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NEWSLETTER

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JANET O'NEIL, Editor

President's Message



BILL GJERTSON
PRESIDENT,
EMC SOCIETY

First I wish to welcome the new Newsletter Editor Janet O'Neil, and say "well-done" to Bob Goldblum, the retiring Editor.

Janet does not have to be introduced to you, our readers, as she is always there: wherever EMC is happening! Most of you have been recipients of her efforts in her roles as a member of the Board of Directors, Secretary of the EMC Society, Representative of Lindgren R. F. Enclosures and as an active member of many, many EMC committees, colloquiums and Chapters.

Bob Goldblum has set many standards in EMC, EMC Newsletters and EMC design/testing. He will be missed and of course he is still just around the corner if we need him.

So I wish both of them good luck and look forward to a continuing great Newsletter and reader response.

The year 1997 continues to be a great EMC year with another super EMC Symposium at Austin, Texas just concluded, membership growing and attendance at all EMC functions on the increase. All of you are to be thanked for this display of progress. As usual, we volunteers always have issues, concerns, events and activities. I would like each of you to consider getting involved at

the Chapter and Section level. Your IEEE and EMC Society membership is varied and multi-structured. Many activities are taking place at the Sections and the Chapters. Scan the EMC Society Chapters on the Web at:

[Http://www.emclab.umn.edu/ieee_emc/emchaps.html](http://www.emclab.umn.edu/ieee_emc/emchaps.html)

You'll notice another dimension to your EMC Society, namely the Chapters. Several EMC Chapters are being established jointly with other Societies, (e.g. MTT, ED & A&P). The Chapters need volunteers and are as active and effective as the volunteers chose to make them. There are many Chapter activities and many more can evolve depending upon the volunteers. Actually, the following are currently available: Distinguished Lecturers, job placement, networking, EMC "fixes" and social enrichments. It is up to you. Another activity that is especially broadening is occurring at the Sections. Most IEEE Sections have web pages, officers, lecturers, student affairs and are the place to interact with other IEEE Societies. You will be surprised and satisfied with the information/data you can obtain through the Section-Connection. Our EMC Chapters out there are a part of the local Sections and are a part of our EMC Society. It is important to your career and significant that you avail yourselves of these relationships and the related benefits.

As the successes of 1997 are reviewed and evaluated, it should become apparent that you as an individual IEEE and EMC Society member can expand your horizons, add depth to your career and have fun. All by increasing participation and then the number of activities. It is a great way to learn what others are doing in EMC and other electrical/electronic fields. Become an IEEE asset and realize the worth of your membership.

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JANET O'NEIL
EDITOR

I must say I am still overwhelmed with my new position as Editor of the EMC Society Newsletter. This is partly due to Bob Goldblum's flattering remarks about me in his last column (thank you Bob!) and the fact that it seems like just yesterday that I became involved in the EMC industry. They say time flies when you're having fun and I can sure attest to this.

To those of you who don't know me, I have been active in the EMC industry since the early 80s. I started working for an RF shielding company called LectroMagnetics, Inc. which was started by my father, the late Fred Nichols, in 1967. While working for my father, his enthusiasm for the study of EMC and his colleagues in the IEEE EMC Society rubbed off on me. Unwittingly following in his footsteps, I became active in my local chapter which was then Los Angeles. I served as Chapter Chairman one year and also held the posts of Vice-Chairman, Secretary, and Treasurer (when I was elected to be Treasurer, I had no idea it was "assumed" I would continue up the ladder, but I did - sound familiar?). Activity in the Los Angeles Chapter led to my appointment as Secretary of the EMC Society Board of Directors in 1988, a position I have held to this day. With the passing of my father, LectroMagnetics was acquired by Lindgren RF Enclosures in 1991. The owner of Lindgren is Bill Curran, Sr., who was a good friend of my father's. They both started out fairly early in the EMC industry and established a long, mutually respectful relationship as manufacturers of complimentary RF shielding products. I was fortunate to continue working for Lindgren and I now enjoy representing the company in my new location in the Pacific Northwest. Last year my husband accepted a position within his company which necessitated a move to the Seattle area so we packed up with two young kids and moved north from Los Angeles. True to form, once I arrived, I hooked up with a fellow ex-Californian,

Ghery Pettit, and reactivated the Seattle EMC Chapter. I was elected Vice-Chairman of the chapter and have lately been busy scheduling speakers and planning the chapter's summer social. Along the way over the past few years, I have also become active in organizing regional one day EMC Society conferences. Since so many of our EMC Society members cannot attend our annual symposia, I believe there is a real need to bring EMC education to the members through these regional conferences.

This journey along the EMC path has been especially rewarding due to the many friendships I have formed over the years with my fellow IEEE EMC Society volunteers. I owe many people, especially my mentor in the early days, Len Carlson, a debt of gratitude for encouraging me to take on new responsibilities, such as becoming Secretary of the EMC Society Board of Directors.

I am looking forward to the challenge of being Editor of the EMC Society Newsletter. I look forward to addressing your need for news and to meeting the "movers and shakers" in the industry that make the news. I hope that you will take the time to say hello and stop for a visit should you see me at an EMC Society chapter meeting or regional conference.

So, there you have it! That's me in a nutshell. Little did I know when I used to wind coils for RF filters for my father in the late 60s that I would one day be editing a Newsletter devoted to EMC. Now I know why he counted the turns on each coil - at the time I thought he was just picky!

Thank you to Bob Goldblum for continuing with the Newsletter as an Associate Editor on DoD E3 activities. You'll find Bob's new column on page 10. Also, many thanks to the Associate Editors for continuing with their positions. I feel extremely fortunate to have such a strong team supporting me as Editor.

So, as Bob said in his last column, "Let's keep in touch!"

Notice to Members of the EMC Society

At the May meeting of the Board of Directors, the Board approved the following change to the Constitution to institute a President-Elect position, rename Technical Director positions to Vice-President positions and to change the President's term of office from one to two years. This change to the Constitution will take effect unless ten percent of the Society membership object in writing within 30 days. A signed objection letter must be mailed to the Secretary of the Board of Directors. Please address your objection letters to: Janet O'Neil, c/o Lindgren RF Enclosures, 2523 239th Place NE, Redmond, WA 98053. If such objections are received, a ballot will be mailed to all Society members.

Proposed Constitution Change Approved at the May 5, 1997 Meeting of the EMC Society Board of Directors

Article V- Administration

Section 2. The Board of Directors shall every other year elect one of its Directors-at-Large or its Executive Directors as President-Elect, whose term shall be for one year and shall then serve as President for a two year term. A Secretary, Treasurer and Vice-Presidents shall also be elected or reelected for two year terms. The Secretary, Treasurer and Vice-Presidents need not be Directors-at-Large.

Section 3. Newly elected President-Elect, Secretary, Treasurer, Vice-Presidents and new members of the Board of Directors shall assume office on the first of January of the year following the year in which elected.

Section 5. The President, under direction of the Board of Directors, shall have general supervision of the affairs of the Society. The President shall preside at meetings of the Board of Directors, at general meetings of the Society, and at the Annual Meeting of the Society, and have such other powers and perform such other duties as may be provided in the Society Bylaws, or as may be delegated by vote of the Society Board of Directors. In the President's absence or incapacity, the Presidential duties shall be performed by the immediate Past President during the President's first year in office and by the President-Elect during the President's second year in office.

Submitted by: Warren Kesselman, Immediate Past President of the EMC/S Board of Directors and Chairman of the Constitution and Bylaws Committee

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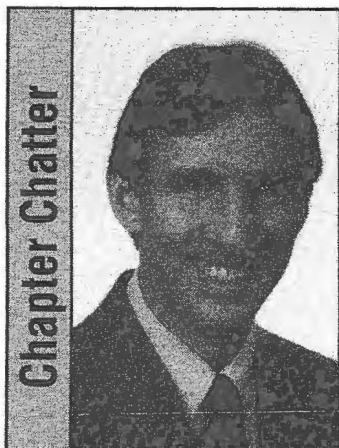
August
November
February
May

Editorial Deadlines

July 1
October 1
January 1
April 1

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TODD HUBING
ASSOCIATE EDITOR

The IEEE EMC Society will be sponsoring part of an exhibit at IEEE headquarters in Piscataway, New Jersey. Each participating society has been asked to identify a prominent historical figure to be commemorated in this exhibit. The EMC Society is asking for your help to identify a person or group who has made a significant contribution to the field of EMC. Many great figures from history were EMC engineers. Most of them, however, are better known for their non-EMC related accomplishments. For example, few people are aware that Wilbur Wright was an EMC engineer. Of course, in the early part of his career, he was more popularly known as Wilbur Wrong; a nickname frequently attributed to his EMC design strategies, which used huge shields to compensate for fundamental design problems. His brother, Orville, a thermal engineer, always insisted on mounting huge cooling fans to every shield. One day, at Kitty Hawk, one of their designs really "took off", giving new meaning to the terms "risetime" and "floating ground". Few people are aware that Dr. Suess, renowned author of children's books, began his career as an EMC engineer.

Sure, I know that you're thinking. How could anyone with the title "Dr." know anything practical about EMC? Nevertheless, I hear he was very good. He probably could have had a long and distinguished career in EMC if only he'd had better communication skills. Here's an excerpt from one of his early ESD test reports:

Here's a box with lots of clocks.
Here's a box with lots of slots.
Shock the box with lots of clocks.



Todd Hubing receives a certificate of appreciation from Bruce Crain, Atlanta EMCS Chapter Chairman

Shock the clocks through lots of slots.

Do the clocks in the box with slots lock?

Is the box with lots of slots shot?

Block the slots in the box that locks.

Shock the box with lots of blocked slots.

Does the box with blocked slots lock?

Is the box with blocked slots hot?...

See the problem? Engineering managers couldn't understand his writing so Dr. Suess had to find a more sophisticated audience. Too bad! If he'd just stuck with his EMC work, he might have been commemorated with a plaque in the lobby of IEEE Headquarters. As it is, we'll have to find someone else. Who's your favorite EMC icon? Submit your nomination to Janet O'Neil (j.n.oneil@ieee.org) before December of this year.

Atlanta

Bruce Crain, Chairman of the Atlanta chapter, reports that the Atlanta EMCS Chapter held its spring seminar on April 16th on the Georgia Tech campus. Dr. Todd Hubing, an EMCS Distinguished Lecturer, presented "An EMC Engineer's Guide to Electromagnetic Modeling Software." The meeting was held at 1 PM after a noon lunch, which was a departure from the normal evening meeting time. Judging from the enthusiastic response (54 in attendance) this definitely won't be the last mid-day meeting of the Atlanta chapter! The on-campus meeting location contributed to a good student turnout, which was in keeping with Atlanta IEEE Section's 1997 goal of improved student involvement. Dr. Hubing's presentation was well received by the audience of students, faculty and engineering professionals from the Atlanta electronics industry. Judging from the audience response, many in attendance entered the meeting with questions and misconceptions about the availability of EMC modeling tools to satisfy their engineering needs.

Dr. Hubing did an excellent job explaining the capabilities and limitations of currently available EMC modeling software. A discussion of the future of modeling systems, including a brief description of an EMC expert system being developed by the University of Missouri-Rolla, concluded the presentation. The Atlanta EMCS chapter thanks Dr. Hubing and the EMCS Distinguished

guished Lecturer program for making this seminar possible and encourages all local chapters to make use of the EMCS Distinguished Lecturer program.

Beijing

The 1997 International Symposium on Electromagnetic Compatibility was held in Beijing, China from May 21 to May 23. The symposium was organized by the IEEE Beijing Section, URSI Committee E, the URSI CIE Committee, and IEE Beijing Center with the technical co-sponsorship of the IEEE EMC Society. The symposium was also supported by the China Electrotechnical Society, the China Institute of Communications, the China Railway Society, the Chinese Institute of Electronics, the Chinese Power Supply Society, the Chinese Society of Aeronautics, the Chinese Society of Astronautics, the Chinese Society of Electrical Engineering, the Chinese Society of Naval Architecture and Marine Engineering, and the IEEE Beijing EMC Chapter. Prof. Gao Yougang acted as symposium general chairman. The chairman for the technical program committee was Prof. Zhang Linchang (China) and the co-chairmen of the technical program committee were Masashi Hayakawa (Japan) and Edward F. Vance (USA). The Chairman of the local organizing committee was Prof. Sha Zhong. Roughly 300 participants from 23 countries attended the meeting. The exhibition included 30 exhibitor booths.

The symposium was highly evaluated by the participants and the exhibitors. Before the symposium, some scientists were invited to the universities and the research institutes in Beijing to give lectures on EMC achievements and to exchange opinions on EMC and EMI problems.

Some of the representatives visited the laboratories of the universities and research institutes. These activities helped to promote technical exchange between the researchers and students. The symposium program committee of EMC'97/Beijing received over 170 technical papers. After careful selection by the technical program committee,

a total of 132 technical papers were presented in 16 sessions. The papers were devoted to EMC measurements, EMC in communication systems, standards, seismo-EM phenomena, shielding and grounding, EM sensors, probes, antennas, EMI prediction/analysis/reduction, EMI coupling/cross-talk, biological effects, EMC in microelectronics, EMC in computer and PCB's, EMC in power engineering, spectrum management and education, EM calculation, lightning and ESD, EMP, and absorbing material. The sessions covered almost all the EMC topics in which people are interested today. The representatives reviewed the current research results as well as the future trends of EMC technology. The full text of the presentations has been made available in the symposium proceedings, which has 533 pages. The symposium was an excellent venue for personal contact and direct information exchange. More than 80% of the participants said that they found solutions or at least information in support of a solution to their practical EMC problems. The attendees also provided many useful suggestions for the next EMC/Beijing symposium which will be held in 2002.

Central New England

John Clarke, Secretary/Treasurer of the Central New England chapter reports that the March meeting featured Jan Coenraads and Ruud Jeltjes, of the Netherlands Measurement Institute. The topic of their presentation was "How to Deal with the EMC Directive in '97." The speakers discussed recent development in the European EMC regulations and standards and the process of implementing the requirements of the EMC Directive. In May, the chapter organized an EMC Technology session for the Electronics Industries Forum (EIF) held in Boston.

Papers were presented at this session by Dan Hoolihan, Art Wall, Ronald Storrs, Stephen Berger, Joe Butler, Bill Ritenour, Lee Hill, and Ronald Brewer.

Chicago

The experts in EMC measurement uncertainty gathered in Chicago on April 7 and 8 to present an "EMC Measurement Uncertainty Workshop."

This workshop was hosted by ANSI ASC C63 and the expert speakers included Don Heirman of Lucent Technologies, Dan Hoolihan of TUV Product Service, Ed Bronaugh of EdB EMC Consultants and Chris Kuyatt of NIST.

Several Chicago Chapter members provided supporting roles in organizing the event including Tom Braxton of Lucent Technologies, Ray Klouda of Elite Electronic Engineering, and Brian Mattson of DLS Electronic Systems. Over 50 people attended this third technical forum held in the United States on the treatment of uncertainty in EMC measurements. Many attendees were interested in ISO/IEC Guide 25 and its requirement that uncertainty values must be specified in order to state whether a product passes or fails or to even make any statement!



The lobby of the Media-Hotel at the 1997 International EMC Symposium in Beijing, China. From right to left: Prof. Ernest K. Smith, Prof. Yasumitsu Miyazaki, Prof. Gao Yougang, Prof. Gas Benging and Dr. Liu Hing.



At the ANSI ASC C63 EMC Measurement Uncertainty Workshop in Chicago, speaker Chris Kuyatt of NIST (L) enjoys break time with attendee Mike Windler (R) of Underwriters Laboratories.

Much discussion was generated and a fourth technical forum on the topic was scheduled for all day October 22 and the morning of October 23, 1997 in Baltimore, Maryland. In fact, interest in Guide 25 was so high that a specific ANSI ASC C63 workshop on Guide 25 audits for test lab personnel and managers was scheduled for the afternoon of October 23 and the morning of October 24, 1997. The Guide 25 workshop will immediately follow the "EMC Measurement Uncertainty Workshop" at the DoubleTree Hotel at the Baltimore/Washington International Airport. Contact Janet O'Neil of Lindgren RF Enclosures at 425.868.2558 for more information.

(Note: There will also be an ACIL Globalization Conference on October 20 and 21 at the same venue immediately preceding the ANSI ASC C63 workshops. For more information, contact Sheila Way at the ACIL, 202.887.5872.)

The last regular meeting of the Spring '97 sessions was held in May at Lucent Technologies. The guest speaker

was Norm Wehling from Elite Electronic Eng. Co. who presented an interesting talk on using "Modified Mode Stirring Methods" for radiated immunity. The data presented demonstrated how this method produces uniform fields and excellent repeatability.

Oregon

Well, no one can accuse the Oregon Chapter of thinking small. After forming in April 1996, the chapter decided to go all out and plan a one day technical conference and exhibition just one year later. "EMC '97: A Colloquium and Exhibition on Pre-Compliance EMC Testing Problems and Solutions" was held at the Red Lion Hotel Columbia River in Portland, Oregon on April 14, 1997.

Over 150 people attended from the growing hi-tech area of Portland and the Pacific Northwest. The attendees represented such companies as Intel, Hewlett-Packard, Tektronix, CKC Laboratories, Boeing, Underwriters Laboratories, In Focus Systems, and Northwest EMC, to name a few. The full day program featured EMC industry experts who spoke on a variety of practical topics. Henry Benitez, Chairman of the Oregon Chapter and Chairman of the Colloquium (whew!), started the program by providing an overview of EMC requirements. Bill Ritenour of EMC Compliance, LLC then spoke on ESD. Scott Roleson of Hewlett-Packard next presented his popular paper entitled "Bench Top Radiated Emissions Test Techniques". After these presentations, there was a relaxed sit down lunch break, which featured "networking" opportunities with the speakers. After the big lunch with a wonderful carrot cake dessert, which is usually certain death for most speakers, Henry Ott rose to the occasion and kept everyone awake with his presentation on PCB design techniques and ground plane inductance.

Next followed Ken Javor of EMC Compliance on the topic of conducted and radiated immunity troubleshooting techniques. Steve Jensen of Steve Jensen Consultants con-



Moto Kanda of NIST (L) and Dan Hoolihan (R) relax during the reception following the ANSI ASC C63 EMC Measurement Uncertainty Workshop. Mr. Hoolihan was one of four speakers at the workshop.



At the Salty's dinner party preceding "EMC '97: A Colloquium and Exhibition on Pre-Compliance EMC Testing Problems and Solutions," speaker Henry Ott (L) discusses PCBs and EMC with fellow guru Bob Dockey of Hewlett-Packard (R).



Oregon Chapter Chairman and EMC '97 Colloquium Chairman Henry Benitez (L) presents Registration Chairman Liz Higgins (R) with a thank you gift for calmly processing the many last minute registrations (and for putting up with Henry's ranting and raving!)

cluded the technical program with his presentation covering conducted emissions troubleshooting techniques and analysis. It was a full day of technical presentations, but most attendees stayed for the reception with the speakers. This was also the ideal opportunity to visit the 30 tabletop displays showing the latest and greatest in EMC related products and services. The highlight of the reception was the raffle of a ScanEm hand-held near-field probe donated by Credence Technologies of Santa Cruz, California. This was won by Rob Castro of Intel who exclaimed, "I never win anything!" when his business card was picked from the fishbowl. (We've all heard that line before!) The reception featured a bottomless bowl of prawns, several tempting hors d'oeuvres, fajita buffet and a pasta station. The desert buffet was visited and re-visited several times during the evening.

Some of speakers presented demonstrations related to their respective presentations. Playing to rapt audiences were Bill Ritenour, Scott Roleson and Ken Javor.



Also at the Salty's dinner to celebrate the Oregon chapter one day EMC Colloquium were local chapter members Dean and Sue Ghizzone (L and C) from Northwest EMC and Colloquium committee member Bruce Brunstad (R).



It's a line up of the EMC industry's "Most Wanted" . . . Speakers, that is! Speakers Henry Ott, Ken Javor, Steve Jensen, Scott Roleson and Bill Ritenour (L to R) seem relieved that the long day at EMC '97 in Portland, Oregon is over!

At the conclusion of the reception, the colloquium organizing committee celebrated the success of the day with a champagne toast to the speakers who donated their time and energy to participate. Ray Adams, Chairman of the Los Angeles Chapter who created this one-day conference format, was also acknowledged for his brilliance.

Exhausted, but happy, were organizing committee members Henry Benitez, Liz Higgins, and Bruce Brunstad of Tektronix, Janet O'Neil of Lindgren RF Enclosures, and Rob Castro of Intel (no, the raffle drawing wasn't fixed!). To participate in the energetic Oregon Chapter and attend the meetings, please contact Henry Benitez at 503.627.1217.

Pikes Peak

The May meeting of the Pikes Peak chapter featured Dr. Todd Hubing, of the University of Missouri-Rolla. Dr. Hubing's presentation was titled, "An EMC Engineer's Guide to Electromagnetic Modeling Software."



At the reception following EMC '97, speaker Scott Roleson (R) provides a step by step demonstration of his presented material to Bruce Carsten of Bruce Carsten Associates (L).

Rocky Mountain

Several members of the Rocky Mountain Chapter were spotted the week of April 28 at the "Mode-Stirred Chamber, Anechoic Chamber, and OATS Users Meeting" held in Vail, Colorado at the Lion Square Lodge. This conference was hosted by the Fields and Interference Metrology Group of the National Institute of Standards and Technology (NIST). This annual conference truly brings together the experts in the field.

Over 150 people attended this conference from the international EMC community. Galen Koepke and Moto Kanda of NIST chaired the technical program and they were obviously pleased at the conclusion of the conference. The papers were very well received by the audience and the question and answer periods following the papers was often very spirited. The Lion Square Lodge is located on the banks of the Gore Creek and this presented an ideal, relaxing backdrop for the conference.

Despite the fact that it snowed, yes snowed, all day on May 1, after the technical program several eager (and warmly attired) attendees, including Janalee Graham of General Motors, Diane Kempf and "Buzz" Brezinski of the Naval Air Warfare Center and a few other hardy souls took a stroll along the banks of the Gore Creek. For Californians Gabe Sanchez of Advanced Electromagnetics, Dave Hanttula of Silicon Graphics, Jim Chiappe of CKC Labs, and Dave Traver of Sony, sitting in front of the cozy lobby fireplace was just fine. The next "Mode-Stirred Chamber, Anechoic Chamber, and OATS Users Meeting" will be held in September 1998 at Rome Labs in New York. For more information, call Ray Tucker at 315.330.4217.

San Diego

Dave Bernardin, Chair of the Chapter, reports that the last chapter meeting before summer break was held June 25th.



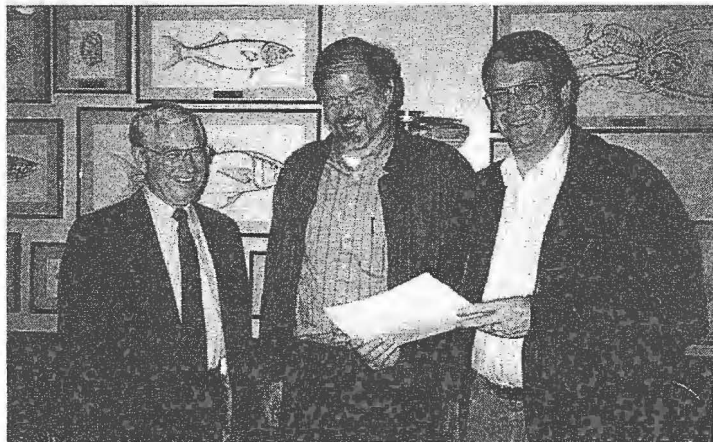
Most everything you wanted to know about mode-stirred chamber technology could be learned during this coffee session between experts Mike Hatfield of the Naval Surface Warfare Center (L), Ted Lehman, consultant (C) and Diane Kempf of the Naval Warfare Center (R). The trio gathered at the "Mode-Stirred Chamber, Anechoic Chamber, and OATS Users Meeting" in Vail, Colorado.

It featured a barbecue and a presentation by Mark Arthur of Sony Corporation. Mr. Arthur's presentation was titled, "Magnetic Fields and the New MPR3 Test Procedure."

Seattle

The Seattle Chapter featured some old time favorites at its April and May meetings. In April, Joe Fischer, of Fischer Custom Communications, spoke on the topic "Bench Top Techniques of Solving Conducted and Radiated Emissions Problems." Joe traveled from sunny southern California to speak in rainy Seattle. The chapter members in attendance certainly appreciated this sacrifice as Joe provided many valuable solutions to common design problems. The practical, tutorial type presentation was a real hit, especially the references to "bread board" phases of design. In May, local hero Warren Boxleitner, President of The Boxleitner Group in Kirkland, Washington, gave a presentation titled "Design Techniques to Achieve Immunity and to Pass All the Tests". How's that for a comprehensive presentation? Again, this was a practical, tutorial type presentation that addressed such topics as basic concepts for immunity, EMI coupling methods, and reduction of ESD caused by moving parts. Practical solutions were provided for circuits, PCBs, enclosures, cables and grounding.

Several nodding heads in the audience indicated that Warren's points were hitting home. No wonder he's listed in Who's Who in Science and Engineering! The Seattle Chapter will take a break for the summer and resume the technical program in the fall. In the meantime, there will be a Chapter summer social at Acme Testing. Acme Testing's Steve Fitzgerald is welcoming chapter members and guests to his lab for an outdoor barbecue picnic. Chapter members will appreciate the ideal location of Acme Testing on the banks of the Nooksack River (bring those inner tubes!). It enjoys the natural RF isolation of a beautiful, secluded valley - the perfect spot for an EMC party! Those interested in attending Seattle Chapter meetings should contact Chairman Ghery Pettit of Intel at 253.371.5515.



Seattle Chapter Chairman Ghery Pettit (R) reviews the handouts of speaker Joe Fischer (L) with Chapter Secretary John Kuras of Boeing (C).



Everyone helps out at the Seattle chapter meetings! That's chapter member Jeannie Olson of Kalmus (L) assisting speaker Warren Boxleitner (R) with the overhead projector (which Kalmus donated for the presentation).

Southern Maryland

The June meeting of the Southern Maryland chapter featured Mr. Keith Wallace of Veda Incorporated. His presentation discussed the system architecture and design of a mobile advance range data system and control station that employs both unaided and differential GPS. Mr. John Pasour, of Mission Research, was the speaker at the July meeting.

His presentation was titled, "Clamp-Lite: A Current Probe for Measurement of RF Induced Current in the Body." Mr. Pasour discussed his invention, which is a current probe that measures RF currents induced in the body or in human-equivalent phantoms, antennas or similar structures. He discussed the use of the probe by personnel in potentially hazardous RF field areas and how it performed.

Washington/Northern Virginia

The Washington/Northern Virginia chapter sponsored the EMC Harmonization Conference on May 1st. Prominent industry, military, and government professionals gave presentations to over 200 attendees at this conference held at the McLean Hilton in Northern Virginia.

Charles Ludoph, Director of the Office of European Union and Regional Affairs from the U.S. Department of Commerce, presented the keynote address. His speech focused on EMC in mutual recognition agreements.

Global Conformity Assessment C was presented by Chuck Berestecky from Lucent Technologies. Don Witter from the FDA spoke about medical devices and emerging and evolving requirements for EMC and FDA approval. Recent advances in the FCC EMC Equipment Authorization Requirements were discussed by Art Wall. Bill Duff from CSC discussed the dangers ahead in EMI communication systems overload. The international track featured Anil Sastry from TTC who addressed tips and techniques of CE marking telecom equipment. Ian McDiarmid from British

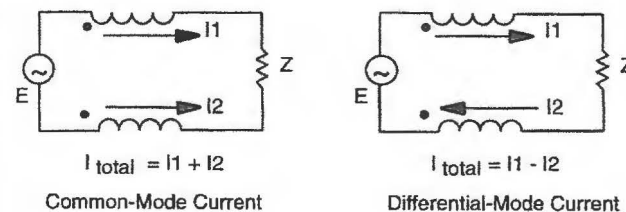
Aerospace discussed proposed developments in EMC design and testing as a result of the use of modular devices. EMC in EU Medical Devices Directive for the June 14, 1998 deadline was given by John Flood from Technology International. Measuring up to the EMC Directive was the topic presented by Mike Violette of Washington Laboratories.

The Army View session was chaired by Dave Bassett from the Army Research Lab in Aberdeen. Eddie Meadows from PMITTS-IMO spoke on the integrated E-3 assessment of combat performance in an anechoic chamber. The Navy view session was chaired by Stephen Caine and Joe Juras from NAVSEA. John Eadie, also from NAVSEA, presented the future of anechoic and reverberation chambers in MIL-STD testing. Kathryn Medley of AFFMA was the session chair for the Air Force session. Sam Fraser from the NAWC discussed C-17 lightning testing. The Joint Perspective session included a discussion by Bill Lenzi from JSC & NSWC/DD of the hazards of EM radiation to ordinance. The show's program also provided two technical tutorials: Norman Violette presented an introduction to EMC and Don Heirman discussed measurement uncertainty.

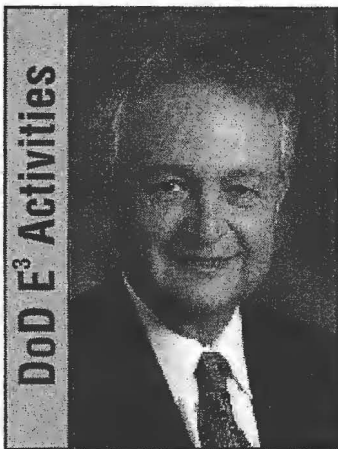
Area testing labs demonstrated equipment and testing set-ups and procedures throughout the day. An exhibition hall full of service and equipment providers from the industry was also a featured part of the Conference.

Corrections

The Editor apologizes for an error which appeared in the last issue of the Newsletter concerning the article by Mark Montrose entitled "EMC Suppression Concepts for Printed Circuit Boards Image Planes and Stackup Assignments." The drawing shown in Figure 2 for the differential-mode current was printed incorrectly. The correct drawing is shown below.



The Editor also wishes to clarify statements made concerning a past review of the book entitled "Electromagnetic Compatibility in Power Electronics" by Alafzlo Tihanyi. This book is published by J.K. Eckert & Co., Inc. It is distributed in the USA by the IEEE Press and elsewhere by Butterworth-Heinemann.



ROBERT D. GOLDBLUM
ASSOCIATE EDITOR

Janet has graciously asked me to become an associate editor of the *EMCS Newsletter* covering DoD E³ activities. Since there is so much EMC focus being placed on commercial EMC requirements imposed by the IEC, FCC, and other agencies, many have overlooked the future role of the DoD and its influence in EMC standardization and technology.

In this new column, it will be my intent to bring readers up-to-date on E³ activities and organization at the DoD level. One should bear in mind that what I write is not the official word from the Government. It is my perspective on government activities. I should also mention that there is a government *Joint E³ Bulletin* published quarterly by the Joint Spectrum Center (JSC). Persons heavily involved in DoD-related E³ matters may qualify for a free subscription by writing on their company letterhead to:

Joint Spectrum Center
Code JSC-PP
120 Worthington Basin
Annapolis, MD 21402-5064
Mr. Marcus Shellman

Note that subscription requests are subject to the approval of the Government. The JSC has a website (www.jsc.mil) which is presently undergoing expansion to include more E³ activities. Past issues of the *Joint E³ Bulletin* are also available on the website.

The Joint Spectrum Center replaced the Electromagnetic Compatibility Analysis Center (ECAC) approximately one year ago. In accordance with the Concept of Operations (CONOPS) for the Joint Spectrum Center, issued 16 Dec 1996, the DoD Joint E³ Effects Program is defined as follows:

- Support MDA in E³

- Lead DOD Standardization Activity (LSA) for EMC standards
- E³ Awareness
- E³ Technology
- Joint Ordnance E³ Program

The CONOPS include EMC analysis models, simulation, and spectrum databases. Other functions include operational spectrum management support, DoD spectrum policy support, and custom-funded activities. The CONOPS is in the process of being entered into the JSC website.

E³ staffing will be provided primarily from SPAWAR personnel with Mr. Stephen Caine being the Director of Plans and Operations. His E³ staff will include Mr. Marcus Shellman, Mr. Jim Tedder, and Mr. Trung Diep, all of whom are transferring from SPAWAR. Mr. Bill Lenzi will also be part of that organization, although he will remain physically located at Dahlgren, VA for the foreseeable future. The last remaining E³ person from SPAWAR, F. Mike Stewart, is transferring to San Diego with the rest of SPAWAR, and will become the E³ focus for SPAWAR. These moves are currently in process and should be completed before the end of the Government fiscal year, September 30, 1997.

I will expand on the activities of the JSC E³ organization in the next issue. However, readers should be advised that the revision of MIL-STD-461D/462D is being contemplated and that comments are being compiled by Mr. Frank Coleman, R & B Enterprises, One Crystal Park, Suite 903, 2011 Crystal Drive, Arlington, VA 22202. To be considered, all comments must be accompanied with a complete justification and rationale.

You Can Help!

The EMC Society is soliciting contributions from individuals and industry to fund its President's Memorial Award. This is the most prestigious award the EMC Society offers to honor deceased members of the Society and to reward promising students in the study of EMC engineering. Contributions of any amount are welcome and will be acknowledged in a future edition of the EMC/S Newsletter. Please direct inquiries to Todd Hubing, Director for Member Services, phone 573-341-6069, e-mail: t.hubing@ieee.org.

I also encourage you to review the list of EMC Society Committees, select one that fits your interests and skills and join. The committees will welcome you. You will also find that they are exactly as you are-volunteers with a wish for a better life through better engineering.

Your thoughts and ideas for promoting and expanding the IEEE EMC Society are always welcome and requested.

Signed:

William G. (Bill) Gjertson,
1997 President,
EMC-Society
w.gjertson@ieee.org

Letters to the Editor

It appears that I didn't retire as editor of the EMC/S Newsletter any too soon. While editing my farewell article, I inadvertently deleted two very important people, Kimball Williams and Joe Butler. Both have been associate editors for the EMC/S Newsletter for many years. Kimball has taken care of the EMC/S Education Committee since 1992 and Joe has written about Inter-Society Activities since 1991. I have apologized to them personally for this omission and want to acknowledge their significant contributions to the Newsletter.

I also realize that I mainly focused on current associate editors and omitted valuable contributors like Henry Ott and Clayton Paul; both wrote the Education Committee column for many years. Of course, I have not thumbed all 120 back issues and know that I run the risk that I omitted others. Thus, I extend my thanks to everyone who has participated over the years, including those who have written letters to the editor.

Thank you, Janet, for publishing this letter for me. Now, in the computer age, perhaps it will be much easier for you to keep track of all those who have contributed and participated.

Sincerely,
Robert D. Goldblum
R&B Enterprises

With interest I read the book review on "The Guide to the EMC Directive 89/336/EEC" in issue no. 173 of the EMC Society Newsletter. As the manager of a major EMC test facility in Germany and now as a Competent Body under the Australian EMC framework, I followed and still follow the establishment and application of the European EMC Directive, especially in regard to the correct choice of standards.

Some standards mentioned in the review, however, seem to be incorrect or at least misleading and I would like to make some comments for your information.

- EN 50-081-1/2 should not be addressed as "generic equivalent" of EN 55-022 or EN 55-011. The generic standard EN 50-081-1 refers to other standards in respect to measurement procedures and limit values, but there is no choice to choose either the one or the other standard.
- When speaking about the European EMC Directive, it would be better to use the European numbering of the immunity standards, so EN 8100-4-X instead of IEC 801-X. If using the IEC numbering, the new numbers IEC 1000-4-X should be used rather than the old numbering IEC 801-X.
- The generic immunity standard EN 50-082-2 has been harmonized in October 1995. This harmonization is extremely important because:
 - 1) many products have to be tested in accordance with the generic standard due to a lack of product dedicated immunity standards and
 - 2) if applying a non-harmonized standard, a Competent Body has to be involved in the certification procedure of a product.

In general, this book review seems to refer to the first edition of the book of 1995, or important changes between 1995 and 1997 have not been implemented in the second edition.

Sincerely,
Dr. Franz Schlagenhauer
Technical Manager,
EMCSI Pty Ltd
Australia



DR. WILLIAM G. DUFF
ASSOCIATE EDITOR

The Editor solicited this timely report from Dr. Duff. Dr. Duff's regular column, EMC Personality Profile, will resume in the next issue of the EMC Society Newsletter.

I am pleased to have the opportunity to serve as the Director of Division IV, Electromagnetics and Radiation. Division IV is composed of seven societies which are Electromagnetic Compatibility, Antennas and Propagation, Microwave Theory and Techniques, Nuclear and Plasma Sciences, Broadcast Technology, Consumer Electronics, and Magnetics. There are approximately 30,000 IEEE members in Division IV. As Director of Division IV, my role is to provide representation on the IEEE Board of Directors for these societies and their members.

One very important issue for all societies in the IEEE is membership development. Although total IEEE membership has remained relatively constant (approximately 310,000) since 1990, there are several areas of concern.

First, IEEE loses approximately 51,000 members each year. Fortunately, this loss is offset by the recruitment of new members. Thus, the recruitment efforts are working, but retention of members is a problem.

Second, membership in Regions 1 through 7 (i.e. the US and Canada) is declining. Fortunately, membership outside the US and Canada is increasing and this offsets the loss of members.

Third, student membership, particularly in the US, is declining. This raises concerns about the future. In an attempt to increase student membership, the IEEE Board of Directors voted at the June Board meeting to reduce student dues.

Fourth, approximately forty percent of the IEEE members do not belong to a society. In order to attract and retain members, IEEE must provide individuals with sufficient benefits to offset the cost of being a member. Many of the benefits of being an IEEE member are provided by the societies and chapters. These include Transactions, Newsletter, Symposia, Chapter Meetings, Technical Interaction, Business Contacts, etc. IEEE members are encouraged to join societies so they can receive these benefits.

Chapters are also very important because they provide the interface between individual members and societies. Chapter activities provide benefits directly to the members and this aids in both recruitment and retention of members. I encourage all Division IV societies to form new chapters wherever possible.

In order to form a chapter, it is necessary to have at least twelve society members in the local area to be served by their chapter. In regions outside the US and Canada, there are many areas that do not have twelve members that belong to any one society so it is not possible to form a chapter for a single society. However, if there are not a sufficient number of members to form a chapter for a single society, two or more societies can form a joint chapter, or a society can join with an existing chapter that consists of one or more related societies.

In order to increase the opportunity for the formation of chapters in regions outside the US and Canada, Rolf Jansen, the past Director of Division IV, and Mike Adler, the Director of Division I, Circuits and Devices, initiated an effort to encourage and assist in the formation of joint chapters consisting of societies from both divisions. I have been working closely with Mike Adler to implement this initiative. There has been a lot of interest and we are confident that this effort will result in a significant increase in chapter activity and membership in regions outside the US and Canada.

I would like to encourage each of our members, chapters and societies to make an effort to retain current members and recruit new members (particularly students). For example, an individual or chapter may find it is very rewarding to sponsor one or more students (i.e. pay the student's dues) and establish a mentor relationship. Please help in anyway that you can to increase our membership and strengthen the IEEE.

I welcome your comments and suggestions.



KIMBALL WILLIAMS
ASSOCIATE EDITOR

IEEE EMC Society Education Committee

What To Study:

So, you have decided to embark on a program of self improvement and self education. Where do you start? The first, most important person you need to interview to answer that question is YOU!

You are the only one who, deep down inside, really knows where your strengths and weaknesses are.

What Interests You:

Each of us has a unique set of interests linked to a unique set of talents. The same impulses that got you where you are now, can be relied upon to help guide you in the future. (That is, of course, if you believe that you took the right course to begin with. If not, then ask what would you have rather done?)

This is not a frivolous or selfish question or attitude. Our natural abilities and talents push us in directions of learning and employment that will give us the best chance of success. Those people with absolutely no sense of rhythm or melody are unlikely to be seriously interested in the study of music. Those with a strong feeling for space and physical relationships and how they fit with human uses are drawn to architecture. Only if you ignore those gut feelings are you likely to wind up as a great chef, frustrated with your job as a CPA.

Trust your feelings and search for ways to explore their depth and breadth.

Build On Strengths:

If there is no conflict with what you want to do and what you are already doing..., do more. Extending your understanding to the next level in any area can only benefit you and your employer.

What you already know can be a stepping stone to new understanding in the same or related fields. The interests, talent and abilities that brought you to the field you are in now still serve you, and can be a reliable guide for future growth.

Stretch:

In many cases there are opportunities to explore beyond what you had intended to learn about. I have almost always found

that these experiences proved to be both educational as well as enlightening. In the end, it seems, everything we learn or find out relates to everything else that we have learned or need to know.

Make one of your goals to regularly dig into something that you never intended to study at all. If the chance to investigate a topic that you have never wanted to know about comes along, take it! If you don't try, you will never know. It is better to know that something has no interest for you than to wonder.

As an example, I often find that someone I am speaking with has always wanted to learn to fly, but never took the time or money to even try a short flight or first lesson in a general aviation aircraft. My advice is always, "Do it!" You might hate it. You might love it. But, at least you will know for sure. The saddest thing would be to reach the end of your life still saying, "I wish I had at least tried it!"

Of course, it doesn't matter what the "it" is. Better to know, than to regret.

Test Your Limits:

Another signal that can help guide you is when you bump against one of the bars of your cage. These are the things that you thought you knew, or understood until something causes you to try go further in that direction and you find yourself up against a stop.

The bars on our cages are invisible to us. We all have them, but we develop blind spots to our limits. It is only when we knock our heads against them that we have the opportunity to identify their existence. Take that revelation and use it to help structure your self learning process.

A question from a co-worker, a quiz in a technical magazine, a technical article that you are having trouble grasping, these can all help uncover more limits. I find it helpful to write these down in a special section of my daily planner. After a while, the list can reveal patterns. Once you know the pattern, and what it means, it can point to areas of study more general than the specific topics.

Review Your Basics:

One of the maxims I have always found true is that you never have a strong enough grasp of the fundamentals of anything. That is why it is so helpful to attend lectures that appear on the surface to be 'too easy', or 'too fundamental'. Another look from a different perspective often reveals some aspect that I hadn't fully appreciated before. The 'ah-ha' experience is typical in these situations.

A helpful tactic is also to list those subjects that I consider to be the fundamentals of the discipline that I am studying. With the list in hand, ask yourself, "Am I completely comfortable with each topic in turn?" Any "no's" will suggest areas for further work.

Make A Difference:

Finally, don't forget that knowledge was meant to be used. We study to understand, and understand so that we can make informed choices. Once a choice is made, some action must follow if our learning is to have any meaning.

Someone once suggested that learning was like storing up ammunition. Some people behave as if they were ammunition wagons, storing up knowledge only to move it from place to place.

Once you have learned something ... "Be a rifle!"

Kimball Williams
Chairman EMCS Education Committee

IEEE EMC Society Technical Advisory Committee (TAC)

In the last issue of the newsletter I gave some detailed information on the charters and chairmen of the Technical Committees of the EMC Society. This month I want to explain the purpose and benefits of becoming an active member of at least one of these Technical Committees.

Purpose of a Technical Committee (TC):

Technical committees exist to develop and interpret standards in different technical areas. Each committee strives to provide the technical community with appropriate and useful information in a concise and easy to understand format which can be used in practical applications.

What a TC Can Do For You:

Involvement in a TC provides several benefits to the individual and to his or her sponsoring organization. The personal contact with experts in the field who bring alternative points of view immediately opens avenues of thought which would be impossible to generate by one person, or one organization. The mix of opinion and view point and the resulting discussions provide an unparalleled opportunity to explore technical alternatives.

From the personal point of view, the chance to learn from your peers who have extensive experience in the field can be invaluable. From the sponsoring organizations' point of view, the professional development of a member of its staff, coupled with the opportunity to help direct the evolution of standards which will directly effect its future products and operations is just too valuable miss.

What You Can Do For a TC:

If you have experience in a field, the chance to share your knowledge that a technical committee provides is a stimulating forum. It also gives you a chance to check what you believe you know against what others have learned. Often both find out that there is more to learn, and that you have a friend who is eager to explore with you.

I often see a young engineer back away from committee involvement believing that he is too inexperienced to provide any meaningful contributions. Nonsense! Some of the most valued additions to a committee comes from our younger members who keep asking "why?" and questioning what we are doing, and our reasons. We all need that 'shaking up' now and then just to keep us from becoming complacent.

How To Get In Touch With a TC:

The listing of the technical committees, their charters and the contact information for the chairmen is listed on the IEEE EMC-S web site at:

http://www.emclab.umn.edu/ieee_emc/

Look under the section titled: Information on the IEEE EMC Society.

I invite you to browse through the information on the committees, contact the chairmen and get involved in their activities. It could be the most meaningful thing you have done for your career and for your organization in a long time.

New TAC Chair:

I also want to take this opportunity to welcome our new chair of the TAC, Dr. Andrew Podgorski. Dr. Podgorski is president of the independent research and engineering company, ASR Technologies. He



**DR. ANDREW
PODGORSKI**
TAC CHAIR

is a recognized world authority in the area of Electromagnetic Compatibility and Electromagnetic Protection and has served on many international inter-governmental military and civilian panels of experts.

Dr. Podgorski is conducting interdisciplinary theoretical (numerical modeling) and experimental technology related research in diverse areas including Electromagnetics, High Power microwaves, Lightning, High Voltage Engineering, Satellite Communication, Semiconductor technology, Fiber and Integrated Optics, Measurements and Standards. He has published over eighty scientific papers and over twenty classified and unclassified reports. Dr. Podgorski holds numerous patents in the area of EMC. He is a member of the Board of Directors of the IEEE Electromagnetic Compatibility Society and is listed in the Canadian "Who's Who".

Please join me in welcoming Dr. Podgorski as the new chair of the Technical Activities Committee.

— **Kimball Williams**
Interim TAC Chairman

EMC Society Board of Directors Activities

By Janet O'Neil, Secretary of the Board

The second meeting in 1997 for the EMC Society Board of Directors was held on May 5 in Boston, Massachusetts at the Boston Park Plaza Hotel.

Attending the Board meeting were officers President Bill Gjertson, Vice-President Dan Hoolihan, Treasurer Warren Kesselman, Secretary Janet O'Neil, and Board members Don Sweeney, Joe Butler, Len Carlson, Franz Gisin, Bill Duff, Jim Muccioli, Todd Hubing, Bill Ritenour, Dick Ford, Andy Drozd, Andrew Podgorski, and Herb Zajac. Board members absent included Bob Hofmann, Don Heirman, Bill McGinnis, Kimball Williams, and Norm Violette. Guests in attendance included Ferdy Mayer, Leo Makowski, Mirko Matejic, Bob Goldblum, and Chet Smith.

President Gjertson called the meeting to order at 8:30 am and thanked everyone for coming. A round of introductions was made. He announced that there is a new Managing Director of Technical Services at the IEEE. Mary Ward-Callan has replaced Bob Wangemann.

Secretary Janet O'Neil then presented the minutes from the February 21, 1997 Board meeting for approval. Some changes were required and the amended minutes were approved.

Treasurer Warren Kesselman next presented his report. The Society posted a 1996 operating deficit of \$32.1K. The 1996 return on long term investments was 13.1%. The IEEE has instituted a new current year Finance Forecasting process. As a result, Mr. Kesselman has recently changed the 1997 EMC/S budget from a surplus of \$57.5K to a deficit of \$33.3K. The change was due to many factors, including a reduction in conference surplus and increased committee expenses. Mr. Kesselman reported that this forecasting process involves submitting updated budget information to the IEEE in April, July and October. He noted that as long as the EMC/S Board is aware of any fluctuations in the budget and the financial situation isn't dramatic, then the IEEE will not intervene in the EMC/S budgeting process. Lastly, the IEEE reports that EMC/S membership is at 4581 active (paid) members with 892 arrears members. The treasurer's report was approved as presented.

Joe Butler presented the report as Director of Technical Services. His report included a preliminary five year plan for the Technical Services Directorate per the request of Dan Hoolihan, Vice-President and Long Range Planning Chair. In the absence of Don Heirman and Kimball Williams, Mr. Butler proceeded in reporting on the activities of the Standards, Education and Technical Activities committees. Don Heirman advised that there has been no significant activity with his committee since the meeting in Zurich earlier this year. The committee is still working on the operations manual, including updating policy and procedures, and continues to seek international members.

Kimball Williams, as Chairman of the Education and Student Activities Committee, advised that the committee is still seeking a Student Activities chairman. As Co-Chairman of the Education Activities Board (EAB) Life Long Learning committee, Mr. Williams is becoming very involved in their activities. The Education Committee is reviewing its activities in consideration of the EMC/S Long Range Plan. The budget will also be addressed.

Regarding the Technical Activities Committee (TAC), Williams has asked the chairmen to provide and to commit to a five year plan for their respective technical committees. Wilf Lauber recently resigned as TC-3 chairman and was replaced by Virgilio Arafiles.

Regarding the IEEE TAB committee entitled "Intelligent Transportation Systems Committee", the EMC/S was invited to join this committee (as one of 16 IEEE Societies). Andy Drozd will be proposed as our Senior Representative and Norm Violette will be proposed as our Junior Representative to this committee. The committee is trying to become a Council within the IEEE.

Leo Makowski, chairman of the Representative Advisory Committee (RAC) presented his report. The RAC report included subcommittee reports by representatives Ed Bronaugh on SAE Automotive EMI & EMR, Dan Hoolihan on COMAR, Don Heirman on ANSI C63 and CISPR A & G & E, Bill Ritenour on the ESD Association, Gary Fenical on the SAE AE4 EMC committee, Dave Chase on NARTE, and John Osburn on EIA G46 and Commercial. The RAC report also includes Len Carlson's report on the Aerospace Policy Committee and Drew Peregrin's report on

the American Society Testing Material (ASTM) D09.12.14 Electromagnetic Shielding. Regarding new activities within RAC, Dave Case was approved as the RAC liaison to USCIL. Todd Hubing replaced Dick Ford as the RAC liaison to ACES. Len Carlson continues as the RAC liaison to the IEEE Technology Policy Council Committee Aerospace R&D and Dick Ford continues as the RAC liaison to the USAB R&D Policy Committee.

Todd Hubing, Director for Member Services, then presented his report and distributed copies of the EMC Society Membership Directory for review (copies are available by calling 573-341-6069 or sending an e-mail request to t.hubing@ieee.org). In the absence of Awards Committee Chairman Bill McGinnis, Mr. Hubing reported that a description of all awards may now be found on the EMC/S web page and nominations may be made via e-mail.

Todd Hubing reported that Chapters Coordinator, Ray Adams, has advised that there is potential new chapter activity in Italy and the UK. Mr. Adams is updating the Chapter Officer's guidebook.

Scott Roleson, Chairman of the Distinguished Lecturer (DL) Program, submitted a report to Mr. Hubing on program activities to date. The report notes that DL program costs have increased in 1996 from the previous year by 61%. One reason is the original budget submitted was based upon four DLs; we now have six DLs. Also, more chapters are now aware of this program. The present Distinguished Lecturer budget was increased by \$10,000 to compensate for this increased activity.

To address the issue of providing DLs outside the USA, the following motion was approved:

The IEEE EMC Society Distinguished Lecturer Program will be authorized to fund presentations by current or past Distinguished Lecturers who are invited to speak at EMC Society Chapters located on a continent other than the home continent of the speaker. Travel expenses will be reimbursed up to an amount equal to \$1,000 per chapter presentation. All trips must be approved by the chair of the Distinguished Lecturer Program and the Director for Member Services prior to making travel arrangements. Budget constraints will only permit a few such trips to be authorized in any calendar year. Coordination between chapters wishing to share a speaker is encouraged. Priority will be given to speaking engagements that have the greatest potential impact on membership development.

Concerning the Constitution and By-laws, Warren Kesselman distributed the latest copy (revised April 24, 1997) of the EMC/S Procedures, Policy, Constitution and By-Laws document. He also distributed a proposed Constitution Change (see page 3) concerning the establishment of a President-Elect position and functional Vice-President positions on the EMC/S Board. This proposal was approved by the Board.

As Nominations Chairman, Mr. Kesselman reported that the 1997 Nominating Committee (approved by President Gjertson) is comprised of Ed Bronaugh, Don Heir-

man, Don Clark, and Barry Wallen. All present Board members are eligible for election or re-election, with the exception of President Gjertson. The call for nominations has been made.

Len Carlson, Director for Communication Services, next presented his report. Chet Smith was present to give the History Committee report. As Chairman of this committee, Mr. Smith has been spearheading the effort by the Board to put all past symposia records, including the early "Armour" conferences, from the years 1955 to 1995, on CD ROM. The project was completed with AMC Applied Microfilm. Since the discs only cover symposia records through 1995, consideration will have to be given for putting 1996, 1997 and beyond EMC symposia records on CD-ROM at some point.

Concerning the EMC/S Newsletter, Bob Goldblum was acknowledged with a round of applause for his 30 years as Editor. His last issue as Editor will be mailed in June. Janet O'Neil will replace Mr. Goldblum as the new Editor.

Henry Ott's report as Chairman of the Symposia and Conferences Committee was presented by Mr. Carlson. This included updated information on the activities of the Austin symposium committee and a calendar listing of all future EMC/S symposia. Mr. Ott's report also included information on policy concerning commercialism in symposia workshops. The 1998 Denver symposium budget of \$470,535 was approved. The estimated surplus is 15%. The Board approved a \$5,000 advance for the Denver Symposium committee.

Dan Hoolihan, Chairman of the 2002 EMC/S Symposium, advised that he has been contacted by the IEEE Travel and Conference Management Services department. He received an outline of their one-stop approach to meeting planning services. The Board approved Mr. Hoolihan's suggestion to invite IEEE Travel and Conference Management Services to the November 1997 Board meeting in Atlanta.

A discussion ensued concerning raising exhibitor fees at the EMC/S symposia. No consensus was reached on this topic though the Board agreed to discuss this further at the next Board meeting. It was also suggested that the IEEE Travel and Conference Management Services department include in-



Bob Goldblum Takes the Cake!
The EMC Society Board of Directors celebrated Bob's 30 years as Editor of the EMC Society Newsletter with a custom cake at its May 5 meeting in Boston. The cake read "Thank You and Congratulations Bob!"

formation on other societies and exhibitor fees at their respective conferences as part of their presentation to the Board at the November meeting.

Mr. Carlson also reported for Moto Kanda and Hugh Denny. Concerning Transactions, Editor Moto Kanda's advised that he has three guest editors from Italy for the special issue on lightning which will be published in 1998. Hugh Denny's report provided information on the April 13 and 14 meeting of the IEEE Press at IEEE in Piscataway. Mr. Denny attended this meeting and represented the EMC/S. The sales of EMC related books amounted to some \$42,000 for the first quarter 1997. Projected sales for the year is \$125,000. The EMC/S will receive 2% in royalties for the books they sponsor. One new book is under sponsorship by the EMC/S. This is entitled *RF Engineers Handbook* by Alfred Smith. It is due to be published in 1998.

Lastly under the Communication Services Directorship, Franz Gisin presented a special report on the internet entitled "Communicating on the Internet".

Herb Zajac then presented the report for the Director for Professional Services, Norm Violette, since Mr. Violette was unable to attend the meeting.

Ferdy Mayer, International Activities Chairman, reported that he received several IEEE EMC/S membership applications while staffing the Membership Booth at the recent Wroclaw and Zurich EMC conferences. The Santa Clara symposium records have been shipped overseas to our cooperating organizations.

The report of Bob Brook, the EMC/S liaison to the Society for the Social Implications of Technology (SSIT) was reviewed. His report highlighted the activities of their April AdCom meeting at Columbia University in New York City.

Regarding the Public Relations Committee, Chairman Herb Zajac reported that the basic project for the EMC/S video produced by Empire Video has been completed. The cost to produce the video was \$9,600. Copies need to be ordered and distributed. Extra funding in the amount of \$1,100 is required to purchase copies of the video. It was agreed to order 101 copies of the new video at a price of \$4.50 each (plus shipping and handling) for distribution to chapter chairmen and others as determined by the Public Relations committee.

Next followed the Planning Committee report. Vice-President and Planning Committee Chairman Dan Hoolihan noted that he has received input from the four Service Directors regarding their respective objectives in meeting the goals of the EMC/S Long Range Plan. He distributed the "EMC Field of Interest Statement" and solicited the Board's input in updating this statement (it was last issued in August 1979).

The following items were discussed under New Business:

A. BOSTON CHAPTER: Chapter Chairman and guest Mirko Matejic commented upon the activities of the chapter including plans for hosting the EMC/S symposium

in 2003. In particular, he endorsed the activities of the DL program and suggested that there be no limit on the amount of presentations per DL. The DL program has greatly helped in revitalizing the Boston chapter.

B. NIST ANNIVERSARY: President Gjertson advised that NIST will celebrate its 100th anniversary in the year 2001. The Board has been asked to provide a volunteer to work with NIST on the anniversary activities. Moto Kanda will be the NIST representative that the EMC/S volunteer will work with. Bill Ritenour volunteered to discuss the level of involvement with Mr. Kanda and report back to the Board.

C. DON BOLLE LETTER: President Gjertson discussed the Don Bolle letter wherein the IEEE is asking each Society to contribute funds towards creating an exhibit/display in the IEEE lobby to recognize the achievements of each participating Society. The questions to answer are: 1) How much should the EMC Society donate for this effort? and 2) Who should be recognized in the EMC Society? It was agreed that the EMC/S will donate \$1,000 for the purpose of an EMC exhibit/display at IEEE in Piscataway. It was suggested that a contest be held with the membership to identify who should be recognized for this exhibit and/or what should be included.

D. CHICAGO 2005. Don Sweeney advised that the Chicago chapter would like to host the EMC/S symposium in 2005. The Board approved having the 2005 EMC/S symposium in Chicago.

In closing, action items assigned during the meeting were reviewed.

There being no further business, the meeting was adjourned at 5:00 pm.

Later that night, following the Board meeting, several members of the Board gathered with Bob Goldblum and his lovely wife Barbara to celebrate Bob's 30 years of service to the EMC Society as Editor of the Society's Newsletter. A special dinner was held in the Fox and Hounds Room of the Boston Park Plaza Hotel. Several toasts were made in Bob's honor and much reminiscing occurred over stories of material published in the early days.



Bob and Barbara Goldblum bask in the glow of the Board's salutations for Bob's excellent work as Editor of the EMC Society Newsletter for 30 (gasp!) years. A special dinner was held in Bob's honor following the Board meeting in Boston.



DON HEIRMAN
ASSOCIATE EDITOR

EMCS Works Well With C63!

Did you know that our EMC Society (EMCS) has a significant presence on the American National Standards Institute (ANSI) Accredited Standards Committee (ASC) C63 (Electromagnetic Compatibility)? Major participants with EMCS membership include:

- Ralph Showers (former EMCS President and member of the Society's founding group), Chairman
- Ed Bronaugh (former EMCS President), Vice chairman and the IEEE representative on C63 balloting groups also representing the EMCS
- Don Heirman (former EMCS President, chairman of the EMCS Standards Committee and Technical Committee TC-2 on EMC Measurements and Instrumentation), Chairman of Subcommittee 1 and the IEEE representative on C63 balloting groups also representing the EMCS
- Dan Hoolihan (EMCS Vice-president), Chairman of Subcommittee 6 and Subcommittee 8
- Bob Hofmann (former EMCS President)
- Norm Violette (EMCS Director for Professional Services), Co-chairman of C63, Subcommittee 2
- Herb Mertel (former chairman of the EMCS International Committee), Co-chair membership committee
- Many other EMCS members participating in C63 subcommittees and working groups

In addition, C63 has member representatives from over three dozen trade, government, military and private companies and organizations and in addition a number of individual experts. That list is a veritable "Who's Who" in standards organizations and/or those who use EMC standards in the United States.

The scope of C63 includes development of EMC measurement methods, instrumentation specifications, appropriate levels of limiting radio noise, and control methods. In addition C63 provides guidelines for RF influence, coupling, and immunity. Most importantly, C63 coordinates most of the US EMC standards activity in adopting US national standards on EMC. They do this by either publishing their own EMC standards (the C63.X series) or by balloting approval of EMC standards submitted to C63 for their approval. Once C63 approves such documents, they are processed as US National Standards via the public review process of the ANSI. In addition, C63 Subcommittee 3 is the technical advisory group (TAG) for the US inputs into the International Special Committee on Radio Interference (CISPR). These inputs are largely based on C63 (and EMCS, where appropriate) standards.

Enough of the background and now on to what C63 is doing for national standardization of EMC measurements, instrumentation and limits. We'll look at major activity along with a sampling of its major publications to highlight areas of mutual interest with our Society. These activities are carried out by the 6 active subcommittees (and their working groups) which are as follows:

- Subcommittee 1: Techniques and Developments
- Subcommittee 2: Terms and Definitions
- Subcommittee 3: International Standardization
- Subcommittee 6: Conformity Assessment
- Subcommittee 7: Unlicensed Personal Communications Services
- Subcommittee 8: Medical Device Immunity

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Relaxing after the informal Minneapolis meeting of the ANSI ASC C63 steering committee are Ralph Showers (L) and Ed Bronaugh (R).

C63.2: Instrumentation (American National Standard for Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz Specifications)

This document originally served as one of the major sources on which CISPR Publication 16 was based. The present activity is to identify the requirements for spectrum analyzers so that they can be applied for making measurements equivalent to those made by a standard C63.2/Pub. 16 receiver.

C63.4 Method of Measurements (American National Standard for Methods of Measurement of Radio-Noise from Low-Voltage Electrical and Electronic Equipment in the Range 9 kHz to 40 GHz)

This document is referenced as the FCC procedure for measuring conformance with Part 15 digital devices. The 1997 draft revision was balloted in July and the comments are being considered. Key areas of improvements in the document include the following:

- a. Strong recommendation that all weather covered open area test sites (OATSs) meet the so-called "volumetric" normalized site attenuation requirements which absorber lined shielded enclosures must meet. The volume is a cylinder covering the circumference of the turntable and about 2 meters in height above the turntable.
- b. Inclusion of the provisions for using wideband TEM devices (TEM cells and GTEM cells) in lieu of radiated emission measurements generally performed at an OATS.
- c. Allow performing conducted emission measurements for table top products with the table top 40 cm above the reference conducting ground plane.
- d. Inclusion of more detailed test setups for complex table top arrangements and for combination of table top and floor standing equipment under test.

C63.5 Antenna Calibration (American National Standard for Calibration of Antennas Used for Radiated Emission Measurements in Electromagnetic Interference (EMI) Control)

This standard is also being revised to take into account international activity in antenna factor determination.

The standard includes the so-called "three antenna" method formally called the "Standard Site Method". It also contains details on a method to construct a reference antenna, i.e. a tuned resonant dipole which has been used as the primary radiated emission measurement antenna for well over two decades. In this revision, there is also a method for calibrating antennas above 1 GHz as well as a method for finding monopole (vertical whip) antenna factors. The ballot is still open.

C63.6 Normalized Site Attenuation Error Budget (American National Standard for the Computation of Errors in Open-Area Test Site Measurements)

This document contains the classical error budget that is allowed for open area test site and alternate test site validation. The normalized site attenuation (classical site attenuation less the sum of the transmit and receive attenuation factors, all in dB) less the theoretical normalized site attenuation must be within the (+/-) 4 dB range to qualify for making radiated emission measurements. Interestingly, the errors or tolerances of the instrumentation used to make these measurements can easily take up +/- 3 dB of the +/- 4 dB range which means that there may be as little as only a +/- 1 dB allowance for the site deviation from theoretical.

C63.7 Construction of Open Area Test Sites (American National Standard Guide for Construction of Open Area Test Sites for Performing Radiated Emission Measurements)

This document is current and gives, among other OATS construction details, the following:

- a. Maximum unevenness of the test site conductive ground plane (Rayleigh Roughness Criteria). This includes the criterion for the maximum height of a turntable with a conductive surface which sits on top of the parent conductive ground plane.
- b. Size and shape of the obstruction free area surrounding the open area test site.
- c. Precautions to take when erecting an all-weather protective cover over the OATS.

C63.12 EMC Limit Setting (American National Standard for EMC Limits—Recommended Practice)

This standard is a guide to be used to set limits in cases where there are no otherwise mandated requirements for both emission and immunity. Much of the guidance is based on FCC requirements, but there are also limits suggested for currents on cables attached to products which are not covered in the FCC regulations. This document is under major revision to include a specific set of generic limit requirements which are similar to, but not necessarily identical to, those adopted in the European Union. Such limits also may be adopted for use by manufacturers of commercial off the shelf (COTS) equipment purchased for military applications.

C63.14 EMC Definitions (American National Standard Dictionary for Technologies of Electromagnetic Compatibility (EMC), Electromagnetic Pulse (EMP), and Electrostatic Discharge (ESD))



Don Heirman, Chairman of the ANSI ASC C63 Subcommittee 1 on Techniques and Development, takes in a boat tour of just one of the famed 10,000 lakes in Minnesota after his committee meeting held in Minneapolis. His wife, Lois (C) and Janet O'Neil, Secretary of C63.1 (R) were happy to join him.

This dictionary draws extensively on the IEEE Standard 100 Dictionary and the IEC International Electrotechnical Vocabulary, Chapter 161 on EMC. In addition, it contains many terms formerly included in MIL-STD 463 which now has been withdrawn in its favor. This document is being further updated and enlarged to now include definitions contained in all the C63 standards.

C63.16 (American National Standard Guide for Electrostatic Discharge for Electronic Equipment)

This document provides significant details on the ESD test methods and limits. It discusses statistical derivations of the number of discharges needed to assess the undesired response of the product being tested. It also provides details on furniture discharge using a floor mounted vane ESD simulator. This guide is now being revised to raise it to the level of a standard and to give improved control over that contained in other ESD standards presently in use.

Other Standards Activity of Interest to EMCS

C63.15 (Draft Immunity Measurements and Instrumentation Specifications)

This document is still in draft stage and is intended to be a resource for immunity measurement methods. It draws from many testing resources including techniques used by the US military as well as civilian private sectors. This proposed standard also provides specifications for the various instruments needed to perform the measurements.

C63.17 (Draft American National Standard for the Methods of Measurement of the Electromagnetic and Operational Compatibility of Unlicensed Personal Communications Services (U-PCS) Devices)

This standard is in the last phases of ballot resolution. It includes procedures for measuring compliance with FCC rules for the radio transmitter and monitoring devices used in U-PCS devices whether they are mobile, fixed, stationary, or portable for use in business and residential environments.

C63.18 (Draft Recommended Practice for an On-Site, Ad hoc Test Method for Estimating Radiated Electromagnetic Immunity of Medical Devices to Specific Radio-frequency Transmitters)

This recommended practice is in the final stages of ballot resolution. It is intended to serve as a guide for health-care facilities to use in performing radiated immunity testing of their existing inventories of medical devices using their existing inventory of radio-frequency transmitters with power outputs of 8 Watts or less.

C63.19 (Draft American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids)

This standard is in its third major draft with an aggressive work schedule objective to go to ballot in 1997. It provides methods of measurement of both the electromagnetic and operational compatibility as well as the accessibility of hearing aids with wireless communications devices in the range 800 to 3000 MHz. The intent is to match the immunity of hearing aids with the levels of emissions from wireless communications devices to give users vital compatibility information necessary in purchasing and using such devices together.

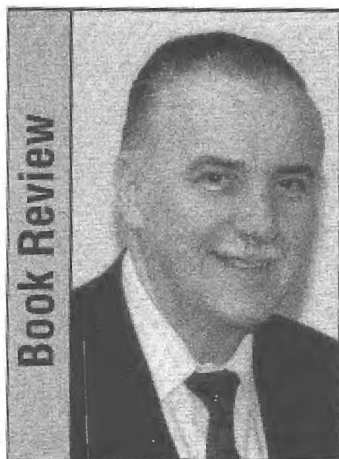
Summary:

As you can see, there are many areas of mutual interest between C63 and our EMC Society. In fact, for most of our EMCS standards when they are revised or when we issue new standards, C63 is automatically listed as coordination. This keeps the close ties even closer. For example, the EMCS standards project 1128 (IEEE Recommended Practice for RF Absorber Evaluation in the Range of 30 MHz to 5 GHz) was coordinated with C63 and comments were accepted and others left for possible consideration in the revision to the document. Similarly, through the IEEE (EMCS) representation on C63, the EMCS comments are considered in C63 documents. By the way, membership on all C63 working groups is open to EMCS members who can contribute their technical expertise. For more information on participating on C63, its subcommittees, and its working groups, contact Rosemary Tennis on r.tennis@ieee.org.



Taking an early evening cruise after the ANSI ASC C63 committee meetings were Herb and Jill Mertel. Herb was one of some 25 people who attended the Subcommittee 8 meeting on Medical Device and Test Methods held in Minneapolis.

**Control and Measurement
of Unintentional
Electromagnetic
Radiation**
by W. Scott Bennett
John Wiley and Sons, Inc.
New York, 1997



J.L. NORMAN VIOLETTE

Preface.

The author establishes the book's objective as: "to provide direct access to basic concepts that must be understood to control unintentional electromagnetic (EM) radiation effectively." The book's organization and guidance for tailoring are also described in the Preface. The essential mathematical level required is applied algebra and trigonometry with additional math topics presented in the Appendix. The reviewer also recommends a basic familiarity with Fourier series techniques.

Chapter 1. Introduction.

The serious problem of increasing interference is described as due to the increasing number of sources that radiate unintentional electromagnetic (EM) energy. Worldwide involvement by governments impose technical requirements to control emissions (conducted and radiated) and improve immunity. The essential message is to design equipment upfront to suppress EM radiation. A basic physical law states that time-varying electric currents are the primary sources of EM radiation. The principle of reciprocity is presented as an explanation of why interference occurs. The application of basic principles, rules, and methods for the control of the radiation from time-varying electric currents forms the main objectives of the book.

Understanding EMI radiation is explained by first understanding the radiation from sinusoidal currents. Non-sinusoidal current waveforms are then converted and described by sinusoidal representations using Fourier techniques. The plan of attack is stated as first to study radiations from sinusoidal currents that follow simple paths and then use these results to model and understand radiations from more complex current waveforms.

Basic radiator models are used to develop the properties of time-varying currents which are the sources of radiation. The reduction of radiations is then described as reducing the current amplitudes, the speed of variation, and by changing the paths that these currents follow. Basic radiating current mathematical models are provided to illustrate the concept. Among the design options open for reducing unwanted radiations, the *path* of the current flow is considered to be the most important arbitrary design parameter.

The *containment* or *shielding* of EM radiation is explained from basic principles of electromagnetics boundary conditions (without the use of "higher" mathematics). A

brief discussion of radiated measurement techniques is included. A summary is provided at the end of the chapter.

Chapter 2. Sinusoidal Antenna Current Radiations.

The concepts of antenna-current radiations are developed as models to describe unintentional radiations. Any current (or portion thereof) can be viewed as an antenna current. When understood, the *total* antenna-current behavior of circuit currents can be applied in circuit design to minimize unintentional radiations. The radiation characteristics (radiation patterns) of an electrically-short current element are developed as a basic model. This is followed by presentations of radiation patterns of longer current segments. Mathematical equations and polar plots of various radiation patterns as functions of typical antenna-type parameters are illustrated. Included are patterns for straight-line current segments, upward and downward propagating segments, folded dipoles, and open-ended current segments.

Chapter 3. Sinusoidal Circuit-Current Radiations.

According to the author, this chapter is considered to be a key chapter for anyone whose primary interest is the reduction of unnecessary EM radiation. The importance of controlling the circuit current path is presented as a key parameter in the control of unintentional EM radiation. A rectangular circuit configuration is used as a basic model with the flow path width dimension proving to be very significant.

The highlights of this chapter consist of the description of radiation patterns for sinusoidal currents in rectangular circuits that can be expected as a function of current segment (spatial) orientation, radiation in the (xy) plane of a circuit loop, radiation from small circuits (length and width less than $1/16$ wavelength), radiation from longer rectangular circuits, and radiation from narrow medium-length circuits. Several equations are provided that describe the illustrated radiation patterns. The end-of-chapter summary provides the conclusions derived by varying the rectangular circuit length vs. its width.

Chapter 4. Frequency Domain Descriptions of Periodic Voltages.

This chapter describes procedures for mathematically representing periodic, time-domain voltage waveforms, by sinusoidal components based on Fourier series techniques. Four basic voltage waveforms are presented that can be

used to construct a large number of commonly occurring periodic voltage waveforms. The Fourier series coefficients of these basic waveforms are determined by integration. The Fourier coefficients of frequently encountered periodic waveforms can then be obtained by a linear combination of the Fourier coefficients of the basic waveforms. From these coefficients, a frequency domain representation can be constructed for the periodic waveform. This is illustrated for waveforms with linear or exponential rise and fall characteristics, and linear rise and exponential fall characteristics, or vice versa. The chapter summary illustrates sixteen different categories of voltage waveshapes whose sinusoidal component amplitudes can be determined with relative ease using the procedures presented in the chapter with minimum mathematical manipulation.

Chapter 5. Periodic Circuit Currents and Their Measured Radiations.

Given the voltage waveforms determined by the techniques of Chapter 4, the circuit currents also can be determined. The author also differentiates between a "circuit" and a "network". As used in this book, a "circuit" is a *single, closed, path* followed by a current; and a "network" is a collection of circuits. The radiations of a network are the sum of the radiations of the circuit currents that make up the network.

For a given periodic voltage, the sinusoidal (Fourier) components are determined per the developments of Chapter 4. If this voltage is applied to a circuit of known or determinable impedance, then the corresponding sinusoidal current components can be determined from Ohm's law and the radiations can be characterized once the current components are determined.

NOTE: *Reviewer comment:* Equations (5-10), (5-15 first equation), and (5-18 first equation): the reactive second terms of these three equations should be multiplied by the complex operator " j " = SQRT(-1).

Application examples are provided using basic RC and RL circuits. The author correctly cautions (most likely from experience) that the lumped, ideal RLC components of a network do not always completely account for the true characteristics of a circuit due to "stray" capacitances and grounding configurations. These unintentional parameters tend to create more than one circuit and current flow path.

Techniques are developed to determine maximum values of measured circuit sinusoidal current radiations. Examples and illustrations are presented for determining maximum expected values of E-field radiations and comparing these values with regulatory limits. The equations indicate the significant parameters that determine the peak radiation levels and thereby identify circuit and signal modifications that can be applied to reduce these radiation levels.

Chapter 6. Control of Circuit-Current Radiations.

This chapter is essentially an extension of the applications of Chapter 5. The equations previously determined for predicting the values of the maximum measured radiated E-field ($\text{meas}|E_n|$) from small, medium-length, and long-length rectangular circuit currents introduce the proce-

dures to be followed in this chapter. These identify the parameters that determine $\text{meas}|E_n|$ and if modified can reduce its value. This includes the modification of voltage waveform and waveshape, circuit impedance, circuit-current path width, and connecting-current symmetry.

Chapter 7. Containment of Unintentional Radiations.

In this chapter, the primary basis for the containment of circuit-current radiations is the concept that EM fields do not exist in the interior of a perfect conductor. This forms the boundary conditions whereby the tangential component of the E-field and the normal component of the magnetic field are zero. The author discusses the concept of completely enclosing a radiating sinusoidal current element with a perfectly-conducting, spherical container. Partial containment is also discussed, along with the fact that full containment will generally not completely solve a radiation problem.

A description of unintentional slot antennas is presented aimed at the effects of openings in conducting enclosures.

Chapter 8. Measurement of Unintentional Radiations.

Unintentional radiations must be measured to determine how much they must be reduced. This chapter deals with what must be done and understood to perform radiation measurements accurately and effectively. Attention is focused on (1) receiving antennas (characteristics and calibration), (2) the measurement environment, and (3) the appropriate use of both antennas and test sites. Details discussed include characteristics of receiving antennas, antenna effective length (dipoles), antenna factors, test site construction and validation, ground plane functions, measurement equipment, and routine radiation measurements.

Appendix and Bibliography.

An Appendix A of useful trigonometric functions and an Appendix B of basic voltage waveform Fourier coefficients are included. A Bibliography provides additional references.

Overall Evaluation.

This book is well written and easy to read. It is quite thorough in the presentation of fundamental electromagnetic radiation concepts with emphasis on the determination of radiated electric field levels and reduction techniques. Magnetic field concepts are not included. The presentations of the mathematical details are straightforward and easy to follow requiring basically a familiarity of algebraic and trigonometric concepts. The wealth of clear examples and illustrations provides insight into the sequence of developments.

This is a valuable book for understanding the sources of E-field radiation, the parameters that determine maximum radiation levels, and how these levels can be reduced by modifying these parameters. Electronic and electrical system designers, and electronic hardware packaging engineers, especially anyone involved in printed circuit layout, should have this book on their shelves. The author has produced a thorough, reasonably understandable, technically-sound, development of a subject often (charitably) considered "black-magic".

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1998

April 28

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June 14-19

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IEEE Administrative Meetings 1997

November 7

EMC Society Standards Committee
Marriott Marquis
Atlanta, GA
Dave Traver, 619.673.2601

November 8

EMC Society Board of Directors
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Janet O'Neil, 425.868.2558

EMCS Cooperating Symposia

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

IEEE EMCS Symposia Schedule

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Bob Hofmann
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