization. The transmit dipole is at a height of 1 meter; the receive dipole is scanned in height for maximum signal between 1 and 4 meters. The solid line shows measured data as published by Bennett [6]. The dotted line shows the site attenuation as calculated with the network model.

Figure 7 is similar to Figure 6, except here the comparison is between Bennett's theoretical site attenuation values and those from the network model, i.e., a comparison between two models. The antenna heights are as in Figure 6 and the polarization is horizontal.

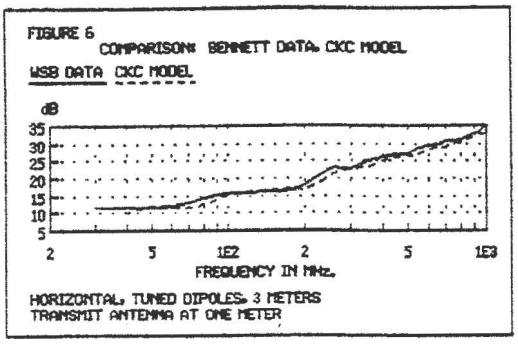
Figure 8 is a plot showing a comparison of Bennett's measured site attenuation data from [6] at a range distance of 10 meters, horizontal polarization, in comparison to the theoretical values from the network model. The transmit antenna is at a height of 2 meters, and the receive antenna is scanned in height for maximum signal from 1 to 4 meters.

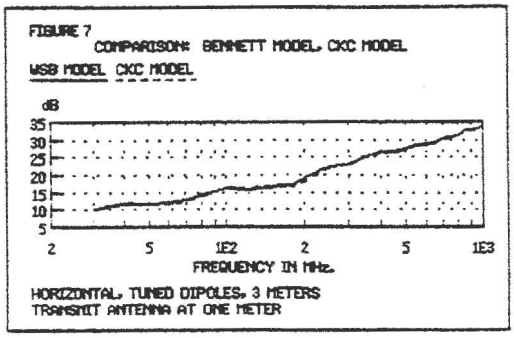
Figure 9 is similar to Figure 8, except here the range distance is 30 meters. The transmit antenna is at a height of 2 meters, and the receive antenna is scanned in height for maximum signal between 2 and 6 meters. The polarization is horizontal.

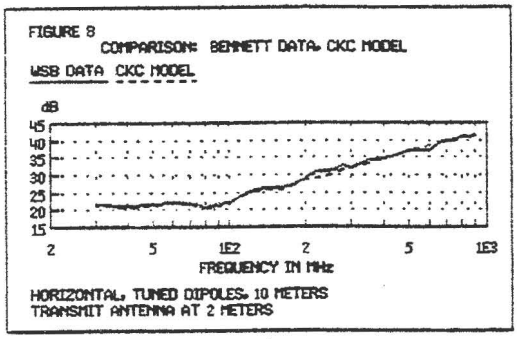
Figure 10 is a comparison of measured data from a range in Tillamook, Oregon, operated by CKC, with the theoretical values of the network model. The range distance is 3 meters, the transmit antenna is at 2 meters height. The receive antenna is scanned from 1 to 4 meters. The polarization is horizontal.

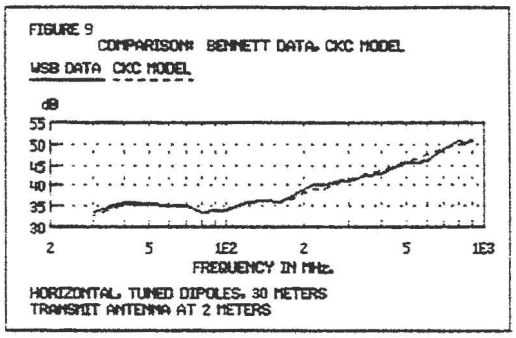
Figure 11 is a comparison of a model by Sugiura [5] with the network model. The range distance is 3 meters, the transmit antenna is at 2 meters, and the receive antenna is scanned from 1 to 4 meters. Sugiura's model has similarities to the network model, except that he has used the method of moments to obtain dipole self impedance and the antenna current spatial distribution.

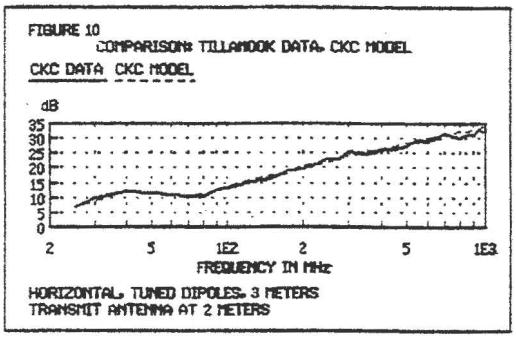
Figure 12 shows the same data and model as in Figure 10, from the Tillamook range, except here the data is shown in the ANSI C63.4 format of Normalized Site Attenuation.











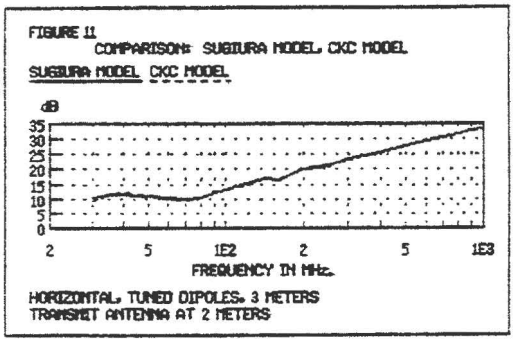
The range distance is 3 meters, the transmit antenna height is 2 meters, and the receive antenna is scanned from 1 to 4 meters. The polarization is horizontal.

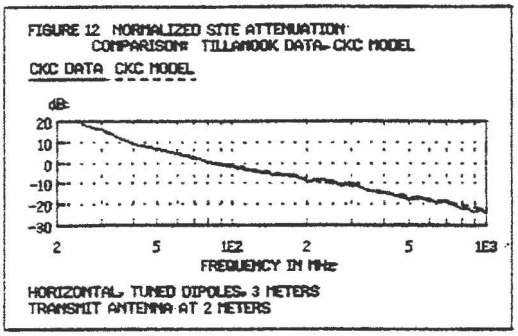
Figure 13 is a comparison of Sugiura's vertical model [5] with the theoretical values from the network model. The transmit antenna is at a height of 2.75 meters. The receive antenna is scanned in accordance with ANSI C63.4, so as to always maintain at least 25 cm. clearance to the ground plane. Above 100 MHz the scan range is 1 to 4 meters. The agreement between the two models is on the order of 0.2 dB at most frequencies, and the small differences are difficult to observe in this plot. Again, Sugiura uses the method of moments for calculation of dipole self impedance and the antenna current distribution, while the network model uses an assumed sinusoidal distribution of current and the induced emf method for calculation of self and coupled impedances.

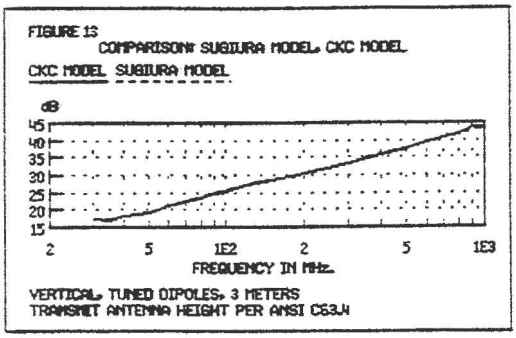
(NOTE: All symbols are defined on page 26.)

CONCLUSIONS

The horizontal network model is in agreement, generally within a few tenths of decibels, with the site attenuation models of Bennett and Sugiura, and demonstrates excellent agreement with data from a large number of open field ranges operated both by CKC and by others. It is in general agreement with the ANSI C63.4 horizontal model, but shows some discrepancies with that model at the lowest frequencies and closest distances. The vertical network model is in close agreement with the ANSI C63.4 vertical model. An interesting feature of the network model is that it demonstrates a unification and continuity of the radiated near field and the far field, and at large distances yields the standard values of dipole path loss, gain and pattern. One test of the validity of a model is its ability to accurately predict over a wide range of variables, and this model meets that test.







ACKNOWLEDGEMENTS

I wish to thank the following for their contributions to this work:

Ryan Bell for significant help in programming; Gerry Fuller, Kevin Slattery and Ralph Trefney for useful discussions; Albert A. Smith for bringing the King paper to my attention; Don Heirman for urging the development of a vertical model; Scott Bennett and Akira Sugiura for comparative models and data; Dale Bean, Craig Mullis, Tracy Park, John Shetler, Dennis Ward, and John Wood for gathering site attenuation data; and Chris Kendall for his support of this research.

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Mr. Roger A. McConnell, BSEE, is Senior EMC Consultant at CK Consultants, Inc., in Mariposa, California, where he has worked since 1986. During this time he has worked on many interesting projects ranging from PC board designs that minimize EMI to investigations of EMI susceptibility of fly-by-wire aircraft control systems and flight safety of aircraft exposed to high-energy radio frequency fields. For the last two years Mr. McConnell has been modeling open area test sites and reporting the results in EMC symposia. Before joining CKC, Mr. McConnell worked in high-energy physics and concomitant EMC problems at the Stanford Linear Accelerator Center and before that on microwave cavities to stabilize microwave oscillators at Varian Associates.

BOOK REVIEW

PROTECTION OF ELECTRONIC CIRCUITS FROM OVERVOLTAGES

Ronald B. Standler, John Wiley & Sons, New York; 1989. $49.95.

J. L. Norman Violette, Associate Editor

The preface sets the stage for what the reader should expect to find within the pages of this book. The book addresses problems associated with transient effects or electrical overstresses (EOS) encountered in electrical systems and equipment as a result of lightning activity, electromagnetic pulse (EMP), and switching of reactive loads. One stated goal is to "index and organize information on protection from overvoltages in one convenient place." Another goal is to "present practical rules and strategies for the design of circuits to protect electronic systems from damage by transient overvoltages." Whenever possible, rules for the latter goal "have been related to the physics of the situation rather than given as the author's opinion or a 'rule of thumb'."

The scope is stated as limited to protection of electronic circuits and systems including protection of equipment operating from mains with nominal voltages up to 1 kV rms. Topics purposely excluded include protection of electric power transmission and distribution equipment, and the details of the generation of overvoltages. Also excluded are specific examples of telephone equipment protection; specific details of protecting three-phase power circuits and shielding from transient electromagnetic fields; testing devices and equipment with potential differences greater than about 6 kV; and the recitation of the complete set of military specifications, commercial standards, and government regulations. Related material and references are provided on the latter topics.

The book is organized into four major parts: Part One: Symptoms and Threats; Part Two: Protective Devices; Part Three: Applications of Protective Devices; and Part Four: Validating Protective Measures. These four parts encompass 24 chapters and 3 appendices.

Part One, Symptoms and Threats, Chapter One, describes briefly and generally the nature of EOS problems and the trend of increasing attention they are receiving. This is tied to the increasing vulnerability to damage of more sensitive electronic devices. A nomenclature of terms used in the book is presented. The concepts of damage vs. upset thresholds are discussed including the problems faced by devices of smaller (and continually decreasing) dimensions.

The damage threshold is defined including its sensitivity to the transient waveshape and duration. The Wunsch and Bell model for the maximum power that can be safely dissipated in a semiconductor junction is described, along with the past investigations (by Enlow, Kalab, and Chowdhuri) of statistically-determined, typical damage failure thresholds for selected transistors and diodes. The research and problems associated with the accurate determination of damage thresholds are described. The concepts and likely causes of the upset threshold are also presented.

A logical approach to transient protection is presented; however, the difficulties of implementing the approach in practice are described.

In Chapter 2, properties of sources of overvoltages (threats) are concisely described, specifically: lightning, EMP, high-power microwave weapons, ESD, and switching of reactive electrical loads. Major parameters are presented, such as typical peak amplitudes of voltages, currents, electric and magnetic fields; rise and fall times; pulse durations; and some waveform and circuit representations. The propagation, coupling, and effects of overvoltages, and some prevention methods are discussed.

Chapter 3 describes threats in specific environments, including overvoltages on telephone lines, computer data lines, and AC power mains. The emphasis is on AC power mains disturbances. Definitions and terms of various AC line disturbances are presented, including: disturbance, overvoltage, notch, swell, sag, brownout, outage, and combinations thereof. Various parameters are defined and technical designations of the different disturbances discussed. A review of selected literature on AC power mains disturbances is presented. Conclusions based on the literature survey are presented, including areas where major transient protection problems are likely to exist, the likely propagation path of the transient, and the average rate (such as transients per day) at which transient overvoltages are likely to occur. Questions to be answered by future surveys, such as the actual waveshapes, peak voltages, and energy content of transients, are discussed. Also discussed are the effects of surge protective devices on surveys of overvoltages. Suggestions for monitoring and measuring disturbances are presented.

The propagation of overvoltages on cables is developed in Chapter 4. The propagation of signals is analyzed in terms of voltage and current differential-mode (DM) and common-mode (CM) components. Basic transmission line

theory is developed and also used to analyze the various effects encountered by a signal during propagation along a cable. The concept of a balanced conductor-pair, with balanced impedances, is used in the analysis of DM and CM effects. Examples are provided in the generation of CM voltages. A section is included on the use of "artificial mains" or "line impedance stabilization network (LISNs)" for making reproducible measurements of conducted noise emissions on power mains. The function of the LISN is described both for noise measurements and calculations of mains impedances.

Standard overstress waveforms used in the laboratory is the topic of Chapter 5. The point is made that current, and not voltage, is the appropriate variable for transient testing, although most test waveforms for electrical overstresses are specified as a voltage and not a current. The rationale for using current is provided. The parameters to specify test waveforms that represent a simplification of the environment are defined and graphically described: virtual waveform origin; front time; rise time; time to half-value; full width at half-maximum; and the alpha/beta-microsecond format. Overstress test waveforms specified in various standards are explained, along with the device rating nomenclature, such as the meaning of "8 x 20 microsecond" current waveshape and "1.2 x 50 microsecond" voltage waveshape. The limitations of the standard waveforms are indicated with mathematical equations presented. Exponentially-decaying, damped oscillation "ring" waveforms, such as the "0.5 microsecond-100 kHz" waveform described in ANSI C62.41-1980, are presented. The ring waveform can be used to specify either a voltage or current wave. Discussions are also included on waveforms defined in ANSI C37.90a-1974 (applied to high-voltage switchgear operations), IEC 801-4, CCITT Recommendation K17, FCC Part 68, HEMP, and constant dV/dT and dI/dT waveforms. Transient energy transfer to the device under test (DUT) is noted to be an important parameter in the selection of an appropriate test waveform with illustrated calculations. Frequency versus time domain analysis are compared for applicability, with the frequency spectra of different test waveforms presented as developed by Fourier analysis techniques.

Chapter 6 provides a brief overview of surge protection, including a comparison of blocking versus diverting methods; and voltage, frequency, and state discrimination. Two typical circuits are presented: one for general overvoltage suppression, and the other a hybrid protection circuit. The presence and significance of parasitic inductance is discussed along with an overview of nonlinear components.

Part 2 of the book, Protective Devices, includes Chapters 7 (Gas Tubes), 8 (Varistors), 9 (Avalanche and Zener Diodes), 10 (Semiconductor Diodes and Rectifiers), 11 (Thyristors), 12 (Impedances and Current Limiters), 13 (Filters), and 14 (Isolation Devices). These chapters present details on the respective suppression devices per the chapter titles. Advantages, disadvantages, and the limits of the respective devices in terms of voltage, current, power, energy handling capabilities, and follow current are specified. Voltage-current (V-I) characteristics are provided, and typical circuit applications are illustrated. Combinations of two or more devices (hybrids) are indicated for specific applications. A short section is provided in Chapter 12 on the potential use of superconductors. The presence and undesirable effects of parasitic inductance on suppression device performance are analyzed in detail in Chapter 15.

Part 3 of the book, Applications of Protective Devices, commences with Chapter 16 which provides an overview of applications. A key point for managers is made, to wit: "... protection from overvoltages, must be considered during the initial design of the system" to avoid "... a panic retrofit." Three design strategies are presented: (1) design the best protection circuit within a predetermined cost ceiling; (2) design for product survival for a specific test waveform; and (3) do not add overvoltage protection. Along with these strategies, where to add protection, what to protect, economic issues, design goals, and desirable properties of protective circuits are essential topics given consideration.

Chapter 17 develops protective device applications in signal circuits. Hybrid circuits containing spark gaps and avalanche diodes are analyzed and specifications for components are developed along with assembly considerations. Diode clamps to the power supply, internal protection circuit inside a CMOS logic circuit, balanced line applications, analog (inverting and noninverting voltage amplifier) applications, digital applications, RS-232 computer data line protection, and the protection of radio frequency signal circuits are included topics.

Applications in DC power supplies are presented on Chapter 18. Circuit protection includes linear power supplies, uninterruptible power supplies (UPSs), and switching power supplies. The determination of component values and specifications is addressed.

Chapter 19 and 20 present protection techniques for AC power mains, with Chapter 20 essentially addressing power distribution to computers. Arrestors installed by the electric utility company on distribution systems are considered outside the scope of the book. The book addresses secondary arrestors, branch circuit protection, and low-pass filter protection. The uses of metallic oxide varistors (MOVs) and spark gaps, and the combination of these devices, are developed. The problem and suppression of filter resonances and minimizing leakage currents are topics discussed. The uses of steel conduit for shielding, dedicated lines, turn-on sequencing, bunching of power cords, line conditioners (including tap-switching and ferroresonant, autotransformers, electronic voltage regulators, motor-generator sets, and UPSs are techniques presented. A rational approach to the selection of power conditioning equipment is included along with the use of a combination of different protection modules.

One area of caution is suggested by the reviewer: the author recommends compact bundling and securing of power cords to surge protection devices (SPDs) and line

(Continued on page 29)

(Continued from page 23)

DEFINITION OF SYMBOLS

ß	π /Lambda
D	Range distance between dipoles
h	Offset or staggering between dipoles
I_S	Current in the transmit dipole
j	imaginary operator
L	Lambda, wavelength
Ln	Natural logarithm
L_1	Half length of dipole 1
L_2	Half length of dipole 2
NSA	Normalized Site Attenuation
n	number of antenna segments in method of moments
π	3.14159
R_L	Load resistance of measuring equipment, 50 Ohms
R_S	Source resistance of signal generator, 50 Ohms
RM_1	Total coupled resistance, dipole 1
RM_2	Total coupled resistance, dipole 2
R_1	Distance from transmit dipole tip #1 to receive dipole
R_2	Distance from transmit dipole tip #2 to receive dipole
R_0	Distance from transmit dipole center to receive dipole
SA	Site Attenuation
V_{CAL}	Calibration voltage in site attenuation measurement
V_L	Voltage developed across receive antenna load resistor
V_{OC}	Open circuit voltage developed at receive antenna
V_S	Voltage developed by the signal generator
XM_1	Total coupled reactance, dipole 1
XM_2	Total coupled reactance, dipole 2
Z_{11}	Self impedance, dipole 1
Z_{22}	Self impedance, dipole 2
Z_{12}	Coupled impedance, dipoles 1 and 2
Z_{13}	Coupled impedance, dipoles 1 and 3
Z_{14}	Coupled impedance, dipoles 1 and 4
Z_{24}	Coupled impedance, dipoles 2 and 4
ZM_1	Total coupled impedance, dipole 1
ZM_2	Total coupled impedance, dipole 2
Z_0	Impedance of free space, 120π Ohms

EMCABS

William H. McGinnis
Associate Editor

In this issue we continue publishing abstracts of papers from previous EMC Symposia, other conferences, meetings and publications. The EMCABS committee is composed of the members listed below. By way of introduction to the community, they are listed with their company affiliations:

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Electromagnetic Biointeraction - Mechanisms, Safety Standards, Protection Guides

EMCABS: 01-05-90

G. Francheschetti,[1] Om P. Gandhi[2] and M. Grandolfo[3]
CNR-IRECE, Naples, Italy,[1] University of Utah,[2] and
Instituto Superiore di Sanita[3]
Plenum Press, 1989

ABSTRACT: This is a collection of lectures held at Capri, Italy in May, 1988. The occasion was an international course on "Worldwide Nonionizing Radiation Safety Standards: Their Rationales and Problems." The starting point for the discussion was the wide disparity between western standards and those of some Eastern European countries. Ten papers ranging from basic definitions and concepts through dosimetry, interaction mechanisms, bioeffects, safety guides and safety standards are included. While some of the papers, e.g., "Numerical Methods," are clearly for the specialist, many others serve the interests of the generalist. Extensive lists of references supporting the papers are included, making this book especially useful for the researcher.
INDEX TERMS: RADHAZ, Bioeffects, Nonionizing Radiation Safety, Standards for Nonionizing Radiation Safety, RF Dosimetry, ELF Fields

An Investigation of Near Fields for Shipboard Antennas Using the Numerical Electromagnetics Code (NEC)

EMCABS: 02-05-90

Lt P. Elliniadis and J. K. Breakall
Department of Elec. & Comp. Eng. Naval Postgrad. School,
Monterey, CA
1989 IEEE APS-S International Symposium, Antennas and Propagation
Vol. 1, June 26-30, 1989, Pgs. 236-239

ABSTRACT: The Numerical Electromagnetic Code (NEC) was used to evaluate the admittance, average power gain, and the electric near and far fields of a monopole antenna ($\lambda/5$) mounted on a cubical box ($\lambda/3$ per side) over a perfectly conducting ground plane. Two models of the box, employing surface patches and wire grids, were evaluated. The monopole was positioned at the center, the edge, and at the corner of the box top surface. NEC results were examined and compared with experimental data and with results from "PATCH," another independent electromagnetic modeling code. Computer graphics techniques were developed for plotting NEC near field results. Contour and 3-D amplitude and phase plots of the near electric fields were presented.
INDEX TERMS: Near Fields, Modeling, Antennas

Pyramidal Horns, Part 1: Simple Expressions for Directivity as a Function of Aperture Phase Error

EMCABS: 03-05-90

Dr. John F. Aurand
Microwave Physics Div. Sandia National Labs, Albuquerque, NM
1989 IEEE AP-S International Symposium, Antennas and Propagation
Vol. III, June 26-30, 1989, Pgs. 1435-1438

ABSTRACT: Pyramidal horn antennas are popular because they offer high gain, low VSWR, very pure linear polarization, and mechanical simplicity. When used as standard gain antennas in measurement situations, the gain and directivity are critical parameters, and theoretical analysis of the directivity is essential. This paper presents approximate equations for the directivity of pyramidal horns. These equations are accurate and much easier to evaluate than the exact equations, which involve complicated Fresnel integrals. The formulas are expressed in terms of gain-reduction factors, based on the quadratic phase errors in the aperture.
INDEX TERMS: Antennas, Horns, Pyramidal

Pyramidal Horns, Part 2: A Novel Design for Horns of Any Desired Gain and Aperture Phase Error

EMCABS: 04-05-90

Dr. John F. Aurand
Microwave Physics Div. Sandia National Labs, Albuquerque, NM
1989 IEEE AP-S International Symposium, Antennas and Propagation
Vol. III, June 26-30, 1989, Pgs. 1439-1442

ABSTRACT: Pyramidal horn antennas are often used because of their well-characterized radiation performance including precise gain as a function of size and very pure linear polarization. When designing pyramidal horns, previous methods have involved approximations and inefficient trial-and-error solutions. This paper presents a novel numerical method for determining the exact horn dimensions for any desired gain. It utilizes exact relationships to yield the required aperture dimensions and horn length, given an operating frequency, waveguide dimensions, and allowable quadratic phase errors in the aperture.
INDEX TERMS: Antennas, Horns, Pyramidal

EMI Reduction Techniques for Analog and Digital Circuits

EMCABS: 05-05-90

Michael Chernus
Chernus Designs
RF Design
May 1989, Pgs. 49-50

ABSTRACT: Today's high speed digital and analog components, with nanosecond rise and fall times, pose various problems for the design engineer. Keeping these circuits from radiating RF energy into space or into adjacent analog or digital circuits are two of the problems. This article offers practical solutions for controlling the EMI from these circuits.
INDEX TERMS: Circuit Design, Analog, Digital

Reduce Noise in Voltage Regulators

EMCABS: 06-05-90

Erroll Dietz
National Semiconductor
Electronic Design
Vol. 37, No. 5, March 9, 1989, Pgs. 84-90

ABSTRACT: Three terminal voltage regulators generally have an inductive output impedance which results in a frequency dependent output noise spectrum. Loading the output of the regulator with capacitors does not necessarily reduce the noise, but rather produces a noise spike at the resonant frequency of the regulator output inductance and the shunt capacitor. This article provides a discussion of the phenomenon and graphs of the frequency dependence of the noise and regulator output impedance.
INDEX TERMS: Noise

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Book Review *(Continued from page 25)*
conditioners to reduce electromagnetic radiations. However, not mentioned by the author, *this technique can lead to increased possibilities of power cable crosstalk which must be considered.*

Chapter 21 presents circuits that avoid upset. This pertains to the fact that protection circuits allow a small fraction of the incident transient overvoltage, called the remnant, to propagate to the protected devices and be misinterpreted as valid data, thereby causing *upset.* Techniques for upset avoidance are presented, which essentially means using circuits with relatively low susceptibility. Practical upset avoidance design techniques are suggested, with the additional consideration of using a coordination of overvoltage protection and upset avoidance techniques. A circuit design for overvoltage detection on power mains is also presented, and techniques are suggested for avoiding upset due to brief interruptions on power mains.

Part 4, Validating Protective Measures, starts with testing considerations in Chapter 22. The main topics addressed include types of tests, test plan formulation, test waveforms and the selection of same, test sequence, test polarities, EUT operation during test, statistical considerations, and criteria selections for pass/fail.

High-voltage laboratory techniques are the topics of Chapter 23. This includes coupling methods; the use of a back filter; time and frequency domain instrumentation, including voltmeters and oscilloscopes for high-voltage transients; the possible pitfalls of improper use of digitizer sampling; high voltage probes; differential amplifier applications; current transformers; current-viewing resistors; and types of surge generators.

The last chapter, Chapter 24, provides hints for safe use of high-voltage laboratory apparatus including "traditional" rules of safety procedures, such as one-hand-in-pocket, two people in room, readily-available "ground stick," ground checks, grounding the coaxial cable braid, safety resistors, shorting straps, barriers and fences, and power *off* when handling. The possible generation of X-rays and ozone by high voltage sources is described. First aid and medical treatment for electrical shock are indicated.

The three appendices include a glossary of terms (Appendix A), a list of manufacturers of components and test equipment (Appendix B), and an extensive bibliography (Appendix C).

The author has written a book that is comfortable to read on a relatively complex, empirical subject. The science and art of protecting circuits and systems from transient overvoltages essentially push the "upper" limits of nonlinear circuit analysis and applications, hence the use of the descriptive term "empirical." Repeatability is usually achieved within statistically broad ranges of parameter values (voltages, currents, power, energy, time), and paper analysis provides limited confidence in the results. Testing and actual performance, important in all practical technical endeavors in varying degrees, is especially applicable in transient protection engineering. The author succeeds in making this clear and he has essentially touched all areas of overvoltage protection.

The book is recommended as a reference for engineers, technicians, and students with an interest in the area of transient overvoltage protection. A shortcoming of the book is the absence of supplementary problems and the shortage of examples which limits its usefulness as a textbook. However, this can be overcome by providing supplementary problems. It is relatively unencumbered with mathematical detail. This may be considered a shortcoming for certain applications, such as may be required for detailed analysis or use as a text, but the list of references in Appendix C provides direction to more detailed developments. As a suggestion, the book can be used and supplemented with detailed specifications and applications notes provided by protection device and circuit suppliers and other sources.

INTER-SOCIETY ACTIVITIES

Donald A. Weber
Associate Editor

The following is a summary of current activities of SAE committee AE4 on EMC.

MIL-E-6051: The SAE has prepared a draft of ARP-4242 which is designed to replace MIL-E-6051E. It was extensively reviewed at the meeting and is scheduled to go out for national committee ballot before the next meeting in the spring.

A commercial susceptibility requirements document, AIR-1499, will be sent out for national ballot before the spring meeting.

The test fixture for measuring the transfer impedance of EMI *gaskets* is being modified to avoid internal resonances. A prototype needs to be built. The subcommittee is reviewing the details.

ARP-936 on feed-through capacitors has been revised and released. The revisions have been entirely editorial and include no technical changes.

ARP-958 on using a two antenna method of determining antenna factors is being reviewed for possible modifications.

A *filter* measurement technique, in non 50-ohm systems, *ARP-4244* is having final revisions incorporated before going out to national ballot.

Committee AE4 will next meet in May in Salt Lake City. Additional information may be obtained from Dwayne Awerkamp, Chairman of AE4, at Motorola, Inc., Scottsdale, AZ. Telephone (602) 441-3138.

Robert Mayher *(Continued from page 12)*

During this period, Bob became interested in the spectrum management activities of other countries and began a series of studies with Papua New Guinea, Venezuela and Thailand to improve their spectrum management practices. The latest study involves the computer-automation of the spectrum management system in China. He recently led a team of experts to China to present a seminar on "Spectrum Management" that was described on national TV and in an interview with Bob in the "Beijing Review."

In 1983, due to increased interest in improving spectrum management in developing countries, a course on "Computer-Aided Spectrum Management" was organized for the United States Telecommunications Training Institute (USTTI). Bob has continued to administer, lecture and take a personal interest in the foreign students that come to this country to take this course.

In 1985, Bob was promoted to Director of Spectrum Plans and Policies in the Office of Spectrum Management at NTIA. In this position he directs long-range planning and policy tasks for national and international spectrum related issues.

In 1990, NTIA is undertaking a "Comprehensive Policy Review of the Use and Management of the Radio Frequency Spectrum." In order to obtain a wide range of views concerning the national and international changes that may be required for spectrum management in the twenty-first century, Bob has organized seminars in Germany and Poland. In addition, a special session will be held at the 1990 IEEE EMC Symposium in Washington, DC, on "Spectrum Management Issues in the Twenty-first Century." From the international and national discussions, Bob plans to put together an overall report on recommendations to improve future spectrum management practices.

Although much of Bob's activities have obviously focused on international spectrum management problems, he has also been an active participant in IEEE activities. He was an officer for the 1980 Baltimore IEEE EMC Symposium, the 1983 Washington IEEE EMC Symposium and is publicity chairman for the 1990 IEEE EMC Symposium. He has written numerous reports for IEEE Symposia.

Additionally, Bob has served as chairman of numerous national and international committees dealing with spectrum management, participated in over 31 international ITU meetings and written over 90 reports dealing with spectrum management and EMC. He has received numerous awards from DOC for his work in spectrum management, but feels that perhaps the most interesting compliment was to have the handbook on spectrum management translated into Chinese and Hebrew.

PC's for EMC *(Continued from page 13)*

pole, vertical, loop, helix, horn, dish and diskcone." Programs are included for isolated antennas, for quads and Yagis, and for arrays. Multi-band design data is given for some types.

At least two antenna types are included for each band from MF to SHF, from 2 MHz to 10 GHZ and more for heavily used bands. Programs are usable for design of new antennas, or for detailed analysis of existing antenna performance. The practical problems of mast selection or design are covered, as are guying, foundation and anchor design. Design of wire and tube elements is covered, including design for icing conditions. All programs are designed for simple input of the basic design data -- typically frequency, gain and allowable size for antennas, or height and antenna size for towers. Output is in simple-to-use units. No theory is needed to use the programs.

EMC Certification *(Continued from page 14)*

MIL-STDs 461 and 462 are being revised. At one point it was suggested to NIST that they should hold off accrediting labs until the revised military standards had been issued to assure that labs would all be able to respond to the revised requirements. I was impressed with NIST's reply:

> ... To become accredited and maintain accreditation, a laboratory shall agree in writing to be capable of performing the tests for which it is accredited according to the latest version of the test method within one year after its publication. In practice, most of the test methods included in NVLAP programs are continuously reviewed and updated by the sponsoring organizations. This ongoing process is intrinsic to standards and accreditation activities. Therefore, the deferral of a program due to test method revisions is not warranted.

The response went on to further state,

> ... The purpose of NVLAP is to identify a group of competent laboratories all of which are capable of providing equivalent test results. The requirements on the laboratories include proper quality assurance programs, staff, documentation, etc. Accreditation of laboratories to the current version of MIL-STD-462 will achieve identifying a group of laboratories capable of meeting the requirements of the current test method. This process in turn will enable the laboratories to more easily incorporate the revised MIL-STD methods when they are available.

Interestingly enough, the first procurement from the Navy which incorporated certification as a requirement was issued by the Naval Sea Systems Command. The procurement closed in January and responses are being evaluated. I hope to be able to discuss the impact of the certification requirement on that procurement in the next issue.

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May 28 - June 1	1990 Nuclear EMP Meeting (NEM '90) University of Mexico Albuquerque, NM	**Contact:**	C. W. Jones NEM '90 Technical Program Committee Metatech Corporation 2309 Renard Place, SE, Suite 401 Albuquerque, NM 87106
June 26-29	10th Intl. Wroclaw Symposium on EMC The Technical University Wroclaw, Poland	**Contact:**	Mr. W. Moron EMC Symposium Box 2141 Wroclaw 12, Poland Tel.: 48-42-41
August 21-23	IEEE Intl. Symposium on EMC The Washington Hilton Washington, DC	**Contact:**	IEEE EMC International Symposium on EMC P.O. Box 19342 Washington, DC 20036
August 28 - September 5	23rd General Assembly of the Intl. Union of Radio Science (URSI) Prague, Czechoslovakia	**Contact:**	Prof. V. Zima, Chairman Local Organizing Committee 182 51 PRAHA 8 Czechoslovakia
October 29 - November 1	35th Annual Conference on Magnetism & Magnetic Materials Town & Country Hotel San Diego, CA	**Contact:**	Dr. John T. Scott American Institute of Physics 335 East 45th Street New York, NY 10017

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