

IEEE EMC SOCIETY

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JANET O'NEIL, Editor

President's Message



DAN HOOLIHAN
PRESIDENT,
EMC SOCIETY

Three of the most important functions provided to members of a Technical Society in the IEEE, such as the EMC Society, are Conferences, Publications, and Awards. These three areas of service are highly ranked in every survey done by the IEEE for any Society's membership.

Our Society's most important conference of the year is the 1998 IEEE International Symposium on Electromagnetic Compatibility that is scheduled to be held in Denver, Colorado from August 24-28. This conference brings together technical experts from all over the world for a series of technical presentations on the latest developments in the area of electromagnetic compatibility engineering. In addition, numerous engineering committee meetings will be held at the same time ranging in size from 50 people down to many informal one-on-one meetings.

In parallel to the technical sessions, there will be over 200 exhibitors showing their EMC goods and services. The exhibits will be located in the Colorado Convention Center to allow plenty of room for all exhibitors

Conferences, Publications, and Awards

and, the CCC is located very close to the main Symposium Hotel, the Adam's Mark Hotel.

This is the premier "networking" opportunity for EMC professionals for 1998. Make sure you take advantage of the opportunity!

The three primary publications of our Society are the Proceedings of the Annual Symposium, the Transactions on Electromagnetic Compatibility, and this EMC Society Newsletter. The Proceedings of the Symposium are called the "Symposium Record" and it contains the technical papers presented at the annual show. The "Record" is sent to every member of the EMC Society whether they go to the Symposium or not. (As a member, don't forget that you can get all the EMCS Symposia Records from 1955-1995 on four CDRoms for \$40! - See the ad in this newsletter).

The second key publication is the "Transactions" which is the location of the archivable papers representing the latest research in the area of EMC. This publication is published quarterly by the IEEE with editorial control by the EMC Society. Our editor for many years has been Motohisa Kanda and we are rightfully proud of the work he has done as editor and the technical papers that have been published in the "Transactions." The EMC Society is discussing "going-electronic" with the Transactions and we hope to have news on our progress shortly.

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IEEE

Networking the World™



Janet O'Neil, Editor, with Len Carlson, EMCS Vice President for Communication Services, at the Seattle EMC Chapter event featuring Henry Ott.

There's lots happening in the EMC Society these days.....

First, with the EMC Society Newsletter, we have a new Associate Editor for Abstracts. After 14 years, Bill McGinnis is stepping down and turning the reins over to Professor Osamu Fujiwara.

For those of you who may not know Bill, he started his career in EMC while he was working for RCA on the Atlantic Missile Range in "Frequency Control and Analysis." Later, he was hired by Gene Cory at Southwest Research Institute to work in the RFI lab. Bill worked at SWRI for 32 years until he retired. Currently, he is working as an RF Design Engineer at Alexander Utility Engineering. (You may contact Bill there at phone 210-496-3200.) I asked Bill about his history with the Abstracts. I was surprised to learn that Bill has been Associate Editor for Abstracts for 14 years, having taken over from Mel Johnson. Bill recalled that his greatest goal and accomplishment as Associate Editor for Abstracts was the increasingly international nature of the abstracts. He was able to recruit abstractors in the United States, Europe, Asia and the Middle East. Bill noted that "the collection of abstracts was greatly enhanced with the advent of the internet". When we were discussing his 14 year history with the Newsletter, Bill asked that I pass along his thanks to those who contributed to the abstracts and to those who expressed appreciation for his work.

We are indeed fortunate to have Professor Fujiwara as our newest Associate Editor. As a bit of background on our newest Associate Editor, Osamu Fujiwara received the B.E. degree in electronic engineering from

Nagoya Institute of Technology in 1971, and the M.E. and the D.E. degrees in electrical engineering from Nagoya University in 1973 and 1980, respectively. From 1973 to 1976, he worked in the Central Research Laboratories, Hitachi, Ltd., Kokubunji, where he was engaged in the research and development of system packaging design of computers. From 1980 to 1984 he was with the Department of Electrical Engineering at Nagoya University. In 1984 he moved to the Department of Electrical and Computer Engineering of Nagoya Institute of Technology, where he is currently a professor. His work in the field of EMC particularly focuses on the bioeffects of electromagnetic fields and measurement and modeling for electromagnetic interference due to discharge. Professor Fujiwara has assembled an excellent team of abstractors to assist him. They are listed in his first column on page 24.

Many, many thanks to Bill McGinnis for his excellent work over the years as Associate Editor for Abstracts and a sincere welcome to Professor Fujiwara.

Second, with our new Society President, Dan Hoolihan, promoting EMC education, many of our regional chapters have responded with one day tutorial/workshops devoted to quality EMC education. You'll find summaries and photos of these educational activities in the Chapter Chat column. These one day EMC events are exciting and action packed!

Third, and last, but not least, we have the International IEEE EMC Society in Denver in August. This is our big Society event of the year and there has been the usual flurry of activity lately with last minute registrations, inquiries, etc. It promises to be a really big show.

See you there!

CORRECTION: In the last issue of the Newsletter, there was an error in the Standards Activities column. The reference on page 14 to "IEEE-STD-299-1998" should be corrected to read "IEEE-STD-299-1997". Further, the document was published in April, not March as shown.



TODD HUBING
ASSOCIATE EDITOR

"X, Y, ceramic, baseball, ..." [Ding] "Alice?"

"What are words that precede 'cap'?"

"Correct!"

"I'll take 'EMC Lingo' for \$400."

If Jeopardy had categories like this, I might watch it more often. But EMC engineers are a very small percentage of the general population. Most people don't know (and don't want to know) what we do. Once in an airplane, I heard someone a few rows behind me use the term "360 degree shield". I knew immediately that this person was either an EMC engineer or had recently been in contact with an EMC engineer. I couldn't figure out who said it, but I immediately felt a sense of camaraderie with that person.

EMC engineers share a special bond, kind of like disaster survivors, recovering alcoholics, or parents of twins. When I meet other EMC engineers, I have mixed feelings of respect, pity, and curiosity. I want to talk to them, share experiences, and learn from them. There are few things in life quite as satisfying as an emotionally charged technical discussion where pictures are drawn, equations are solved, and everyone emerges a little weary and a little wiser.

The problem is that EMC engineers are hard to spot. They don't wear uniforms or carry tools around with them. In public places, they look just like anyone else. It would be nice if EMC engineers were issued special badges or

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IEEE EMC Society Newsletter Publication Schedule

Publication Dates

August
November
February
May

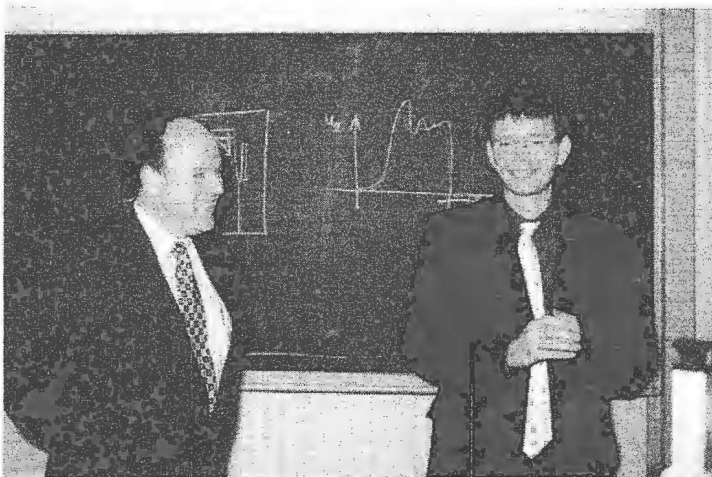
Editorial Deadlines

July 1
October 1
January 1
April 1

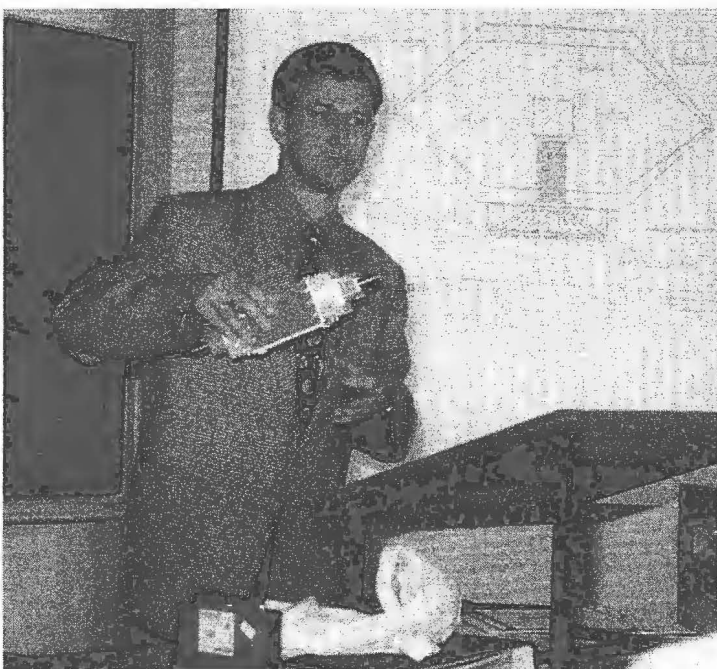
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Continued on page 4



Germany Chapter Chairman Professor Heyno Garbe (left) introduces the May meeting speaker, Dr. Oeing of INCASES. Dr. Oeing spoke about the latest developments in EMC-CAD tools for printed circuit boards.



At the June Germany Chapter meeting, Dr. Form of Volkswagen AG spoke about EMC aspects in the automobile industry. Some 35 people attended the meeting. Dr. Form presented a TEM-cell used for susceptibility testing.

We could even equip these watches with proximity detectors that would notify us if we ever came within 3 meters of someone else wearing one of these watches. Of course, if we all start wearing watches that emit some kind of EM signal, there are bound to be some interference problems. Also, it wouldn't be long before enterprising entrepreneurs began marketing devices triggered by this signal to help people avoid EMC engineers. These avoidance devices would probably be quite popular with product engineers, managers, technicians and spouses of EMC engineers.

OK, forget the proximity detectors. Perhaps we can convince the IEEE EMC Society to issue luggage tags with the EMC Society logo to all of its members. At least that way we could spot other EMC engineers in hotels and airports. Let's all send email to Dan Hoolihan, the society president, asking for luggage tags. Better yet, let's all ask for watches. That way, when the board votes to give us luggage tags, they can view it as a cost-saving measure.

Atlanta

On May 28, 1998, Lockheed Martin Aeronautical Systems in Marietta, Georgia hosted a meeting of the Joint EMC/IM Society Atlanta Chapter. After a delicious meal of pizza and chicken wings, Jack Crossscope of Technical Objectives, Inc. presented "A Look at Eddy Current Inspection." Dr. Crossscope explained the basic physics of eddy current testing, discussed its uses and limitations, and presented some of his ideas for neural network processing of measurement data. Before the lecture, a quick survey revealed that no one in the audience had any prior exposure to eddy current testing. The technical depth of the discussions at the conclusion of the presentation was a testament to the excellent job Dr. Crossscope had done in explaining this subject.

For those who may not have heard, Herb Zajac, the Vice Chair of the EMCS Atlanta Chapter and a member of the EMCS BoD, was diagnosed with a brain tumor in May. At this writing (June 30), Herb is undergoing radiation treatments and chemotherapy - surgery is a possibility after the treatments. Please keep Herb and his family in your thoughts and prayers. Notes and telephone calls are very much appreciated, and may be directed to: Herb and Linda Zajac, 4525 Apache Ct., Kennesaw, GA 30152, Phone: (770) 425-1986.

Beijing

Dr. Li Shufang and Beijing chapter chair Prof. Gao Yougang report that the domestic EMC academic meeting was held in Laizhou, Shandong province in November. Eighty-three delegates attended and sixty papers were published. During the meeting, some developing cooperation projects from factories and research institutes were discussed with satisfying results.

On Mar. 10-20, 1998, a small-scale international conference on new technology for lightning protection and electromagnetic compatibility was held at Beijing Univer-

pins that identified them. That way, when two EMC engineers found themselves waiting in the same line or riding the same plane, they could strike up a conversation.

"I couldn't help but notice that you have the words 'EMC ENGINEER' tattooed to your forehead. Are you an EMC engineer?"

"Why yes, I am."

"I hear static in my cell phone every time I hold it near the metal plate in my head. Could you take a look at it?"

Well ... perhaps we shouldn't be quite so obvious. Maybe we could have a secret symbol, something that identifies us as EMC engineers, but only to other EMC engineers. For example, we could all wear green wristwatches. [Green is a good color because, as all EMC engineers know, EMI data plotted in green is more likely to meet specifications.]

sity of Posts and Telecommunications (BUPT). About 60 scholars from Germany, Australia, Russia, China and other countries attended the meeting.

Seven new IEEE members have been signed and the IEEE Student Branch in BUPT was formed. The China chapter president, Prof. Gao Yougang, is the student advisor.

Central New England

John Clarke reports that the April meeting of the Central New England chapter featured Werner W. Paster, of EUROCONSULT, Inc. in Manchester, MA. Twenty-one people attended the presentation titled, "European Compliance and CE Marking." The European Union (EU) Directives covering EMC, Low Voltage equipment, Machinery and Medical Devices have a major impact on U.S. industries exporting to EU member countries. The speaker discussed new standards and industry requirements regarding EMC and safety that must be met to comply with these Directives. Several related issues have also resulted from the need to meet these new and/or changing requirements, namely; CE marking, component marking and the German Safety(GS) Mark; Self-Declaration as opposed to third party approvals; and the differences between CE Declaration of Conformity and Declaration of Incorporation. Equipment today must be designed for the global market with safety and EMC compliance in mind.

The subject of the May meeting was "Joining of Two Conductors for EMI/ESD Protection." The speaker was Dr. Richard Haynes, of Richard Haynes Consultants. A common trouble spot is the electrical discontinuity at an interface between two conductors. Material choices for such joints are usually compromises between the minimum impedance and maximum corrosion resistance at the interface. The talk reviewed (1) The representation of corrosion and its prevention using equivalent circuits, (2) conductive materials and surface finishes commonly used in making joints and (3) technical principles used in the proper choice of materials. Design guidelines for joints that could be used in electronic products were also presented.

CNE Chapter Officers for 1998/1999 are:

Chair and Secretary: John Clarke, EMC Consultant
Vice-Chair: John Luchini, Brite Voice Systems
Vice-Chair: Lee Hill, Silent Solutions

Germany

Prof. Heyno Garbe reports that the German chapter hosted two presentations this spring at the University of Hannover. 25 persons attended the May meeting where Dr. Oeing, of INCASES, Paderborn, reported on the latest developments in EMC-CAD tools for Printed Circuit Boards (PCBs). The auditorium agreed with the speaker that it is absolutely necessary to create software tools in order to decrease the development time. Dr. Oeing pointed out that with the present EMC-CAD tools it is possible to treat a sin-

gle PCB, but it is a great challenge for EMC engineers to include the whole system into the CAD program.

In June, 35 persons were present when Dr. Form, Volkswagen AG, Wolfsburg, gave his talk about EMC concerns in the automobile industry. First, he introduced the typical environment in which cars have to work and the EMC requirements that have to be met. It was very impressive to see that a normal car has to withstand a field strength that is more than fifty times higher than the limit for household equipment.

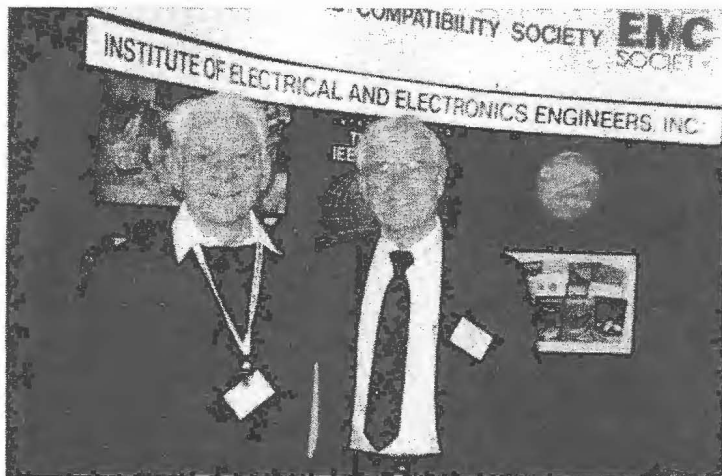
The speaker also described the different measurement and test facilities that are necessary for automotive EMC testing. He also discussed the EMC management system at Volkswagen AG. After this talk everyone agreed that Dr. Form's talk was excellent.

Los Angeles

The Chairman of the the Los Angeles Chapter, Ray Adams, is one smart cookie. Once Ray heard that Henry Ott



(L-R) Jennifer Fisher of Test Equipment Corporation and Virginia Fischer of Fischer Custom Communications join Janet O'Neil of Lindgren RF Enclosures for the raffle following the Henry Ott event in Manhattan Beach.



Long time EMC Society members and legendary "experts" reunite at the Manhattan Beach Henry Ott event. Pictured are Al Parker (L) of Solar Electronics and Joe Fischer of Fischer Custom Communications.

Photo by Janet O'Neil



Photo by Janet O'Neill

The spotlight is on Pam Tucker of CKC Labs and Chris Steding of Electro-Metrics during the Henry Ott event in Seattle. Pam and Chris also participated in the Henry Ott event in Manhattan Beach.

would be in Seattle on April 28 for the Seattle Chapter event, he begged, pleaded and borrowed to get Henry to repeat the program for the Los Angeles Chapter. Ray thought that since Henry was already on the West Coast in Seattle, he could make the trip down to Los Angeles fairly easily. Fortunately, Henry agreed, and thus the LA Chapter also sponsored the one-day tutorial with Henry Ott titled "The Ten Most Common EMC Problems and Their Solutions Plus EMC Measurement Diagnostic Techniques." This was held on April 30 at the Marriott Hotel in Manhattan Beach. Over 130 EMC professionals attended. As in Seattle, attendees were treated to a full day of Henry Ott, continental breakfast, a delicious sit-down lunch and a reception which featured a pasta bar and a bottom-less bowl of jumbo shrimp. All at a luxury hotel overlooking a golf course! In addition to the tutorial, there was a vendor tabletop display area which featured the latest and greatest in EMC products and services. The highlight of the reception was a raffle. Credence Technologies donated a ScanEM hand-held near-field probe and Fischer Custom Communications donated H and E field sniffers.



Photo by Janet O'Neill

Los Angeles Chapter Chairman, Ray Adams (L) of Hughes, promotes the sales of EMC Society CD-ROMs at the Henry Ott event in Manhattan Beach. David Fischer of Fischer Custom Communications provides good company for Ray.

Mohawk Valley

The Mohawk Valley Chapter held its first meeting in over a year following a period of significant change in the engineering and technical community of the Rome-Utica, NY area. Our sincere gratitude goes out to outgoing Chair Donald Pflug of the US Air Force Research Laboratory in Rome for his past efforts to keep the chapter active amidst a time when local engineering companies and military facilities were being downsized, relocated, and restructured. The chapter membership roster and cycle of meetings were disrupted as a result of these recent events. Due to the dedication, sacrifice, and planning of the Section members and local community professionals, this situation is improving. We are now in a growth mode and going back to a regular cycle of EMC Chapter meetings. Following in Don Pflug's footsteps is Andy Drozd. Andy took over the Chapter Chair position at the beginning of this year.

The May luncheon meeting of the Mohawk Valley Chapter featured Don Bush of dBi Corporation as guest speaker. Don's participation was sponsored through the EMC Society Distinguished Lecturer Program. His talk was titled "A History of EMC, Impacts of the Information Age and Instituting Collaborative/Concurrent Engineering Practices in the Workplace." The presentation focused on the evolution of EMC measurement methods and how modern information technologies have affected the way engineers perform measurements today compared to comparable practices over the past several decades. Don also highlighted the importance of properly considering EMC in view of other technical disciplines including human factors and safety engineering. His presentation hit home for many who are working directly in the combined areas of EMC, integrated product team engineering, and the application of advanced information technologies in

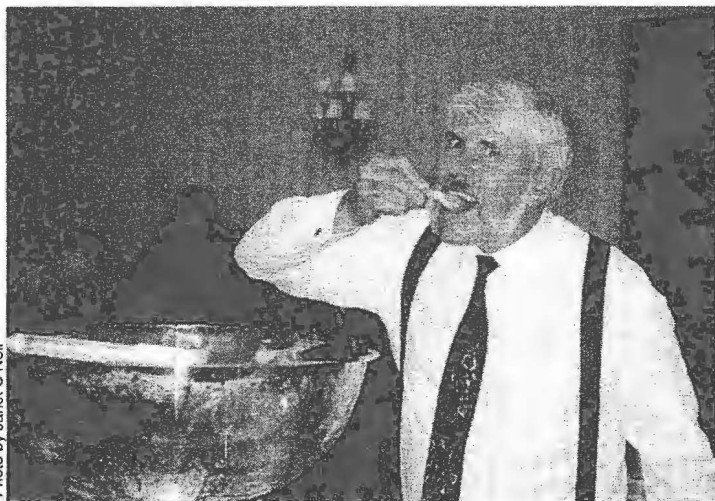


Photo by Janet O'Neill

Lowell Beezley of ARC Technical Resources clearly enjoys the "bottom-less" bowl of jumbo shrimp at the Henry Ott event in Manhattan Beach.



Henry Ott is shown with Janet O'Neil following the one-day tutorial he presented entitled: "The Ten Most Common EMC Problems and Their Solutions Plus EMC Measurement Diagnostic Techniques." During the Seattle and Manhattan Beach tutorials, Henry provided quality EMC education to over 200 engineers.

product designs as well as for conducting specifications compliance testing. Over 25 members and guests were in attendance at the May luncheon meeting. Overall, an excellent presentation and a job well done by Don Bush!

The Mohawk Valley EMC Chapter is planning for several more presentations courtesy of the Distinguished Lecturers Program following a brief Summer hiatus.

Philadelphia

The April meeting of the Philadelphia chapter featured Dr. William Duff of Computer Sciences Corporation. Dr. Duff gave a very interesting presentation titled, "Danger - Electromagnetic Interference (EMI) Communication Systems Overload."

Santa Clara

Joining the bandwagon to promote EMC education, the Santa Clara Valley Chapter organized a one day EMC event titled "EMC '98: A Colloquium and Exhibition on Product Compliance, Understanding the Fundamentals." This was held at the Westin Hotel and Santa Clara Convention Center on June 1. Some 200 EMC professionals attended the event which featured two parallel tracks of presentations; one addressed Product Compliance while the other addressed EMC Design. The objective was to enable attendees to hear nationally and internationally recognized industry leaders and technical experts present up-to-date information on all aspects of regulatory agency approval processes and product design. Featured speakers included EMC Society Board of Directors members Don Heirman,



Photo by Janet O'Neil

Scenes from under the "big top" at EMC '98 in Santa Clara. Attendees are shown gathering around the lunch buffet which was served in the vendor table top display area.



Photo by Janet O'Neil

Don Heirman takes a break from the action at EMC '98 in Santa Clara. The dessert buffet was just one of the highlights of the one day event which featured some 15 speakers, including Mr. Heirman, during the two parallel sessions.

Dan Hoolihan, and Todd Hubing, as well as Dr. Zorica Pantic-Tanner (who was also the Treasurer for the event), Jim Chiappe, Bill Ritenour and Franz Gisin, among others. In fact, Franz Gisin of Silicon Graphics chaired the event and was ably assisted by a planning committee which included Ken Renda of Lockheed-Martin as Vice-Chair, Jennifer Fisher of Test Equipment Corporation for Arrangements, Jay Gaertner of ARC Technical Resources for Exhibits, John Shelter of TRW for Registration, Susan Savage of Advanced Performance Materials for Publicity, John Will of Sun Microsystems for the Technical Program, Jon Zobel of TRW for Publications, and Jeff Evans of Silicon Graphics as the Webmaster. It took a big crew to put on this summer blockbuster! In addition to the technical presenta-



Lee Hill of Silent Solutions (L) was the featured speaker at the May Seattle Chapter meeting. He is joined after the meeting by Ghery Pettit (center) of Intel and Seattle Chapter Chairman, and Ed Blankenship of Hewlett-Packard (R) in Camus who represented the Portland Chapter at the meeting.

tions, the exhibition featured over 40 vendors of EMC products and services.

Seattle

On April 28, over 100 EMC engineers and professionals converged at the Hyatt Regency Hotel in Bellevue to attend a one-day tutorial with Henry Ott. Titled "The Ten Most Common EMC Problems and Their Solutions Plus EMC Measurement Diagnostic Techniques", this event was organized by the Seattle Chapter to promote affordable, high-quality EMC education. Tutorial topics included PCB layout, grounding, cabling, and shielding. The morning session of the tutorial addressed the most common EMC problems and provided the designer with a check list of what should be considered at the beginning of a design. The afternoon session addressed simple measurement techniques that could be used in a lab to determine the EMC performance of a design. The objective was successful "up-front" EMC design. Attendees were treated to a full day of Henry Ott, continental breakfast, a delicious sit-down lunch and a reception which featured a pasta station. In addition to the tutorial, there was a vendor tabletop display area which featured the latest and greatest in EMC products and services. There was also a book signing with Henry Ott for those who purchased his book "Noise Reduction Techniques in Electronic Systems", 2nd edition. All agreed it was a great event, thanks largely to the excellent speaker, Mr. Ott, and the super organizational skills of the planning committee. No detail was left unturned!

In May, Lee Hill from Silent Solutions in Hollis, New Hampshire visited the Pacific Northwest to speak on the topic "Inductance, Ground Plane Gaps, and Radiated EMI in PC Boards." Lee treated the chapter to a very professional presentation which was lively and informative. He noted that previous work in EMC literature has demonstrated that the presence of common mode current on the external cables of electronic equipment is often the primary source of radiated EMI at frequencies above 30 MHz. To reduce radiated EMI, many engineers have imple-



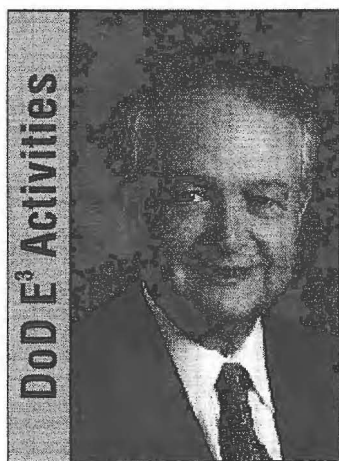
(L-R) Del Black of Del Black/McDonald Associates enjoys a yummy lunch with Tom Lindgren of BF Goodrich Aerospace and Jim Muccioli of Chrysler at the Henry Ott event in Seattle. Note the height of the chocolate cake!

mented segmented, gapped and/or narrow width ground plane geometries in multi-layer PC board designs. Lee presented the results of recent research and experiments to explore and develop a better understanding of inductance, common mode voltage, and the fundamental mechanisms responsible for radiated EMI from PC boards....all in one hour! In closing, the effects of inductance in PC board assemblies were demonstrated with working hardware and a spectrum analyzer.

This was the last meeting of the regular year for the chapter. New chapter officers were elected for next year (September 98 through May 99). Re-elected as Chairman, Vice-Chairman, and Secretary, respectively, were Ghery Pettit of Intel, Janet O'Neil of Lindgren RF Enclosures and John Kuras of Boeing. Kitty Tam of Northwest EMC was elected as Treasurer, replacing outgoing Treasurer Tom Lindgren. Tom, formerly of Boeing, moved to New Mexico to join BF Goodrich Aerospace. The Seattle Chapter wishes Tom the best of luck with his new job! We'll miss you!



Jovial Jerry Page of Northwest EMC (center) welcomes David and Allen Fischer (Left and Right) to his table top display at the Henry Ott event in Seattle.



BOB GOLDBLUM
ASSOCIATE EDITOR

The Department of Defense, Joint Spectrum Center (JSC), is currently conducting two ongoing E³ efforts. One is the Department of Defense/Industry Electromagnetic Environmental Effects Standards Committee (DIESC) whose objective is to compare military EMI standards with commercial EMI standards for the purpose of harmonization. Considering the mandate for military agencies to utilize as much commercial equipment as practical, the DIESC is developing a handbook, "Guide on the Use of Commercial EMC/EMI Standards by Military Agencies." A draft of the handbook will soon be circulated within DoD agencies for review and approval. It will not be made available to industry, in general, until its formal release. However, representatives from industry participated in the preparation of this handbook. For instance, Dr. Ralph Showers from the University of Pennsylvania, was a representative for the American National Standards Committee C63. Other industry organizations that were represented in its preparation include the Society of Automotive Engineers, AE4 Committee on Electromagnetic Compatibility, Electronic Industry Association, G-46 Committee on Electromagnetic Compatibility, IEEE EMC Society, and NEMA. Other non-DoD participants included NASA and the NTIA.

The other ongoing activity involves the updating of MIL-STD-461D/462D, with the last meeting having been conducted in June 1998. Most of the changes have been clarifications, some changes in frequency ranges to harmonize with the European Union and RTCA DO-160 (FAA) requirements, and matters of this nature. No totally new requirements were added nor were any specific requirements deleted. However, the applicability of some requirements, such as CS115 and CS116, were broadened. Additionally, the use of a reverberation chamber as an alternate method for performing RS103 testing will be provided. The most significant revision was the combining of MIL-STD-461 and 462 into a single standalone interface document. This will ultimately result in the cancellation of MIL-STD-461D and 462D and the issuance of MIL-STD-461E.

One of the topics discussed at the recent revision meeting of MIL-STD-461/462 was the addition of ISO Guide 25 "General Requirements for the Compliance of Calibration and Testing Laboratories." Notice 1 to MIL-STD-462 specifies ISO Guide 10012-1 "Quality Assurance Requirements for Measuring Equipment, Part 1" which addresses equipment calibration. However, there was some concern that test laboratories performing military testing should be on a par with commercial laboratories relative to capability and quality. In this regard, commercial laboratories are required to comply with ISO Guide 25 for FCC testing, European Commission requirements testing, and for certification by the NIST NVLAP Program and the A2LA EMC Test Laboratory Accreditation Program. It was noted, on the other hand, that MIL-STD-461 is an interface standard and that a laboratory quality standard should not be imposed in the document. This matter is still under consideration.

Other Government E³ activities included an E³ meeting conducted by the Army in Huntsville, Alabama which was planned for the week of August 10, 1998. This conference included three training seminars focusing on MIL-HDBK-237, the spectrum certification process, and the design of equipment to withstand HEMP environments. This conference follows the general DoD E³ Conference which was conducted in Orlando, Florida during the week of April 6 and the NAVAIR EMC Conference which was conducted in San Diego during the week of May 15, 1998.

It is important to note that the contents of this article represent the opinions and views of the author and not that of the Government. I write this column to help keep the membership informed of DoD EMC activities (as I see them) since many of our EMCS members are still involved in DoD EMC matters. Comments on this column as well as this article are welcome. In particular, I would like to learn of the specific interests in DoD E³ activities by our membership. Readers can contact me at rgoldblum@RBitem.com.



BOB ROTHENBERG
ASSOCIATE EDITOR

Here are two articles which should be of interest to EMCS members. In the first, on open field test site validation, W. Scott Bennett exposes errors in the ANSI C63.4 definition of an ideal site for a vertically polarized source. (Scott is the author of *Control and Measurement of Unintentional Electromagnetic Radiation*, which was reviewed in the Summer '97 Newsletter.) In the second, Daryl Gerke and William Kimmel of Kimmel Gerke Associates tackle the issue of grounding, with a useful "sewer" analogy.

Our intention in this section of the Newsletter is to provide EMC practitioners with an outlet for sharing knowledge or perspective gained from experience. Tips on problem finding, solving, avoiding or understanding are especially appropriate. Opinions and ideas are as welcome as irrefutable facts. Unlike archival works, such as IEEE Transactions or Symposium papers, Newsletter submissions will not undergo the scrutiny of multiple peer reviews prior to publication. They may be edited for length or content, but only with the concurrence of the author. Reader feedback is also welcome, either as a Letter (or e-mail) to the Editor or directly to the author.

To submit an article for consideration, send it via fax, e-mail or real mail to this Associate Editor. See page 3 for addresses and phone numbers.

NORMALIZED SITE ATTENUATION AND TEST SITE VALIDATION

W. Scott Bennett

Abstract

With vertically polarized antennas it is often difficult to measure acceptable values of normalized site attenuation (NSA) on otherwise acceptable radiated EMI test sites. That difficulty is due in part to errors in the standards that must be met. Simple formulas for NSA on the ideal open-field test site are developed here, and standards errors are quantified.

Free-Space Attenuation

Mathematical expressions for *site attenuation* are obtained by inverting a well-known expression for power transmission from one antenna to another [1]. Then, to obtain expressions for *normalized site attenuation* (NSA), both antennas are assumed to have antenna factors of 1 meter^{-1} . That implies that the transmitting antenna radiates equally in all directions and the receiving antenna receives equally from all directions. In other words, normalization eliminates any directional variations in site attenuation other than those caused by the site itself.

If the "site" is free space, then, for the same distance from source to receiving antenna NSA will always have the same value, regardless of direction. In free space, NSA will vary only with wavelength, or frequency, and the distance from one antenna to the other. In mathematical terms,

$$NSA = \left(\frac{R_c \lambda}{Z_0} \right)^2 d^2 \quad \text{or, in decibels,}$$

$$NSA_{dB} = 20 \log \left(\frac{R_c \lambda}{Z_0} d \right)$$

In these expressions

R_c is the *characteristic impedance of the measuring system* (typically 50 ohms),

λ is the *radiation wavelength* (in meters),

Z_0 is the *characteristic impedance of free space* (120π ohms), and

d is the *distance separating the antennas* (in meters).

NSA has no units, because the units of the antenna factors (meters^{-1}) cancel those of λ and d (meters).

In free space, radiated electric and magnetic fields, or E-fields and H-fields, are both inversely proportional to the distance from their source to their observation point. In other words, if the source is uniformly directional and d is that distance, then the E-field and H-field magnitudes are both proportional to $\frac{1}{d}$. So, if

$|E_d|$ and $|H_d|$ denote those magnitudes a distance d from the source, then it is easily seen that $d = \frac{|E_1|}{|E_d|}$, and $d = \frac{|H_1|}{|H_d|}$.

Also, as a sinusoidal E-field and H-field propagate away from their source, they remain in phase and, at any distance d , $|E_d| = Z_0 |H_d|$. Therefore, if the units of $|E_d|$ and $|H_d|$ are volts/meter and amperes/meter, the *radiated power density* at any distance d will be $|E_d| |H_d| = Z_0^{-1} |E_d|^2 = Z_0 |H_d|^2$ in watts/meter². And, as the fields propagate in any direction from $d = 1$ to any greater distance d , the power density will be *attenuated* by an amount equal to $\frac{|E_1| |H_1|}{|E_d| |H_d|} = \frac{|E_1|^2}{|E_d|^2} = \frac{|H_1|^2}{|H_d|^2} = d^2$. Thus, in free

space NSA is the product of $\left(\frac{R_c \lambda}{Z_0} \right)^2$ and any one of those four equal quantities, regardless of direction.

Free-space on actual test sites is limited, however, and radiated E-fields and H-fields will be reflected by objects that limit the free space. As a result, on actual test sites radiated E-fields and H-fields are sums of two, or more, components. One component travels *directly* to the observation point, and the others arrive there *indirectly*, because of reflection. Therefore, if $|E_{obs}|$ and $|H_{obs}|$ are the magnitudes of the *total* electric and magnetic fields arriving at the observation point on a test site, the power density attenuation at that point will be

$$\frac{|E_1| |H_1|}{|E_{obs}| |H_{obs}|} = \frac{|E_1|^2}{|E_{obs}|^2} = \frac{|H_1|^2}{|H_{obs}|^2}. \quad \text{That}$$

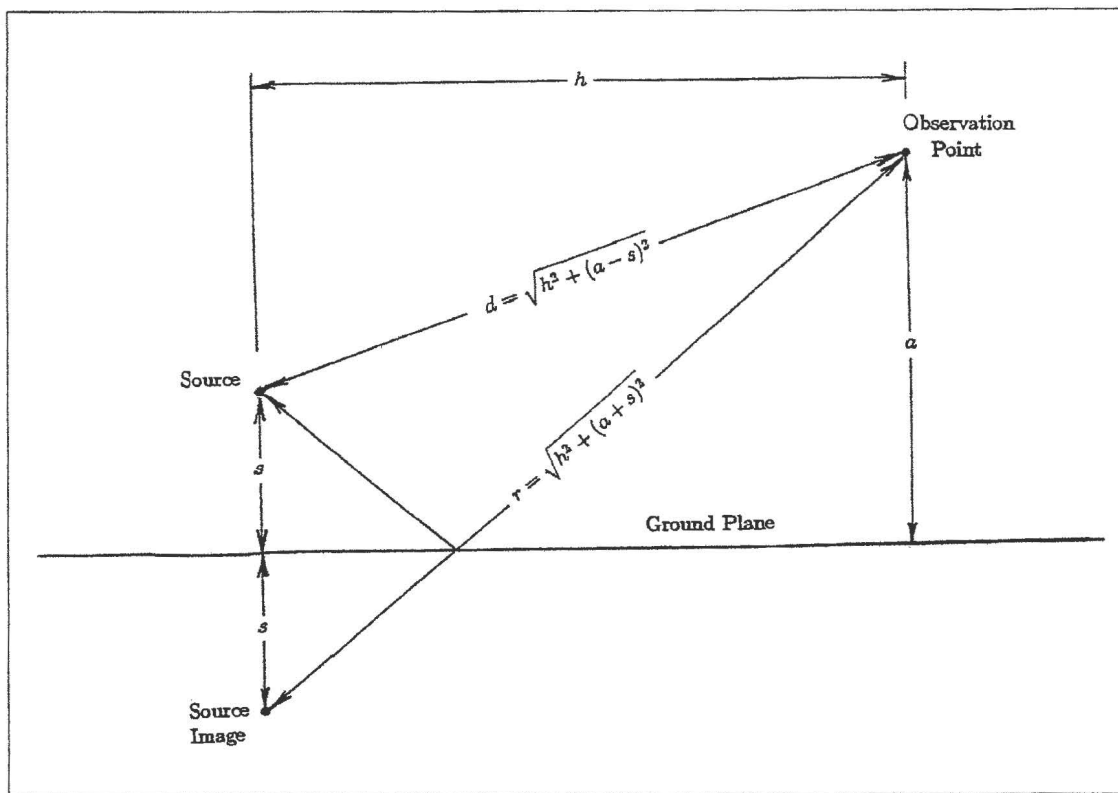


Figure 1. Open-field test site measurement geometry

says that on *any* test site NSA is the product of $\left(\frac{R_c \lambda}{Z_0}\right)^2$ and any one of those three equal ratios.

Open-Field Test Sites

On an open-field test site with a highly conductive ground plane, the ideal to be simulated is an empty half-space over a perfectly-conducting horizontal ground plane of infinite extent. The only reflecting body on the ideal test site is the ground plane. Therefore, the observed fields $E_{obs}(t)$ and $H_{obs}(t)$ will each be the sum of two components — one arriving directly and one arriving indirectly because of reflection by the ground plane.

Now, at any observation point the directions of the E-field and H-field of any radiated wave will always be perpendicular to each other and perpendicular to the direction in which they propagate. Also, a radiated wave on an open-field test site is said to be *horizontally polarized* if its E-field is horizontal and parallel to the ground plane. And, that wave is said to be *vertically polarized* if its E-field lies in the vertical plane that contains both the source and the observation point. Therefore, *horizontal polarization* means the E-field is horizontal, and *vertical polarization* means the H-field is horizontal.

An H-field that is reflected by an infinite perfectly-conducting ground plane to which it is parallel has a reflection coefficient of $\rho_H = +1$. In other words, just above the ground plane the incident and reflected H-fields of a vertically polarized wave will be equal in magnitude and have the *same* direction. On the other hand, an E-field that is re-

flected by an infinite perfectly-conducting ground plane to which it is parallel has a reflection coefficient of $\rho_E = -1$. That means that just above the ground plane the incident and reflected E-fields of a horizontally polarized wave will be equal in magnitude with *opposite* directions.

Therefore, with a vertically polarized source on the ideal open-field test site, the radiated H-field arriving at any observation point will have two collinear horizontal components. However, whether those components have the same or opposite directions will depend on the difference in the distances they

have traveled. As shown in Fig. 1, the distance traveled by the direct wave is $d = \sqrt{h^2 + (a-s)^2}$, and the distance traveled by the reflected wave is $r = \sqrt{h^2 + (a+s)^2}$. In these expressions h is the *measurement distance*, s is the *source height*, and a is the *height of the receiving antenna* (the observation point). And, since a is always greater than 0, r is always greater than d .

Suppose the H-field arriving *directly* at the observation point a distance d from the source is $H_d(t) = \frac{|H_1|}{d} \cos(\omega t)$.

Then, the *reflected* H-field arriving at that point after traveling the distance r will be $H_r(t) = \rho_H \frac{|H_1|}{r} \cos(\omega(t - (r-d)/c))$ because of the difference in propagation times $(r-d)/c$. (The divisor $c = 3 \times 10^8$ meters/second is the *velocity of light* and also that of the H-field and E-field.) And, because $H_d(t)$ and $H_r(t)$ have either the same or opposite directions, the *total* H-field at the observation point, $H_{obs}(t)$, will be their sum.

So, with vertical polarization on the ideal open-field test site, and noting that $\frac{\omega}{c} = \frac{2\pi f}{c} = \frac{2\pi}{\lambda}$, it is seen that

$$H_{obs}(t) = \frac{|H_1|}{rd} [r \cos(\omega t) + \rho_H d \cos(\omega t - 2\pi(r-d)/\lambda)]$$

And, from basic trigonometry it follows that the magnitude of $H_{obs}(t)$ is

$$|H_{obs}| = \frac{|H_1|}{rd} \sqrt{r^2 + \rho_H^2 2rd \cos(2\pi(r-d)/\lambda) + d^2}$$

Thus, since $\rho_H = +1$, the power density attenuation from source to receiving antenna will be

$$\frac{|H_1|^2}{|H_{obs}|^2} = \left(\frac{rd}{\sqrt{r^2 + 2rd\cos(2\pi(r-d)/\lambda) + d^2}} \right)^2$$

and multiplying that by $\left(\frac{R_c\lambda}{Z_0}\right)^2$ yields NSA.

Therefore, with *vertical polarization* on the open-field test site

$$NSA_{dB} = 20\log\left(\frac{R_{c\lambda}}{Z_0} \frac{rd}{\sqrt{r^2 + 2rd\cos(2\pi(r-d)/\lambda) + d^2}}\right)$$

Now suppose the polarization is horizontal. Then, in the preceding equations H is replaced with E and, since $\rho_E = -1$, it follows that the power density attenuation from source to receiving antenna will be

$$\frac{|E_1|^2}{|E_{obs}|^2} = \left(\frac{rd}{\sqrt{r^2 - 2rd\cos(2\pi(r-d)/\lambda) + d^2}} \right)^2$$

Therefore, with *horizontal polarization* on the ideal open-field test site

$$NSA_{dB} = 20\log\left(\frac{R_{c\lambda}}{Z_0} \frac{rd}{\sqrt{r^2 - 2rd\cos(2\pi(r-d)/\lambda) + d^2}}\right)$$

In other words, expressions for NSA differ for vertical and horizontal polarization only in the sign of the co-

sine term. And, that difference results because $\rho_H = +1$ and $\rho_E = -1$.

Comparative Values of NSA

In measuring NSA, the value recorded for each source height and frequency is the minimum value obtained over a specified range of receiving antenna heights. In calculating those values for NSA_{dB} with the above equation for *horizontal polarization*, there is complete agreement with the values given in ANSI C63.4 [2], for all frequencies and geometries. However, the values obtained with the above equation for NSA_{dB} with *vertical polarization* do not agree with the values given in that standard. For a measurement distance of 10 meters, source heights of 1.0, 1.5 and 2.75 meters, and vertical polarization, the values for NSA_{dB} in ANSI C63.4 are too high by the amounts shown in Fig. 2. For a measurement distance of 30 meters and vertical polarization, the values of NSA_{dB} given in ANSI C63.4 all appear to be only 0.1 dB higher than they should be.

Therefore, to accurately determine how well a given 10-meter open-field test site simulates the ideal with *horizontal polarization*, measured values of NSA_{dB} can be compared to the values given in ANSI C63.4. However, with

vertical polarization, to make that determination with the same accuracy, measured values of NSA_{dB} should be compared to values given in ANSI C63.4 after they have been reduced by the amounts given in Fig. 2. For additional measurement geometries, the required value of NSA_{dB} can be accurately determined for either polarization using the equations given above.

References

- [1] Friis, H. T., "A note on a simple transmission formula", *Proceedings of the IRE*, vol. 34, pp.254-256, May 1946.
- [2] ANSI C63.4-1992, "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz."

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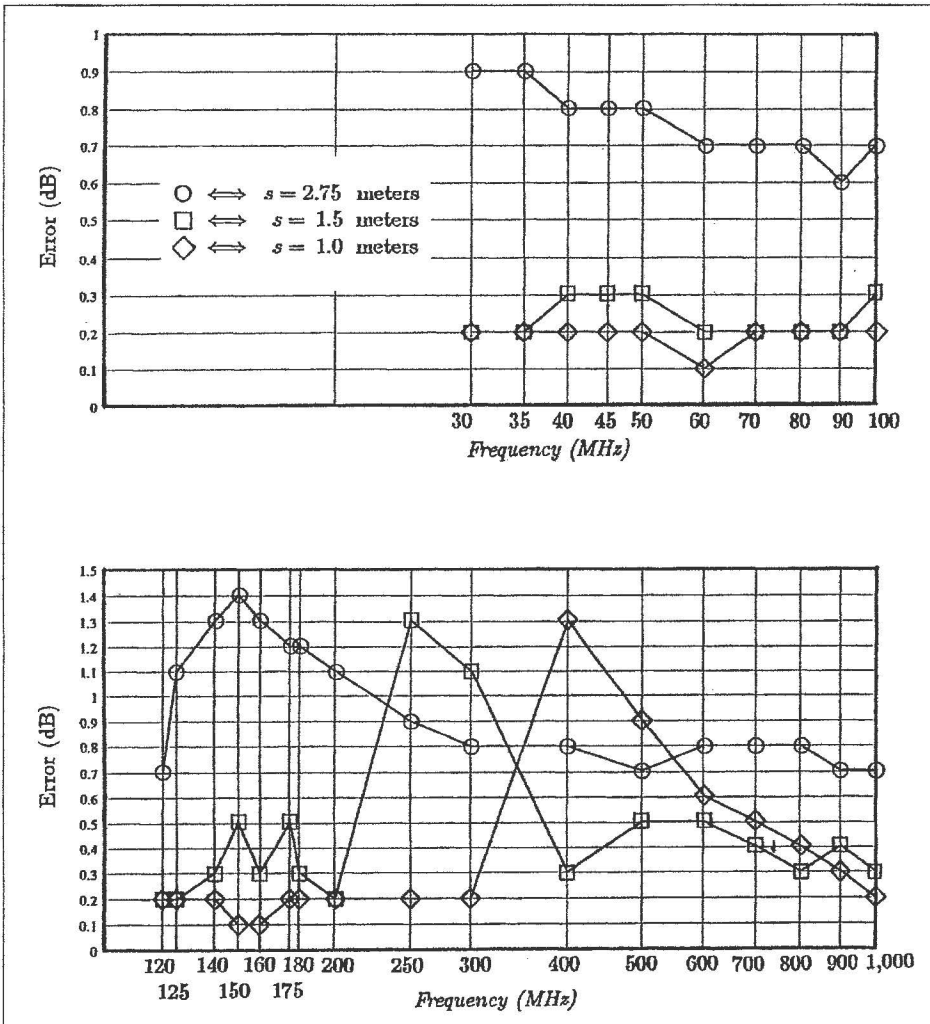
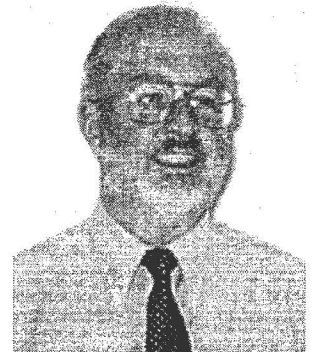


Figure 2. Positive error in values of NSA_{dB} given in ANSI C63.4 for the 10-meter measurement distance with vertical polarization.

The Mysteries of Grounding...

Daryl Gerke, PE, and William Kimmel, PE
Kimmel Gerke Associates, Ltd.

Grounding is one of the most important, yet least understood, aspects of electrical engineering. As EMC engineers, most of us have seen grounding as a major contributor to EMC problems at both the systems and equipment levels. Entire books have been written on the subject, so this article will be but a brief attempt to highlight some key concepts on grounding. We'll do this by asking several simple questions.

First, what is a ground? Ask an electronic design engineer, and you will get a different answer from a power engineer. Ask someone dealing with ESD, and you may get another answer. That's part of the problem — the term is often vague, ambiguous, and context dependent.

The answer we like is that a ground is simply a "return path for current." That path may be intended, or it may be unintended. Electrons don't care, as they can't read schematics anyway. Just remember that electrons "always return to their source".

One answer we don't particularly like for EMC issues is the classical "equipotential reference" definition. Anytime we have a finite current flowing in a finite impedance, we must have a finite voltage difference. (Yes, Ohm's Law really works.) If the voltage difference is small, perhaps we can ignore it, and use the "equipotential" approximation. But often times the non-equipotential reality is what causes EMC problems.

We have a favorite analogy for grounds — the "sewer analogy". Consider a ground as a path for "used electrons" if you like, and remember, it's a path, not a cesspool. To expand the analogy, what is a desirable attribute of a sewer? Low impedance to flow. Is it acceptable to have more than one sewer? Sure, such as separate sanitary sewers and storm sewers (like separate "analog" and "digital" grounds.) Separation prevents unwanted mixing of sewage (or currents) that might otherwise share a common path.

Why use a ground? Grounds are used for many reasons, including power, safety, lightning, EMI, and ESD. Sometimes one ground may perform several functions — intended or unintended. This is why grounding can be such a sticky issue.

Grounding requirements may vary widely due to vastly different amplitudes and frequencies. The latter is a key issue, since ground impedance is often highly frequency dependent. For example, round wire inductance becomes an issue above about 10 kHz, which necessitates lower inductance ground planes, grids, or bond straps at higher frequencies. Transmission line effects also become an issue when ground dimensions become significant. A common EMC rule of thumb for these effects is physical distances greater than 1/20 wavelength — about 250 km for 60 Hz, but only about 15 cm at 100 MHz. As a result, specific

grounding techniques may vary widely. A general purpose ground may not solve a specific problem at all. Let's look at several of these areas.

Power Ground — In power systems, this is often referred to as the "neutral". This conductor carries current back to the sources, such as a transformer, service panel, or battery. This type of ground may carry large currents (many amps) but needs only to work at relatively low frequencies (50/60 Hz or DC). As a result, the constraints are resistance and current carrying capability.

Safety Ground — In power systems, this is the conduit or the "green wire". Unlike the neutral, this conductor is only supposed to carry current during a fault condition, such as a short circuit to a metal cabinet. Like the neutral, it must carry large currents at low frequencies, but only for a relatively short time.

Lightning Ground — This type of ground provides a controlled connection to the earth for lightning currents to follow. A lightning ground must carry huge currents (upwards of 200,000 amps) but only for a fraction of a second. Due to the transient nature of lightning, the frequency content is in the 300 kHz to 1 MHz range. The constraints for lightning grounds are inductance and peak currents. This requires solid connections with a minimum of bends.

EMI Ground — For "noise" control, an EMI ground must often work over a very wide frequency range. At the same time, currents are often small (microamps or milliamps). Thus, low inductance paths with low inductance/resistance connections are often needed.

ESD Ground — This is a special case of an EMI ground. A human body discharge can result in tens of amps, but only for nanoseconds. Due to the very fast rise times, ESD frequency content is in the 300 MHz range. Thus, low inductance grounds are mandatory for ESD. Sometimes we use "resistive" or "soft" grounds to limit the ESD current as well.

Single point, or multi-point? In simple terms, it depends on the threat frequency. For low frequency threats, such as stray 60 Hz power currents, the *single-point ground* is preferred. This prevents "ground loops", which can let unwanted noise currents mix with intended signal currents in a common path. The strategy is to steer currents with careful wiring practices.

For high frequency threats (RF, or even power line transients), the *multi-point ground* is preferred. Above about 10 kHz, parasitic inductance and parasitic capacitance allow noise currents to follow alternate paths, so the single point ground becomes difficult, if not impossible, to implement. In addition, transmission line effects become an issue, also mandating multiple connections. Furthermore, to lower the inductance, planes and grids are needed.

The single-point/multi-point guidelines extend to cable shield grounding as well. For low frequencies, the preferred

approach is to ground cable shields at one end, while for high frequencies, the preferred approach is to ground cable shields at both ends.

For systems facing a combination of high frequency and low frequency threats, *hybrid grounds* may be needed. Capacitors can be used to provide multiple "high frequency" connections, and inductors can be used to isolate "high frequency" paths. Once again, these techniques apply to cable shield grounding. For example, we've solved numerous transient (high frequency) problems in instrumentation systems that traditionally use single-point (low frequency) techniques, by simply adding a small high frequency capacitor to the open end of a cable shield.

What about "earth" grounds? An earth connection is really only needed for lightning, but by convention it is widely used for power line safety as well. But you don't need an "earth" ground for many situations. For example, an airframe can be used as a ground (return path for current flow), but you don't see many 747s flying across the country dragging an earth ground cable with them. A common misunderstanding we often see is the urge to "drive more ground rods" to lower ground impedance. While this

may help if your primary concern is lightning, usually it indicates a desperate approach that fails to address the real ground problems in the system.

One final comment. Safety issues must always take precedence over any other grounding needs. Before making any grounding changes, always be sure the system remains safe.



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IEEE AND ABET SEEK PROGRAM EVALUATORS TO ENSURE QUALITY OF ENGINEERING PROGRAMS

PISCATAWAY, NJ, June 18, 1998 — The IEEE Educational Activities Board is now accepting applications for program evaluators for engineering and engineering technology programs at U.S. colleges and universities. The application deadline is October 30, 1998. Candidates sought are engineering professionals from industrial, government and academic sectors.

The goal of prospective evaluators is to assess the quality of engineering education. Selected applicants attend a one-day training session, sponsored by the IEEE, that explains the IEEE/ABET accreditation process. Following training, evaluators are prepared to assist with program evaluations that take place each fall and generally run for two to three days.

Nomination packages are available from: Accreditation Administrator, IEEE Educational Activities, 445 Hoes Lane, Piscataway, NJ, USA 08855-1331; tel:732.562.5484; e-mail: "accreditation@ieee.org" or via the World Wide Web; for engineering:

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for engineering technology:
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RAY PEREZ
ASSOCIATE EDITOR

**Engineering
Electromagnetic
Compatibility: Principles,
Measurements, and
Technologies**
by
V. Prosad Kodali
Publisher: IEEE Press

In this book review, we address an introductory EMC book written for the undergraduate level of teaching. This book has been well researched and well written by the author. The material of the book seems to have originated from many technical papers published by the EMC community over the last 15 years (I recognize much of this material). The author has done a good job in compiling all this material together in a concise and understandable manner. The book is made up of 13 chapters and 4 appendices and covers the fundamentals of a senior level EMC engineering course.

Chapter 1 is introductory in nature and outlines some of the early history of EMC as an art and science from the pre-W.W.II era to today's modern standards. The chapter also describes some basic definitions and provides some examples of practical experiences concerning EMI situations such as high voltage transmission lines, switches/relays, biological effects, aircraft navigation, etc. Some discussion concerning the present and future demands of frequency spectrum and the EMI implications are also discussed. Chapter 2 addresses some natural and quasi-natural sources of EMI; specifically, the work is dedicated to lightning, electrostatic discharge (ESD), and electromagnetic pulse. Each of these subjects are introduced briefly but with sufficient detail for a good conceptual understanding. It includes also some models representing the effect of the phenomena.

Chapter 3 provides a description of several sources of electromagnetic noise in electrical, electromechanical, and electronic apparatus. The electromagnetic noise accounted for is the one originated within these apparatus. Among the noise sources described are: systems (e.g. radar, aircraft, communications systems, mobile transmitters, power lines), relays and switches, including those in telephone equipment, and nonlinear sources such as rectifiers, mixer, logic in digital circuits. Simple noise models for amplifiers and modulation techniques are introduced. The chapter next explores the well-known subject of interference coupling through crosstalk for multi-conductor lines. Finally, the chapter ends with an introduction on the subject of field to wire coupling.

Chapter 4 follows an alternate approach in describing electromagnetic interference using analytical macromodels of statistical

nature when EMI is assumed not to be of a deterministic nature but instead random and non-Gaussian. In such an approach, EMI is expressed as a function of random variables or stochastic variables. Analytical models that are based on statistical physical information combine the physical and statistical description of general EMI.

Chapters 5 through 7 are dedicated to EMI measurements. Actually, in this reviewer's opinion, these are the best chapters in the book where the subject of measurements is well discussed. Chapter 5 addresses open area test site (OATS) measurements for radiated emissions and radiated susceptibility. Several important issues related to OATS are discussed, such as: a) the type of test antennas, b) measurement considerations such as the electromagnetic environment, scatterers and power cable connections, c) the shape and proper sizes of OATS, d) measurement configurations (the stationary EUT vs the stationary antenna), and e) terrain roughness. The chapter then addresses the very important subject of OATS and normalized site attenuation measurements (for far zone electric field). Using calculations of the maximum electric field possible in the presence of a conducting plane, the horizontal half-wavelength dipole, the vertical half-wavelength dipole, and a general antenna electric field expressions are calculated. Several sections are also dedicated to the concept of site attenuation, measurement test site imperfections and antenna factor measurements. Chapter 6 covers the material of radiated emission measurements using other facilities besides OATS. Among the facilities discussed are the anechoic chamber, the TEM cell, the reverberating chamber and the GTEM cell. For each of these testing facilities, the chapter describes the physical fundamentals of such facilities and how measurements are usually performed in them. The chapter ends with a brief comparison among the testing facilities. Chapter 7, which is the last of the measurement chapters, addresses the subject of conducted interference measurements. Among the subjects discussed are: a) electrical transients and other disturbances carried by electrical power supply lines, their characterization, and approaches to measurements, b) procedures for the measurements of con-

ducted EMI (power line or signal line) originating from the operation of electronic equipment, and c) procedures for determining the immunity of equipment under test to conducted interferences. It is this chapter where the concepts of differential mode and common mode currents are discussed and how to perform such measurements.

In Chapter 8 the book addresses the concept of interference due to pulse interference or interference caused by pulses or transients. There are three types of pulses covered in the chapter: electrostatic discharge, fast electrical transients/burst, and electrical surges. Most of the chapter is dedicated to ESD and it includes the physics of ESD and the proper way of doing ESD testing (there is also a section on the usage of ESD testing hardware). Test set ups include table-top apparatus, standing equipment, and in-situ. Electrical fast transients are generated when inductive, capacitive circuits are interrupted from inductive loads such as relays, coils, timers, motors, or contactors that generate arcs of different kinds. Test beds for electrical fast transient immunity and some physical examples of burst generators are discussed. The chapter ends with a discussion of high voltage surge testing per IEEE standards.

Chapter 9 addresses the subjects of grounding, shielding, and bonding that are usually the most popular subjects within EMC. As in other EMC books, the subjects are well covered with the help of the many good papers in this area that have been written over the last 20 years. Among the topics covered are: earthing of facilities and other systems (including the concept of earth impedance, single rod electrons, multiple rods, and measurement of ground noise resistance), single point/multi-point grounding, cable shield grounding, shielding and shielding effectiveness (theory of single and multiple shields), shielding materials, discontinuities and apertures in shields, cable shields, measurements of shielding effectiveness and an introduction to bonding issues.

Common mode filters are discussed in Chapter 10. Conventional filter analysis and design is a well-established science except that all this work assumes that the filter is ideal. This chapter covers mainly power line filters. Imped-

ance mismatch effects are considered (i.e when load and source impedances are different). Lumped element low-pass filter types are considered such as capacitor filter, inductor filter, LC filter, the pi and T filter, lossy lines, and active filter. High pass/low pass filters and band reject filters are also considered briefly. The chapter ends with the subject of power line filter design for common mode and differential mode current suppression.

Chapter 11 addresses the importance of proper cable selection in achieving electromagnetic compatibility and minimizing interference. Among the topics discussed are absorptive cables (such as the single braid, double braid, foil, and their application depending upon the frequency and shielding effectiveness desired). Ribbon type cables are also discussed. The role of connectors in shielding effectiveness is discussed such as pig-tail effects, connector shielding and the "rusty bolt effect". Together with connectors, EMC gaskets and the different kinds of gaskets most commonly used in the industry are reviewed. A couple of more items discussed in this chapter are the isolation transformer, which suppresses common mode and differential mode interference, and optical isolators to greatly reduce electromagnetic interference in signal transmission lines. The chapter ends with a brief discussion of transient suppression devices (gas discharged tubes) and semiconductor devices (varistors and zener diodes).

In Chapter 12, the concept of frequency assignment and spectrum conservation are discussed. Frequency allocation is important in order to make the several radio services function in a compatible manner without electromagnetic interference among each other. The increasing demands on the frequency spectrum necessitates the development of methods and frequency assignments for spectrum efficiency. The chapter outlines the principles of frequency assignment and proper spectrum usage. The final chapter, or Chapter 13, briefly covers EMC standards most familiar to the EMC community.

In summary, the book is well written and can be recommended as an introductory EMC book.

NEW "BEST STUDENT PAPER" CONTEST!

CASH PRIZE – WIN BIG BUCKS & TRAVEL ALLOWANCE TO ATTEND 1999 EMC SYMPOSIUM!

The IEEE 1999 International EMC Society Symposium in Seattle, Washington is holding a student paper contest. Abstracts from undergraduate or graduate students (where the student is the primary author) are due by October 19, 1998. Watch for further details in the official "Call for Papers" mailed to EMC Society membership, or contact Dave Walen, Technical Program Chairman, phone 425.227.1156, e-mail: dave.walen@faa.dot.gov for more information.



DR. WILLIAM G. DUFF
ASSOCIATE EDITOR

Penny Caran, born in May of 1948, graduated from the College of William and Mary in 1969, and began her working career working for then Governor of New York State, Nelson A. Rockefeller. Upon Governor Rockefeller's retirement as Governor, she went on to become Deputy Director, Washington D. C. Office for the Commonwealth of Massachusetts. In the ensuing years, she continued in the political, government service arena, married and had two children.

After returning to Warrenton, Virginia where she was raised, Penny first heard the term "EMC" in February of 1982, when she joined the consulting firm, known as Don White Consultants Inc., in Gainesville, Virginia. Employed as Assistant Marketing Director, Penny worked for the organization until 1987. During the six years with Don White Consultants, the company expanded its consulting and training services to include offices in Western Europe, Japan, and Australia.

She advanced to Sales Director and was responsible for managing the Sales Department and supporting the International Representative Offices. While advancing her knowledge and experience with Don White Consultants in the 80's, she actively participated in the EMC business expansion.

The huge growth in the EMC business market spurred the company to change its name to Interference Control Technologies, Inc. (ICT), start a quarterly technical trade journal, called EMC Technology, launch a new annual EMC Symposium, and continue publishing an expanded library of its technical books. In 1983 when the FCC implemented its new Part 15J rules, the demand for EMC consultants, training courses, and regulatory information was huge. Little did she know that this huge EMC growth phenomenon would be repeated fifteen years later. In 1987, Penny left ICT and went on to other pursuits.

In 1990, she was contacted by a former ICT business associate and adjunct instructor, Martin Green, who in 1987 had established his own company located in the United Kingdom. Because of the coming European Union single internal market changes on the horizon, particularly the pending impact of the EU Directive on EMC, Mr. Green was very interested in developing a North American business subsid-



Penny Caran

iary. As Mr. Green's company was on the advance list of "to be appointed" regulatory bodies known as "competent bodies" for the EMC Directive, he wished to develop early market access to North American companies who might wish to have technical support and assistance to meet the CE Marking requirements of the EMC Directive.

Calling on long time business associates, Penny began to develop a marketing and sales plan to start a North American business subsidiary. Today Technology International Inc., headquartered in Richmond, Virginia has offices in Dallas, Texas and Sunnyvale, California and serves the broad industrial and commercial market of manufacturers. Today Technology International (Europe) Ltd., the parent company, provides the legal certification support for not only the EMC Directive but also for the Low Voltage Directive and Machinery Safety Directives.

Although Penny says she is not officially an EMC Engineer, and she is not, she does participate actively in IEEE activities, and is a member of the Northern Virginia Chapter of the EMC Society. "Haven't missed an annual IEEE EMC Symposium in many years", she says, and attributes her success in developing Technology International to the excellent business relationships and personal friendships she has developed over the years of working in the EMC community. "The International EMC Society is a small group of hard working

people who all know each other. I certainly don't know all of the members, but to those I do, I owe some measure of thanks for their support and assistance over the years."

She was the 1997 Program Co-Chairman of the First Annual EMC Harmonization Conference sponsored by the Northern Virginia Chapter of the IEEE EMC Society. As the 1998 Conference Chairman of the Second Annual EMC Harmonization Conference sponsored by the IEEE sections (including the National Capital Area Council, the Washington Section, the Northern Virginia Section, and the Washington and Northern Virginia Chapter of the Electromagnetic Compatibility Society), she actively worked with the other committee members to put together an excellent technical program with the theme of "Getting the Job Done".

Penny lives in Richmond, Virginia. Her two sons are both full time college students. Chris (22) is completing his Masters Degree in Public Administration at North Carolina State University in Raleigh, North Carolina. David (20) is a rising Junior at Virginia Tech in Blacksburg, Virginia and is pursuing a degree in technical theater production.

Penny is president of a local investment club, a member of the Board of Directors of the Virginia Biotechnology Association, a member of the EMC Society, AAMI and several other business associations. She is also active in local community groups. She enjoys reading, sailing, music and scuba diving.

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INTERESTING WEB SITES

(Do you know of other non-commercial websites which may be of interest to EMC Society members? If so, please contact the Editor.)

Sites at the National Institute of Standards and Technology (NIST)

National Institute of Standards and Technology (NIST)
<http://www.nist.gov/>

National Voluntary Laboratory Accreditation Program (NVLAP)

<http://ts.nist.gov/nvlap>

NIST Office of Weights and Measures (OWM) also National Conference on Weights and Measures (NCWM)

<http://ts.nist.gov/ts/htdocs/230/235/owmhome.htm>

Office of Standards Services (OSS)

<http://ts.nist.gov/oss>

Global Standards Program (GSP)

<http://ts.nist.gov/gsp>

International Organization of Legal Metrology (OIML)

<http://ts.nist.gov/ts/htdocs/210/215/oiml-fxs.htm>

Sites Around the World

International Laboratory Accreditation Co-operation (ILAC)

<http://www.ilac.org/>

Asia Pacific Laboratory Accreditation Cooperation (APLAC)

<http://www.ianz.govt.nz/aplac.htm>

Asia-Pacific Economic Cooperation (APEC)

<http://www.apecsec.org.sg/>

Interamerican Accreditation Cooperation (IAAC)

<http://www.ibpinetsp.com.br/iaac/>

International Organization for Standardization (ISO)

<http://www.iso.ch/>

International Bureau of Weights and Measures (BIPM)

http://www.health.gov.au/hfs/arl/irs_tm.htm

National Conference of Standards Laboratories (NCSL)

<http://www.ncsl-hq.org/>

Sources of Publications

NIST publications on standards and conformity assessment activities

<http://ts.nist.gov/ts/htdocs/210/217/osc.htm>

ISO Quality Management Standardization

<http://ts.nist.gov/ts/htdocs/210/216/iso9000.htm>

EMCS Board of Directors Activities

By Janet O'Neil, Secretary of the Board

President Dan Hoolihan called the meeting to order at 8:00 am. A round of introductions was made. Board members in attendance included President Hoolihan, Treasurer Warren Kesselman, Secretary Janet O'Neil and Directors Franz Gisin, Don Heirman, Bob Hofmann, Jim Muccioli, Joe Butler, Andy Drozd, Herb Zajac, Henry Benitez, Todd Hubing, Mark Montrose, Henry Ott, Don Sweeney, Kimball Williams and Takeo Yoshino. Absent Board members included Bill Gjertson, Bill McGinnis, Norm Violette, Ferdy Mayer and Andrew Podgorski. Mr. Hoolihan welcomed the guests in attendance, including past Board members Don Weber and Walt McKerchar, as well as Barry Wallen, Chairman of the 1998 IEEE EMC Symposium in Denver. Members of the 1999 IEEE EMC Symposium in Seattle organizing committee, Bill Price, John Kuras, and Diane Heidlebaugh, were also welcomed as guests. The agenda for the meeting was presented and approved.

President Hoolihan presented the minutes from the November 8, 1997 meeting on behalf of Secretary Janet O'Neil. The minutes were approved with minor amendments.

Treasurer Warren Kesselman presented his report. He noted that the IEEE's 1997 post-closing pre-audit financial report for the EMC Society projects a 1997 operating surplus of \$99,400. This surplus is largely due to investment/interest income as well as the partial surplus from the 1997 symposium. The Society's net worth at December 31, 1997 is \$681,070. This represents approximately \$100,000 in growth over the year, which again is primarily due to increases in investment/interest income.

Todd Hubing, Vice-President for Member Services, presented his report. The Board voted upon the awards that will be presented during the Awards Luncheon at the Denver symposium. Regarding chapter activity, Ray Adams is in the process of updating the Chapter Officer's Handbook. He has also contacted the Chapter Chairmen regarding the Angel fund policy. Bill Duff reported that there were seven candidates from the EMC Society for the Fellow award this year. This is a significant number for the Society. Scott Roleson, Chairman of the Distinguished Lecturer Program, is looking at the possibility of adding one or two Distinguished Lecturers (DL) who will lecture primarily in Europe and Asia. The program is attempting to address the need for a global program to reflect our international membership. Regarding Professional Activities (PACE), Al Mills is organizing a session on professional activities at the 1999 Seattle EMC Symposium. Ferdy Mayer will represent the EMC Society and run the IEEE EMC Society membership booth at the Wroclaw Symposium in June. Dick Ford presented a summary of the data taken from the surveys received from the Austin symposium. Mr. Hubing concluded his report by noting that EMC Society membership is cur-



Photo by Dick Ford

(L-R) Janet O'Neil, Dan Doolihan, and Diane Heidlebaugh pause in front of the Westin Hotel, headquarters hotel for the IEEE 1999 International EMC Society Symposium in Seattle. Diane is in charge of arrangements for the symposium organizing committee.

rently at 5,605 members, an increase from the 5,243 members in November 1997.

Len Carlson, Vice-President for Communication Services, presented his report. Newsletter Editor Janet O'Neil reported that good articles are now regularly submitted for the practical papers column. The goal is to feature a minimum of two practical papers or commentary type articles with each issue. Costs for using cover color photos turned out to be higher than estimated so the cover photos will be black and white. The Newsletter is now available on the Society's web page in the html format. An increase in next year's budget for the Newsletter will be requested so that the page count can regularly be at 32 or 36 pages to accommodate the increase in material submitted. Regarding the proposed creation of an EMC Society Magazine, Mr. Carlson discussed his research with the IEEE about this topic. The IEEE discouraged the EMC Society from starting a magazine at this time since the membership number is low relative to other Societies that have magazines. Thus, the current plan is to delay the development of an EMC Society magazine and rather "beef up" the existing Newsletter to include a minimum of three practical papers or commentary type articles per issue. Transactions Editor Moto Kanda reports that he has been assigned a new Senior Editor at the IEEE for the Transactions on EMC. This is Helene Dorthheimer. A special August issue on lightning is currently being prepared with 15 papers.

Henry Ott, Chairman of the Symposia and Conferences Committee, reported that the 1996 Santa Clara Symposium is ready to close its books now that the final audit has taken place. The IEEE is currently auditing the financial books of the 1997 Austin Symposium. The 1998 Denver Symposium is running smoothly. The 1999 Seattle Symposi-

sium has successfully resolved the problem of not having enough booth space by moving the exhibits from the Westin Hotel to the Seattle Convention Center. The committee is investigating having the IEEE Travel and Conference Management Services (ITCMS) group handle part of or the entire symposium operations. Lastly, Hugh Denny reports that the revised edition of the EMC Society Symposium Manual is ready and will be distributed to all future EMC Society Symposia chairmen. Regarding the History Committee, Chet Smith reports that sales of the CD-ROM discs have been steady since the August symposium in Austin. However, more publicity is required to move inventory. Mr. Smith would like to advertise sales of the CD-ROM discs in the IEEE's Spectrum Magazine. Also, chapters are encouraged to sell the CD-ROMS from the IEEE booth, if possible, during tabletop shows and/or one-day technical events. Sales of the CD-ROMs at international EMC symposia are being considered as well.

Kimball Williams, Vice-President for Technical Services, presented his report. Mr. Williams first reported as outgoing Chairman of the Education Committee. Mike Boguzs, chair of the Student Activities subcommittee, is actively fostering the involvement of students in EMC technology. This includes promoting/advertising the President's scholarship as well as the student paper contest. Andy Drozd and Larry Cohen, co-chairs of the Demonstrations subcommittee, report that they have secured a large open area immediately outside the exhibit hall for the demonstrations in Denver. The demonstrations are being treated as a special paper session, but with hardware. Jim Drewniak, chair of the Experiments Manual, Volume II subcommittee, reports that the committee activity is currently at a standstill. Attempts are being made to reactivate the committee work. Vichate Ungvichian, chair of the Standards Education subcommittee, reports that they are considering holding a "standards workshop" during the Seattle symposium in 1999 which will provide an introduction to the standards process as well as an overview of the standards community. They are coordinating with SAC on this effort. Dick Ford, chair of Video Productions, reports that the committee is continually updating the demonstrations video from Santa Clara with material from each succeeding symposium added where appropriate. The production of a standards overview education video is being considered. The NARTE video is still being evaluated. If suitable, the video may be used to help prepare NARTE certification applicants for all NARTE examinations. IEEE EAB has requested the creation of a video on EMC geared towards high school teachers. Lastly, a member of the EMC Society has offered to overdub the current EMC Society video in Spanish. This is being considered in conjunction with a membership drive in Spain and South America. John Howard, chair of the University Grant subcommittee, reports that advertising for the grants has been sent out via e-mail this year. Last year's award was presented to Dr. McGill at the meeting of the IEEE Student Chapter at Northern Illinois University on March 19, 1998. Maqsood Mohd, chair of the Tutorials subcommittee, re-

ports that planning for the Denver symposium is complete with an expected 400 attendees. Jim Whalen, chair of the NARTE subcommittee, reports that the exam preparation workshop will be held once again in Denver and that the actual exam will also take place. 40 students are expected to take the NARTE exam. Kimball Williams, chair of Life Long Learning, reports that several activities are being organized to prepare and assist retired engineers to act as

mentors and tutors for students. Also, a pre-college committee is under consideration to prepare students for careers in science and engineering.

Other Education Committee related items include a TC-2 workshop in Denver on measurements and a TC-8 workshop on product safety and the low voltage directive.

Mr. Williams distributed Andrew Podgorski's report on the Technical Committees. This provides a summary of the chairmen and charters of the nine technical committees. Regarding the Denver symposium, some 240 papers were received and reviewed. The largest number of papers (79) were related to TC-2 "Electromagnetic Compatibility Measurements". 72 papers were related to TC-4 "Electromagnetic Interference Control". TAC activities in progress include posting the TAC Policy and Procedures Handbook on the EMC-S website and regular submission of articles for publication in the EMC-S Newsletter.

Mr. Williams distributed the report of Leo Makowski, Chairman of the Representative Advisory Committee (RAC). He advised that Mr. Makowski resigned as chairman of the RAC. Mr. Makowski recommends committee member David Case as the new RAC chairman. The Board accepted Mr. Makowski's letter of resignation and his recommended replacement. Mr. Williams commended Mr. Makowski's years of service as chairman of this important committee. The 10-page RAC report included information on several liaison committees, some of which are discussed herein. EMC-S representative Dan Hoolihan reports that COMAR is developing a new position statement on the possible health effects that might result from cellular phone use. The Technical Information Statement (TIS) on "Radio Frequency Interference with Medical Devices" written by Howard Bassen et al. will appear in the EMB magazine May/June 1998. There are several TIS's under review by COMAR this year. A list of TIS titles was distributed. Len



EMC Society Board member Takeo Yoshino personally invited the Board to attend EMC '99 Tokyo from May 17-21, 1999. He provided an overview presentation on the conference to the Board.

Photo by Dick Ford

Carlson, EMC-S representative to the IEEE Technology Policy Council Committee Aerospace R&D reports that the Society needs to be aware of any legislation impacting EMC in order to provide the appropriate technical expertise. The RAC committee to the USAB R&D Policy Council is developing a metric for evaluating the quality of research done by Federal Research Laboratories, according to representative Dick Ford. Dave Imeson, representative to the Association of Competent Bodies (ACB), advised that the ACB is in the process of transforming itself into the ECACB which means that it will operate with assistance from the European Commission. Assistance includes the administrative and technical secretariat. Don Heirman, representative to ANSI ASC C63, reports that final ballot preparation is under way for C63.4, including a modification to add such items as TEM devices. Application/geometry specific antenna calibrations are under review as they apply to qualifying semi-anechoic chambers. EMC-S representative to CISPR B, Dan Hoolihan reports that the committee is discussing a number of topics including alternative test sites, labeling, test equipment, measurement at closer distances than specified, RF welding, limits in the 1-18 GHz range, microwave lighting devices, relaxation of limits for Group 2 Class A equipment from 470-1000 MHz, medical devices, and the 61.25 GHz ISM band. The 61.25 GHz issue is that the communications industry would like to use the bandwidth but the industrial community does not want to give it up because it is a unique area of the spectrum where oxygen is a significant absorber of energy. The EMC-S representative to the Radio Technical Commission for Aeronautics (RTCA) is Erik Borgstrom. Mr. Borgstrom reports that the committee is working on the expected Change Notice 1 to DO-160D which will be a complete revision of Section 20, RF Susceptibility (Radiated and Conducted). The two major changes involve the more than ten-fold increase in the maximum radiated susceptibility test level, to a test level of 7200 volts/meter. Also, the mode-stirred chamber test method will be revised completely to bring it up to date to "state-of-the-art" and in line with international standards under development. RAC is chairing a special session during the Denver symposium. This features speakers Elena Santiago from the EU DGIII and Mary Saunders from the NIST Office of Standard Service. RAC will be represented by Dave Case and Dave Imeson who will co-host the session.

Vice-President for Standards, Don Heirman, presented his report. This included a two page copy of the April 26, 1998 Standards Status Report and a roster of the SCOM membership and working group chairs. Briefly, Standards 139, 140, 187, 377, 473, 1140 and 1309 are current with no working group activity. Standards 213 and 376 have reached four years since reconfirmation. Standard 213 needs to be revised to update LISN requirements of FCC Part 15 that should begin in 1999. A reconfirmation ballot will be circulated by October 1, 1998. PAR 482-1992 was cancelled. Mr. Hoeft submitted a working group report and a new PAR that needs some minor work. PAR 1128 had a passing ballot

and negative comments completed re-circulation to the balloting group. The SCOM secretary received an extension until the December 1998 IEEE Standards Board meeting. Mr. Heirman also circulated a copy of an article by Donald C. Loughry of Hewlett-Packard titled "The IEEE-SA: A New Era for Standards". This article describes the new IEEE-Standards Association which has become the umbrella organization under which all IEEE standards programs are carried out. The objective is to ensure the IEEE-SA is well positioned to keep abreast of the most important developments in technology.

Under Committee Business on the agenda, in the absence of Bill Gjertson, Nominations Committee Chairman, President Hoolihan advised that the services of the IEEE for the Society's election process have been secured by Mr. Gjertson to handle nominations for the Board of Directors. The EMC-S Directors-at-Large nomination slate with biographical sketches will be submitted for circulation to the membership in June. A minimum of 12 names will be on the ballot. Voting results will be reported in early October. Those elected will serve a three-year term on the EMC-S Board of Directors effective January 1, 1999. The Nomination Committee's members include Joe Butler, Dave Hanttula, Mike Violette, Warren Kesselman and Bill Gjertson, Chairman.

Andrew Drozd reported on the February 1998 meeting of the Intelligent Transportation Systems (ITS) committee held during the IEEE TAB meetings in Los Angeles. He advised that TAB was expected to approve the ITS petition to transition to a technical council by early 1999. His report included the roster of voting members from participating societies as well as the Constitution and Bylaws of the ITS. Mr. Drozd recommends that the EMC Society support the activities of ITS.

President Hoolihan next invited the EMC Society symposia chairs in attendance to present their respective reports.

Barry Wallen, Chair of the 1998 Denver symposium committee, presented a report. To date, 130 exhibitors are



EMC Society Board of Directors visit the Seattle Convention Center, site of the exhibits and technical presentations during the IEEE 1999 International EMC Society Symposium in Seattle.

Photo by Dick Ford



During the Seattle Board meetings, John Osburn (right), Chairman of the IEEE 1997 International EMC Society Symposium in Austin, presented EMC Society Treasurer Warren Kesselman with the final check representing the surplus of funds received from the Austin symposium.

participating with a total of 220 booths. TEAM Inc. has been retained to handle the registration process. A housing bureau will be used for the hotel reservations. The committee expects to achieve its goal of a 16.7% surplus. 236 technical papers will be presented, resulting in a two-volume record.

In the absence of Chair Bill Gjertson, Bill Price, Vice-Chair of the 1999 Seattle symposium committee, presented a report. He reviewed the budget summary that shows a 16% surplus of the operating budget. The contracts with the Westin Hotel and Seattle Convention Center, which were negotiated with the assistance of IEEE Travel and Conference Management Services (ITCMS), have been signed. The Call for Papers will be mailed to the EMC-S membership in August and will also be included in the registration packets distributed at the Denver symposium. Diane Heidlebaugh, Arrangements Chair, was introduced to the Board. She provided a brief overview of the hotels that will be used and the allocation of meeting/exhibit space during the symposium. The Board was then taken on a tour of the Seattle Convention Center, led by Ms. Heidlebaugh and the manager of the Seattle Convention Center. It was noted that the Seattle symposium would occur during the city's famous "Seafair" week during August 1-5 so the hotels will fill quickly with symposium attendees and tourists.

Takeo Yoshino gave a brief presentation on the 1999 International Symposium on EMC in Tokyo, Japan from May 17-21. This is sponsored by the Technical Group on EMC of IEICE and the Technical Group on EMC of the IEE of Japan. The EMC Society of the IEEE and its Tokyo Chapter are technical co-sponsors. The symposium will be held at Surugadai Memorial Hall, Chuo University. Further information about the Tokyo symposium may be found on their web page at <http://www.cs.takushoku-u.ac.jp/is/emc99/>

Under Old Business, several motions were proposed and approved, including a motion regarding e-mail voting. The Board agreed to adopt a procedure for making, seconding, discussing and balloting on urgent ad-

ministrative matters via e-mail for those matters requiring only a majority vote of the Board of Directors. The Board also agreed to direct the Planning Committee to investigate the implications of requiring all members of the Board to upgrade their software operating/business systems to Microsoft Windows 95 and Microsoft Office 97. Regarding the office of the Treasurer, the Board approved the purchase of a new personal computer, a new Microsoft Windows 95 operating system and a new Microsoft Office 97 software package with for the Treasurer. The Board also requested that the Planning Committee investigate the establishment of a "paid" business administrator position for coordinating current Treasurer functions. The Board agreed to direct the Member Services and Communication Services Vice-Presidents to investigate member options for receiving Transactions.

The Board agreed to allocate funds to reimburse Board member travel in an amount not to exceed \$1,500 per Board member in order to hold an EMC Society Board of Directors meeting at the Tokyo EMC Symposium in Japan in May 1999. The Board approved providing financial resources in 1998 for the support of the new Standards Coordinating Committee for Disability Access. It was also agreed that at the conclusion of each Board meeting, the Society Policy and Procedures Manual editor shall be given an action item to update the manual to capture those Board approved motions that are identified as modifications to the Policy and Procedures Manual. Regarding the WWW page for the EMC Society, the Board approved allocating funds to establish a web page alias that is not tied to the UMR site. The Board approved allocating funds for the marketing committee to advertise for the sale of the EMC-S CD-ROMS. The Board approved the audited financial report for the 1996 Santa Clara Symposium. Lastly, the Board approved the request of the 1999 IEEE EMC Symposium in Seattle for an additional advance of \$4,000, bringing the total advance to date to \$9,000.

Under New Business, several motions were proposed and approved, including a motion regarding the approval of the President's Memorial Scholarship Award recipient in 1998. The Board approved allocating the initiation fee to provide for EMC-S representation on the ITS. The Board approved establishing a Distinguished Lecturer Program for Europe and increasing the budget for the program for this purpose. It was agreed that an EMC Society "New Member" welcome letter be created and distributed via IEEE member services in 1999. The Board authorized the reimbursement for travel expenses in an amount not to exceed \$1,500 per Board meeting for Region 8 and 10 Directors-at-Large to attend 1998 BOD meetings held in Regions 1-6. The Board requested that the Secretary and Bob Hofmann develop an action plan to track receipt of important e-mails. The Board established the photographer as an official position reporting to the Vice-President of Member Services.

Action Items assigned to various Board members were then reviewed.

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



KIMBALL WILLIAMS
ASSOCIATE EDITOR

A New Beginning

The natural growth of every organization requires new leadership from time to time in order to ensure that the leaders keep their 'edge'. When I received the appointment as chair of the Education Committee in 1993 I had no idea how long that tenure should last. Within this last year I no longer had any doubt. It had become obvious, at least to me, that I no longer had the 'edge'.

Fortunately, we have an excellent candidate for the chair of Education. Most of our members already know Dr. Maqsood (Mac) Mohd from attending the "Fundamentals Tutorials" that he masterminded and organized at the last four IEEE EMC-S symposia. Many may not have realized that Mac was also the Vice-Chair for Education. Based upon his experience within the Education Committee, and his record of contribution to the society, the Board of Directors followed the recommendation of the Committee Executive Board and appointed Mac as the



Dr. Maqsood Mohd

Chair of the Education and Student Activities Committee.

I hope everyone in the EMC Society will join me in welcoming Mac as the new Chair of the Education Committee. I also hope many of you will also consider how you may be able to help the Education Committee. Many EMC-S members have talents, abilities, knowledge and skills that can significantly contribute to EMC-S Education activities. If you would like to help, please join us at the Symposium in Denver or contact

Mac in Denver. The Education Committee meeting will take place on August 25th at 7:00 am (sorry about that) in the Plaza CT room in the Adam's Mark Hotel. Please check the hotel directory when you arrive to catch any last minute changes.

Off the Hook and Back to the Grindstone

With the Education Committee in good hands, I can just sit back and relax, right? Well, not exactly. The policy and procedures of the Education Committee prescribes that the recent past chairs remain in close communication with the current Chair in order to lend support when needed, guidance when asked and in general, kibitz from the sidelines on the activities of the new Chair and the Executive Committee.

At our meeting in Denver there will be opportunities for a major re-alignment of the personalities within the Education and Student Activities Committee. Most sub-committee positions usually remain under the direction of the persons who volunteered and were confirmed into that position from year to year. However, the Chair and the Executive Committee have the duty to review current activities of each position and make changes which they feel would be in the best interests of the Society as a whole. To quote the Policy and Procedure Manual, "Committee chairpersons, members at large, liaisons to other organizations, etc., shall be appointed at the discretion of the Chair with the consent of the executive board".

I hope to see you in Denver.

Kimball Williams
Past Chair
Education and Student Activities Committee

President's Message

Continued from page 1

The EMCS Newsletter is our quarterly publication that is intended to keep our members aware of late-breaking news while also publishing some timely technical articles which are largely practical in nature. It is also the primary means that the EMC Society's Board of Directors uses to keep the 5000 EMCS members informed of what is going on in the Administrative Activities of the Society. The Newsletter is now available electronically from the Society's web page (http://www.emclab.umn.edu/ieee_emc/).

Awards constitute a very visible sign of the "rewards" of participating in a volunteer organization such as the IEEE, and, more specifically, the EMC Society. The EMC Society has a major program of awards which includes special recognition for both technical and administrative achievements. It includes recognizing one-time events and life-long support of the Society and the IEEE.

We will be distributing the Awards for this year at the Awards Luncheon on Thursday, August 27 at noon during the Annual Symposium. Come and bask in the fame and glory of the award recipients.

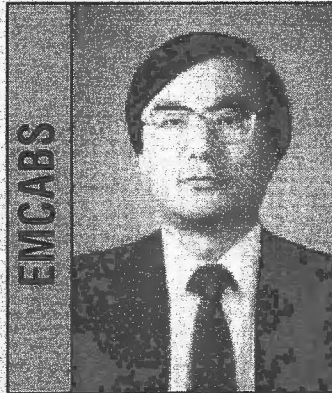
I hope to see many of you at the Symposium in Denver. Please, stop and say "hi" to me when you are there.

Dan Hoolihan
President, EMCS 98-99
IEEE

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OSAMU FUJIWARA
ASSOCIATE EDITOR

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

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

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

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

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

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

NUMERICAL MODELING OF MOBILE PHONE EQUIPMENT

R. Ehmann

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S.Gutschling, B.Trapp and T. Weiland

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Proceedings of 14th International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility, Wroclaw, Poland, June 23-25, 1998, pp.334-338

Abstract: The influence of using a cellular phone inside a car on the radiated electromagnetic field is analyzed numerically. The specific absorption rate (SAR) inside the head and the antenna characteristics are considered for a simulation with and without car. For the computations, the Finite Integration Technique in time domain implemented in the Software Package MAFIA (Maxwells Finite Integration Algorithm) is used.

Index terms: cellular phone, SAR, antenna characteristics, simulation

EMCABS: 01-8-98**EFFECTS OF ELECTROMAGNETIC INTERFERENCES ON OPERATIONAL AMPLIFIERS**

J.Kolodziejski

Institute of Electron Tecnology, Warsaw, Poland

e-mail: jekolo@ite.waw.pl

M.Skorupski

Technical-Agriculture Academy, Bydgoszcz, Poland

Proceedings of 14th International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility, Wroclaw, Poland, June 23-25, 1998, pp.522-526

Abstract: In the work some results of simulation and experimental investigations are given, concerning the susceptibility of operational amplifiers (OpAmps) to electromagnetic interferences (EMI). The effects of EMI, mainly hf (out-of-band) in the form of short pulses, on the inputs of OpAmps and on their power supply lines are considered. Conventional (voltage dependent) and current feedback amplifiers (FCAs) are taken into account. Final conclusions embrace some practical recommendations.

Index terms: operational amplifiers, EMI, simulation, experiment

EMCABS: 04-8-98**MICROSTRIP ANTENNAS ON MULTILAYER DIELECTRIC FOR MOBILE SYSTEM COMMUNICATION**

M.Wnuk, W.Kolosowski and M.Amnowicz

Military University of Technology, Warsaw, Poland

e-mail: mwnuk@wel.wat.waw.pl

Proceedings of 14th International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility, Wroclaw, Poland, June 23-25, 1998, pp.346-350

Abstract: Intensive development of cellular personal communication systems has been observed lately. Thus, protection of a man, and especially protection of his head against non-ionizing electromagnetic radiation generated by cellular telephones is becoming one of the most important problems. The results of elaborated microstrip antennas which have minimized radiation towards the user's head are presented in this paper.

Index terms: cellular telephones, radiation protection, microstrip antennas

EMCABS: 02-8-98**HAZARD FOR ELECTRONIC SYSTEMS DUE TO EFFECTS OF LIGHTNING ELECTROMAGNETIC IMPULSES**

C.Mazzetti

University of Rome, "La Sapienza"

Rome, Italy

Z.Flisowski and B.Kuca

Warsaw University of Technology, Warsaw, Poland

Proceedings of 14th International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility, Wroclaw, Poland, June 23-25, 1998, pp.500-505

Abstract: The paper deals with a simplified method of the hazard assessment for electronic systems due to lightning electromagnetic impulses (LEMP). The main idea of the method is presented in which the immunity level of the considered system is to be correlated with the statistical distribution of overvoltages appearing inside the protected structure. On the basis of this correlation, the way for risk and frequency of possible damages of the system under consideration is discussed and evaluated.

Index terms: lightning EMP, hazard assessment, statistical analysis

EMCABS: 05-8-98**ENGINEERING MODEL FOR SHIELDING EFFECTIVENESS EVALUATION**

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Proceedings of 14th International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility, Wroclaw, Poland, June 23-25, 1998, pp.300-305

Abstract: This paper presents results of the modeling of Shielding Effectiveness for modular type shielding enclosures of 3-m and 10-m EMC chambers. Propagation of electromagnetic waves inside and outside the shielding enclosure was analyzed. Engineering models based on the equivalent circuit approach and mode matching solution were employed. Results of the two approaches were compared with each other and with experimental data. Influence of structural configuration and mechanical tolerances on the overall Shielding Effectiveness of the chamber was studied based on the typical enclosure design. Frequency band from 1 to 20 GHz was taken under consideration though results might be applicable for other frequency bands as well.

Index terms: shielding enclosures, shielding effectiveness, analysis

EMCABS: 03-8-98**THE OCCURRENCE OF TRANSIENT FIELDS AND ESD IN TYPICAL SELECTED AREAS**

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Proceedings of 14th International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility, Wroclaw, Poland, June 23-25, 1998, pp.486-490

Abstract: The occurrence rate of Electrostatic Discharges (ESD) depends extremely on the environment. Several parameters influence ESD and the severity of this interference. A special measurement system to measure the transient fields of ESD was designed. Measurements were done in different environments. A theoretical model was developed, helping to predict and to evaluate the severity level of an environment towards ESD.

Index terms: ESD, transient fields, measurement system

EMCABS: 06-8-98

COMPUTER SIMULATION OF ESD FROM OBJECT WITH SURFACE RESISTANCE**EMCABS: 07-8-98**

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Proceedings of 14th International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility, Wroclaw, Poland, June 23-25, 1998, pp.511-513

Abstract: Electrostatic discharge of the body with different surface resistance is investigated. Influence of the surface resistance on the current in the arc and on the radiated by the body fields is studied. The problem is formulated in the terms of surface integral equation for magnetic field. The equation is solved by the Method of Moments in time domain. Results are given for spheroid with different surface resistance. It is shown that for some kind of distribution of surface impedance, the level of radiation from electrostatic discharge can be reduced.

Index terms: ESD, object with surface resistance, computer simulation**ANALYSIS OF MICROWAVE ABSORPTION AND MATERIAL PROPERTIES OF M-TYPE HEXAGONAL FERRITES****EMCABS: 08-8-98**

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Proceedings of 14th International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility, Wroclaw, Poland, June 23-25, 1998, pp.396-399

Abstract: The microwave absorption properties of M-type hexagonal ferrites are investigated. The complex permeability and permittivity were measured using a network analyzer. In the BaFe_{12-x}(TiCo)_xO₁₉ system, the ferrimagnetic resonance frequency shifts down to the 1-20 GHz range, when x is increased. Due to the relatively high μ_r value, thin matching thickness of 0.9-1.9 mm were obtained in the 5-10 GHz range. The frequency characteristics of μ_r' and μ_r'' were analyzed and simulated successfully using a parallel resonant circuit model based on the crystalline structure. Dual peak characteristics of μ_r'' were observed for a certain sintering temperature and duration, and a relative absorption bandwidth of 16% was obtained. The simulation showed that a wider absorption bandwidth of 33% may be possible.

Index terms: M-type hexagonal ferrites, microwave absorption properties, measurement

SHIELDING OF THE DIELECTRIC BALL RESONATORS WITH WHISPERING-GALLERY MODES**EMCABS: 09-8-98**

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Proceedings of 14th International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility, Wroclaw, Poland, June 23-25, 1998, pp.380-384

Abstract: New results of the investigation of shielded dielectric ball resonators (DBR) with whispering gallery modes (WGM'S) are represented. The characteristic relations TM and TE modes are obtained. The dependence of resonant frequencies Q-factor of WGM'S on resonator parameters have been calculated numerically. It is shown that the shielding of DBR provides the increasing modes Q-factor in ten times. A good agreement between theoretical and experimental results are obtained.

Index terms: shielded dielectric ball resonators, whispering gallery modes, theory, experiment**ELECTROMAGNETIC FIELD UNIFORMITY TEST USING MODULATED SCATTERING PROBES****EMCABS: 10-8-98**

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Proceedings of 14th International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility, Wroclaw, Poland, June 23-25, 1998, pp.183-187

Abstract: The use of the Modulated Scattering Technique (MST) for electromagnetic field uniformity test is proposed. Measurement times associated with the conventional technique employing mechanical positioning of a single probe, are usually long. By using an array of modulated scattering probes, electronically driven, the technique allows a dramatic reduction in measurement time. In the paper, the theoretical basis of the technique is discussed, the prototype system is described and some measurement data is presented.

Index terms: field uniformity test, modulated scattering technique, prototype system**DEVELOPMENT OF FIELD PROBES PRINTED ON SUBSTRATES FOR DOSIMETRIC ASSESSMENTS IN THE FREQUENCY RANGE FROM 1 MHZ TO 18 GHZ****EMCABS: 11-8-98**

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Proceedings of 14th International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility, Wroclaw, Poland, June 23-25, 1998, pp.224-228

Abstract: The electric and magnetic fields in the proximity of strong sources of radiation (e.g. RADAR and broadcasting) can exceed the limits mentioned in the national standards for the exposition of persons. Several field probes have been developed to ensure that people working close to these sources of radiation will not be exposed to energy densities above the limit. However, many field probes have disadvantages in the everyday use by people that are not experienced in measuring electromagnetic fields.

Index terms: dosimetric assessments, field probes**TEM CELL VS. FREE SPACE: COMPARISON OF THE FIELDS INSIDE DIELECTRIC SPHERES****EMCABS: 12-8-98**

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Proceedings of 14th International Wroclaw Symposium and Exhibition on Electromagnetic Compatibility, Wroclaw, Poland, June 23-25, 1998, pp.193-197

Abstract: The Crawford cell is a very convenient equipment for generating high intensity Transverse Electromagnetic fields; it has a straightforward design, and it is inexpensive to be built. Unfortunately, when an object is placed inside the cell, the field distribution can be significantly distorted. To date there is no definite answer on whether the (loaded) Crawford cell is a good approximation of (loaded) free space. In this work a typical Crawford cell is considered, properly designed to obtain a uniform TEM field when empty. A dielectric hemisphere is then assumed to be placed on the central conducting septum; this hemisphere is equivalent (for the images theorem) to a dielectric sphere in the free space. The field inside the dielectric hemispheres is numerically evaluated, using a 3DEM simulator; this field is then compared with that inside the corresponding sphere in free space, illuminated by a plane wave, for which the analytical solution is known. Comparisons are carried out at several frequencies, for (hemi)spheres of different sizes and refractive indices.

Index terms: Crawford cell, dielectric hemispheres, uniform TEM field, numerical evaluation

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