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EMC

IEEE EMC Society Newsletter

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2000 IEEE INTERNATIONAL SYMPOSIUM ON EMC



Photo by Janet O'Neil

The international EMC community was well represented at the EMC Society Board of Directors meeting held on August 20. Attending the meeting were (seated L-R) Markus Heidemann from the University of Hannover, Germany and Elya Joffe from KTM Project Engineering in Israel, (standing L-R) Marcello D'Amore from the University of Rome, Italy, Heyno Garbe from the University of Hannover, Germany, Carlos Sartori from the Escola Politecnica de Universidade de Sao Paulo, Brasil, Benoît Nadeau from Matrox in Quebec, Canada, and Takeo Yoshino from the Fukui University of Technology in Tokyo, Japan. For more information about the Board of Directors activities during the symposium, see page 28.



Photo by Dick Ford

At the Annual Awards Luncheon, the President's Memorial Award was presented in memory of the late Motobisa Kanda. EMC Society President Joe Butler is shown with the recipient of the award, Ke Wang, along with Yoko, Michael and Matthew Kanda (L-R). For more information about the Awards presented at the luncheon, please see page 24.



Photo by Dick Ford

Symposium attendees and families gathered outside the headquarters hotel to board busses bound for the Smithsonian's National Air and Space Museum. Can you spot our EMCS President and Treasurer in the crowd?



Photo by Dick Ford

A five-member band played during the Wednesday evening reception. Michel Mardiguian (EMC Society Distinguished Lecturer) acknowledges the fine support effort on clarinet by Jacques Montebruno (foreground left to right). Rounding out the band are Brooks Tegler on drums, John Previti on bass, and Tom Mitchell on guitar. For more Symposium scenes, please see pages 20-23.



President's Message

Joe Butler – President, EMC Society

As I'm writing this column for our fall newsletter several weeks after the event, I continue to hear praise for the success of our Washington, DC International EMC Symposium. Chairman Bill Duff and his symposium committee as well IEEE Convention Services Marie Madden and her staff deserve our thanks for running a very successful and likely very profitable event for the society. Many of us on the Board of Directors had some well-versed reservations of retreating back to a hotel venue for the symposium. These concerns were well-founded, given we had previously been driven from our planned hotel venues into convention centers, due to our increasing size, in Denver, CO (1998) and Seattle, WA (1999). As it turns out, despite record attendance at 3500 plus total attendees (exhibitors, one-day, full, complimentary, etc.), the event went rather well. Initially overcrowded meeting rooms were expanded as necessary. Exhibitors relegated to hallway tabletop locations found out that they had the best location possible and enjoyed large numbers of well-qualified leads. At the annual Thursday morning exhibitors breakfast, always a potential locale for venting frustrations about the week's activities, the only complaint offered from the exhibitors in attendance was related to the inability of finding a parking space in the hotel garage. If all the symposia could go as well, it would be great.

Despite the rousing success of Washington, DC, however, we will go back and most certainly remain at convention centers for future symposia. The 2001 IEEE International EMC Symposium in Montreal Canada, August 13 – 17, 2001 will be held at the large and beautiful *Palais des Congres* in Montreal. Benoit Nadeau and his committee are working very hard to raise the success level of our symposia even higher. Visit their web site at www.2001emcmtl.org.

In September, I had occasion to attend "EMC Europe 2000 Brugge", a five day (September 11 – 15) EMC conference held in the beautiful city of Brugge,

Belgium. The IEEE EMC Society was a technical co-sponsor of this conference that was chaired by Professor Johan Catrysse of KHBO in Oostende, Belgium. This very successful conference was attended by over three hundred participants from 41 countries and consisted of tutorials on Monday and Friday and many very good technical papers in three parallel session tracks from Tuesday through Thursday. The Tuesday evening reception and canal tour as well as the Wednesday evening banquet was outstanding. It should be noted that this conference has its roots in the EMC Roma conferences of 1996 and 1998. For this reason, this biannual conference will move back to beautiful Sorrento, Italy, September 9 – 13, 2002.

The EMC Society is actively courting and is being courted by several other EMC related conferences. We have already negotiated or are in the process of negotiating Memoranda of Understanding (MOU's) as regards our technical co-sponsorship of the following conferences: "Wroclaw EMC Symposium", June 27 – 30, 2000, Wroclaw, Poland (this conference is held biannually); "IEEE Millennium Workshop on Biological Effects of Electromagnetic Fields", October 17 – 20, 2000, Heraklion, Crete, Greece; "EMC Zurich", February 20 – 22, 2001 (this conference is held biannually); "International Conference on Electromagnetics in Advance Applications (ICEAA-01)", September 10 – 14, 2001, Torino, Italy; "IV International Symposium on EMC and Electromagnetic Ecology", June 19 – 22, 2001, St. Petersburg, Russia; "3rd International Beijing EMC Symposium", May 21 – 24, 2002, Beijing, China; and "EMC Europe 2002", September 9 – 13, 2002, Sorrento, Italy. The EMC Society welcomes communication from other entities engaged in EMC related activities. Note that technical co-sponsorship does not imply any



Jan Luikenter Haseborg received his IEEE Fellow Award from EMC Society President Joe Butler at the Awards Luncheon. The President was quite active during the Awards Luncheon greeting the some 75 deserving EMCS members who received awards.

financial involvement but can and does address advertisement in our newsletter and website, technical paper review if needed as well the controlled use of EMCS membership mailing lists.

Our BOD secretary Janet O'Neil is actively promoting EMC Chapter Regional Conferences. This year she has coordinated these one-day events for the following EMCS chapters: Southeastern Michigan, Rocky Mountain, Chicago, and Research Triangle Park. These events consist of a single technical track of well qualified speaker or speakers, coupled with table-top exhibits from EMC related companies and is complimented by continental breakfast, morning and afternoon refreshment breaks, lunch and a follow-on cocktail party. Speakers, exhibitors (10 – 20), attendees (typically 75-150) and local chapters alike, all feel they are very successful. It's also a great way to infuse some cash into chapter bank accounts. The organization of these events has been well organized. Contact us if you'd like to pursue this for your chapter.

Well, I'm running out of time and column space. It was great meeting and speaking with many of you in Washington, DC and Brugge, Belgium. I look forward to meeting many more of you in the months ahead at other EMC events. Please feel free to contact me at the Chomerics Division of Parker Hannifin in Woburn, MA USA, tel. 781-939-4267 or e-mail me at j.e.butler@ieee.org. **EMC**

Letter from the Editor

Janet O'Neil – Editor, EMC Society Newsletter

If you attended the 2000 IEEE International Symposium on EMC in Washington, DC, then we most likely share having the same highlight of the summer. It was a great event which drew record crowds; there were over 3500 attendees from various parts of the world. Even the weather cooperated. Washington, DC can be quite humid and hot in August, but this summer during the symposium week the weather was mild and very pleasant. I noticed too that many engineers and exhibitors who attended the symposium brought along their families this year. Washington, DC is a great city to tour during the symposium week. There is so much to learn.

Symposium Chairman **Bill Duff** commented, "The objective for this event was to spread knowledge to help engineers combat the EMI difficulties inherent in sophisticated electronics. This symposium brings together some of the best minds in the EMC community from all over the world. It is an opportunity for everyone to sharpen their technical skills and to find out about the latest information in this industry." Judging from the comments I overheard in the hallways near the technical sessions, while viewing the demonstrations and walking the exhibits, I can safely say that Mr. Duff and his committee certainly met their objective!

One interesting thing happened on the exhibit floor during the symposium. I happened to run into **Ken Wyatt** who is an EMC engineer with Hewlett-Packard in Colorado. Ken is also a professional photographer who specializes in nature photography. You may recall that he took some great photos of the experiment demonstrations for the Newsletter during the Denver EMC Symposium so I seized the moment and asked Ken if he would

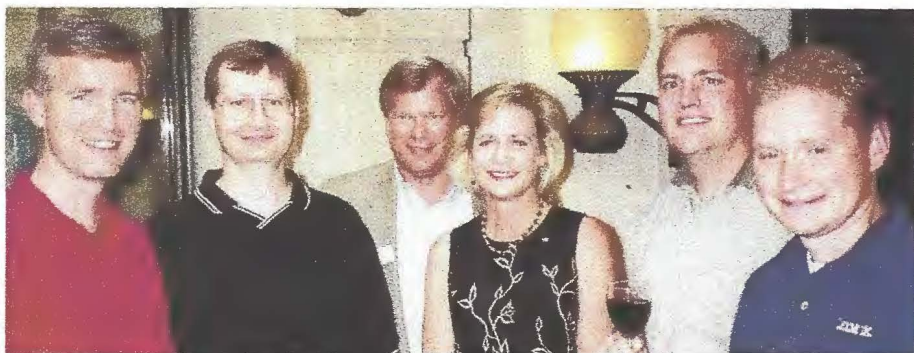


Janet O'Neil, Editor, with Bill Duff, Chairman of the 2000 IEEE International Symposium on EMC in Washington, DC.

take some photos of this year's experiment demonstrations. After all, he did have his camera hanging from his neck and certainly looked ready to shoot! You'll find the results of Ken's efforts on pages 40 - 42 of this Newsletter. Ken wonderfully captured the dedication to and enthusiasm for their work shown by those performing the experiment demonstrations as well as the intentness of those watching. Many thanks to Ken for providing these photos. If you'd like to see more of Ken's work, visit his website at www.wyattphoto.com

I'd also like to acknowledge the efforts of our Society photographer, **Dick Ford**. Dick was Treasurer of the Washington, DC Symposium steering committee and as such wore many hats during the week. Talk about being pulled in different directions: from finance to photos! Dick managed to capture the essence of the symposium in his photos which you'll find throughout this issue of the Newsletter. Many thanks to Dick, too!

Thanks to the many readers who have responded positively about the new look of the Newsletter, the use of color photos, and the addition of more practical papers. It's great to hear from you. **EMC**



Editors have fun too! Joining yours truly at festivities held during the symposium week are the Lexmark group of engineers and my colleague from ETS-Lindgren. (L-R) That's John Fessler and Keith Hardin of Lexmark; Mark Mawdsley and Janet O'Neil of ETS-Lindgren; and lastly Rob Oglesbee and Bob Menke of Lexmark.

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Chapter Chatter

Todd Hubing, Associate Editor

Going to Zurich in February? How about Montreal in August? These are two EMC symposia you won't want to miss. The state-of-the-art in EMC is advancing at a rapid pace. This past year at the symposia in Washington DC and Brugge, I was amazed at the amount of progress reported in a number of areas. Design rules and EMC design practices that were once widely accepted and applied are being debunked and replaced continuously. The overall quality of the research being done and the papers being presented is increasing steadily. If you haven't attended an EMC symposium in the past couple years, you might be missing information on tools or techniques that could significantly improve your productivity.

There was a record turnout at the Washington symposium. Not only was the technical program excellent, but the conference was well organized and fun too. Did you know that Washington DC is the Country Music Capital of the World? I didn't. I always thought the Country Music Capital was further west. Nevertheless, at the symposium I heard several people comment that Washington DC was in fact the Country Capital.

Being at an EMC symposium in the Country Music Capital of the World inspired me to write a song about EMC. Of course, I don't know very much about song writing or country music, so I had to do a little research. As near as I can tell, the thing that makes country music different from other music is mostly the subject matter. Country music usually tells a story incorporating the following elements:

- unrequited love
- unfaithfulness
- bad habits
- addictions
- employment problems
- clueless people
- ironic twists of fate

To write a country song, these elements should be folded into a story that is interrupted frequently by a nonsensical chorus. Combine this with a catchy rhythm and an intentional lack of sophistication, then throw in a few twangs of a steel guitar and you're sure to have a hit song.

Here's my first attempt. Of course, since you're reading this in a newsletter, you'll have to imagine the music. Fortunately, most country music songs are pretty much the same so you can substitute any country music melody that employs roughly the same number of syllables per line. Just remember to sing the verses with a slightly monotone voice and then wail as if you'd just been kicked by a horse when you get to the chorus. Also, when you see a "...", imagine a long twang on a steel guitar.

My Wife Left Me for 3 dB

*I love my wife and she loves me.
We hardly ever disagree.
But once in a while I come home late ...
which tends to make her quite irate.*

*One day I promised I'd be home by three.
But my product was failing the FCC.
I searched in vain for that elusive fix ...
By the time I got home, it was half past six.*

*{chorus}
My wife left me for 3 dB.
Now I'm as lonely as I can be.
Honey, I miss your company ...
Don't fricassee me for 3 dB.*

*When I got home I found a note on the door.
Say'n I can't take this any more.
It's time for me to be self-reliant ...
I evaluated you and you're non-compliant.*

*She said, "Time is money and money is power
and you weren't here at the designated hour.
Take 10 times the log of 6 by 3 ...
You were over the limit by 3 dB."*

*{chorus}
My wife left me for 3 dB.
Now I'm as lonely as I can be.
Honey, please come back to me*

Don't flee my tree for 3 dB.

*I found my wife at the home of her mother.
Told her, "Please come back, I don't want
no other."*

*I said, "The two of us can take a long vacation
when my product complies with the regulation."*

*She said, "Where have I heard that before.
I won't be an EMC widow no more.
Should have listened to my parents who
were very clear
when they said never get involved with an
engineer."*

*{chorus}
My wife left me for 3 dB.
Now I'm as lonely as I can be.
Honey, please come back to me
Don't be absentee for 3 dB.*

*I convinced my wife to come with me,
late at night to the laboratory.
Showed her my product and the troubles within
and she fixed the thing with a bent hairpin.*

*... {extra steel guitar twang inserted here to
reflect the passage of time.}*

*It's been a month since that revelation,
but we've yet to take our planned vacation.
My product passes and it's in production
but my wife is working on a cost-reduction.*

*{chorus}
My wife left me for 3 dB.
Now I'm as lonely as I can be.
Day and night she's in the laboratory ...
I lost my wife to EMC!*

*... {Final twang of steel guitar to drive home
the irony and wake those who fell asleep dur-
ing the song.}*

So what do you think? If you didn't like it, it's probably because you don't like country music. Or maybe it's because you couldn't hear the melody. I'd be happy to bring my steel guitar to your next chapter meeting and play this song for you. I heard that Johnny Cash started out this way. Perhaps I have a future in the country music business. On second thought, never mind. I can't imagine anything more fun or rewarding than being an EMC engineer.

Atlanta

David Dennis, Chair of the Atlanta chapter, reports that their last meeting was held in June and featured a presentation by Donald J. Sherratt of Intertek Testing Services. Don is a renowned expert in medical device technology and standards activities. His discussion was entitled "EMC and Medical Devices", and it covered a broad range of related topics. For more information on upcoming meetings you can check the Atlanta Chapter's website at <http://www.euh.ieee.org/soc/emcs/atl/atl-emc.htm> or subscribe to the chapter's e-mail list. Instructions to join the list are on the website.

Central New England

John Clarke, chair of the Central New England chapter, reports that the chapter organized an EMC session for ELEC-TRO 2000 in Boston. Invited speakers presented the following four papers on Wednesday, June 14, 2000 at the Bayside Exposition Center, Boston, Massachusetts.

The first paper was "Overview of the European Union Radio Equipment and Telecommunications Terminal Equipment (R&TTE) Directive" presented by Denise Haley of Agilent Technologies. Her presentation provided a comprehensive review of the EU R&TTE Directive effective on April 8, 2000 for all radio and telecommunications products being marketed in the European Union.

The second paper was "IEC STD 60601-1-2 Safety Standard Dealing with EMC/EMI Issues Applied to Medical Electrical Equipment" presented by Jim Conrad, also from Agilent Technologies. His talk provided an overview of the International Electrotechnical Commission (IEC) Standard 60601-1-2; Second Edition EMC for Medical Electrical Equipment. IEC 60601-1-2 is currently under development by IEC and is expected to be published as an IEC and European Norm in 2001. The FDA is also planning to adopt the standard as soon as it is released.

The third paper was titled, "Adverse Interactions Between Medical Devices and Electronic Article Surveillance (EAS) Systems, Metal Detectors and Security Systems." It was presented by Jon Casamento, FDA Center for Devices and Radiological Health, Rockville, MD. During the last decade the U.S.

Food and Drug Administration (FDA) received more than 70 medical device-reporting incidents of adverse interactions between medical devices and electronic article surveillance systems (EASS), metal detectors, and security systems. Several case reports and four peer-reviewed studies documented adverse interactions between EASS and implanted pacemakers, and other implanted medical devices. The speaker discussed an FDA study that provided data to characterize electromagnetic (EM) fields generated by EASS. These data are used for susceptibility testing of various ambulatory medical devices to EM fields emitted from EASS.

The final paper was titled, "CASSPER EMI - Ambient Cancellation and Source Localization System." It was presented by Kevin P. Baldwin, EMC Test Systems, L.P. Norwalk, CT. The CASSPER System effectively brings an Open Area Test Site (OATS) into the engineering department, test lab or the production floor, measures EMI and determines compliance at any location. The speaker provided a description and demonstration of the operational system. CASSPER is a new PC-based instrumentation system that records and isolates EUT signals of interest without the need for anechoic chambers. The system delivers true ambient cancellation and removes the guesswork in EMI signal identification. The product's source localization measurement feature allows you to identify and locate sources of EMI noise including multiple sources at the same frequency.

Phoenix

Harry Gaul reports that the Phoenix EMC Chapter held their September meeting with a presentation on lightning protection by Jack Opocensky of Polyphaser Corporation. Jack began his talk with a review of how lightning is formed and a discussion of the myriad of lightning specifications. Jack explained that the fundamental principle for lightning protection of communications shelters is to group all the power, coax, and signal penetrations together. Then a single-point ground with lightning protectors can be provided for these penetrations at the entrance to the building with the goal of shunting all currents to ground outside the building. This will reduce the likelihood of damaging currents flowing through electronics within

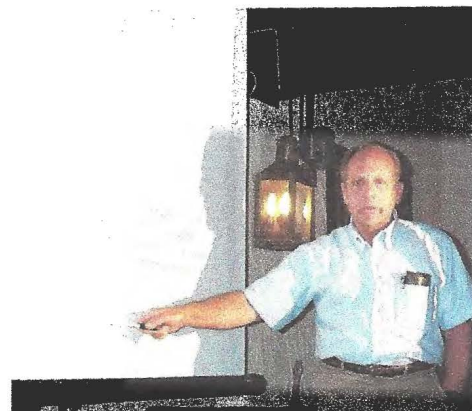


Photo by Harry Gaul

Jack Opocensky of Polyphaser Corp. explains the concept of single-point grounding for communications shelters.

the building. A separate "halo" ground can be provided within the building to provide safety protection to the occupants. The halo ground provides a path to ground for the surge currents induced in doorframes, window frames, and other structural elements. But the halo ground must not be used as a signal or power ground for the electronics. The thirty attendees really appreciated Jack's talk and now have a better understanding on designing communications shelters to withstand lightning.

The Phoenix chapter is making plans to host a one-day EMC colloquium on May 7th, 2001. Check out our web site at <http://www.euh.ieee.org/r6/phoenix/phoenixemc> for the latest schedule on upcoming talks.

Rocky Mountain

Charles Grasso reports that the September meeting of the Rocky Mountain chapter featured a talk entitled, "Can Just Anyone Understand Electromagnetic Fields?" presented by Professor Edward Kuester from the University of Colorado at Boulder. This talk was part seminar, part tutorial and part give-and-take with the audience. Historically, an electrical engineer's education provided a solid background in circuit analysis, and touched somewhat on other subjects (like computers, power conversion, electromagnetics, etc.). Much of what a working engineer was called upon to do could be accomplished by building on this foundation of circuit theory. As our use of the frequency spectrum pushes ever higher (1-GHz computer processors, cell phones at microwave bands, and so on), designs can no longer be made purely on the basis of classical circuit concepts. Professor Kuester tells students in the



At the September meeting of the Rocky Mountain EMC chapter, Professor Kuester analyzes a problem for the audience.



Professor Kuester (r) displays Maxwell's Equations on his t-shirt. Charles Grasso (l) admires the unique fashion statement.

beginning electromagnetics class that EM fields are really the basis of everything we do outside the quantum level in electrical engineering. Does this mean that you have to be an expert in EM to design anything these days? Or can the impact of Maxwell's equations be understood in a simpler way, using ideas already familiar from electric circuits?

Twenty-eight intrepid folks turned up to see Professor Edward Kuester emphatically give a "yes" answer to the second question. He looked at several issues that arise in practical applications (use of computers to calculate fields, the effect of EM fields between neighboring circuits, and others) and showed how readily understood techniques of circuit analysis can be used to deal with these problems.

Professor Kuester started his talk right at the beginning – Maxwell's Equations. He briefly reviewed the four equations and

showed that although most engineers are concerned with approximating Maxwell's equations, they are themselves an approximation of quantum electrodynamics. He then reviewed some of the basics of field theory as a reminder and as a nice lead in to how, by keeping element size small with respect to a wavelength, lumped-circuit theory can be obtained from EM

fields. Professor Kuester then traveled back in time to 1850 and introduced Lord Kelvin who developed the telegraphers equations, an analytical connection between circuits and fields. He then posed the question – Can we go the other way? That is, from fields to circuits? The answer was yes, by taking the finite difference approximation for Maxwell's curl equations in all three space directions. A circuit was then shown that approximated the field description with the advantage that the circuit can be analyzed using SPICE and similar computing tools. Professor Kuester then discussed the numerical computation of fields with some of the advantages and drawbacks. Keeping to the focus of talk, Professor Kuester then analyzed printed circuit traces and described a way of making a "real" circuit model that models the actual currents on the traces rather than fields that most people have

little interest in. He described the PEEC or Partial Element Equivalent Circuit Method and walked the audience through the connection between fields and circuits. He really stirred up the pot with a discussion of partial inductance. At the conclusion of his talk, Professor Kuester opened up a discussion with the audience and fielded questions for about an hour.

Seattle

In July, the Seattle chapter held a special joint technical meeting with the members of ANSI-ASC C63 who happened to be meeting at the AT&T Wireless facility in Redmond. The title of the presentation was "Multimedia – It's Not Just ITE and TV Anymore." The speakers were Dave Traver and Ian Matthews of Sony in San Diego, CA. The presentation covered various aspects of multimedia and its effect on EMC measurement standards. EMC issues (is it consumer electronics or is it ITE?) were presented. The question was posed: What will the new standards need to measure? The meeting was held at CKC Labs, who generously treated the attendees to a catered dinner prior to the technical presentation. It was a unique opportunity for chapter members to informally mix with the members of the ANSI-ASC C63 committee, many of whom came to Redmond from all over the US.

There was a good turn out for the September chapter meeting with speaker Tom Van Doren from the University of Missouri at Rolla. At the Kalmus facility

Continued on page 34



Tom Van Doren was the speaker at the September Seattle chapter meeting. Note the demo equipment in the background (and on the chair) which was used throughout the evening to supplement the material presented.



The winners of the "Noise Diagnostic Competition" held following Tom Van Doren's presentation at the Seattle chapter meeting in September. The winning team consisted of Joe Mason (front center) and Mark Chase (left) of CKC Labs and Dennis Anderson of the FCC (right).



TC-9 Computational EMC

Two Modeling Workshops Draw International Crowd at EMC Symposium

By Colin E. Brench

The EMCS Technical Committee Nine (TC-9) meets each year during the Symposium to discuss the activities of the past 12 months and to plan for the upcoming year. The charter of this TC is very wide and encompasses all aspects of applied computational electromagnetic techniques as used to model electromagnetic interactions in circuits, devices, and systems. A primary focus is the identification, development and validation of modeling methods that are well suited to EMC phenomena. Along with this is the very practical side of defining the applicable limits for these methods and providing the society with an educational resource as needed to encourage the development of the field. Included are low and high frequency-domain techniques as well as time-domain methods.

This year, as in the past, TC-9 organized two modeling workshops at the Symposium that provided basic training and insight into the world of computational electromagnetics. These two workshops vary only slightly from year to year. The Monday session focused on the basic numerical techniques while the Friday session examined simple applications designed to highlight the use of the various techniques. In addition, TC-9 organized sessions dedicated to modeling throughout the main part of the

Symposium including an invited papers session. The goal for this session of invited papers was to highlight significant advances in the field.

Quite apart from the direct TC-9 sessions, many other sessions included papers that relied heavily upon numerical modeling. In particular, a session on measurement antennas provided many examples of how the inclusion of computational electromagnetics can improve the accuracy of the most fundamental EMC tasks – performing verification measurements. By improving basic site models and including specific antenna details, it was shown that over all measurement uncertainty can be significantly reduced. This is a most important area of research as it allows for less over design and greater repeatability, both of which can translate to potential cost savings.

In the planning for next year it was observed that the basic workshops were well attended, and feedback indicated that these workshops were targeted appropriately for those just beginning to become interested in modeling EMC problems. The Committee has many enthusiastic members who offered a wide variety of suggestions for expanding the role of TC-9 in the coming year. One of the most popular thoughts was the inclusion of modeling demonstrations as

part of the experiment sessions. This would permit engineers to get a first hand view of what can be done.

The activities of TC-9 that continue throughout the year include a column in the EMCS Newsletter and a web site that provides detailed information on reference modeling problems. TC-9 also provides technical expertise for reviewing papers submitted to the IEEE and other EMC symposia that are primarily based in computational electromagnetics.

The EMCS Newsletter column provided basic modeling information and reported on related conferences. It will be replaced in the future with full-length articles on computational electromagnetics in EMC that will have a wider appeal.

The TC-9 web site is an ongoing effort. This site is a joint effort between the Applied Computational Society (ACES) and the IEEE EMC Society TC-9 subcommittee. The purpose of the web site is to provide data for EMC modeling validation. Measurement data and modeling data will be provided with enough detail so the user can repeat the work, and compare new results to previous results. In addition to the test/model data results, a section is provided for 'standard' EMC modeling problems. These problems have been documented with sufficient detail so that a user can easily create these models, and potentially analyze commercial or new software codes for their ability to perform meaningful EMC simulations.

TC-9 has an international membership and within this Committee expertise can be found in a very wide range of numerical techniques, application and validation methodologies. The members of this Committee are dedicated to the promotion of EMC modeling in all its aspects, and welcome all suggestions for how this can be most effectively achieved. Please contact one of the members listed below with your comments or suggestions.

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Members of Technical Committee Nine on Computational EMC (TC-9) gathered during the EMC symposium in Washington, DC. Pictured left to right are TC-9 Chairman Jim Drewniak of the University of Missouri at Rolla, committee member Franz Gisin of Nortel Networks, TC-9 Vice-Chair Zorica Pantic-Tanner of San Francisco State University, and Bruce Archambeault of IBM who maintains the committee's modeling website.



Practical Papers, Articles and Application Notes

Bob Olsen, Associate Editor

In this issue you will find three practical papers that should be of interest to the EMC community. The first is a comment by Jasper Goedbloed on a previous Newsletter paper by Stephane Laik about measurement uncertainties in standardized compliance tests. The second is a description of a piece of software for field to cable coupling written by Art Glazar and available directly from the author via e-mail at aglazar@ieee.org. Finally, Elya Joffe has written a very interesting "war story" about how the source of unacceptable emissions from a data communication system was identified.

The purpose of this section is to disseminate practical information to the EMC community. In some cases the material is entirely original. In others, the material is not new but has been made either more understandable or accessible to the community. In others, the material has been previously presented at a conference but has been deemed especially worthy of wider dissemination. Readers wishing to share such information with colleagues in the EMC community are encouraged to submit papers or application notes for this section of the Newsletter. See page 3 for my e-mail, FAX and real mail address. While all material will be reviewed prior to acceptance, the criteria are different from those of Transactions papers. Specifically, while it is not necessary that the paper be archival, it is necessary that the paper be useful and of interest to readers of the Newsletter.

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

Comments on 'Radio Disturbance Measurement and its Uncertainties' [1]

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The model used by Laik and Boizard [1] to establish the uncertainty budget of a radiated emission measurement has deficiencies since important parameters (influence quantities) are not taken into account. Therefore, that model is not applicable to a standardized compliance test such as CISPR 22 (or EN55022). In this paper, some of the deficiencies, also present in [2, 3], will be considered. In addition, some ongoing work on standards compliance uncertainty will be mentioned.

The Model

The radiated emission compliance test is based on the determination of an emission level. Chapter 161 of the IECV (International Electrotechnical Vocabulary), a mandatory document in CISPR22, defines the emission level as "the level of a given EM disturbance

emitted from a particular device, equipment or system, measured in a specified way". Consequently, all relevant influence quantities associated with the test should be taken into account and not only those limited to the measurement instrumentation, as in [1], Table 2. Moreover, Refs. [1-3] tacitly and incorrectly assume that all sensitivity coefficients giving the relation between the uncertainty in an influence quantity and its effect in the uncertainty budget are equal to 1.

By using the relation $E=kVP(1+D)$, Ref.[1] essentially assumes that a radiated emission measurement is only a voltage measurement (E is the field strength, k the antenna factor (AF), V the voltage reading (U), P the cable loss (A_c) and D the mismatch uncertainty). The test however requires the measurement of the field strength at a certain distance d from the EUT, while the EUT is at a height h , above a reflecting metal plane having an effective reflection coefficient $\rho = \exp(j\phi)$, using a specified lay-out of the

EUT and its cables. In addition, at the measurement frequency a scan of the height h of the receiving antenna (1m to 4 m) plus a 360° rotation of the EUT set-up is required to find the maximum E_{\max} of the emission. Of course, these influence quantities are nearly all geometrically instead of electrically specified. However, that does not mean that they can be excluded from the uncertainty budget.

Geometric Optics

It is instructive to calculate the maximum field strength $E_{c,\max}$ at the center of the receiving antenna by using geometric optics and assuming that the EUT is a point source in the far-field:

$$E_{c,\max} = \max_{\substack{\phi=0 \\ \phi=2\pi \\ h=1m}}^{h=4m} \left\{ \frac{K(\phi, \vartheta)}{D_d} \sqrt{\left(1 - \frac{D_d}{D_r}\right)^2 + 4 \frac{D_d}{D_r} \cos^2\left(\frac{\alpha s + \phi}{2}\right)} \right\} \quad (1)$$

In Eq.(1), K is a factor proportional to the square root of the power emitted by the EUT in the azimuth direction ϕ and the elevation direction $\vartheta = \arctan(d/(b-h_r))$, $D_d = \sqrt{d^2 + (b-h_r)^2}$ is the direct distance between the point source and the center of the receiving antenna and $D_r = \sqrt{d^2 + (b+h_r)^2}$ that via reflection to the metal plane, $s = D_r - D_d$, $\beta = 2\pi/\lambda$ and λ is the wavelength. The equation illustrates how geometrically specified influence quantities may enter into a model.

The voltage U_i induced in the receiving antenna follows from the integral over all antenna elements of the incident field tangential to these elements (described by an expression comparable with Eq.(1)), weighted by the current distribution over these elements in the transmitting state of the antenna [4]. The measured voltage $U = Z_r U_i / (\alpha(Z_r + Z_a))$, where Z_r is the input impedance of the receiver, Z_a the antenna impedance, and α a factor determined by the antenna cable loss A_c , mismatch, etc., so that

$$U_{\max} = \max_{\substack{\phi=0 \\ \phi=2\pi \\ h=1m}}^{h=4m} \left\{ \frac{Z_r}{\alpha(Z_r + Z_a)} \int_{\Gamma} E_i^i(x) \cdot \frac{I(x)}{I_0} dx \right\} \stackrel{\text{def}}{=} \frac{E_{\max}}{\alpha AF} \quad (2)$$

or $E_{\max} = \alpha AF U_{\max}$; see under 'Discussion' below. The form of the latter equation is identical to that used in [1], but Eq.(2) takes important specified influence quantities into account that were neglected in [1-3].

Unfortunately, geometrical optics fails in taking important mutual couplings into account. As is well known from antenna calibration and site valida-

tion measurements, several mutual couplings play a part in the actual model predicting U_{\max} . In such a model, the EUT can be represented by an effective Thévenin source inside that EUT, supplying its signal to an effective antenna formed by e.g. the printing wiring board, the chassis and the connected cables. So the EUT (including its antenna) is fully comparable with the transmitting antenna (including its source) in, for example, an antenna calibration. Similarly, the EUT has its mirror source in the reflecting plane and the receiving antenna (including its load impedance) has its mirror too.

Next, a model can be constructed consisting of a 4-port-network in which the various mutual couplings are represented by the impedances in that network [5]. The impedances depend on the dimensions, shape and mutual orientation of both antennas and on the distances between the antennas and the reflecting plane (location of the mirror devices). Of course, there is no simple method (if at all) for calculating these impedances for an actual radiated emission test configuration. However, that does not change the physics of the problem and the need to address the mutual couplings in uncertainty considerations.

Uncertainty and sensitivity coefficients

The uncertainty ΔE_{\max} in E_{\max} resulting from the uncertainties ΔX_j in the n ($j=1, \dots, n$) influence quantities X_j follows from

$$\Delta E_{\max} = \sum_j \Delta E_{\max}(j) = \sum_j \frac{\partial E_{\max}}{\partial X_j} \Delta X_j = \sum_j c_j \Delta X_j \quad (3)$$

where $c_j = \partial E_{\max} / \partial X_j$ is the j^{th} sensitivity coefficient. In general, $c_j \neq 1$.

CISPR/A Round Robin Test

The difficulties associated with the actual modeling and the estimation of parameter values made CISPR/A decide to start a radiated emission Round Robin Test (RRT) [6]. In such a test quantitative and statistical information is collected relating to the important influence quantities and their uncertainties. In the RRT, 14 qualified EMC test houses in the EU, Switzerland and the USA will perform well-specified emission measurements using two EUTs, various types of antenna and sites (OATS, SAR,

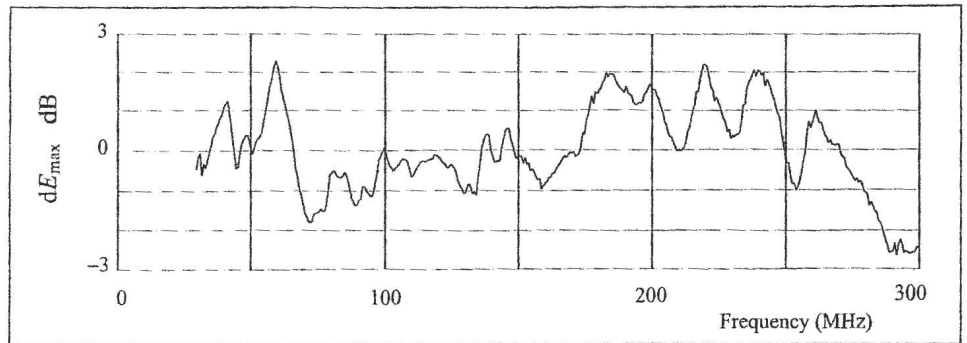


Figure 1: Measured field strength difference dE_{\max} (dB) after a biconical antenna has been replaced by a log-biconical antenna

FAR) with test distances 3m and 10m.

EUT1 is a tightly specified, electrically long monopole antenna (rod antenna on a small ground plane), driven by a battery-operated comb generator. The rationale to use this EUT, which resembles a battery-operated digital equipment with one connected cable, can be found in [7]. The current close to the feed point of the rod antenna is measured via a clamp-on probe and an optical link. This current is comparable with the common-mode current in the mentioned cable. The rod is positioned vertically. In the emission measurement the receiving antenna is used only in vertical polarization but a height scan is included. EUT1 is not rotated. EUT1 is a calculable device, which means that the outcome of the experiments can be verified and a parameter sensitivity analysis can be performed.

EUT2 consists of three boxes interconnected via two-wire cables, while two of the boxes are connected to the mains. EUT2 represents a kind of 'computer' system consisting of a computer (comb generator), a printer (metal box) and a mouse (metal box). Its emissions are to be measured in full accordance with CISPR22, including rotation of EUT2 and the measurement of the horizontally and vertically polarized field components.

Discussion

The 'GUM' theory [8] used in [1] for the calculation of the standard uncertainty assumes that all $\Delta E_{\max}(j)/E_{\max}$ are small and of the same order of magnitude. If a large relative variation plays a part (see below) additional considerations may be necessary. Furthermore, from Eq.(1) it is directly clear that it will not be possible to write E_{\max} dB(μ V/m) as a sum of terms in dB units, where each term accounts for only one influence quantity. Therefore, the

'root-sum-square' approach with dB units, used in [1] to calculate the standard uncertainty, is not automatically valid as it assumes a full linear relation. Ref. [1] gets around this problem by writing D dB instead of $(1+D)$ dB. Moreover, it is not possible to deal with the measurement equipment uncertainties separately [7, 10].

The right-hand side of Eq.(2) has been obtained 'by definition' as the radiated emission test asks for $E_{\max} = \alpha \cdot AF \cdot U_{\max}$, where AF is the antenna factor of the receiving antenna as determined in the chosen calibration procedure. This factor does not only depend via Z_a on the height h of the antenna above the reflecting plane (as mentioned in [1]) but also on the mutual coupling with the EUT and its mirror, and(!) on the radiation pattern of that EUT (entering via the integral in Eq.(2)). If the radiation pattern in the compliance test differs from that during calibration, which is very likely, the integral will yield a different result.

As an example, Fig. 1 shows the difference dE_{\max} when in a RRT/EUT1 measurement only a biconical antenna is replaced by a log-biconical antenna. Now part of dE_{\max} may result from the fact that the antennas integrate over different parts of the field distribution. Moreover, the height h_{\max} at which E_{\max} is found in the compliance test and h_{\max} in the antenna calibration need not be identical. Therefore, $\Delta Z_a(h)$ is not directly known, even in absence of a mutual coupling with the EUT. See also an 'old' paper by Dvorak [9] that is still very relevant today.

As a second example, Fig.2 shows the change dI_a in the EUT1 feed-point current when only the height h_t of EUT1 above the reflecting plane is changed from the standardized height of 10 cm (floor-standing equipment) to 80 cm

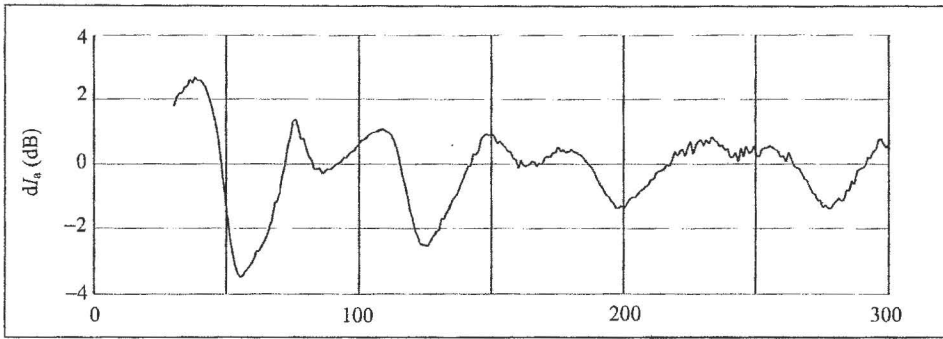


Figure 2: EUT1 feed-point current difference dI_a (dB) after the EUT1 height above the reflecting plane has been changed from 10 cm to 80 cm.

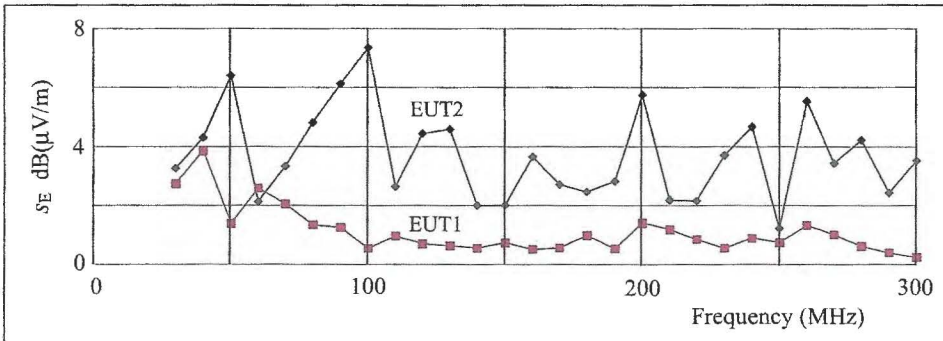


Figure 3: Preliminary RRT results: Standard deviation of E_{max} for EUT1 and EUT2

(table-top equipment). This graph shows that the radiating properties of EUT1 also change. The effect is caused predominantly by the change in the mutual coupling between EUT1 and its mirror, causing a change in the load impedance of the mentioned Thévenin source. Consequently, the associated variation of E_{max} cannot be fully explained by geometric optics. Of course, the uncertainty in h_c will never be as large as $(80-10) = 70$ cm, but the effect shown in Fig.2 demonstrates that mutual couplings should be addressed in uncertainty considerations.

An important contribution to ΔE_{max} stems from the uncertainty in the anten-

na properties of the EUT, in particular as a result of the variation in cable lay-out allowed by the emission standard. In Eq.(1) this would become evident in an uncertainty in K . As an illustration, Fig.3 shows the standard deviation s_E of E_{max} resulting from the first four available RRT results. The deviation associated with the tightly specified EUT1 is clearly less than that associated with EUT2 where the cable layout has a relatively large tolerance. The somewhat larger s_E values of EUT1 at the lower frequencies can be attributed to site imperfections known from the reported NSA data.

The larger EUT2 s_E values can be

attributed to variations in the radiation pattern of EUT2 and to variations in the resonance frequencies of the 'EUT2 antenna' comparable with those of an actual antenna [7]. The latter also explains why the s_E relating to an open-area test site hardly differs from that relating to a fully anechoic room (FAR), as regretted by those promoting a FAR to reduce ΔE_{max} . It has to be investigated whether this relatively large contribution to ΔE_{max} allows the application of the 'small-signal' GUM theory.

CISPR22 requires the measurement of the horizontal and vertical components of the field, but only the larger of these two components is to be reported. As a last example, Fig.4 shows that the variability of the cable layout also results in a variation in the horizontal and vertical components yielding E_{max} . At several frequencies the polarization is not unanimously found.

Some metrology-oriented experts are of the opinion that the variations caused by the variability in the cable layout do not contribute to ΔE_{max} . They consider these variations to be a reproducibility problem. Such a view is allowed, but the result of their ΔE_{max} cannot be used in the compliance criterion since, as said before, the compliance test requires the determination of the emission level measured in a specified way. That specified way includes the specifications of the cable layout and, hence, its variability. Alternative formulations of the compliance criterion may be found in [7, 10]. Finally, the metrology-based uncertainty considerations refer to a 95% confidence level. It is not known how that level is to be reached when a compliance test is carried out only once.

Work in progress

If everything proceeds according to plan, the actual RRT measurements will be finished by spring 2001. The analysis of the data has already been started and the first results will be discussed at the 2001 CISPR/A meeting and presented at an EMC conference as soon as possible. In addition to the measurements, numerical calculations (NEC-like calculations) have been started to describe the EUT1 measurements. CISPR/A now uses the results of uncertainty considerations to improve emission standards [11].

At present, UKAS is rewriting NIS81

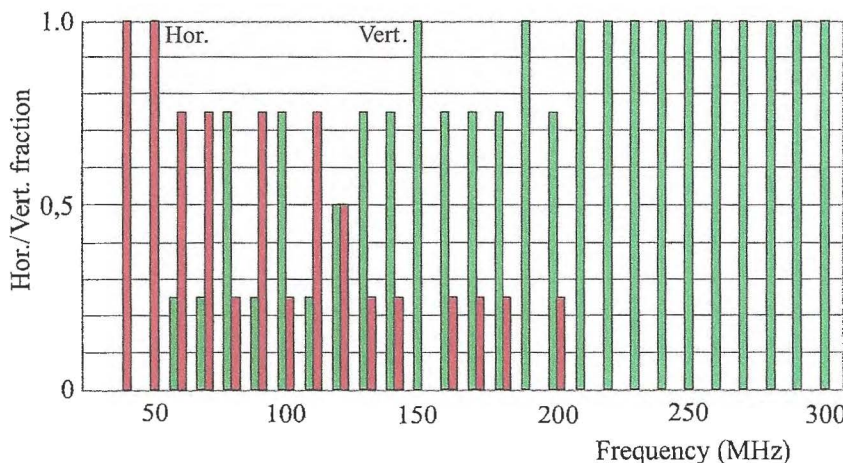


Figure 4: Preliminary RRT results: horizontal/vertical polarization fraction associated with E_{max}

[2] as quoted in [1]. In the new version attention is being paid to improved modeling and to uncertainty contributions from non-specified influence quantities (in the electrical sense) such as cable layout effects [12].

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He contributed to the work of IEC/TC77, e.g. by writing IEC 1000-1-1 'Application and Interpretation of Fundamental Definitions and Terms', and to the EMC Working Group of the ZVEI (Germany), in particular to the statistical investigations (transients on the mains, EMI properties of telephone-subscriber lines). Until his retirement he chaired IEC/CISPR/A WG2 and is still active in the field of uncertainties in standardised EMC compliance testing. Mr. Goedbloed can be reached via e-mail at jjg@iae.nl

A Software Implementation of TL Field-to-Cable Coupling Equations

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Life Senior Member, IEEE

Abstract - In 1977, Albert A. Smith, Jr., first published "Coupling of External Electromagnetic Fields to Transmission Lines". Smith analyzed the coupling mechanism between ambient electromagnetic (EM) fields and a transmission line (TL), and formulated a suite of equations broadly applicable to the prediction of radiated susceptibility (RS) of various wire and cable configurations. Smith's seminal book, and the expanded 1987 second edition, provides many practical worked-out examples and spectrum profiles. The present author, however, needed specific solutions to a cable susceptibility problem and therefore undertook the task of implementing a subset of Smith's equations for use on a personal computer. The end result is the subject of this paper: a simple-to-use program designed to quickly evaluate the RS of shielded cables above perfect ground in typical applications. The program (COAX.EXE) generates solutions in graphic format, displaying load current or voltage spectra resulting from four different EM field orientations, and it facilitates parameter variations such as cable length, height above ground, terminating impedances and coax characteristics. Using COAX.EXE, the author

was able to closely replicate several problem solutions published by Smith, thus lending confidence to the code. COAX.EXE is compact and will run on minimally-configured personal computers. It is available as freeware to EMC Society members and others.

1. INTRODUCTION

The EMC engineer's toolkit typically comprises textbooks, clipfiles, software, and most importantly, his own knowledge acquired from prior experience. Although software has become increasingly important, it has been the author's experience that software is often too generalized and overly complex, or just too expensive or otherwise inaccessible.

One frequently-encountered EMC problem is that of predicting the radiated susceptibility (RS) of box-to-box cabling. Whenever a system incorporates cabling interconnection, the question of RS must be addressed whether or not a formal specification exists. Credible RS prediction tools can help to avoid the need to rework and retest a design. In those instances when formal analysis is required, confidence is enhanced if a mathematically-defensible solution can be obtained, rather than an extrapolation from a similar application.

This paper discusses the author's software implementation of a subset of the equations developed by Albert A. Smith, Jr.[1]. The software allows the user to set up a circuit consisting of a coaxial cable whose shield, as well as its signal-carrying center conductor, can be terminated in complex impedances at both ends. The cable is positioned above, and parallel to, a perfect ground plane, and is illuminated by a uniform electromagnetic field. After the user enters various problem parameters, the program displays graphical solutions of the load current (or voltage) spectrum over six decades of frequency, from 10 KHz to 10 GHz. Graphical solutions are provided for each of four field orientations.

In setting up a problem, the user is prompted for problem-definition parameters. Possibly the most significant of these is the surface transfer impedance, Z_c of the coaxial (or other shielded) cable. In the past, specifying Z_c in a useful way has been difficult. The present program, however, reduces that task to simply choosing one of seven stored functions, or to generating a customized function by entering a series break of frequencies and magnitudes.

The foregoing is best illustrated by studying Figures 1, 2 and 3 which are screen captures obtained while running

Coax characteristic impedance	50
Coax velocity factor66
Coax O.D. in cm5
Field strength in volts/meter	100
Length of coax in meters	1
Height of coax above ground in meters1
Shield terminating resistance (source end), (s/p) ohms1
Shield terminating reactance (source end), +/- ohms at 1 Mhz ..	3.14
Shield terminating resistance (load end), (s/p) ohms1
Shield terminating reactance (load end), +/- ohms at 1 Mhz ...	3.14
Signal Circuit source resistance, (s/p) ohms	50
Signal Circuit source reactance, +/- ohms at 1 Mhz	0
Signal Circuit load resistance, (s/p) ohms	P50
Signal Circuit load reactance, +/- ohms at 1 Mhz	-15900
Shift dB Scale (+/-) dB	0
Frequency Multiplier (0.99 to 1.01)	1
Voltage or Current Spectrum (V/I)	V
Plot Ex(y) ... (y/n)? N	
Plot Ex(z) ... (y/n)? N	
Plot Ez(x) ... (y/n)? N	
Plot Ez(y) ... (y/n)? Y	

Figure 1.

the following example problem: A one-meter length of RG-58/U connects two ideal system boxes. The cable is supported 0.1 meters above ground and subjected to a 100 v/m, horizontally-polarized field. The source end of the signal-carrying center conductor is terminated by 50 + j0 ohms, and the load end by 50 ohms in parallel with a capacitive reactance of -15,900 ohms at 1 MHz (i.e., 10 pF). At both ends, the coax shield is terminated to ground by a pigtail connection which is simulated as a series-connected 0.1 ohms and +3.14 ohms of inductive reactance at 1 MHz (i.e., 0.5 microhenries). Figure 1 is the DATA ENTRY menu showing all of the problem parameters; Figure 2 is the TRANSFER IMPEDANCE SELECTION screen, from which Curve #1 (RG-58/U) has been selected. Figure 3 is the problem solution graph.

Part II of this paper reviews transmission line (TL) coupling theory, and Part III discusses the features and limitations of the software.

II. TL COUPLING THEORY

TL theory treats the outer shield (sheath) of a coaxial cable as a conductor above a ground plane, which forms a uniform, lossless transmission line. Such a transmission line has a real characteristic impedance equal to

$$Z_0 = 138 \log_{10} (4h/d)$$

where

h = shield height above ground,
d = shield diameter

d, h in consistent units

The end points of the shield are terminated at the ground plane in impedances ZS_1 and ZS_2 which may be complex. Figure 4 illustrates the shield and signal terminations. For TL theory to be valid, the shield height, h, must be small compared to the line length and also must be a negligible fraction of a free space wavelength.

As far as the signal-carrying portions of the coaxial cable are concerned, the interior characteristic impedance of the coax will be denoted as Z_c to distinguish it from Z_0 . Also, the signal-carrying center conductor is terminated in complex impedances Z_a and Z_b , representing the source and load ends of the signal circuit, respectively.

If this configuration is illuminated by an electromagnetic field having a component parallel to any portion of the shield, current will flow on the surface of the shield. Because the shield is imperfect, the surface current will couple into the center conductor (i.e., into the signal circuit) of the coaxial cable. The mechanism for this coupling between shield and signal circuit can be described by a function known as the *surface transfer impedance*, Z_t , of the cable. This function has the dimensions of ohms per unit of cable length along the z-axis, and is defined by the differential equation

$$dV(z) = Z_t I(z) dz$$

This definition implies that a differen-

tial voltage is generated in the *interior* of the cable, which voltage is proportional to the shield surface current, $I(z)$ and the magnitude of Z_t . It is this differential voltage along the center conductor that causes an undesired component in the signal load. It should be noted that Z_t is also frequency dependent, and in practice is usually a measured parameter and is presented as a plot of impedance magnitude vs frequency.

Figure 4. illustrates the E-field notation used by Smith [1] and adopted herein. The four fields shown are those which provide maximum coupling into the cable system defined in Figure 4. All are assumed to be uniform, transverse plane wave fields. $Ex(y)$ represents a vertically-polarized field traveling in the y, or -y, direction (broadside incidence). $Ex(z)$ represents a vertically polarized field travelling in the z, or -z, direction (end-fire incidence). $Ez(x)$ represents a horizontally polarized field traveling in the -x direction; that is, propagating from directly overhead toward the ground plane (edge-fire incidence). Finally, $Ez(y)$ represents a horizontally polarized field traveling in the y, or -y direction.

Note that two additional horizontal-polarized fields $Ey(x)$ and $Ez(x)$ would be orthogonal to all parts of the conductor system defined in Figure 4, and no coupling would occur. Also, $Ex(x)$, $Ey(y)$ and $Ez(z)$ are not physically realizable fields since transverse electromagnetic (TEM) waves can have no field component in the direction of travel.

$Ez(x)$ requires additional comment. Of the four fields being considered, it is the only one wherein the *total* field in the vicinity of the conductors may be different from the *incident* field. If we assume that an $Ez(x)$ field having an incident magnitude, E^i , was launched from some large distance above the ground plane, it would encounter the ground plane and experience total reflection at the surface of the plane. The net result would be a standing wave producing a *total* field having a magnitude of zero at the ground plane and at even-multiples of a half-wavelength above ground. Similarly, the *total* field would have a magnitude of 2 E^i at odd-multiples of a quarter wavelength above ground; that is, $Ez(x) = 2 E^i \sin 2\pi h/\lambda$. In a test chamber or in any other real environment, a cable system will respond to the total

field, which can be vastly different from the incident field. At any given frequency and height above ground, this difference can range from a +6dB increase to an infinitely deep null response.

Smith [1] showed that a current $I_L(z, \omega)$ will flow in the signal load, Z_b , due to a current distribution, $I(z, \omega)$, along the length of the shield:

$$I_L(z, \omega) = (Z_a / P) \int_0^s I(z, \omega) [Z_c \cos \beta_i z + j Z_a \sin \beta_i z] dz$$

where:

$$P = Z_c (Z_a + Z_b) \cos \beta_i s + j(Z_c^2 + Z_a Z_b) \sin \beta_i s$$

Z_a = coax signal source terminating impedance, $R_a + j X_a$

Z_b = coax signal load terminating impedance, $R_b + j X_b$

Z_c = coax internal characteristic impedance, ohms

ω = radian frequency = $2 \pi f$

f = frequency, Hz

z = distance along cable, meters

Z_c = surface transfer impedance, ohms/m

β_i = coax internal wave number = βV_f

β = free space wave number = ω / c

V_f = coax velocity factor

c = 3×10^8 m/s

s = cable length, meters

For $E_x(y)$:

$$I(z, \omega) = K1 \{ Z_w [\cos \beta(s-z) - \cos \beta z] + j[Z_2 \sin \beta(s-z) - Z_1 \sin \beta z] \}$$

For $E_x(z)$:

$$I(z, \omega) = K1 \{ (Z_w - Z_1) \sin \beta s \sin \beta z + j(Z_w + Z_2) \sin \beta s \cos \beta z - j(Z_1 + Z_2) \cos \beta s \sin \beta z \}$$

For $E_z(x)$:

$$I(z, \omega) = K2 [1 - (N1 + jN2) / D]$$

For $E_z(y)$:

$$I(z, \omega) = K3 [1 - (N1 + jN2) / D]$$

where:

E^i = Incident electric field strength, V/m

h = shield height above ground, meters

d = shield diameter, meters

$Z_w = 2 Z_0 = 276 \log_{10}(4h/d)$

Z_{S1}, Z_{S2} are the shield terminating impedances at ends 1,2 respectively

$Z1 = 2 Z_{S1} = 2 (R_{S1} + jX_{S1})$

$Z2 = 2 Z_{S2} = 2 (R_{S2} + jX_{S2})$

$D = Z_w (Z_1 + Z_2) \cos \beta s + j(Z_w^2 +$

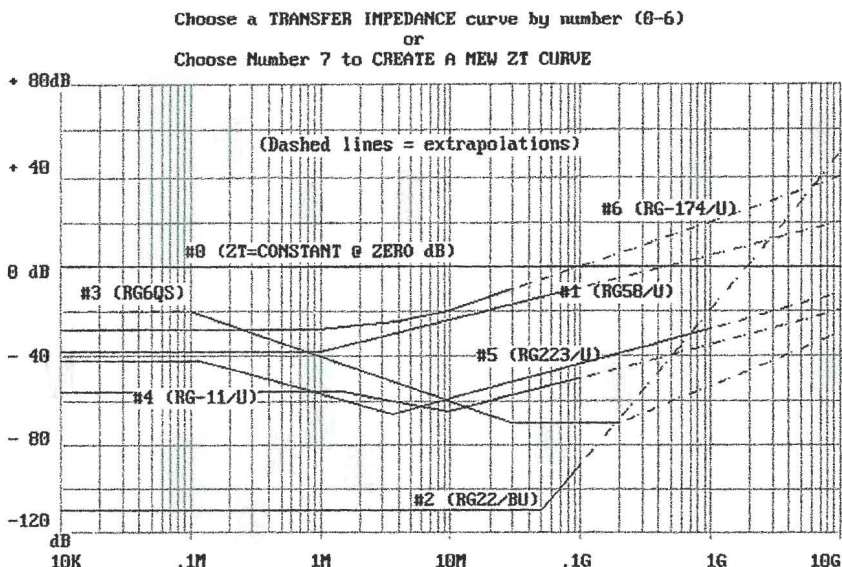


Figure 2. Transfer impedance selection screen for the example of Figure 1.

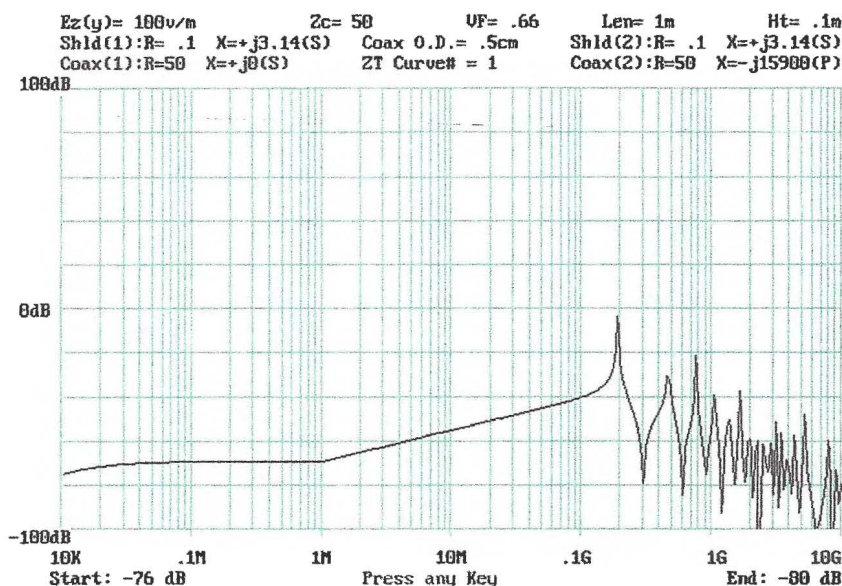


Figure 3. The problem solution graph for the example of Figure 1.

$$Z_1 Z_2 \sin \beta s$$

$$K1 = 2 h E^i / D$$

$$K2 = (2 / Z_w \beta) (2 E^i \sin 2\pi h / \lambda)$$

$$K3 = (2 / Z_w \beta) (E^i)$$

$$N1 = Z_0 Z_2 \cos \beta z + Z_0 Z_1 \cos \beta(s-z)$$

$$N2 = Z_1 Z_2 [\sin \beta z + \sin \beta(s-z)]$$

It is evident that paper-and-pencil solution for any specific set of parameters would be a formidable undertaking.

III. SOFTWARE DEVELOPMENT

Implementing equations was a straightforward programming task, but developing a simple and intuitive user interface

required careful consideration. The following discussion addresses some of the considerations and their resolution.

Plot Display. Solutions are plotted in semi-log format. The frequency range is fixed at six decades (10 KHz to 10 GHz), and the magnitude range is fixed at 200 dBv or dBa. Automatic range scaling was initially considered but found to be unnecessary because the dB range becomes evident after the first pass and the user can shift the dB scale up or down as necessary. The default range is ± 100 dB. The user can also select either load voltage (dBv) or load current (dBa) for presentation.

The display utilizes 300 pixels across

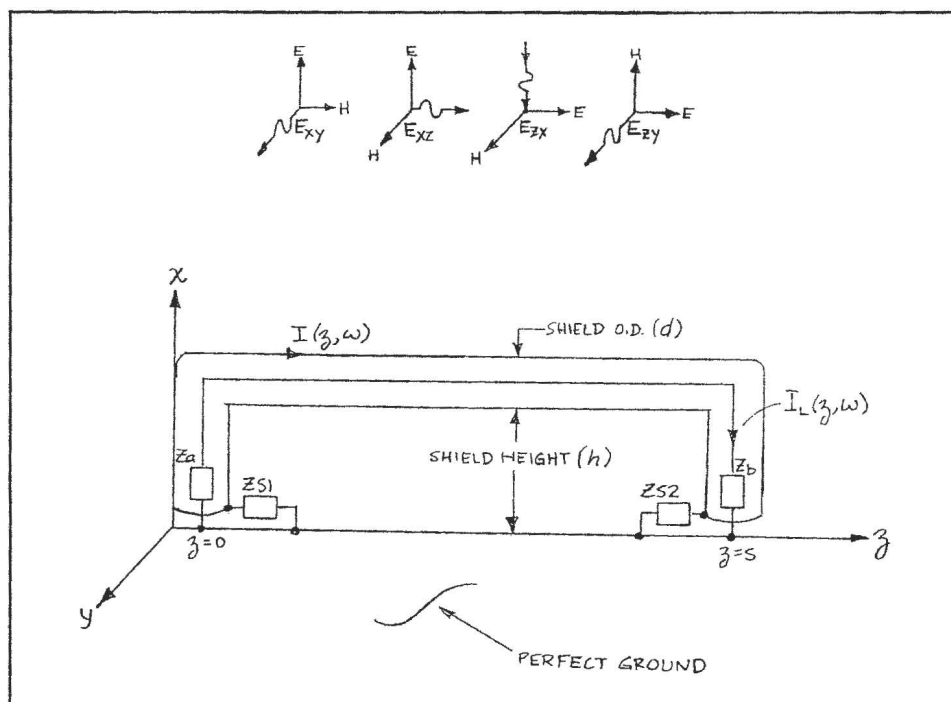


Figure 4.

COAXIAL CABLE PARAMETERS				
TYPE	Z ₀ (ohms)	V.F.	O.D. (cm)	Z _t Curve No.
RG6QS	75	.78	.726	3
RG11/U	75	.66	1.03	4
RG22B/U	95	.66	1.07	2
RG58/U	50	.66	.495	1
RG174/U	50	.66	.254	6
RG223/U	50	.66	.549	5

Figure 5.

the frequency axis; i.e., 50 pixels per decade, to achieve maximum plot resolution. During a plot, the program assigns these pixel numbers as the independent variable, and frequencies are calculated as a function of pixel number. Since the plot comprises 300 discrete frequencies, it is possible that a particular plot feature (a cusp, for example) may fall between two frequencies and thus fail to present a true maximum or minimum. In such cases, the user can "zero in" on the true frequency and amplitude by selecting a "frequency multiplier" factor from the data entry menu. The allowable multiplier range is $\pm 1\%$ (0.99 to 1.01). When the multiplier is within that range (but not unity), the plotting routine goes into single-step mode and all frequencies are multiplied by the selected factor. By this means, the frequency and amplitude of any plot feature can be evaluated.

Complex Loads. From the data entry menu, the user can select terminating impedances for both the shield and the signal line. The allowable impedance choices are series-connected or parallel-connected resistance and reactance. Reactance values are specified at 1 MHz, and may be either capacitive (negative) or inductive (positive). The data entry menu requests the user to prefix the resistive value with a "p" for a parallel R-X connection; otherwise the default configuration is series connection. The program makes the necessary impedance transformations during problem execution. This particular scheme for designating impedance may be unorthodox, but the author found it convenient and intuitive. The terminating impedance values and all other problem input parameters appear at the top of the solution plot for reference.

Transfer Impedance. The transfer impedance selection screen enables the user to synthesize any Z_t curve. Building the curve is an interactive process. The program repetitively asks for break frequencies and dB values and continuously displays the construction of the curve. Any number of frequencies between 10 kHz and 10 GHz can be employed to create a piecewise linear curve to any degree of smoothness desired, up to 100 breakpoints. The program offers no means to store user-generated Z_t curves. Figure 2. shows the Z_t selection screen and identifies the seven available curves which are approximations derived from several different sources.

Coaxial Cable Parameters. Figure 1 reveals that three coaxial cable parameters must be provided by the user. These are (a) characteristic impedance; (b) velocity factor; (c) shield outside diameter. For convenience the program includes a short table of common coaxial cable types with these parameters. The table is reproduced in Figure 5.

About the Program. COAX.EXE was written and compiled using Microsoft's (R) BASIC version 7.1 Professional Development System. This DOS-based software includes the QuickBASIC Extended (QBX) development environment which has served the author for numerous engineering applications. COAX.EXE is a modest 80 kilobytes in length, requires only minimal memory and no installation. VGA is required, but a color monitor is optional. Maximum execution speed is obtained by running directly from DOS. Execution time for a typical plot was timed at 40 seconds when run under DOS from diskette on a 486 DX33 computer. The program has no provision for hardcopy or for saving problem data. All computation is done "on the fly". The program's introductory screen offers the user the option of switching to a white background which is better suited to printing a screen. If the program is run under WINDOWS, a screen image can be captured (cut) by pressing Alt+PrintScreen, then pasting into an accessory program such as PAINT or WORDPAD, from where it can be printed.

Program Availability. COAX.EXE is available directly from the author at aglazar@ieee.org.

References

[1] A. A. Smith, Coupling of External Electromagnetic Fields to Transmission Lines, second edition, Interference Control Technologies, Inc., Gainesville, VA (1987).



Art Glazar obtained his B.E.E. degree from Pratt Institute in 1960, P.E. Certification in 1977, and retired from industry in early 1991. His last position was with Loral Fairchild Systems in Syosset, NY, where he was responsible for EMC analysis and compliance for the USAF ATARS program. He can be reached by telephone at 631-724-1520, and email at aglazar@ieee.org.

A Compliant Power Supply with the Non-Compliant Control

by Elya B. Joffe
K.T.M. Project Engineering

Introduction

This is a true story!

Once upon a time, there was a high performance airborne data-communication system, required to meet strict emission and susceptibility requirements of MIL-STD-461C.

In the EMC tests (Figure 1), excessive emissions (+10dB) were identified in the RE02 (E-Field radiated emissions) at approximately 30MHz.

Aaaargh! Failure!!! That was totally unacceptable.

In the conducted emission tests, similar excessive emissions at 30MHz were found on the CE03 (Conducted Emission) tests (see Figure 2). OK. So solving our problem was "a piece of cake", isn't that right? Just fix the emissions on the 115VAC 3 phase lines, and we're done. Right?

Wrong!!!

The power supply was tested as a separate LRU (line replaceable unit) by the manufacturer, and fully complied with the CE03 test limits! So, the problem is not from the power supply (or so we assumed... Oh, but in EMC, never assume anything!)

Where do we begin?

The first suspicion – a ground loop!

Since the conducted emissions were not identified in the power supply, as a stand-alone unit, we considered a possible resonance in the power line filter, excited by some noise near 30MHz. Particularly, possible interactions in the multi-point grounding topology of the system could generate such loops. Since the LRU's external power connector was wired by a high-performance shielded

cable directly (and not via the motherboard) to the power supply's power-input connector, possible ground loops could be generated. So, we "cannibalized" the shielded cable's shield, "opening" a possible "ground loop" and... and guess what? **NOTHING!** The problem was still there. Well, actually, no one really believed it was a ground loop...

So, hi-ho, hi-ho, back to the bench we go! Since we saw that the conducted emissions and radiated emissions were (expectedly) correlated, we decided to continue with conducted emission (CE) tests only at that time, believing that if we solved the CE problem – we'll be OK with radiated emission (RE) too. Not so simple, apparently!

The second suspicion: a system coupling problem!

At this stage it was quite evident that the power supply was compliant, but – it may have been tested using resistive loads, not dynamic loads. That could have explained coupling of noise emissions from the load circuits via the power supply to the output leads (with insufficient or inadequate filtering at those high filters, EMI from the circuits could have leaked through the power supply). Naturally that could be identified in a stand-alone power supply test, we thought. So we removed all the load circuits from the system (the System Controller (CPU) card, the I/O card, the Video Display card, and the Transceiver card). Thus the entire "system" under test

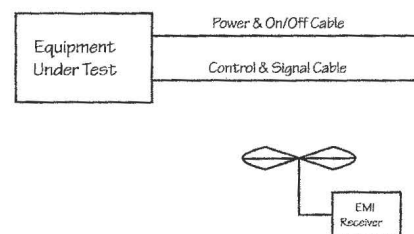


Figure 1: Radiated Emissions (RE02) Tests

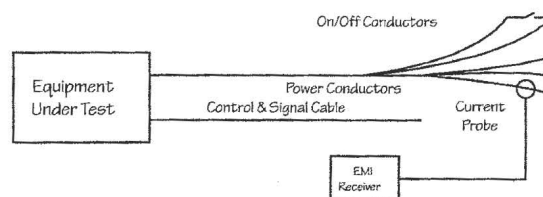


Figure 2: Conducted Emissions (CE03) Test on Phase Lines (note the long overlapping phase and on/off lines)

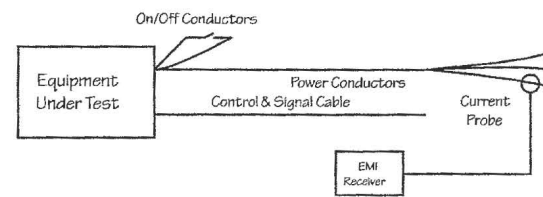


Figure 3: Conducted Emissions (CE03) Test on Phase Lines – Power Supply Manufacturer's Setup (note short On/Off lines)

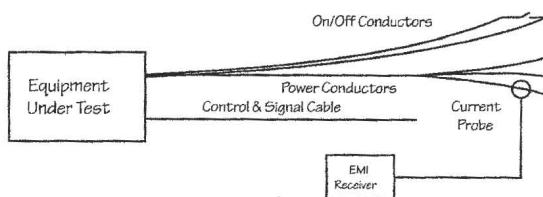


Figure 4: Conducted Emissions (CE03) Test on Phase Lines – On-Off Lines separated

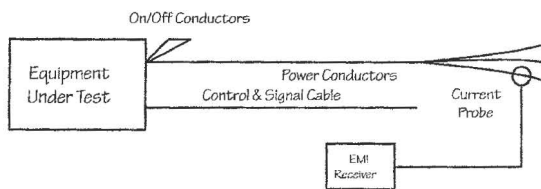


Figure 5: Conducted Emissions (CE03) Test on Phase Lines with Shorted On/Off lines

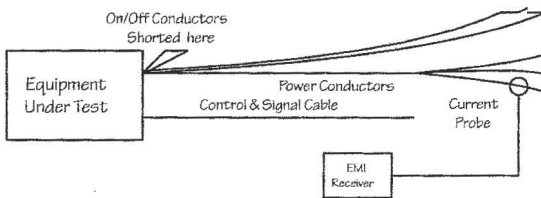


Figure 6: Conducted Emissions (CE03) Test on Phase Lines with Long On/Off Conductors Shorted near Connector

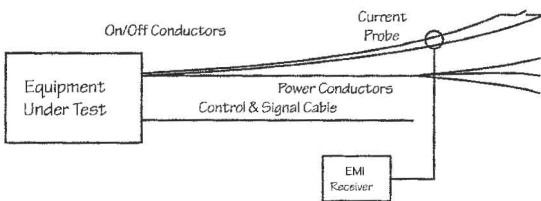


Figure 7: Conducted Emissions (CE03) Test on Both On/Off Conductors (Measuring Common Mode Emissions)

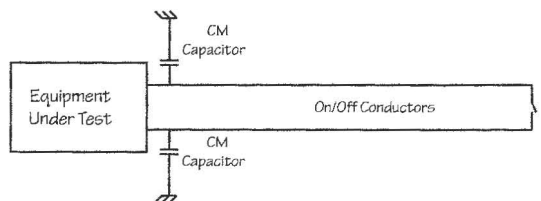


Figure 8: Line to Chassis (CM) Capacitors installed on both On/Off Lines (note that power lines are in place but not shown in the figure for clarity)

was reduced to the power supply and the motherboard only. Shouldn't it comply now? Sure as hell it... **DID NOT!** Of course – nothing is simple in EMI!

Now what? No! It could not be the Motherboard... Nothing else was connected to it, and it was totally passive.

The third suspicion: Back to the Power Supply!

"No other way – the problem must be

within the power supply!", we thought. But we could not tell why...?

So, we did the only reasonable thing at this time – **when the test fails – check the set-up!**

Actually, we called the power supply manufacturer, and checked the set-up HE used during his tests. And **Eureka!** The set-up was not the same! In fact – it was significantly different. The "On/Off" control line and return (2-wire line) were very short, and the 3-Phase power lines were routed separately along their entire length (see Figure 3). In our cable, the power lines were run together with the "On/Off" wire pair, and were 2.5 meters long! It looked like we were getting on track!

We are making progress – we've got a suspect!

So – first of all, we separated the "On/Off" lines from the power lines (see Figure 4). Having done that, and having repeated the CE tests, the conducted emissions (on the 3-phase power lines) were significantly reduced (but not eliminated)... OK, now what?

It looked like what we had here was a case of conducted emissions on "innocent" passive control lines (Open/Ground logic). Those emissions were apparently coupling to the power lines (see Figure 3). Separating the "On/Off" lines from the phase lines reduced crosstalk between them, thus conducted emissions were reduced.

So this is a complex "crime": Conducted emissions and Crosstalk. Wasn't that enough?

Well, then - how could we prove that the "On/Off" line was the culprit? Easy! We shortened the "On/Off" line to 2" and short-circuited the lines, providing the "On" command to the power supply but also reduced the current loop size (see Figure 5). Wow! Conducted emissions on the phase lines were down... We WERE on track! We thought we knew the emission source – the "On/Off"

wire pair. But – was the problem solved? Not so quickly...!

We reinserted all the load circuits, and repeated the conducted (CE03) and radiated tests (RE02). **GREAT!** Low emissions!

Characterizing (and subsequently solving) the Problem...

Encouraged by the results, we reconnected the long "On/Off" wire pair, and maintained the separation between them to the phase lines. However, we maintained the short circuit ("On" command) close to the EUT (see Figure 6). As expected (sure!), emissions were increased. Why "sure!"?

The explanation was actually quite simple. At the frequency of 30MHz, emissions are typically common mode, so even if we short-circuited the "On/Off" lines near the EUT, still common mode currents could and would flow on the longer lines...

We decided, therefore, to apply the "emergency room" approach, and do some "research and diagnostics": We conducted CE03 tests, with the current probe placed on both lines of the wire pair (see Figure 7). Naturally, we got emissions! **BINGO!**

Of course – it was a case of common mode conducted emissions! We tried a ferrite bead on both lines (in a common mode choke configuration), but – it did not work! Surely a small capacitor between each of the "On/Off" lines to the chassis (CM capacitors) of the enclosure would do (or so we thought). So, we stuck there whatever caps we had, 30nF, I believe (see Figure 8). **Emissions were... still there!**

Oh, boy! What now? Apparently the power supply did not know that at this frequency emissions are typically common mode...

So, we repeated the CE03 tests, on each of the "On/Off" lines separately. Of course, the emissions were still there, even with the caps.

So, next - we played the well known trick: We twisted one of the lines through the current probe, in practice – reversing the direction of the common mode current on one of the lines through the probe and we routed the other wire straight through it (see Figure 9). Here we are – we still got non-zero (in fact – significant) levels of emission on both lines! So there was also a differential

current emission component!

Now, it was easy – we added an 80nF capacitor (that's what we had) between the "On/Off" line and it's return (line to line) (see Figure 10). The problem was solved!

Back to the Power Supply Manufacturer

We went back (with drawn swords) to the power supply manufacturer, and queried his design. Why wasn't that line filtered?

Apparently – it was, but with a common mode choke, only. Since it was a passive and optically isolated line, the manufacturer assumed that capacitors were unnecessary...

Naturally, the power supply had to be retrofitted, and a miniature capacitor circuit was added to the power supply "On/Off" lines input leads. Now we had A COMPLIANT POWER SUPPLY WITH A COMPLIANT CONTROL.

Oh – what was the source of the emissions?

It is believed to be due to a resonance generated internally to the power supply power line filter, which could be expected since no damping resistors could have been added without degrading other performance characteristics of the power supply (heating, efficiency, etc.). Such a resonance would also explain why the interference appeared as a combination of both common mode and differential-mode emissions.

Summary

The problem was solved after 3 full days and sleepless nights of work, about 50 spectral plots, and many, many cups of coffee. In the final analysis - three small capacitors did the job!

This was a complex EMC problem, although not really complicated:

- Conducted emissions on "innocent", passive control lines
- Crosstalk between those lines and adjacent power lines
- Functional requirements of the power supply increased filter resonance beyond expected levels. The extent of emission was not foreseen...
- Inadequate filtering was implemented on the "On/Off" lines. Small capacitors would have done the work and had simply been ignored...
- Optical isolators were assumed to be sufficient for noise isolation, however – they too had their performance limits.

Lessons Learnt:

- EMC problems are complex, but not complicated. The principles and effects identified are quite simple. The problem could be easily explained, once identified.
 - Each problem (EMC problems included), has many solutions, most of which are wrong!
 - Almost always, EMI problems appear as a combination of several mechanisms. Until you identify (and solve) them all – the problem is there to stay! Adopt the saying – "You've found the problem – now look for the next one!"
 - Do not assume anything. The obvious is never! The unexpected, should always be! Remember: Murphy was the Patron Saint of EMC Engineers, but furthermore: Murphy was an OPTIMIST!
 - Always seek for "sneaky paths". Do not "close the door and leave a window open" when heating a room. The power lines were "clean" but the EMI "sneaked" and coupled through an "innocent" line.
 - Never ignore parasitics! "Real world" isolation and protection components do have limitations, which must be understood.
 - Contradicting design requirements may increase EMI and limit the range of available solutions. Strive to identify those cases as early as possible.
 - When comparing results of "equivalent" tests, make sure test set-ups are identical and comparable too. Had the power supply manufacturer used the formal set-up – the problem would have been discovered at the power supply level and not at the system-level tests.
 - For diagnostics, simplify the tests: when possible use CE rather than RE tests...but know the limitations of each!
 - Keep track of test results! It is difficult to remember results of over 50 measurements and their outcome!
 - Always perform development EMC tests for power supplies. They are critical items and a potential "pain in the neck".
- By the way, after modification, the RE02 tests passed successfully, with flashing colors, having corrected the problem.

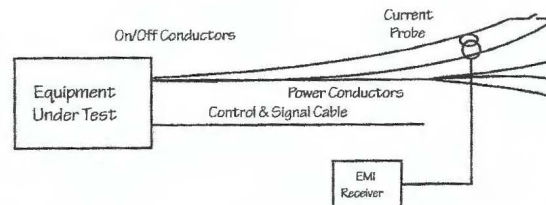


Figure 9: Conducted Emissions (CE03) Test on Both On/Off Conductors (Measuring Differential Mode Emissions)

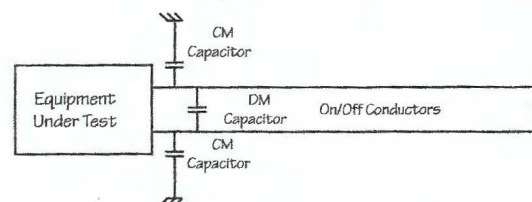


Figure 10: Line to Chassis (CM) and Line to Line (DM) Capacitors installed on On/Off Lines (note that power lines are in place but not shown in the figure for clarity)

We called this case – the "Twist and Shout" problem (the more "twists" it had, the more our bosses shouted at us...)



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EMC

Editor's Note:

"Call for War Stories 2001!" This paper was presented at the special "War Stories" session held during the 2000 IEEE International Symposium on EMC in Washington, DC. Several EMC engineers submitted papers for presentation at this session, while several more EMC engineers who attended the session verbally shared similar "War Stories" following the session. It was a lively, informative and very interactive session – not to mention being educational and entertaining, too. Many thanks are due to those who participated. Encouraged by the paper submittals and attendance at this inaugural session, organizer Tom Ghesworth of Seven Mountains Scientific is seeking material now from authors for a repeat "War Stories" special session at the 2001 IEEE International Symposium on EMC in Montreal. If you would like to submit a "War Story" along the lines of this paper, please contact Tom at 814-466-6559 or tom@7ms.com.



EMC Standards Activities

Don Heirman, Associate Editor

Advance Look at ANSI C63.4-2000

Don Heirman is a member of ANSI-ASC C63 and its editing committee for C63.4-2000.

Well at long last the next edition of ANSI C63.4 is about to hit the street. The final recirculation ballot (for draft 4.1) to nail down consensus is well underway. Here are some of the principle changes/additions that will be contained therein:

Addition of Wideband TEM devices as an alternate to open area testing for a limited set of products based on their size and correlation with OATS tests.

Clarification of final radiated emission testing, i.e. "...full frequency spectrum... shall be investigated.EUT rotated 360 degrees, ...antenna height scanned between 1 and 4 m, ...antenna rotated ..for both....polarizations. During the full frequency spectrum investigation, particular focus should be made on those frequencies found in exploratory testing that were used to find the final test configuration, mode of operation, and arrangement... This full spectrum test constitutes the compliance measurement.

Addition of test set-ups for tabletop EUT systems which are comprised of more than two peripherals.

Clarification on location of power adapters (battery eliminator) conducted emission testing; clarification on the use

of "extension cords" attached to the LISN during LISN calibration procedures.

New test setups for floor standing EUTs using overhead cable trays and suspended ceilings for cable raceways; new test set-up for combination floor standing and tabletop EUT systems.

Addition of reference to ISO Guide 25-1990 when "any requirement concerning statements of uncertainty of the measurement results" are specified by voluntary or regulatory requirements.

The draft document can be ordered by contacting Tricia Gerdon on p.gerdon@ieee.org. The final standard is expected to be issued before the end of the year. No substantive changes are expected from that in draft 4.1. **EMC**

During the C63.4 seminar, students were divided into teams to solve "workshop problems" involving the standard. The teams then presented their respective problems and solutions to the entire class under the watchful gaze of instructor Don Heirman (far left).



Don Heirman, lead instructor, welcomes students to the ANSI-ASC C63.4 seminar held over two days prior to the 2000 IEEE International Symposium on EMC in Washington, DC.

Photo by Richard Georgerian



Photo by Richard Georgerian

New Members of the IEEE EMC Society Board of Directors Announced!

As you know, a ballot for the election of the six members to the IEEE Electromagnetic Compatibility Society Board of Directors was issued on August 14, 2000. The ballots returned have been counted and the following candidates have been elected for a three-year term beginning January 1, 2001:

Henry Benitez
Richard (Dick) Ford
James P. Muccioli

Bruce Crain
Mark I. Montrose
Henry W. Ott

Additionally, in accordance with recent changes to Society Bylaws, a member from Region 10 has been elected to the Board of Directors to satisfy the requirement for adequate international representation on the Board.

Candidate Takeo Yoshino was elected for a three-year term beginning January 1, 2001.

To fill the vacancy created by the passing of Board member Motohisa Kanda, Carlos Sartori of Escola Politecnica de Universidade de Sao Paulo Brasil, was selected as a new Board member. Mr. Sartori's name was included as a candidate on last year's ballot for the EMC Society Board of Directors.

Brief biographies of these candidates will be featured in the next issue of the EMC Society Newsletter.

Standards Advisory and Coordination Committee (SACCOM)

EMC-S SACCom Activities Update

By Elya B. Joffe – SACCom Chair

An Introduction to SACCom

The world of EMC Standardization is flooded with a multitude of organizations involved in the development of EMC Standards. Some of those organizations are “specialized” in their application and thus develop EMC standards in a narrow field, e.g., ITI TC5 (Information Technology Equipment) and SAE AE-4 (Aerospace Equipment), to mention a few.

Other organizations, however, develop general, wide spectrum EMC Standards which could be applied to a broad range of equipment and systems, the most commonly known are the IEC TC-77 (International Electrotechnical Commission) and CENELEC SC-210A (European Organization for Electrotechnical Standardization).

But regardless of the scope of the various organizations, it is evident that with this multitude of EMC Standardization activities, the duplication of efforts and the contradiction between EMC Standards are almost inevitable.

That is where the EMCS Standards Advisory and Coordination Committee (SACCom) comes into the picture.

The scope of SACCom is to monitor the activities of other standards developing organizations with a view toward making recommendations to the EMCS Board of Directors on any required coordination of those activities within the Society. Thus, the Committee provides a technical liaison between the IEEE EMC Society Standards Committee and other entities involved with EMC standards activities.

SACCom Representatives provide technical liaison between the various non-IEEE standards organizations by serving as an active member of the subject committee. In particular, the representative position is meant to provide a



Attendees at this year's annual RAC/SACCom luncheon included (front row left to right) Brian Farmer of SENTEL, Fred Heather of the US Navy at Pax River, Bill Ritenour of EMC Compliance LLC, Dave Case of Cisco Systems who is the RAC Chairman, Mike Oliver of Instrument Specialties, Eric Borgstrom of TUV Product Service, Bob Brook of Brook Electromagnetics, and Gbery Pettit of Intel. Standing (left to right) are Henry Benitez of Intel, Ed Bronaugh of EdB EMC Consultants, Bob Hofmann of Lucent Technologies, Mark Montrose of Montrose Compliance Services, Jose Perini, Noel Sargent of NASA, and SACCom chair, Elya Joffe of KTM Project Engineering.

conduit for information of mutual interest between the particular entity and the EMCS Standards Committee.

Reports are provided regularly, mostly before SACCom meetings, and are compiled into a “Compiled Report”.

The intention of those reports is to provide an overall picture of the standardization activities worldwide thereby enabling one to identify any parallel activities which may benefit from each other.

Distribution of the Compiled Reports include:

- All SACCom representatives, all EMCS TC Chairs and TAC Chairman, SDCOM and SETCOM Chairs and others (upon request).
- In addition, the Compiled Reports are uploaded on the Committee web site.

During the Committee meetings, representatives who are present provide an updated report and often discussion follows as overlapping or common activities are presented.

Representatives

Current SACCom membership represents over 20 EMC and EMC-related standardization organizations, namely:

Department of Defense, ANSI C63, CISPR A, B, C, D, E and G, H, RTCA SC 135, 177, SAE AE-4, ITIC/ITI TC5, ECMA/TC-20, IEC TC-66/SC66A, ISO TC22/SC3 WG3, IEC TC-77, CIGRE, ETSI TC-EMC/Radio Matters (ERM), Electrostatic Discharge Association, IEC TC46, EIA R1/R2, G46 and ASTM D09.12.

In recognition that there are many, many more EMC-related standardization organizations, an effort has been made to expand the “coverage” of SACCom to additional entities.

In fact, at the August committee meeting which took place during the 2000 IEEE International Symposium on EMC, in Washington DC, representatives from two new organizations joined the Committee, namely: TC20, SC14, WG1 (Space Systems) and RRSNA (Rehabilitation Engineering & Assistive Technology Society of North America).

There are currently still openings for representatives to the following three organizations:

Continued on page 46



Photo by Dick Ford

EMC Society President Joe Butler presents the "Best Student Paper" prize to author Emily Godfrey. Last year, she was a candidate for this prize, this year she won it!



Photo by Dick Ford

EMC Society President Joe Butler (L) and University Grant Committee Chairman John Howard (R) present this year's University Grant Award to Antonio Orlandi of the University of L'Aquila, Italy.



Photo by Dick Ford

The North American X-15, a rocket powered research aircraft, bridged the gap between manned flight in the atmosphere and space flight. Attendees of the Tuesday evening reception at the Smithsonian's National Air and Space Museum got to see this NASA aircraft and others up close and personal!

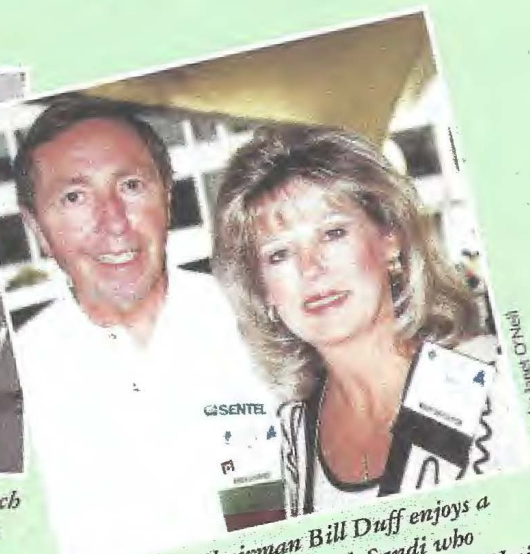


photo by Janet O'Neil

Symposium Chairman Bill Duff enjoys a quiet moment with his wife Sandi who supported the committee as Hospitality Chair.



Photo by Dick Ford

Elya Joffe wore many hats during the symposium and one of them was in his role as the proud father of his daughter, Tami-Lee.



Photos by Dick Ford

Bill Kimmel of Kimmel Gerke Associates participated in the special "War Stories" session held during the symposium. His tale was quite animated as you can see!



Photo by Janet O'Neil

Mack Davis of ETronic/Ferrico attentively manned his booth during the symposium.

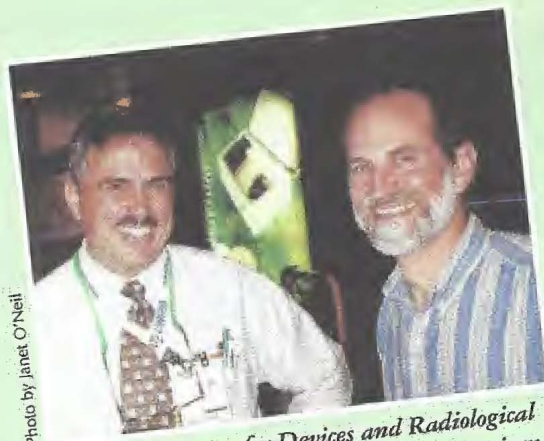


Photo by Janet O'Neil

The FDA Center for Devices and Radiological Health was well represented at the symposium by Jon Casamento and Jeff Silberberg (L-R).



At the dB Society party held during the symposium week, several members got into the spirit of Washington, DC. Dressed to the hilt are (L-R) Dave and Patti Traver (he's with Sony Electronics), Dave and Barbara Staggs (he's with Dell Computers), Dan Hoolihan of Hoolihan EMC Consulting and Janet O'Neil of ETS-Lindgren.



Photo by Janet O'Neil

NIST enjoyed the opportunity to participate with a table-top display at the symposium. The table-top displays provided a unique opportunity for more vendors to participate. Manning the NIST display were the jovial Bob Jobnk and John Ladbury.



Photo by Janet O'Neil

Dan Hoolihan, Immediate Past President of the EMC Society, conferred at the Awards Luncheon with Antonio Orlandi from the University of LAquila, Italy and Salvatore Celozzi from the University of Rome, Italy.



Photo by Janet O'Neil

Joe and Virginia Fischer of Fischer Custom Communications celebrated their 15th consecutive year of exhibiting at the annual IEEE EMC Society Symposia.



Photo by Janet O'Neil

Sunol Sciences's Dale Guthrie welcomed Jesse Marquez and Tom Ellam of Advanced Technical Sales (L-R) to his booth during the symposium.

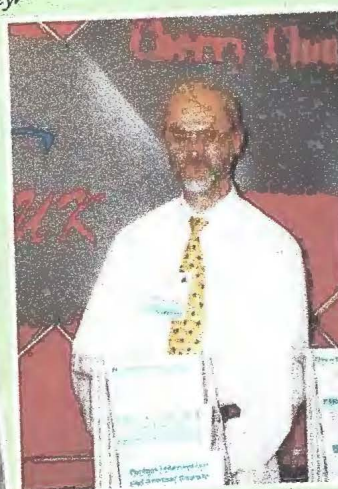


Photo by Janet O'Neil

Keith Armstrong of Cherry Clough Consultants traveled from the United Kingdom to exhibit at the symposium.



Photo by Janet O'Neil

Several parents brought along the kids to see the sites in Washington, DC during the symposium week. Jeannie Olson of Kalmus treated her son Sam to an educational week of touring the nation's monuments. Here they enjoy dinner out together.



The symposium offered a great opportunity for EMC engineers to "talk shop". Pondering the latest in EMC technology are Cbris Holloway of NIST, Lowell Kolb of Hewlett-Packard, and John Kraemer of Rockwell Collins (L-R).



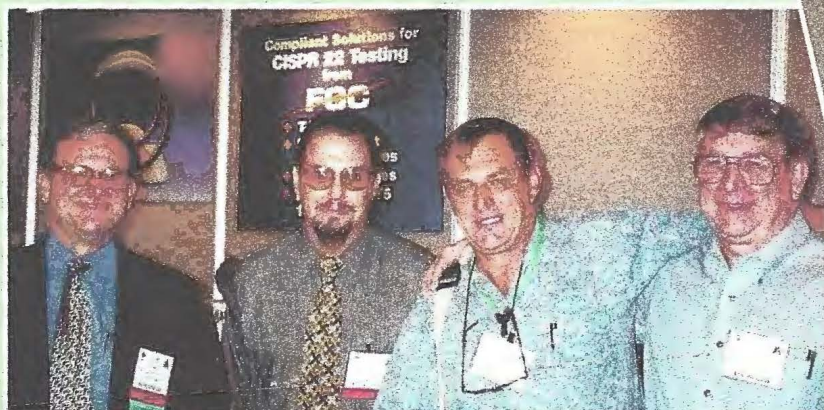
The weather proved exceptional the week of the symposium. Enjoying a pleasant outdoor evening are Paul Gregory of ETS-Lindgren and Hugh Hagel of Sun Microsystems.



Venturing from the Washington Hilton and Towers provided a great opportunity to visit wonderful restaurants in this cosmopolitan city. Kevin Slattery of Intel coaxed Terry North of DaimlerChrysler and Jim Muccioli of X2Y Attenuators (L-R) out for dinner one night.



NoiseKen sent the best and brightest to staff their booth, namely, Tak Matsuba, Kazutaka Iwamoto and Norihiro Tsumura (L-R).



The symposium week is great for catching up with good friends. Enjoying the hospitality of the Fischer Custom Communications (FCC) booth are (L-R) Allen Fischer and Bruce Harlacher of FCC with Ken Hall and Bob Dockey of Hewlett-Packard.



Manufacturers and academia convened in Washington, DC. Sharing common interests in GTEM technology were Bill Curran, Sr. of ETS-Lindgren and Zorica Pantic-Tanner of San Francisco State University.

Photo by Janet O'Neil



EMC symposia "regulars" Herb and Jill Mertel of Mertel Associates celebrated the "red, white and blue" during the symposium week.



Photo by Janet O'Neil

Bruce Fiorani of GE Milwaukee joined his wife, Harriet, and fellow GE engineers Brent Anderson, Jerry Itzenbeiser and Keith Griffiths (L-R) at a social function held during the symposium week.

Photo by Janet O'Neil



Northwest EMC traveled across the country from their home base in Oregon to exhibit at the symposium. Helping out with booth duty are Dave Tolman and Jennifer Hewitt (seated L-R) with Brian Harlan, James Tilley, Dean Ghizzzone, and Jerry Page (standing L-R).



Photo by Janet O'Neil

IBM engineers John Maas (L) and Don Gilliland (R) stopped in the Amplifier Research booth to peruse the latest AR product literature. Harald Kunkel of EM Test (C) was happy to show them the material. Amplifier Research sells the EM Test products in the United States.



Symposium Chairman Bill Duff meets the China Electrotechnical Society (CES) Delegation at EMC 2000. Shown in the first row (L-R) are Lin-chang Zhang, Bill Duff, and Chang-yu Wu, second row (L-R) Zhao Gang, Xu Li-ping, and Li Xian-xin, third row (L-R) Du Li, Xue Meng-lin, and Ouyang Su-li, fourth row (L-R) Liu Xiao-chun, Yuan Gang-yun, Ma Gen-bai, and Kwok M. Soohoo, and fifth row (L-R) Zuo Yan-min, Li Kang, Wang Hai-ying, and Liu Xue-zhi.



Photo by Janet O'Neil

Tony Ciriaco of International Certification Services took a break from the action during exhibit hours. A record number of people visited the booths this year.



2000

IEEE International Symposium on
Electromagnetic Compatibility

EMC Society

Awards Luncheon • August 24, 2000
Washington D.C.

2000 EMC Society Awards

CERTIFICATE OF ACKNOWLEDGEMENT

For contributions to EMC '99 Tokyo Symposium.
Shuichi Nitta

For contributions to the development of the Oregon and Southwest Washington EMC Chapter web page.
Ali Elmi

For contributions as officer for the Oregon and Southwest Washington EMC Chapter and Oregon Section.
Edward Blankenship

For Chairing chapter tabletop exhibitions and colloquium.
Kimball Williams • Frank Krozel • Lyle Luttrell

For contributions to the development of the Rocky Mountain Chapter Website.
Charles Grasso

CERTIFICATE OF RECOGNITION

For contributions to EMCFEST 2000 Colloquium for the Southeastern Michigan EMC Chapter.
**Scott Lytle • Mark Stefka • Graeme Rogerson
Jim Muccioli • Janet O'Neil**

For contributions to TC-9 Technical Committee on Computational Electromagnetics.
**Bruce Archambeault • Al Ruehli
Salvatore Celozzi • Antonio Orlandi**

For contributions as Associate Editor of the EMC Society Newsletter.
Bob Rothenberg

CERTIFICATE OF APPRECIATION

For contributions toward the organization and operation of the Phoenix EMC Chapter.
Harry Gaul

For revitalizing the Standards Advisory and Coordination Committee.
Elya Joffe

For contributions to successful social events for the Oregon and Southwest Washington EMC Chapter.
Charles Tohlen

For chapter support with "Build your own 1 GHz probe" workshops.
Doug Smith

For services as Exhibits Chair.
Glen Watkins

For contributions to the IEEE EMC Symposium Experiments and Demonstrations since 1993.
**Mark Klein, Tektronix, Inc.
Cliff Morgan, Tektronix, Inc.
Peggy Rogers, Tektronix, Inc.
Marivell Thomas, HP/Agilent Technologies, Inc.
Jim Carney, HP/Agilent Technologies, Inc.
Jan Brown, HP/Agilent Technologies, Inc.
Irene Geyer, Fluke Corporation**

For contributions as Chairman of the Washington D.C. 2000 EMC Symposium Steering Committee.
Bill Duff • Bill Gjertson

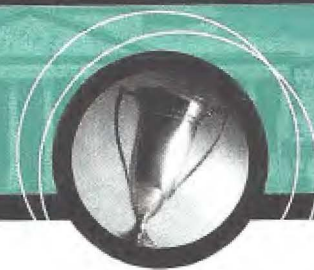
For contributions as Chairman of the Seattle 1999 EMC Symposium Steering Committee.
**Marianne Gjertson • Diane Heidlebaugh
Dave Walen • John Windell • Ghery Pettit
John Kuras • Len Carlson • Rob Steinle
Grant Erickson • Jeannie Olson • Bill Hall**

For contributions as member of the EMCS Board of Directors through 1999.
Dick Ford • Bob Hofmann • William McGinnis

For outstanding support of the Israel EMC Chapter and the development of its technical activities and for promoting the cooperation between the Israel EMC Chapter and non-EMC organizations.
Moshe Netzer

For outstanding support of the Israel Chapter, with particular emphasis on increasing the support and cooperation between high-tech industries and the Israel IEEE EMC Chapter.
Moshe Henig

For his leadership and pioneering in the development of EMC Standardization in Israel, as Chairman of the Israel Technical Committee for EMC, which led to the national recognition in the need for Israeli EMC Standards.
Albert Kalo



IEEE THIRD MILLENNIUM MEDALS

E. Bronough • J. Butler • B.L. Carlson • W. Cory
W. Duff • D. Heirman • H.R. Hofmann • D. Hoolihan
T. Hubing • M. Kanda • W. Kesselman • H. Mertel
J. O'Neil • H. Ott • C. Paul • R. Showers
K. Williams

CERTIFICATE OF TECHNICAL ACHIEVEMENT

For outstanding contributions to the EMC Society, especially in the field of natural noise.

Takeo Yoshino

For over two decades of significant professional achievements and leadership, in Israel and internationally, in the study and development of models for Electromagnetic Interactions with Ordnance (HERO) and Electrostatic Discharge hazards.

Moshe Netzer

BEST TRANSACTIONS PAPER AWARD

"Numerical and Experimental Study of the Shielding Effectiveness of a Metallic Enclosure", IEEE EMC Transactions, Vol.41, No.3, August 1999.

AUTHORS: F. Olyslager • E. Laermans
D. De Zutter • S. Criel • R. De Smedt
N. Lietaert • A. De Clercq

BEST SYMPOSIUM PAPER AWARD

"Shielding Effectiveness Estimation of Enclosures with Apertures."

AUTHORS:

I. Belokour, University of Western Ontario
J. LoVerti, University of Manitoba
S. Kashyap, Defense Research Establishment,
Ontario, Canada.

BEST STUDENT PAPER AWARD

"Measuring the Shielding Effectiveness of Coaxial Cables Using a Reverberation Chamber"

AUTHORS: Emily A. Godfrey
Justin T. Kousky, Naval Surface Warfare Center,
Dahlgren, Virginia

BEST STUDENT DESIGN AWARD

Bryan Stern and Ben Herberg, North Dakota
State University

UNIVERSITY GRANT AWARD

University of L'Aquila, Italy

LAURENCE G. CUMMING AWARD

For outstanding service as an EMC Society member in contributing to the administration and overall success of the Society.

Andrew Drozd

RICHARD R. STODDARD AWARD

For outstanding leadership of the military EMC communities over a 34 year period, specifically recognizing his work with EMC military standards 461/462/463/464.

Steve Caine

HONORARY LIFE MEMBER AWARD

For outstanding contributions to the EMC Society.

Tasuku Takagi

FELLOW AWARD

For Advancing Shipboard EMC Designs Through Developing Low Frequency EMI Models and Intelligent EMC Analysis and Design Systems.

Dave Dixon

For Contributions to Calculations of Coupling to Shielded Multiconductor Transmission Lines and of Developments of Nonlinear Protection Circuits.

Jan Luikenter-Haseborg

EMC SOCIETY PRESIDENT'S MEMORIAL AWARD (In memory of Motohisa Kanda)

Ke Wang, University of North Dakota

MOST IMPROVED CHAPTER AWARD

Israel Chapter

CHAPTER OF THE YEAR AWARD

Seattle Chapter

Washington D.C.

2000 AWARDS LISTING



Membership Development: What's in it for All of Us?

*By Andy Drozd, Chair
EMC Society Membership
Development Committee*

Earlier this year I attended the fifth annual IEEE Membership Development (MD) Retreat held in Newark, NJ. To call it a "retreat" is definitely a misnomer. It is actually an intensive, three-day workshop sponsored by the IEEE Regional Activities Board (RAB) MD Committee that concentrates on developing strategies for increasing our membership and launching new membership incentive programs. Emphasis was definitely on the work part. This entailed lively discussions, presentations, group meetings, and soaking in a great deal of very useful information in the process. Despite feeling a little saturated by the amount of good information provided, the retreat was a highly rewarding experience and well worth my time and effort. Allow me to stick with the word "retreat" though instead of "workshop" because it sounds less frenetic or more relaxed depending on how you view it.

During the three days of the retreat I met with members from our sister societies, sections and chapters around the world to discuss various facets of membership development focusing on the "4R's": recruitment, retention, recovery and renewal. Approximately 18 societies were represented. We were briefed by IEEE staff on current membership statistics, membership renewal and retention strategies, and other 'best practices' for increasing our membership rolls. The retreat was moderated by 2000 MD Chair Michael Garretson who did an excellent job keeping the presentations and group discussions on track.

For those who are unfamiliar with the retreat, day one begins with an orientation session and tour of the IEEE Operations Center in Piscataway. This is followed by a networking social and a walk through of a number of IEEE exhibits displaying the latest information on member benefits, technical and educational programs, publications, and other outstanding programs

and resources available to members. If you were confused about the benefits of being an IEEE member, then this retreat is for you. The first day puts the benefits of IEEE and society membership into proper perspective.

Day two is spent on a series of tutorials by IEEE staff members that address: worldwide membership demographics; use of the SAMIEEE database tool to effectively track membership information; web-based resources for members; the benefits of elevating to senior member grade; and more on the "4R" best practices. Day three is largely devoted to a series of breakout sessions focusing on identifying successful technical activities at the chapter level, reassessing requirements for student and higher grade member and non-member retention, industry support programs, Fellow mentoring programs, and a variety of other MD initiatives. The retreat ends with a wrap-up presentation in which the top ten or so recommendations and best practices (e.g., "member get a member") borne out by the breakout sessions are prioritized. These became the marching orders for the remainder of this year's membership drive for the societies, sections, chapters, and regions.

I wanted to share this information with you because I feel we are all stakeholders in the Institute and the Society. As someone once put it, "Membership development is every member's responsibility." It is important that we understand the advantages of being a member and be aware of things that could be improved to enhance membership. Constructive suggestions can be turned into new ideas and novel programs for the benefit of members at large. Hopefully, cognizance of these MD points can make our endeavors to recruit and retain members highly effective.

Highlighting a Few Membership Facts

The following are some interesting facts and statistics that were brought out during the retreat:

- The 1999 IEEE worldwide membership totaled 352,259. This represents a 5.2 percent increase in members over 1998, exceeding the minimum goal of 350,000 members set during the 1999 retreat.
 - The 2000 membership goal is 365,000 members, representing a 4.5 percent increase over 1999.
 - A slight decline in US membership (Regions 1-6) has been offset by a net increase in non-US membership (Regions 7-10). Non-US membership will continue to steadily increase over the next several years.
 - The IEEE is presently the most "global" (nearly 40 percent are non-US members), has the highest number of members, and the largest number of women members than ever in its history.
 - Demographically, the focus is on retaining higher grade, student, and GOLD (Graduates of the Last Decade) members. The best renewal and retention rates can be expected for these groups.
 - Higher-grade members account for the largest number of renewals.
 - The World Wide Web is becoming increasingly important to members and potential members, particularly to those overseas.
- Armed with these facts and figures, the MD Committee proposed a number of initiatives to be pursued for calendar year 2000. These included:
- Instituting a one-time permanent membership plan targeted for younger members.
 - Providing "electronic membership" programs and tools such as IEEE Xplore to electronically deliver products and services to members in a manner consistent with individual needs.
 - Adding renewal options that facilitate retention i.e., developing and instituting other member benefits programs and incentives including special or extended benefits programs to non-US members.
 - Investigating new membership pricing structures for overseas members.
 - Leveraging "corporate recognition programs" and awards to enable more industry involvement, cooperation and support of the IEEE's goals (an example of a best practice!).
 - Possibly broaden the membership base

Continued on page 32



Personality Profile

Bill Duff, Associate Editor

Introducing... Benoît Nadeau from Montréal, Canada

Benoît Nadeau (pronounced Benwa Nado) was born in 1959 in Charny, Canada on the south shore of Quebec City. He was fourth in a family of seven. Half of the family pursued technical careers and the other half became artists. Benoît was the only one who combined both interests. His last summer job as a student was to play electric guitar in a rock band.

Benoît received a bachelor degree in 1984 at Université Laval in Quebec City and started to work in EMC a few months later for Matrox Electronic Systems Ltd.

The FCC rules were new and the application to computer add-on cards was not clear especially for cards designed for MULTIBUS or VME busses. So his initial work in EMC was to do pre-compliance tests and to answer customer's questions. During his first years in engineering he also worked on the mechanical design of card cages. At that time he learned the ABCs of shielding, bonding and grounding.

In 1989, Matrox won an important contract with the US army to develop a video disc based learning system called EIDS (Electronic Information Delivery System). Benoît participated in this project by performing the mechanical design of the chassis and preparing the test plan which included EMC as well as sound, temperature, over voltage and drop tests.

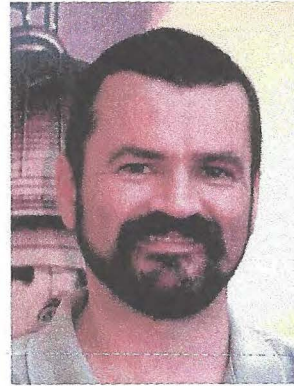
Also, in 1989 the FCC modified Part 15 making a clear statement about add-on cards. As a result, almost all of Matrox Products were not FCC compliant. Matrox started a tremendous effort to correct this situation. First by using outside laboratories, then by the design and construction of the first Open Area Test Site to be listed by the FCC in Quebec province.

Early in 1990, Benoît left Matrox to set-up the first commercially available EMC test laboratory in Quebec at the Centre de Recherche Industrielle du Québec (CRIQ). His years at CRIQ were very productive. Along with Mr. Christian Dubé, he started the Montreal Chapter of the IEEE EMC Society. He also developed and taught a number of courses and gave presentations on EMC.

Benoît obtained a Master degree in EMC at École Polytechnique of Montréal. Two University professors, Dr. Stanley Kubina, from Concordia University and Dr. Jean-Jacques Laurin from École Polytechnique, played a major role in this achievement.

Benoît also started to be active in National EMC Committees. He is a member of CSA C311, CISPR A, CISPR G (recently CISPR H) and TC 77B. In 1993, with Cristian Dubé and Jean-Jacques Laurin, Benoît requested and obtained the honor to organize the 2001 IEEE EMC Symposium.

In 1996, he left the CRIQ to return to Matrox which had changed a lot during the past six and a half years. Matrox had grown considerably and become a multinational company having numerous OEM accounts with Dell, Compaq, IBM and HP. The new challenge of having to comply with many different regulations, especially in Asia, was stimulating and demanded a lot of research and special efforts. In addition, he had to prepare all the Quality System needed to get the ISO Guide 25 certification for the EMC laboratory at Matrox. He participated in the



Benoît Nadeau

listing of the first 3 meter semi-anechoic room and the only 10 meter OATS in Quebec.

In 1997, he participated, with his friends Dubé and Laurin, in the organization of the 1997 IEEE Symposium on Antennas and Propagation chaired by Dr. Kubina. This was their big rehearsal for the upcoming 2001 Symposium.

Today, as the Chair for the 2001 IEEE International Symposium on EMC, he is working actively to prepare a memorable event for everyone who will visit Montréal next August.

Benoît said "We would like to increase the number of participants that come from outside North-America. Our theme: "International Rendez-vous" uses a French term that underlines the fact that this is the first major IEEE EMC Symposium to be held outside the USA. Since I knew that we had to prepare this event years ago, I went to every Symposia wrap-up meeting from Austin in 1995 to Washington last August and made notes of every good and bad aspect relating to the organization and logistics that our predecessors went through." With the ongoing work of the organizing committee and dedicated effort of their PCO (JPD Multi Management) Montréal is in good shape for the next EMC Society big event.

On a personal note, Benoît Nadeau has a family of three children. He is active in the community as a member of the twin cities association in his hometown. He loves traveling, reading, soccer and ice hockey. **EMC**

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

Board of Directors Activities

Washington, DC
Sunday, August 20, 2000

Call to Order

President Butler called the August 20, 2000 meeting of the EMC Society Board of Directors to order at 9:00 am. A round of introductions was made. Board members present included H. Benitez, D. Bush, J. Butler, L. Carlson, T. Chesworth, L. Cohen, A. Drozd, F. Heather, D. Heirman, D. Hoolihan, T. Hubing, E. Joffe, W. Kesselman, D. Millard, M. Montrose, J. O'Neil, H. Ott, J. Perini, G. Pettit, C. Sartori, D. Smith, D. Sweeney, K. Williams and T. Yoshino. Board members absent included A. Podgorski and Ferdy Mayer. Guests present included M. D'Amore, R. Brook, E. Bronaugh, R. Carstensen, D. Clark, W. Duff, D. Ford, H. Garbe, W. Gjertson, M. Heidermann, H. R. Hofmann, J. Muccioli, B. Nadeau and B. Wallen.

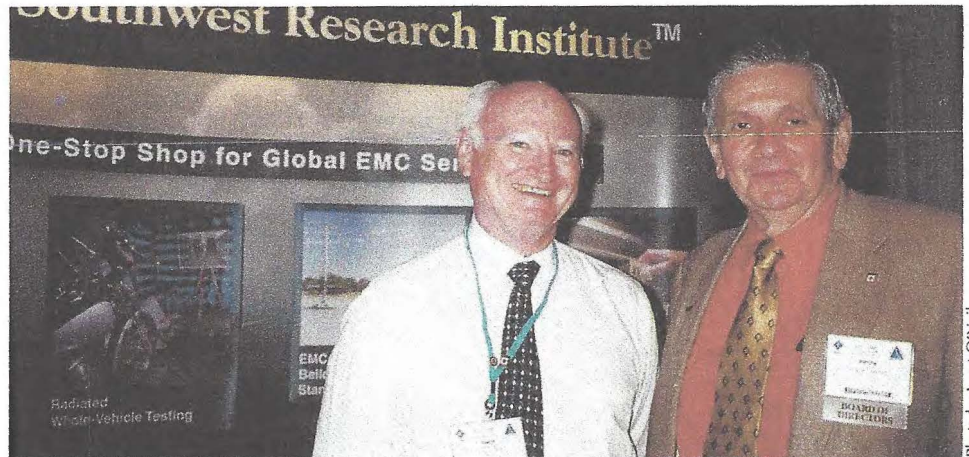
President Butler asked for a moment of silence for Board member Moto Kanda who passed away in June. President Butler noted that In Focus Corporation had been approached for a donation of an LCD projector for Board activities. He was pleased to advise that the donation request was approved and the LCD projector was available for use at this meeting. The agenda was then approved as presented.

Treasurer's Report

Treasurer Warren Kesselman advised that the total EMCS surplus as of June 30 was \$405,000. Cash reserves as of June 30 were \$684,000 and the investment value was \$803,880. Mr. Kesselman discussed the IEEE budget process and presented a financial comparison table of the budget. This showed "actuals" for the various income and expense line items of 1999, the 2000 budget for these line items and June 2000 YTD totals for these line items. Mr. Kesselman then presented a travel assistance policy for Board members who require financial assistance to attend meetings.

Secretary's Report

Secretary Janet O'Neil presented the minutes from the previous Board meet-



Gene Cory (L), past president of the EMC Society, welcomes EMCS Board member Henry Ott to his booth during the symposium.

ing on June 9, 2000 for review. Changes were required. The Board approved the minutes as amended.

2000 Washington, DC Symposium Chairman's Report

Chairman Bill Duff reported on the activities of the symposium. He advised that there were no problems foreseen and the committee has been working very hard to ensure things run smoothly. The budgeted surplus is expected to be \$180K. 2,200 people are registered to date (of this some 800 are full registrations to the exhibits and technical program). 500 people are expected to register on site. 260 exhibit booths were sold.

Member Services Report

Todd Hubing, Vice-President for Membership Services, presented his report. Henry Benitez reported on Awards. The awards nomination process needs to be revised. Those interested in assisting with the revision process should contact Mr. Benitez. There are several awards which will be given at the awards luncheon this year, including the IEEE Millenium Medals and the President's Memorial Award. Regarding Chapter Activities, Ghery Pettit advised that he will chair the chapter chairmen's luncheon on Tuesday. Some 45 people are expected to attend. He used the form originated by Henry Ott to solicit nominations from the chapter chairmen for the Chapter of the Year award. This will be presented at the Awards Luncheon. Elya Joffe reported as the

Region 8 Membership chair. He attended the Wroclaw EMC Symposium along with Board members Andy Drozd, Andrew Podgorski, and Takeo Yoshino. Mr. Joffe thanked Mr. Drozd for his assistance in staffing the IEEE EMC Society membership booth. No new members were signed up, but interest was indicated. Mr. Joffe feels that the price of IEEE membership is a deterrent to recruiting new members. Many engineers in Poland do not have an international credit card, for example. This fall he will take the booth to the EMC Millenium Workshop in Greece and to Turino, Italy for their respective EMC conferences. Next year, he plans to take the booth to the Zurich EMC symposium. Mr. Joffe will attend the IEEE Region 8 Section meeting in Paris in October to represent the EMC Society. Jose Perini reported on EMC activities in Region 9. He has sent e-mails to various professors in Region 9 to offer his services in promoting the EMC Society. He has also contacted industry representatives. Carlos Sartori presented a report on EMC activity in Brazil. He outlined the main EMC groups in Brazil, including companies and commercial laboratories, among others. He recommended that the EMC Society build a relationship with the automotive and telecommunications groups as these are the two top industries which are active in EMC in Brazil. He outlined the top EMC groups in South America, including Uruguay, Argentina, and Venezuela. There are 54 total members of the EMC Society in Region 9. Takeo Yoshino reported on EMC activity in Region 10. Again, with Region 10, Mr. Yoshino noted that the price of IEEE

Photo by Janet O'Neil

membership is very high relative to the average annual income for an engineer in Region 10. Mr. Butler advised that they will have an IEEE representative present at the November Board meeting who will discuss what the IEEE is doing to address this problem. Regarding the symposium survey, Dick Ford distributed a copy of the IEEE EMC Society 2000 survey which will be distributed on Thursday during the symposium week. The survey is virtually identical to those that have been distributed at the last eight symposia. The results will be provided at the November Board meeting. Membership Committee chair Andy Drozd reported that he has ordered all the IEEE materials necessary for the EMCS booth in Washington, DC. Mr. Drozd advised that the booth was in need of repair. He addressed this. Membership exhibit costs came in under budget at some \$1,500. As of June 30, we have 5,067 active members of the EMC Society, with an additional 892 members in arrears. Todd Hubing reported for Lee Hill, chair of the Distinguished Lecturer (DL) program. DL activity is at an all-time high and the budget for this year in August is close to being fully allocated. Dan Hoolihan presented his report as chair of the Nominations and Bylaws Committee. The ballots for candidates for the EMC Society Board of Directors were printed by July 24 and received in the mail by members some two weeks later. There were 11 names on the ballot; including two candidates from Region 10. Election results will be available in early October. Tom Chesworth advised that Elya Joffe and Michel Mardiguian will present "War Stories" during the symposium special workshop. Some four to five war stories total were submitted. Mr. Chesworth would like to see this set up as a special session in the future. Todd Hubing reported for Bill McGinnis, PACE chair who advised he attempted to contact the US EMC Chapter chairs to promote the IEEE's PACE program, but the results were not encouraging. Mr. McGinnis will attend the PACE conference in September and work with the Southeastern Michigan EMC Chapter who would like to implement the PACE program.

Technical Services

Kimball Williams, Vice-President for Technical Services, presented his report. He noted the vision of Technical Services is



Photo by Dick Ford

Several past presidents of the IEEE EMC Society convened following the Awards Luncheon in Washington, DC. Standing (L-R) are Warren Kesselman (1994-95), Dan Hoolihan (1998-99), Bob Hofmann (1992-93), Don Heirman (1980-81), Gene Cory (1974-75), and Bill Duff (1982-83). Seated (L-R) are Ralph Showers (1960-61), Don Clark (1988-89), Len Carlson (1986-87), Ed Bronaugh (1990-91) and Joe Butler (2000-01).

to promote the growth of the worldwide EMC technical community for the benefit of all man kind. Mr. Williams reported for Maqsood Mohd, Chairman of the Education and Student Activities Committee. The committee received a good response to the Student Paper Contest to be held during the Washington DC symposium. There will be over 20 experiments this year at the symposium over Tuesday-Thursday of the symposium week. Regarding the eight-minute Clayton Paul experiment video, Dick Ford advised that the DC Symposium committee contacted several local universities to ask professors to show this video to their students. The committee also promoted student attendance at the EMC Symposium. As a result, a few universities agreed to show the Clayton Paul video and several students registered for the symposium. ITCMS advised that student registrations are at an all time high this year. The Student Design Contest received four entries. Mr. Mohd traveled to North Dakota State University to perform demonstrations of the entries in order to determine the winner. The University Grant committee received three requests from various universities. The \$10,000 Grant will be awarded at the Washington DC symposium to L'Aquila University in Italy. The tutorials will again be held on Monday of the symposium week. The NARTE workshop and exam will again be held at this year's symposium in Washington DC. Mr. Mohd's report

concluded with a summary of the committee's current tasks. Mr. Williams reported in the absence of TAC Chairman Andrew Podgorski. There is a revised charter for TC-1. The activities of TC-8 will be discussed at the November Board meeting. Mr. Williams advised that Dave Case, chair of the Representative Advisory Committee (RAC), organized a special RAC session, entitled "Testing and RF Hazards" for the Washington DC symposium. Noteworthy RAC activities include the addition of representatives from four new committees, including one European group, the appointment of Steve Berger as Vice-Chair, and the update of the RAC website. Bob Brook reported on the activities of the Society for the Social Implications of Technology (SSIT). SSIT has received various awards for its magazine "Technology and Society." Russ Carstensen, Executive Director of NARTE, discussed the MOU between his organization and the EMCS. Basically, NARTE wishes to formalize its relationship with the IEEE EMCS such that the EMCS is the official "body of knowledge" for technical matters relating to EMC. Mr. Carstensen advised that he has revised the document to take into account the proposed revisions requested by the Board at the June Board meeting. Mr. Williams concluded his report by noting that the effort with the NANO Technology Council is evolving slowly, but progress will continue to be monitored.



(L-R) Ernie Freeman and Bill Duff, Vice-Chairman and Chairman of the symposium steering committee respectively, delivered the registration packets to the Board during a break in their meeting. Board member Don Bush of dBi Corporation thanked Bill and Ernie for the personal service.

Standards Services

Don Heirman, Vice-President of Standards, presented his report. It was noted that the webpage for EMC Standards is now operational (<http://grouper.ieee.org>). Standards activity covers three major areas: The Standards Education and Training Committee (SETCom) chaired by Hugh Denny, the Standards Advisory Committee (SACCom) chaired by Mr. Joffe and the Standards Development Committee (SDCom) chaired by Steve Berger.

Regarding the SDCom, all standards are currently active. However, Standard 140 must be reaffirmed by October of this year. A PAR for the update of 187 has been submitted to IEEE REVCOM. The revision will expand the standard to address digital television systems as well as analog systems.

Regarding SETCom, a workshop has been scheduled for Monday afternoon, August 21 during the DC EMC Symposium. Speakers include Don

Heirman, Sue Vogel of the IEEE, and Hugh Denny. Articles on standards will be a regular feature of the EMCS Newsletter.

Regarding SACCom, there are several opportunities for further representation. Please contact Elya Joffe at eb.joffe@ieee.org for more information.

Communications Services

Len Carlson, Vice-President for Communication Services, presented his report. Professor Marcello D'Amore, Transactions Editor-in-Chief, pre-

sented his report. He discussed issues involving the Associate Editors and the length of time currently taken to review the papers. His goals with the Transactions on EMC include expediting the review process, preserving and increasing the technical scientific level of the journal, and increasing the number of submitted abstracts per year. He is also looking at possibly forming a new Editorial Board and/or Advisory Board; in any case, the current structure of Associate Editors will be revised. The proposed Editorial and/or Advisory Board were discussed. A balance was requested of Board members who represented the various IEEE regions as well as members who represent a balance between academia and industry. The Board approved overrunning the Publications budget to cover the Transactions expenses by \$5,600. Newsletter Editor Janet O'Neil advised that Bob Rothenberg has retired as Associate Editor for Practical Papers. He will be replaced by Bob Olsen of

Washington State University. Feedback from readers on the all-color newsletter has been very favorable. Mark Montrose presented his report as IEEE Press Liaison. He wrote an article for the Summer Newsletter about the IEEE Press which encouraged members to become authors. Henry Benitez reported for Public Relations that they are planning a chapter information packet that would help to promote chapter development and the formation of new chapters. It was clarified that the material that was once included in the chapter chairman handbook is now included on the Society's website. Thus, Mr. Benitez and his committee will develop a new product for chapters. EMCS Webmaster Andy Drozd reported on his recent activity with the EMCS website. Changes are underway to update the TC web pages. The Education and Standards Committee web pages have been updated. Mr. Drozd is working with the Atlanta EMC Chapter to assist them with their website. Some 20 chapters are listed on the site and will be linked to the Society's website. The hosting of the website has been transferred from the University of Missouri, Rolla to the IEEE. The IEEE hosting of the website is provided at no charge. He has worked with the IEEE to develop a website advertising policy and this is posted on the website. A counter on the website to determine the number of "hits" received daily has been established. Regarding the individual TC websites, Mr. Drozd is continuing his work to review and evaluate the sites to ensure that they present a consistent look and information.

Conference Services

Henry Ott, Vice President for Conference Services, presented his report. Dick Ford volunteered to work with Mr. Ott in updating the EMC Society Symposia Manual. For next year's symposium in Montreal, Canada, Benoît Nadeau, Symposium Chairman, advised the "Call for Papers" has been distributed. Their committee will have a table-top display during the DC symposium to promote Montreal. There will be considerable promotion for the symposium, including a slide show presentation on Montreal, prizes and give-aways. The exhibitor liaison from their show management company will be present at the exhibitor's breakfast to assist vendors with signing up for next year. The symposium website address is www.2001emcmntl.org. Mr. Ott



Already busy planning for the 2005 IEEE International Symposium on EMC in Chicago are (L-R) Henry Ott of Henry Ott Consultants, Derek Walton of LF Research Company, Tom Braxton and Bob Hofmann of Lucent Technologies, Barry Wallen of TUV Product Service and Bill Bumbliss of Siemens Building Technologies.

then called upon Barry Wallen, EMCS Symposia Committee Chair, to present his report. He reported on the following symposia: 1998 Denver: the symposium books were closed at the June 2000 Board meeting; 1999 Seattle: Books are closed, audit is underway, net surplus is \$283K; 2000 Washington DC: Bill Duff presented his report earlier in the day; 2001 Montreal: The revised budget was presented. Revenues are shown at US \$1,158,392, expenses are US \$855,000, with a net surplus of US \$198,035. This represents a 17% surplus. The Board approved this budget. Regarding 2002 Minneapolis: The preliminary budget was presented showing revenues of \$1,269,750, expenses of \$961,249, and a net surplus of \$308,502 representing 24%. The Board approved this budget. The Board approved the 2002 symposium steering committee loan request of \$10,000. For 2003 Boston: The preliminary budget was presented showing revenues of \$1,109,250, expenses of \$849,081, and a net surplus of \$260,170 representing 23%. The Board approved this budget. The Board approved the 2003 symposium steering committee loan request of \$10,000. Lastly, concerning 2003 Israel: Elya Joffe distributed the preliminary announcement for the symposium. A conservative budget has been set with expenses of \$240,000, income of \$280,000, thus a net of \$32,000 or a 15% surplus. The Board approved this budget. The call for papers is being prepared and will be circulated to the entire Region 8 membership in addition to being distributed during the Montreal symposium. Mr. Wallen advised that both the German and Eastern North Carolina (Research Triangle Park) chapters have indicated an interest in hosting the 2006 IEEE International Symposium on EMC. Janet O'Neil reported as chair of the Regional EMC conferences committee. These regional conferences will be discussed at the Chapter Chairmen's luncheon in Washington DC. A presentation will be made to share information on how to organize one of these conferences. Global EMC Symposia Coordinator Chairman Elya Joffe advised the status of MOUs which have been signed by the various global EMC conferences. The membership booth will be present at these conferences. He will attend the IEEE Region 8 and Division I and IV Chapter Chairs meeting in Paris, France on October 1,

2000. Mr. Joffe discussed the request of the St. Petersburg, Russia EMC conference committee for the IEEE EMC Society to be a technical co-sponsor of their EMC conference on June 19-22, 2001. Elena Gerstman of the IEEE presented the results of the 2000 IEEE scientific survey of the EMC Society. 1,100 members received the survey of which 48% responded. Overall, the survey documented that the Society is providing benefits to its members. It showed areas for growth and new services/products the Society can provide in the future.

Old Business

2007 will be the 50th anniversary of the IEEE EMC Society. President Butler asked that an ad hoc committee be formed to address how to recognize the anniversary. Dan Hoolihan agreed to chair this ad hoc committee. The committee will present recommendations in the future.

New Business

The proposed new EMC Society magazine was discussed. The Board approved moving forward with plans to publish an EMC Society magazine.

The meeting was recessed at 5:15 pm.

The meeting reconvened on Thursday evening, August 24 at 6:00 pm.

President Butler called the meeting to order at 6:00 pm. He introduced the guests present, including Bill Duff, 2000 Symposium Chair, Maqsood Mohd, Education Committee Chairman, Bob Hofmann, Dick Clark, Ed Bronaugh, Russ Carstensen NARTE, Bob Smrek IEEE, Susan Schneiderman IEEE, Jim Muccioli, and Larry Cohen. The following topics were addressed before returning to the agenda items:

A. PRESENTATION BY IEEE TAB MEMBERSHIP CHAIR – Michael Garretson

Mr. Garretson discussed some new ideas proposed by the IEEE regarding membership dues for those in less developed countries. Lifetime memberships, group memberships, and reduced membership fees were discussed. Barriers to developing programs include how to handle individual Society dues. It was noted that while IEEE membership numbers have stayed steady, the number of memberships in individual Societies has been steadily

declining at a rate of 1% per year. Dick Ford suggested that the IEEE send letters now to non-members who attended the EMC Symposium this year and encourage them to join so they can register at the member fee for the symposium next year. This could be an on-going standard procedure following every symposium to increase IEEE membership.

B. PRESENTATION BY IEEE PUBLICATIONS – Susan Schneiderman and Bob Smrek

Ms. Schneiderman showed the IEEE survey results which documented that the majority of EMC Society members want to have a magazine and are willing to pay a minimum of \$10 more annually for this. They wish to have tutorial material, practical papers, and general interest stories included in the magazine. She visited the vendors during the symposium and received favorable support for advertising in the new magazine. Bob Smrek talked about the MTT Society's magazine and its transition from newsletter to magazine as an example of how the EMC Society can move forward with its plans to create magazine.

C. VICE-PRESIDENT FOR STANDARDS – Don Heirman

Mr. Heirman discussed the meetings that were held during the symposium. Standards activity can be viewed on line at <http://grouper.ieee.org>.

D. VICE-PRESIDENT FOR TECHNICAL SERVICES – Kimball Williams

Mr. Williams reported that the RAC, TAC, and SAC committees met during the symposium. Maqsood Mohd reported that the tutorial on Monday was well attended with some 450 people. It was well received by the audience. The demonstrations were successful as well. The demonstrations process is being formalized and will be in place by the next symposium. The feedback from the three universities present who had received EMC Society grants was very positive. The website university survey hits have increased. Andy Drozd will help improve the look of the website. They are trying to consolidate their outreach efforts into three areas: 1) grades K-12, 2) college and post graduates, and 3) working profession-

als. Regarding the TCs, Mr. Williams reported that all committees are active. There are four new TAC chairs. TC-1 will now be chaired by Dan Hoolihan. Bill Straus is the new chair for TC-3. Bob Scully is the new chair of TC-4. Jack Burns is the new chair of TC-8. The TCs would like to require full paper review of the papers reviewed for the symposium. If a paper wishes to be considered for best paper consideration, for example, the full paper needs to be submitted. The committee is looking at the Zurich symposium committee's in place process for the electronic review of technical papers. The committee would like to see more of the TC chairmen appointed as session chairmen for the papers reviewed by their respective committees.

E. WASHINGTON SYMPOSIUM REPORT – Bill Duff

Mr. Duff reported that the symposium went well. The papers were of good quality and were well attended. The vendors were pleased with the booth traffic and there were few complaints at the exhibitor's breakfast. Vendors appreciated the table top display option. Total numbers included:

- 1,564 paid full registrations
- 260 exhibit booths sold
- 706 free exhibitor passes issued
- 773 free exhibit hall passes issued
- 174 complimentary registrations
- 3469 total registrations

F. NARTE MOU – Russ Carstensen

Mr. Carstensen discussed the draft MOU presented during the Sunday Board meeting. Mr. Williams advised that the TCs were approached about this MOU and they saw no problems with being involved with the question review, etc. The Board approved the NARTE MOU as amended during discussion. The doc-

ument will be sent to the IEEE for review by legal counsel.

G. ZURICH TECHNICAL SESSION DECISION – Elya Joffe

There will be a special EMCS technical session at the Zurich symposium. For this session, Mr. Joffe advised that the "hot" topics include measurements above 1 GHz (but no emphasis on SAR measurements). Ed Bronaugh and Don Heirman volunteered to be co-chairs of this special session. They would like a session with 3-4 speakers on this topic and others.

H. REGION 9 EMCS MEMBERSHIP OFFER

In order to increase membership in Region 9, the Board approved offering new IEEE memberships in Region 9 a free 16-month maximum EMC Society membership.

I. BY-LAWS CHANGE FOR ELECTION SCHEDULE

As chair of the By-laws committee, Dan Hoolihan would like to change the by-laws in order to formalize the recently adopted Board motion to extend the deadline for receiving ballots for the Board of Directors elections. The purpose of extending the deadline is to avoid having ballots returned in August, which is typically a vacation month for most of our international members. It is hoped that this extension will result in an increase in returned ballots. The Board approved this plan.

J. MISSED MEETINGS BY BOARD MEMBERS

Don Sweeney discussed the problem of Board members not attending meetings. He feels if elected, Board members should be committed to attending at least two Board meetings a year. Unless

there are extenuating circumstances, he suggested that Board members be dismissed if they miss two meetings in any given year. Mr. Kesselman noted that the current bylaws state that members will be dismissed if they miss three Board meetings in a given year. President Butler asked that Mr. Sweeney draft a motion on this for the Board to review.

K. CO-SPONSORSHIP OF SHANGHAI EMC SYMPOSIUM 2002

Elya Joffe advised that he has received a letter from Prof. Gao Yougang requesting that the IEEE EMCS be a technical co-sponsor for their Shanghai symposium in 2002. The Board approved this request.

Action Item Review

President Butler reviewed the action items assigned during the meeting and those open from previous meetings. Arising from an open action item, the Board discussed the surplus/distribution of the 1999 Seattle EMC Symposium print copies and five year CD-ROMs currently in storage at Applied MicroImage. The Board approved shipping a supply of the Seattle EMC Symposium records to the Millenium Workshop in Greece in order to be distributed free of charge from the IEEE EMCS membership booth manned by Elya Joffe. The Board would like to supply these records at the global EMC conferences where the EMC Society is a technical co-sponsor in order to further outreach efforts.

There being no further business, the meeting then adjourned at 9:00 pm.

Janet O'Neil
Secretary
EMC Society Board of Directors
EMC

Membership Development

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- to include non-traditional fields, disciplines, and subscribers.
- Instituting discounted multi-year membership renewal plans.
- Continuing to improve "rapid response" teams and procedures to efficiently process new member applications, renewals, subscription orders, etc.

- Expanding benefits for senior members.

In the coming months I hope to keep you posted on the progress of these and other initiatives that are being pursued within the Institute and to address the anticipated impacts on the EMC Society. As a 'median' Society in comparison to our sister entities, we can expect these initiatives to have an overall positive effect on us. Growth and continued vibrancy of the EMC Society can be reasonably expected.

Membership Advantages

Membership in the IEEE and in the EMC Society offers both tangible and intangible benefits. So what are some of the benefits of being an IEEE and Society member? Current members provide the answer. Members have cited the following benefits that influence their decision to join: affiliating or identifying

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Inter-Society Activities

Representative Advisory Committee (RAC)

By David A. Case NCE, RAC Chairman

There is no doubt that wireless has changed almost every aspect of our lives. At times I feel being wireless is just a more politically correct way of saying I am tethered. There is no doubt that the wireless revolution is well on its way through out the world and just as often as it offers conveyances it also gives us headaches.

When I attended the IEEE EMC Symposium years ago, the only effective way to reach me was by calling the hotel and leaving a message or have some one page me. I was away from problems unless I checked in or someone sent out the goon squad to track me down.

Now, while I wander around the symposium, my pager, PCS phone, and in my room my remote e-mail keeps me connected all the time back to the office in real time. No longer can I avoid the irritating phone call from someone who was too lazy to look up the information for themselves or could not wait a few days for an answer for a non emergency question.

Wireless also affects the way we live, go out of town on a family trip and if you have the cell phone in the car (just for emergencies), your leisure time gets interrupted by calls from the office.

However, there is some good news: the PCS coverage at the location for this year's IEEE EMC Symposium was spotty in some locations on coverage. I was so disappointed that I missed a few non-critical pages and since I was extremely busy, I did not seem to find time to check my e-mail regularly.

Once again it seems more and more wireless issues are cropping up at the show in special sessions. The FCC hosted an all day presentation on spectrum management, there was a special session on Wireless Devices in the Medical Environment, and RAC hosted a special session on RF Exposure from Wireless Devices. All three sessions had very good attendance, which showed a clear interest in the field of wireless.

The RAC special session addressed an area that has received unfortunately lots

of publicity and most of it not positive. The session addressed a discussion of the standards for RF exposure both in the US and Canada and presented by members of the FCC and Industry Canada. We also had several speakers who spoke from the industry on the issues from Aprel Laboratories (Canada) and the Wireless Research Center at the University of Oklahoma. Lastly, we had a special guest speaker that was representing Bluetooth.

My disappointment from the Symposium was that there were not a lot of microwave test equipment systems being displayed. As we move more and more into the GHz bands for RF devices (and computers for that matter), we need more and more specialized cables, filters, and test instruments to perform the tests. With HP/Agilent pulling out of the market, the need to fill this void will be greater then ever.

This year the Symposium being in Washington, DC offered some of its own interests. Unlike the other symposia, this year the FCC booth actually had several of the engineers from the FCC Lab in Maryland present so one could ask questions. This seemed to be a big draw for those who had questions for the FCC staff.

This year RAC hosted a special lunch with the Standards Advisory and Coordination Committee (SACCom). My co-host this year was the new SACCom Chair Elya Joffe. We had an attendance of about 31 members including EMC Society board members. This was a roundtable event and everyone gave a quick update on his or her professional affiliation.

This year we added two new groups to report into the RAC and that is the R&TTECA committee and the Telecommunications Certified Body Council. It seems slowly but surely RAC is starting to gain new memberships from other outside non-IEEE EMC Society organizations.

Elya Joffe was busy wearing many hats during the symposium (EMC Society Board member, SACCom host, speaker, and official advance delegate from the IEEE EMC Symposium to be held in 2003 in Tel Aviv, Israel.) I actually did not get to discuss any issues with him until dinner on Friday night when we both had a chance to sit and unwind after a long, hectic week of symposium activity. However, my pager going off interrupted that dinner conversation!

I hope to see everyone next year in Montreal. **EMC**



RAC Chairman Dave Case of Cisco Systems (C) queries Mike Hart of Quantum Change/EMC Systems (L) and Steve Berger of Siemens (R) for their opinions of where the wireless EMC market is heading.

Photo by Janet O'Neil

Chapter Chatter

continued from page 6

in Bothell, he presented "How to Diagnose Electrical Noise Problems." He began his presentation with the statement "There are only four basic EMC problems that keep happening again and again. And they're the same problems regardless of the industry you're in!"

The evening focused on these four problems with diagrams and demonstrations of the material presented. At the end of the presentation, teams of three were created for the "Noise Diagnostic Competition." The teams were given noise diagnostic problems to solve in a limited amount of time. After completing the problem, a team would hand their results to another team to grade. Some four problems were presented and solved with titles such as "Noise Activation of a Sensing Circuit" and "Radiation from a Handheld Computer". The winning team members were Mark Chase and Joe Mason of CKC Labs and Dennis Anderson of the FCC. Congratulations Mark, Joe and Dennis! This meeting started at 4:00 pm and ended at 8:30 pm, with a short dinner break in between. With the expert presentation by Tom, the delicious dinner from Texas Smokehouse of Hollywood, and the fun competition, it was a long, but great chapter meeting.

Singapore

Dr. Siou Teck Chew reports that in Singapore, EMC is part of a joint EMC/AP/MTT chapter. Professor See from the Nanyang Technological University has undertaken the task of forming an independent EMC chapter. The Joint Chapter welcomes this move, as the activities organized by the new chapter will be more focused and beneficial to EMC members. Professor See is in the process of seeking signatures from IEEE EMC Society members and setting up the chapter. **EMC**



Photo by Stephen Slimac

Dinner was personally and cheerfully served at the September Seattle chapter meeting by (from left) Leo Smale and Jeannie Olson of Kalmus and Janet O'Neil, Chairman of the Seattle chapter.



Photo by Janet O'Neil

In July the Seattle Chapter held a special meeting with members of ANSI-ASC C63 in attendance. The meeting included a tour of the CKC Labs facility in Redmond, which Dennis Camell of NIST and John Lichtig of Lichtig EMC Consulting (L-R) enjoyed seeing.

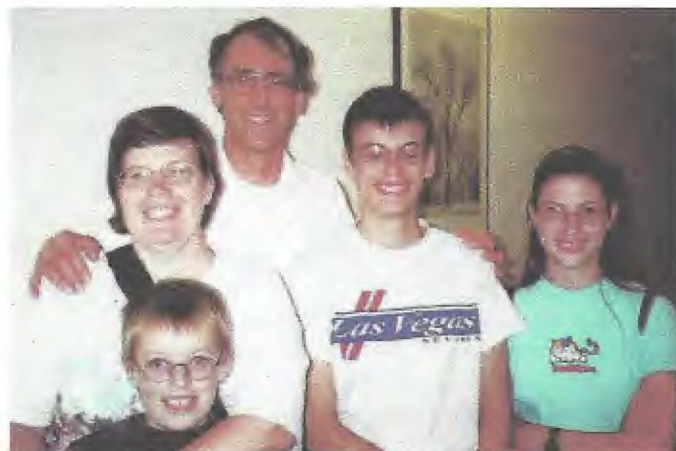


Photo by Janet O'Neil

Doug Smith brought his family with him to the July C63 meetings in beautiful Redmond. The Smith family consists of parents Deborah and Doug with kids David, Doug Jr., and Didi (L-R).



Photo by Janet O'Neil

John Hirvela of Compaq joined Mark Chase (L-R) of CKC Labs at the special July meeting of the Seattle Chapter.



Photo by Janet O'Neil

Also attending the Seattle Chapter meeting while in town for the C63 meetings were Bob DeLisi of Underwriters Laboratories and Carl Felts of Intertek Testing Services (L-R).



EMC Society Webmaster Activity

*By Andy Drozd,
Webmaster Committee Chair
EMC-S Board of Directors,
Communications Services*

In November 1998, Len Carlson, Vice President of Communication Services, appointed a Webmaster Committee to survey and oversee World Wide Web activities across the EMC Society. This committee reports directly to the EMC Society Board of Directors and is charged with ensuring that the web pages containing the official IEEE and EMC Society logos are being maintained in accordance with IEEE policy. The committee is also evaluating how our web resources are being leveraged by the various committees under the EMC Society for the benefit of the members. Working with me on this are Dave Southworth and Doug Smith with assistance from Todd Hubing and Tom Chesworth. Our attention very recently has been on the EMC Society's main web site, the Technical Activities Committee (TAC) web page and its component entities (TCs 1-9, RAC, and Education), and the Standards committees.

The administrative role of the Webmaster Committee is to identify web page problems, alert the committee or entity concerned, and coordinate corrective actions with an individual who is assigned the responsibility of maintaining the page (usually the committee secretary, webmaster, or chair). The technical role of the Webmaster Committee is to provide specific recommendations, guidance and direct support for web page development and maintenance.

One of our immediate goals is to ensure that the technical committee web pages contain, as a minimum, the following information presented in a concise, consistent, readily usable format:

- Committee officer, subcommittee and member rosters.
- Postings of approved meeting minutes and committee/subcommittee status reports (both html and downloadable text versions).
- Upcoming meeting and announcements of special events.

- Basic membership information and associated web page links (this includes listings of committee projects and points of contact, email addresses of key contacts, postings of committee opportunities or positions, invitations to join committees, and a link to the IEEE Membership page).
- Hyperlinks that work and web links that do not transfer to non-existent pages. Solid working links will be required, for example, to conduct electronic paper reviews among the TCs, and to electronically coordinate results with the TAC and symposium program committees in the future.

Why all the fuss? The obvious answer is that we are relying more and more on web-based means to network and communicate with members around the globe. We want to make sure that the information conveyed to members via the web is current, accurate, and as complete as possible. Also, we are in the starting block to extend the Society's current web configuration to facilitate coordinated electronic paper reviews among our technical committees. This involves the use of specialized document routing and database software; but first, a stable and consistent internal web "infrastructure" must be achieved. Several options are presently being investigated to handle documents electronically. Last but certainly not least, the web can be an effective tool for apprising members of Society projects and opportunities as they arise. In this way we can encourage the active involvement of members - strike while the iron is hot! Members can be informed of committee and project status, important events, meeting schedule updates, and new opportunities in a very timely way.

To achieve these goals, it was necessary for us to carry out several important tasks this past year. One of these was to establish individual web page accounts for each of the Society's technical committees under the IEEE's Entity Web Hosting (EWH) server. Dave Southworth made this happen in 1999. In parallel with this, we also transferred the EMC Society web site from

the University of Missouri-Rolla server to the EWH server while retaining the familiar www.emcs.org URL address. Doing so allows us to take advantage of the IEEE's web resources and technical support that are provided to us at no cost. Other subtle changes were made to standardize the manner in which the home and directory pages are displayed for the purposes of enhancing efficiency. Additional modifications are in the works to update links and page contents. This activity is ongoing.

We will continue to periodically monitor the status of the Society's technical committee web pages over the coming months to identify outdated, erroneous or missing information that would either indicate under-utilization or lags in maintenance activity. We plan to notify the committee webmaster or secretary of any problems that are found and ask that updated information be uploaded as necessary. Our intention is to cooperate with the committees and offer constructive suggestions for improvement, rather than be an "enforcer".

Society Web Initiatives – Advertising and Sponsorships

Several web-based initiatives are underway that are expected to benefit communications services, membership development, and education programs within our Society. One of these is a web advertising and sponsorship program. In this program, which will be launched during the Fall 2000 time frame, companies and labs that are suppliers of EMC products and services can purchase advertising/sponsorship space on the EMC Society Web Site. This will amount to posting proportionally sized company logos on a dedicated page. Company logos placed on this page would be grouped by the primary type of product or service provided. The logo would actually be a hot link to the subscribing company's web site. Subscribers would pay a fixed fee of \$1,500 per year for this service allowing for an unlimited number of "hits" to the company's web site. A "Directory EMC Products/Services" button has already been posted on the EMC Society home page in anticipation of the launch of this program. This button links to another page that is presently under construction. Eventually, this page will be populated with hot link buttons for each paid subscriber. The proceeds from this advertising and sponsor-

ship program will be used to support new communications services and member benefits programs. These include an electronic magazine, web-based educational instruments, new information delivery systems, and web-based professional development resources.

The program will be restricted to traditional or institutional suppliers of EMC products and services. A list of prospective subscribers has already been compiled. The terms and conditions as well as subscription policy and renewal forms (i.e., "agreements") will be available in electronic form on the EMC Society Web Site. These forms are currently being reviewed by the IEEE as the final step in formalizing and initiating the program. Two items being carefully examined include intellectual property rights and ensuring appropriate web site

safeguards at the vendor's site. This process of ironing out these and other web-related issues has taken some time, but we are nearly there. If you are interested in participating in this program, please contact me at a.l.drozdz@ieee.org or go to the EMC Society Web Site and forward an email inquiry to the Webmaster.

Web Delivery Systems and Web-Assisted Education

As part of the Webmaster activity we are also looking at leveraging new web delivery systems, web-assisted educational instruments and multimedia tools. Several new information delivery systems have been looked at such as electronic conferencing and white board technologies, real time video streaming on demand, and synchronized multimedia formats. Such capabilities are

envisioned to support professional development and distance learning as well as enhance the Society's communications infrastructure. Other applications could include the creation and rapid dissemination of project and career materials "any time, any place, at a reasonable cost". We are in the early stages of assessing and considering such options for the EMC Society. We anticipate some exciting developments within the next several years.

Any Volunteers?

We are always looking for dedicated volunteers. If you are interested in getting aboard this train please contact Dave Southworth, Doug Smith or me. We are also interested in your comments and suggestions.

Happy web surfing! **EMC**

Membership Development

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oneself with a prestigious professional organization; having access to multi-disciplinary technical information; creating opportunities for peer networking; participating in IEEE Financial Advantage discount programs; having the opportunity to publish and participate in conferences at member reduced rates; and advancing professionally on-the-job.

Best Practices and Marching Orders

What is a "best practice"? An example of this is offering a one-year free society membership when one joins the Institute and registers for an IEEE conference. Other examples include sponsoring Fellow mentoring programs, industry partnership programs, publishing press releases on IEEE events in local newspapers, and providing web-based memberships. We will continue to utilize these and employ other methods within our own Society to achieve the MD goals, but we are also seeking your feedback on what you consider to be a best practice and how it could be introduced at the society, section, chapter, or region level.

Based on these and other recommended best practices, specific MD initiatives were adopted for pursuit this year and into 2001. While there were many worthy

suggestions that resulted from the breakout sessions and discussions at the retreat, only the top ten initiatives for meeting the 2000 MD goals were formally selected. These were:

1. Work with societies to establish their goals for membership.
2. Nurture relationships between students and sections (include in planning and electronic communications).
3. Devise a system for follow-up with members who joined the IEEE at conferences.
4. Encourage active involvement (workshop, section/chapters program, and technical committees).
5. Publicize and emphasize technical and additional benefits of joining the IEEE.
6. Organize benefits along individual needs.
7. Develop multi-faceted mentoring programs.
8. Encourage increased volunteerism by promoting professional development value, and reward/acknowledge individuals with letters of recognition.
9. Provide multi-lingual membership forms and abstracts.
10. Create a process for automatic (multi-year) membership renewal.

You are now armed with information that will help in enlisting new members and keeping current members actively involved in our activities. I hope to update

you in the future on how the IEEE fared in meeting the overall 2000 MD goals.

I point out that the EMC Society Board of Directors is very interested in what makes your EMC Society membership work for you. To that end, Dick Ford conducts a survey each year at the annual EMC symposia to determine members' needs and level of satisfaction with the products and services offered by the EMC Society. This feedback is taken seriously and useful suggestions are often put to the test, so if Dick asks you to complete a survey the next time, please do so because your comments certainly affect the way we conduct our business. The IEEE also takes the pulse of the societies by conducting a survey approximately every five years to ascertain whether members' needs are being met or not and what improvements could be made. Your voice is heard!

In the meantime if you have any thoughts or comments on membership development, please feel free to contact me at (315) 334-1163 or via email at a.l.drozdz@ieee.org. You can also contact our Member Services Vice President, Dr. Todd Hubing at t.hubing@ieee.org.

I hope to attend the next annual MD Retreat, which is scheduled at the end of February 2001 in Newark. I look forward to it, but couldn't we hold it in Hawaii, Bermuda, or some other tropical setting? Just kidding (I think?!)

More to come... **EMC**



EMC Society President Joe Butler congratulates student Bryan Stern and Maqsood Mohd, EMCS Education and Student Activities Committee Chairman (L-R), upon presentation of the new award for "Best Student Design."

IEEE EMC Society Education and Student Activities Committee

Maqsood Mohd, Associate Editor

The environment is becoming richer with man-made electromagnetic energy and the susceptibility of electronic technology decreasing. In this era of high technology, EMC is alive and well. Growing attendance at the annual symposium each year is a testimony to this fact. The fever of high technology is touching every aspect of our lives and industrial sector of the world's economy. Even religious institutions are going high tech. The increasing participation of novices in this field at seminars and symposia and even the enhanced desire of seasoned professionals to brush-up and soak up every tidbit of EMC knowledge are noteworthy. After all, knowledge is power. This makes our Committee's responsibility very important, and we don't take that lightly. As in the past, we will continue to strive to bring the best in EMC Education to EMCS members. We need new ideas and volunteers to meet this goal. If you are interested in making this task easier, more efficient, and innovative, please contact any of us on the Education Committee and get the ball rolling.

Again, knowledge is power. And indeed education is the means to get the knowledge. To seek knowledge is a birth right of every human being – young and old alike. EMC professionals are included in this. It is never too late to learn and seek education. Education is a verb. Our goal is to become the premier education committee of the IEEE. This is your Committee. We are here to help you and support your educational needs. We are striving to undertake unconventional and innovative means to achieve our goals. Help us help you better. Let me update you on the

activities of the various subcommittees of the Education Committee. We welcome your help and support that you may be able to provide to any of our subcommittees. Please feel free to contact any of the subcommittee Chairs.

Washington DC Symposium 2000

The Washington DC Symposium is now behind us; and it was the best yet for educating and enriching the EMC professionals. The Washington DC Symposium Committee deserves thanks and appreciation for the job well done. At this Symposium, the Education and Student Activities Committee achieved great success in several areas. In the following paragraphs I have highlighted some of the events that took place that you may find of interest.

Student Award Winners at the 2000 EMC Symposium

Each year the Education and Student Activities Committee conducts two student competitions. The awards to the winners are presented during the Annual Awards Luncheon. The competitions are "Best Student Paper Contest" and the "Best Student Design Contest." The details of the evaluation process and how the winners are selected will be provided in the next Newsletter. But for now, the winning entries for this year are shown below:

Best Student Paper Contest: "Measuring the Shielding Effectiveness of Coaxial Cables Using a Reverberation Chamber" by Emily Godfrey of Lehigh University and Justin Kousky of the

University of Maryland. A cash award of \$900 is shared by both and the primary author (Emily) got an expense paid trip to the Symposium in addition to her share of the cash award.

Best Student Design Contest: The winning entry was from North Dakota State University. The winning entry was a team of students, Bryan Stern and Ben Herberg. A cash award of \$900 is shared by both and the primary author (Bryan) also got an expense paid trip to the Symposium in addition to the cash award.

Congratulations to these students, their professors, sponsors, and universities.

Tutorials

It was another landmark year for the Fundamentals Tutorials. Although the tutorials are primarily targeted for the entry-level engineers in the EMC field, quite a few seasoned engineers also enjoy brushing-up on concepts that they might not have used in a while. This year, several noted experts from several organizations provided the tutorial material to help explain EMC concepts and show how to better design systems from an EMC point of view. A highlight of the Tutorials was that not only theoretical concepts from PC board design to system engineering were discussed, but also practical examples of analyzing communication systems and diagnostic issues in real systems were presented.

If attendance is any measure of success and popularity, the Fundamental Tutorials were very successful. Throughout the day on an average there was an impressive

attendance of about 400 participants. We had standing room only most of the day. We had to bring in extra chairs a few times in the day. This year, the first-time symposium attendees were relatively larger in percentage than previous years. Maybe the seasoned engineers didn't want to sit in standing room only sessions. But the newcomers didn't know any better. With every body's understanding and patience, we managed to cater to the audience. Thanks to all the speakers and the attendees who made the Fundamentals Tutorials a great success. The tutorial subcommittee is busy planning for another exciting and informative session during the Montreal Symposium. They have assured us that the room size is not a problem at all in Montreal. If you would like to propose a topic or a speaker for the Montreal Symposium, email your comments and ideas to maqsood@ieee.org.

Demonstrations

This is another popular and "educational" activity we do as a committee. A variety of EMC concepts are demonstrated experimentally during the symposium to educate the symposium attendees. For three main days of the symposium, more than 20 experts demonstrated 24 EMC concepts that sometimes might be classified as abstract or black magic. Many happy souls were pleased to learn these concepts during these demonstrations. Their doubts changed into convincing beliefs.

There were at least three noteworthy highlights during this year. We had presenters from around the world and a new demonstration of EM modeling with simulation examples. Our thanks are to Andy Drozd and Larry Cohen for putting together a fine demonstration program. Our thanks are also due to very supportive vendors like HP, Tektronix, Fluke, Phillips, EMCO, Amplifier Research, etc. who donate their equipment during the symposium for this "educational" cause. If you would like to demonstrate an experiment or demonstrate an EMC concept at the next symposium in Montreal, please contact Andy at andro1@aol.com.

NARTE Activities

As during the past several years, Dr. James Whalen conducted the workshop for engineers and technicians who are

preparing to take the National Association of Radio and Telecommunications Engineers (NARTE) examination to certify as EMC engineers and technicians. This year David Case assisted Dr. Whalen. David Case is co-chair of the NARTE subcommittee.

At the NARTE examination on Friday, 26 engineers and technicians sat for the exams. The word from NARTE is that 66% of the participants passed the exams. Our congratulations to all the successful applicants, and welcome to the ranks of certified NARTE professionals. Our thanks to Dr. James Whalen for championing the cause of "preparing for the NARTE exams," and his able co-host, David Case.

University Grant

John Howard heads the University Grant Committee. This year we had responses from around the world requesting the grant money. The grant is provided to an institution that is on the verge of offering an EMC course. The grant money is used as seed money to start an EMC course as an established part of the curriculum in the Electrical Engineering department. The grant is open to all universities in the world. For more details contact John Howard at jhoward@emcguru.com. This year's winning school is outside the US and it is the University of L'Aquila in Italy.

University Survey

Professor Antonio Orlandi is the Chair of this subcommittee. The mission of the University Survey Committee is to survey the universities and collect data about the EMC course offering, student population, modeling and simulation usage, etc. The data collected will help the EMC Society and its members in various ways. Information will be useful for prospective students, industry, employers, etc. If you have not already done so, please, complete an online survey by going to the website <http://dau.ing.univaq.it/art>. If you know of a school, university or a college with an EMC course offering that has not participated in the survey, please encourage them to complete an online survey. For more information on this activity, please contact Professor Orlandi at orlandi@ing.univaq.it.

Student Design Contest

This is the most exciting area of growth this year for our Committee. This effort epitomizes the proverbial synergistic cooperative effort between industry and the Society. Ahmad Fallah of Phoenix International is the Chair of this effort. This year was a pilot year and we have learned a lot. We will still learn and fine-tune the process as we go. If you would like to get on this bandwagon and help advance and fine tune this contest, then contact Ahmad Fallah. In this competition parts of a circuit (designed by Fallah) in the form of a kit are sent to the students at the universities. The kit is yours for the asking. This year 14 kits were sent; one to an international address and 13 to US addresses. We received nine entries. The entries were evaluated against a set of criteria provided in the information packet sent with the kit. The evaluators are EMC engineers from the industry. This year's winner is a team from North Dakota State University. The award consists of a check for \$900 and an invitation to the primary student to attend the annual symposium in order to present a poster board presentation of the emi-reduction techniques used in the winning entry. If you are a student and want to participate in the 2001 EMC Design Contest then contact Ahmad Fallah at afallah@phoeintl.com. Get started early and remember: the early bird gets the worm! The price is right: A free trip to the Montreal EMC symposium and \$900 US dollars! Ain't bad, eh?

Experiments Manual On-line

Dr. Jim Drewniak is heading up this effort. The Experiment Manual published by the Education and Student Activities is on the web site at: <http://www.ewh.ieee.org/soc/emcs/pdf/EMCman.pdf>. If you have an Adobe Acrobat Reader, you can download the entire manual from this site. If you don't have the Adobe Acrobat Reader, it can easily be downloaded from the site: <http://www.adobe.com>. Jim can still use some help from a volunteer who can do the follow-up work of soliciting and arranging the new experiments. If you are interested in broadening your career horizons, contact Jim or any other officer of the Education and Student Activities Committee.

Continuing Education Products (and Web Site)

Andy Drozd is the Chairperson of this subcommittee. This committee is an adjunct to the life-long learning committee. This committee is examining the development of products such as Introduction to Antennae, and Introduction to EMC. Possibly this material can be put on our Committee's web site. Andy is also helping us get our web site in shape. Take a look at our web site at <http://www.ewh.ieee.org/soc/emcs/emcsedu.html>. If you have any ideas how to improve our web site please contact Andy, Bob Nelson, or me.

Student Activities

Ahmad Fallah is the new Chair of this subcommittee. The mission of this committee is to reach out and touch some students (in fact, all students). Primarily, the focus is on working with student chapters in four areas: Awareness of EMC, Student Paper Contest, President's Memorial Award, and Student Design Contest.

Video/CD-ROM Based Educational Material Production

The task of this committee is to produce educational material in appropriate and useful medium to the EMCS membership. Dick Ford is the Chair of this committee. He will welcome any help you can provide him in this task. What we do in this committee will have a far-reaching impact in the 21st century.

Education and Student Activities Officers

Some changes have occurred during the symposium. Contact any one of the following to become a part of the ongoing innovation in EMC engineering through education.

Student Activities

Ahmad Fallah, afallah@phoeintl.com

NARTE BOD Liaison

David Case, dcase@telxon.com

Experiments Manual II

Jim Drewniak, drewniak@ece.umn.edu

Vice Chair & CEPC

Andy Drozd, andro1@aol.com

Demonstrations

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Student Design Contest

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Video Productions

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University Grant

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NARTE

Jim Whalen & David Case,
jjw4@ece.umn.edu

Life Long Learning

Maqsood Mohd, maqsood@ieee.org

I would like to express my personal thanks and appreciation to each of these officers who tirelessly work throughout the year to bring the very best in EMC education materials, workshops, demonstrations, tutorials, and student contests at every symposium and to all the members of the EMC profession throughout the year. When you email them, contact them, or see them during a symposium, please express your appreciation for their volunteering of valuable time for the EMCS and the Education and Student Activities Committee. **EMC**

2001 Student EMC Design Competition

Apply Your EMC Design Knowledge to a Real-Life Problem. Win a Trip to the EMC Symposium in Montreal and \$900 Cash!

It's that time of year again! You are invited to take part in the 2001 Student EMC Design Competition. The winner will be announced at the 2001 IEEE International Symposium on EMC in Montreal, Canada.

The 2000 EMC Student Design Competition was a major success! The winning entry was a team of two students from North Dakota State University. For their efforts, they shared \$900 in cash and one student received an expense paid trip to attend the 2000 IEEE International Symposium on EMC in Washington, DC. This included a free pass to all technical sessions and exhibits and a special recognition during the Awards Luncheon! The most important reward for the participants was the experience of applying their EMC design knowledge to a real-life problem.

All you need to do to enter the 2001 Student EMC Design Competition is contact Ahmad M. Fallah at (701) 277-6322, or via email at afallah@phoeintl.com, and request a design kit and a copy of the competition rules. Then, apply your knowledge of EMC design principles and submit your design entry and a detailed report on how you arrived at your solutions by May 30, 2001. You will be notified well in advance so you can attend the 2001 IEEE International Symposium on EMC in Montreal and present the results of your efforts in a poster session. And, of course, *you can then collect the \$900 cash award!*

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



2000 EMC SYMPOSIUM EXPERIMENT DEMONSTRATIONS IN WASHINGTON, DC AND A "CALL FOR EXPERIMENTS" FOR THE 2001 EMC SYMPOSIUM IN MONTREAL

By Andy Drozd, Vice Chair
EMC Society Education Committee

EMC Mysteries Revealed!

The turnout at this year's EMC Symposium experiment demonstrations in Washington, DC couldn't have been better! The three days of experiments once again proved to be an integral part of the symposium drawing sizable crowds, and stirring up lots of discussions and audience interaction. One individual I spoke to likened it to a "magic show" with a difference - much of the mystery behind EMC is revealed proving it is indeed an art and a science offering some interesting, unexpected, but always thought-provoking challenges. Were some clever tricks and secrets revealed? You bet they were and a good time was had by all!

Once a Novelty, Now a Symposium Tradition

Since inaugurating the forum in 1993, the experiments have helped raise the awareness level of engineers to the importance of implementing good EMC design and measurement practices as well as provide keen insights into electromagnetic phenomena and effects. What started out as a

grand experiment itself nearly ten years ago is now becoming a traditional format. It's safe to say that we will continue to cultivate and possibly expand this forum in future symposia. In fact, we are about to launch another novel idea somewhat related to the experiment demonstrations, but more about that later.

This year we had a very diverse mix of demonstrations covering the measurement of cable crosstalk and interference, to assessing the effectiveness of noise suppression techniques on PCBs, to computer modeling and validation. Up to five demonstrations were conducted continuously during each morning and afternoon period. The lineup this year included 23 experiment demonstrations. This was one of our more ambitious years and except for a few equipment setup problems, everything ran relatively smoothly. Recall that the experiments are partially based on the EMC Society Education Committee's EMC Experiments and Demonstrations Manual, Volume 1 originally compiled and reviewed by Clayton Paul and Henry Ott (a PDF version of this document can be downloaded from the IEEE EMC Society Web Site at <http://www.emcs.org>). We added several other experiments to the agenda as in past symposia where some were of a more elaborate nature. The experiments demon-

strated this year included:

"Separation of Common-Mode and Differential-Mode Conducted Emissions for Diagnostic Purposes" by Don Bush, dBi Corporation, Winchester, KY.

"Infrared Images of Electromagnetic Fields (Aircraft Scattering Model)" by John Norgard of the University of Colorado at Colorado Springs, CO and Michael Seifert of the Air Force Research Laboratory Information Directorate, Rome Research Site, Rome, NY.

"Simple Lessons Learned for EMI Control" by Jack Meyer of Anteon Corporation, Fairfax, VA.

"Non-Ideal Behavior of Circuit Elements and the Effect on Signal Spectra" by Elya Joffe, KTM Project Engineering, Ltd., Kfar Sava, Israel.

"Study of the Effectiveness of ESD Suppression Devices and Topologies in Protecting a Timing Circuit" by Ahmad Fallah of Phoenix International, a John Deere Special Technologies Group Company; and Lincoln Davidson, President of Analog Design, LLC (this experiment was developed under the supervision of Dr. Robert Nelson from North Dakota State University).

"Spectrum of Non-Sinusoidal Signals" by Jose Perini, Professor Emeritus of Syracuse University.

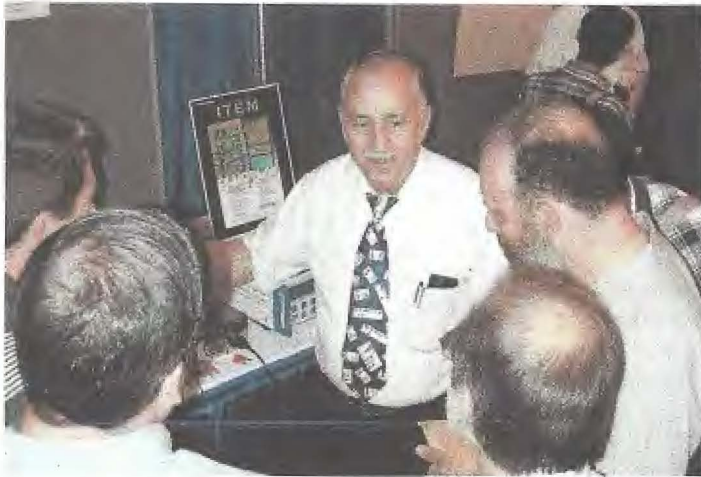
"Conducted Mode Noise on Small DC Motors"



John Daber of the Georgia Tech Research Institute demonstrates spectrum analysis using a spectrum analyzer.



Clayton Paul of Mercer University demonstrates the effects of pulse rise/fall on signal spectrum.



Norm Violette of Violette Engineering Corporation demonstrates transient protection of facilities and equipment.



Art Light of ITT Industries demonstrates the EMC of spread-spectrum modulation.

in a Shield Tool Box" by James Muccioli of Jastech EMC Consulting, LLC and X2Y Attenuators, LLC, Farmington Hills, MI.

"Compromises in Shielding Integrity" by Bill Duff of Sentel Corporation, Alexandria, VA and Ernie Freeman, SFA, Inc., MD. *"Analyzing Current Paths and Effects on Circuits"* (based on Doug Smith's experiment *"Noise Measurement by Induction"*) by Roy Ediss of Philips Semiconductors, Southampton, UK.

"Crosstalk Between Parallel Current Loops" by Hans Regtop of Philips Research Laboratories, EMC Department, Eindhoven, The Netherlands.

"Influence of Properties of Antennae on the Results of Measurements" by Vladimir Kraz, Credence Technologies, Inc., Santa Cruz, CA.

"Effects of PWB Layout on ESD Immunity" by Doug Smith, D. C. Smith Consultants, Santa Clara, CA.

"Spectrum Analysis Using a Spectrum Analyzer - The Basics and Some Subtleties" by John Daher, Georgia Tech Research Institute, Atlanta, GA.

"A Most Unusual Mode Stirred Chamber" by Mike Hatfield of the Naval Surface Warfare Center, Dahlgren Division, Dahlgren, VA.

"Artificial Lightning Generation" by Fred Heather of the Naval Air Warfare Center, Aircraft E3 Engineering Division, Patuxent River, MD.

"Demonstration of Modeling Simple Canonical Objects" by Maqsood Mohd of Sverdrup Technology, Eglin AFB, FL.

"Parasitic Effects in Circuit Elements and the

Effect on Signal Spectra" by Clayton R. Paul, Sam Nunn Eminent Professor of Aerospace Engineering and Professor of Electrical and Computer Engineering of Mercer University's School of Engineering, Macon, GA.

"Surge and Lightning Suppression Fundamentals" by Norman Violette of Violette Engineering Corporation, McLean, VA and Mike Violette of Washington Laboratories, Gaithersburg, MD.

"Spread Spectrum and The Electromagnetic Environment" by Art Light of ITT Industries, Alexandria, VA.

"How Parasitic Effects in Inductors and Capacitors Affect Electrical Equipment" by James J. Whalen, Department of Electrical Engineering, University of New York at Buffalo.

"Radiated Emission Due to the Finite Partial Inductance of PCB Ground Planes" by Frank Leferink of Hollandse Signaal-apparaten B.V., The Netherlands.

"Effects of Logic Devices and Their Spectral Emissions Profile" and *"Effectiveness of Image Planes and Distance Spacing to Signal Traces on PCBs"* by Mark Montrose of Montrose Compliances Services, Inc., Santa Clara, CA.

As usual, the presenters did an outstanding job. In upcoming newsletter articles we plan to highlight some of the interesting findings and results of several of these experiments. Stay tuned!

We are also indebted to the supporters behind the scenes who helped coordinate and make the detailed arrangements for this year's experiments session. These included my Co-Chair Larry Cohen of NRL, Greg Snyder and Mike Violette of Washington Laboratories, and Mike



Ron Duffy of Agilent Technologies discussed line filter design with product safety implications.

Hatfield of NSWC, Dahlgren who in team fashion helped acquire or supply the various test stands and other hardware for the demonstrations. We are also very grateful to Tektronix Inc., Rohde & Schwarz, Advantest, Agilent/Hewlett-Packard, Fluke Corporation, KeyTek, and Schaffner EMC for providing the special test equipment used in the experiments. It's mind-boggling to think of all the test equipment that is needed such as oscilloscopes, spectrum and network analyzers, EMI receivers, signal and function generators, meters and probes, and so on that these companies so readily supply us with each year. Greg Snyder by the way did an exceptional job coordinating, setting up, and dismantling the experiment stations. Thank you Greg and all of our supporters for another successful event!

What About Next Year, She Asked? A "Call for Experiments", He Said!

We have already begun planning next year's experiments session and have a candidate list of demonstrations that have been volunteered. For Montreal we are also conducting a "Call for Experiments" in an attempt to solicit other novel ideas that would be of interest. Our hope is to expand and continue to maintain the high quality that the forum is known for while adding to the growing suite of experiments documented in the *EMC Experiments and Demonstrations Manual*. It is anticipated that next year's experiments for Montreal would be selected with the aid of an impartial symposium technical evaluation committee, so if you have ideas for an experiment and want to have it considered, please contact me at (315) 334-1163 or 337-4396, a.l.drozdz@ieee.org to discuss your ideas and get the ball rolling. Our goal is to establish a preliminary agenda of experiments by early December 2000.

Periodically visit the official Montreal 2001 IEEE International Symposium EMC Web Site to find out more about the upcoming conference and session agendas. The site will also provide a list of experiment topics being considered. The experiments are to be located in an open venue

once again nearby to the technical paper sessions and vendor exhibits in the Palais des Congres de Montreal. The URL for the Montreal Symposium Web Site is www.2001emcmntl.org or go directly to the EMC Society home page to link to their site. We look forward to your comments and suggestions on novel ideas for experiments. The advice I usually give is to keep it simple and base the experiment on the use of some fairly ordinary test equipment. This is not to say that more elaborate ideas will not be considered.

Something Borrowed, Something New

What do I mean? Well, we will be making use of the tried and true experiments format to launch a new special session aimed at demonstrating computational electromagnetics computer modeling and simulation methods for basic EMC problems. The growing importance of CEM modeling, simulation and analysis in our discipline and within our Society, as well as the formation of a number of CEM groups outside of the Society have stimulated a great deal of interest in this area. CEM represents the synergy among electromagnetics, mathematics, numerical methods and computer science. We are looking at alternative ways of educating EMC engineers in the fundamental of computer modeling and simulation including perhaps some of the more advanced computational techniques for EMC problem solving that are available today. We would like to appeal to both the novice and experienced EMC engineer in this regard, so a proper balance of demonstrations and software technologies would need to be brought together in this forum. The software demonstrations will be based on: (a) simple models or example problems that could be efficiently simulated on a personal computer; (b) emphasizing the physics and solution methods behind the software tool rather than the tool itself; (c) an experiment counterpart for conducting empirical-analytical validations when possible; and (d) the use of software tools, technologies and techniques that are not subject to export control restrictions and are not proprietary (e.g., applying a public domain university

developed tool perhaps?). It is important to add that every effort will be made to prevent commercialism and to dissuade any type of commercial product endorsements. This will be a challenging endeavor as you can tell. Nevertheless, we plan to test out the idea in Montreal. The computer simulation demonstrations will be conducted in parallel with the hardware experiment demonstrations. Please let me know what you think and if you have any thoughts on an interesting simulation you would like considered.

What's Next, CEM Standards?

Well, quite possibly. How do standards fit into EMC education and the demonstrations? The answer is awareness and a better understanding of the validation problem. The electromagnetics community at large is being prodded for good reason to get even more serious about developing modeling standards that could be used to cross validate various CEM codes as well as compare simulation results to measurements. Developing sound standards is one potential solution to the validation issue. For example, the structural and thermal engineering, and computational fluid dynamics communities have taken big steps towards developing standards to support collaborative, concurrent, and integrated product team engineering tasks. There is still some controversy with applying CEM tools in a similar way. Some have questioned the validity and legitimacy of comparing the results of diverse simulation methods because of the various ways in which a given problem can be defined. With these points in mind, suffice it to say that the experiments and modeling-simulation demonstrations may lead to some interesting observations and conclusions on the relevancy of standards for CEM simulations and validations. I also note that there is an initiative within the EMC Society Standards Development Committee to investigate the possible generation of a CEM modeling standard. I hope to address this matter further in a future newsletter article as developments occur.

Stay tuned. **EMC**

2001 IEEE EMC Symposium

August 13-17, 2001

Montréal



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

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



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

We are looking forward to seeing you.

The 2001 IEEE EMC Committee

For further information please contact:
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Tel: (514) 287-1070 • Fax: (514) 287-1248
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Photographs: Tourisme Montréal



EMCABS

EMC Abstracts

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, you can order it from NTIS or DTIC. Recently it became clear that EMCABs were more timely than publications which were being listed in data files. Therefore, additional information will be included, when available, to assist in obtaining desired articles or papers. Examples are: IEEE, SAE, ISBN, and Library of Congress identification numbers.

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

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

EMCABS:01-11-00

ICS SUSCEPTIBILITY: A CRITICAL ASSESSMENT OF THE TEST PROCEDURES

Franco Fiori

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Dipartimento di Elettronica, Politecnico di Torino, C.so Duca degli Abruzzi 24, 10129 Torino, Italy

Proceedings of 15th International Wroclaw Symposium on EMC, Poland, June 27-30, 2000, pp.41-44

Abstract: In this paper some methods to perform integrated circuit (IC) susceptibility tests are described. The Work Bench Faraday Cage method allows the measurements of small PCBs or ICs immunity to common mode conducted RF interference, while the direct injection method makes possible the evaluation of IC immunity to differential mode disturbance. The evaluation of ICs susceptibility to electromagnetic radiated field can be performed by the TEM cell method. Test benches related with methods summarized in this paper were realized and used in order to verify experimentally the immunity of a micro-controller IC. In this work, the different measurement procedures are compared and the test benches weak points are highlighted.

Index terms: Susceptibility, immunity, IC, workbench Faraday cage, TEM cell.

EMCABS:02-11-00

THE EFFECT OF DISCONTINUITIES ON GROUND/POWER PLANES OF HIGH-SPEED PRINTED CIRCUIT BOARDS

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Technical University of Budapest, Department of Microwave Telecommunications, Goldmann ter 3. 1111 Budapest, Hungary

Proceedings of 15th International Wroclaw Symposium on EMC, Poland, June 27-30, 2000, pp.64-69

Abstract: Power and ground planes are required to have low impedance over a wide range of frequencies. Parallel ground and power planes in multilayer printed-circuit boards exhibit multiple resonances that increase the impedance. When rectangular shape of printed circuit board is not allowed for optimal using of the available physical dimensions, the cut area can be seen as a discontinuity of the plane. This kind of discontinuity can decrease the impedance of the plane pair. Simulation based on transmission line grid model and measurements results are presented for some typical configurations.

Index terms: Printed circuit board, ground/power planes, discontinuity, resonance, transmission line grid model.

EMCABS:03-11-00

NUMERICAL MODELING OF NONLINEAR INTERFERENCE AND DISTORTIONS FOR WIRELESS COMMUNICATIONS

Sergey L. Loyka

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Proceedings of 15th International Wroclaw Symposium on EMC, Poland, June 27-30, 2000, pp.132-136

Abstract: Nonlinear interference and distortions have a profound impact on wireless communication system operation, especially under conditions of severe electromagnetic environment (overcrowded spectrum, strong interfering signals, multi-path and multi-signal environment etc.). In this paper, we propose a new behavioral-level simulation technique – the "instantaneous" quadrature technique, which can be employed for the EMC/EMI analysis of wireless systems in a computational-efficient way taking into account nonlinear effects (over wide dynamic and frequency ranges) and, secondly, we discuss how to apply the instantaneous quadrature technique to simulate wireless receivers and transmitters for EMC/EMI problems.

Index terms: Wireless communication, nonlinear interference, nonlinear distortion, modeling.

PRIMARY AND SECONDARY ELECTRO-MAGNETIC SCREENING (SHIELDING) PARAMETERS

Lauri Halme

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Proceedings of 15th International Wroclaw Symposium on EMC, Poland, June 27-30, 2000, pp.203-207

Abstract: This paper serves as a basic, background and introduction to better understanding of the work done in IEC and CENELEC in the field of the electromagnetic screening of cables, cable assembly and connecting hardware.

Index terms: Cable, shielding, electromagnetic screening, cable assembly.

EMCABS:05-11-00

ANALYSIS OF COMPLEX SYSTEMS WITH CABLES USING ELECTROMAGNETIC TOPOLOGY

Torsten Steinmetz and Jurgen Nitsch

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Proceedings of 15th International Wroclaw Symposium on EMC, Poland, June 27-30, 2000, pp.225-229

Abstract: Electromagnetic topology is a powerful tool to investigate disturbances in complex systems. It can be used to calculate voltages and currents that occur on the wiring of a system. However, in this approach so far only uniform transmission lines are included. In this paper, a method to treat non-uniform transmission lines in topological networks is presented and some frequently used non-uniform cables are analyzed. Wiring in a PC housing is investigated and a comparison with measurement, numerical simulation using a method of moments code and with the results of the topological method is carried out.

Index terms: Electromagnetic topology, non-uniform transmission line, cable, wiring, multi-conductor.

EMCABS:06-11-00

ANALYSIS OF THE SHIELDING PERFORMANCES OF LOADED PERFORATED SHIELDS

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Proceedings of 15th International Wroclaw Symposium on EMC, Poland, June 27-30, 2000, pp.235-239

Abstract: In a lot of cases the shielding effectiveness of a shielding structure is determined by apertures that have to be present for different practical reasons. In order to try to minimize the unwanted coupling between the external environment and the shielded volume due to the apertures, they are often loaded with different media. The analysis of the shielding performances of loaded perforated shields is here presented. The analysis is performed through a suitable formalism in the spectral domain, which leads to a circuit interpretation of the electromagnetic problem. The network analysis yields a sort of Wiener-Hopf equation that can be interactively solved through the method of moments, until the required accuracy is reached. The considered analytical approach, suitable for any kind of aperture, is validated through an experimental analysis of a typical configuration of practical interest showing a good agreement of the measured and predicted data.

Index terms: Shielding, perforated shield, aperture, Wiener-Hopf equation, method of moments.

DOSIMETRIC ANALYSIS OF BASE STATION ANTENNAS VIA SIMULATION AND MEASUREMENT

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Proceedings of 15th International Wroclaw Symposium on EMC, Poland, June 27-30, 2000, pp.240-244

Abstract: A simple and accurate model for base station panel antennas is proposed for dosimetric analysis. A unit cell of the antenna is modeled and is denoted as the generic model. The field of the entire antenna, denoted as the synthetic model, is obtained by superposing shifted field contributions of the generic model. Comparison of the synthetic model with the full antenna modeled and with measurements illustrates the accuracy of the synthetic model.

Index terms: Base station, panel antenna, radiated field, numerical modeling.

EMCABS:08-11-00

ELECTROMAGNETIC FIELDS IN PROXIMITY OF GSM BASE STATIONS

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Proceedings of 15th International Wroclaw Symposium on EMC, Poland, June 27-30, 2000, pp.250-254

Abstract: In this paper we present evaluation techniques for the electromagnetic field levels radiated by antennas used in the radio base station for mobile service. Theoretical modeling and experimental results are explained for the electromagnetic field in the near zone of the antennas. Besides, a numerical technique for the calculation of the electromagnetic field levels in an urban area is presented.

Index terms: Mobile communication, base station, antenna, near-field, urban area.

EMCABS:09-11-00

A PROBABILISTIC MODEL FOR TRANSMISSION LINE VOLTAGES INDUCED BY AN EXTERNAL FIELD

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Proceedings of 15th International Wroclaw Symposium on EMC, Poland, June 27-30, 2000, pp.260-264

Abstract: In this work, a probabilistic approach for the characterization of wiring harness susceptibility to external interference is presented. The problem of field-coupling onto a uniform, two-conductor transmission line is considered by modeling the external field as a plane wave with random parameters. The probability density function of the voltage induced in one of the line loads is derived analytically, under a low-frequency assumption. The proposed model allows computation of statistical parameters of interest, such as expected values, variances, and confidence intervals of voltages and currents in the line loads.

Index terms: Transmission line, susceptibility, external field, probabilistic model.

ESTIMATION OF ATTENUATION CHARACTERISTICS OF FEED-THROUGH TYPE EMI FILTERS USING FE-SI ALLOY FLAKE-POLYMER COMPOSITE

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Proceedings of 15th International Wroclaw Symposium on EMC, Poland, June 27-30, 2000, pp.566-470

Abstract: The authors have constructed a prototype feed-through type EMI filter by filling the hollow portion of a coaxial structure having an outer diameter of 7 mm and an inner diameter of 3.04 mm with composite magnetic material made up of Fe-Si alloy flakes and polyphenylene sulfide resin. Insertion losses were measured in the frequency range from 100 MHz to 20 GHz for filter specimens containing different length of composite magnetic material, and an insertion loss of 10 dB and greater was observed from 1 GHz to 20 GHz in the case of 20 mm. In addition, using material constants of the composite magnetic material measured beforehand, insertion losses were calculated, and it was found that the results of calculation agreed relatively well with the above measurements. On basis of the above, the authors have been able to clarify how the material constants of the composite magnetic material affect insertion loss.

Index terms: EMI filter, attenuation characteristic, insertion loss, composite magnetic material, material constant.

EMCABS:11-11-00

TRANSMISSION LINK RADIATION AND COMMON CURRENT GENERATION BY 15 PIN D CONNECTOR

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Proceedings of 15th International Wroclaw Symposium on EMC, Poland, June 27-30, 2000, pp.575-578

Abstract: Norms impose the limitation of electromagnetic radiation of numerical links between equipment, in the frequency range 100 MHz — 1 GHz. This radiation is caused mainly by common mode current. This paper describes with the finite-difference time-domain (FDTD) method the asymmetry of the transmission line created by different termination for a 15 pin D connector. This asymmetry has a direct impact in the level of transmission link radiation.

Index terms: Common mode current, transmission link, radiation, asymmetry, connector, FDTD.

MAINS RFI-FILTERS DESIGN METHODOLOGY

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Proceedings of 15th International Wroclaw Symposium on EMC, Poland, June 27-30, 2000, pp.591-595

Abstract: RFI power line filters are used to decrease interference in the Main and provide EMC. For these filters design it is necessary to know the impedance of the Mains — as a conductive electromagnetic interference receptor (EMI) — and of the power supply Mains terminals — as an EMI source. Mains impedance may be considered standard, but switched mode power supply (SMPS) impedance is a problem. The method of power supply Mains terminal impedance simulation taking into account non-linear nature of SMPS as EMI source is suggested. In the paper the methodology of RFI-filter design is suggested to provide filters synthesis for given SMPS, subject to rated parasitic component's parameters.

Index terms: EMI filter, power supply, power line, impedance, design. **EMC**

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Standards Advisory and Coordination Committee (SACCOM)

continued from page 19

- CENELEC 210A (European Organization for Electrotechnical Standardization)
- ASTM D09.12.14 (Shielding Effectiveness)
- ASTM E06.53 (Reusable Structures)

In addition, representatives of other organizations, not included on this list, but who are active in the field of EMC, are encouraged to volunteer to the Committee.

A Report from the August, 2000 Meeting

The Committee held its third meeting on August 21, 2000, during the Symposium. 14 members and guests attended the meeting.

During the meeting, representatives present provided their reports. A most interesting discussion was initiated when Mike Oliver, SAE-AE/4 and ASTM D09.12 representative, presented the activities on those committees on the topic of EMI Shielding. It seems that those activities overlap, to an extent, the IEEE EMCS Standards 299 and 1530, and thus — interaction between the representatives and working groups may save effort and time for both organizations.

This is a clear win-win situation.

After all, this is one of the main objectives of SACCOM.

Summary

In summary, the SACCOM activities are ever increasing and productive, and I wish to thank all those who support the activities of the Committee and assist in its development and productivity.

If you are interested in joining SACCOM or exploring the possibilities of contribution to its activities (and benefiting from its outcomes), please contact Elya B. Joffe, SACCOM Chair.

He may be reached at Tel: +972-52-783793 (GMT+2), e-mail eb.joffe@ieee.org. **EMC**

Calendar

EMC Related Conferences & Symposia

2001

February 20-22

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June 19-22

IV International Symposium on EMC
and Electromagnetic Ecology

St. Petersburg State Electrotechnical
University "LETI" Russia

Prof. D.V. Puzankov, Chairman

Phone: +812.346.46.37

E-mail: *michel.ianoz@epfl.ch*

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EMCS Cooperating Symposia

U.K.: Biannually, even years,
in September

Zurich: Biannually, odd years, in
February

Wroclaw: Biannually, even years,
in June

EMCS Symposia Schedule

2001 Montreal, Canada
Montreal Convention Center
Benoît Nadeau
514.822.6000 x2475

2002 Minneapolis/St. Paul
Hyatt Regency, Minneapolis
Dan Hoolihan
651.213.0966
E-Mail: *d.hoolihan@ieee.org*

2003 Tel-Aviv, Israel
(International IEEE)
Elya Joffe
Fax: 972.9.765.7065

2003 Boston, MA
Sheraton Boston
Mirko Matejic
508.549.3185

2004 Santa Clara, CA
Franz Gisin
408.495.3783

2005 Chicago, IL
Derek Walton
815.637.3729

IEEE EMC Society Board of Directors Meetings

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

February 23, 2001
Zurich, Switzerland

June 15, 2001
Minneapolis, Minnesota

August 12, 2001
Montreal, Canada

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

2001

April 23

Southeastern Michigan EMC Chapter, contact Kimball Williams 248.354.2845

May 7

Phoenix EMC Chapter, contact Terry Donohoe, 602.436.5974

May 21-22

Chicago EMC Chapter, contact Frank Krozel, 630.924.1600

June 4

Portland EMC Chapter, contact Henry Benitez, 503.696.2284.

<http://www.emcs.org>

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