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ROBERT D. GOLDBLUM, *Editor*

MESSAGE FROM THE PRESIDENT



WARREN KESSELMAN
PRESIDENT, EMC SOCIETY

Your 1994 Board of Directors, standing committee members, '94 symposium committee, Transactions editor and paper reviewers, and Newsletter editor and associate editors worked diligently to preserve your Society's tradition of quality service. I will not attempt to estimate their total combined work hours, but I'd guess it is well over 10,000. When you have the occasion, please thank the individuals for their unselfish efforts. My personal thanks go to all and my special thanks to the elected Board members who are not continuing as part of the 1995 management team.

You elected Bill Duff, Bill Gjertson, Todd Hubing, Bill Ritenour, Don Sweeney and Kimball Williams to our Board of Directors' Class of '97. They met with the 1994 Board of Directors in November, and the

assembly reelected the 1994 Board Officers to serve for 1995. (As one person remarked, "We're giving you another chance to get it right!") In addition to the regular Board meeting, an all-day planning retreat was conducted. The focus of that session was on the five IEEE 21st Century Goals. Those goals are: career enhancement, globalization, organizational improvement, products and services, and public responsibility. The results of the planning session will be fine-tuned into a three-year objectives implementation plan which will be reviewed and updated yearly.

You all are aware of the increased world-wide concern about EMI. I'd like you to give thought to the goal *Public Responsibility* and accept it as an individual challenge. That IEEE goal is "Align IEEE initiatives with the public interest by advocating the application of electrotechnology to promote economic development and by increasing public awareness, acceptance and appreciation of electrotechnology and its allied professions." (Electrotechnology is defined as the arena of technology addressing the development of new knowledge concerning electricity, electronics and related sciences such as photonics and software, and the

application of the knowledge to the solving of practical problems.) I feel that the EMC professional's public responsibility is to influence EMI-free design. The challenges and opportunities are there in the areas of personal global communications/computing systems, automated personal transport, and medical devices, for example. I challenge you to play a leading role to advance the concept of built-in EMC design rather than after-the-fact retrofit. In addition to public responsibility, it is also good business practice. Please accept the challenge.

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ROBERT D. GOLDBLUM
EDITOR

LET'S HAVE A SINGLE WORLDWIDE EMC STANDARD

Some in Congress would say that we should relieve NASA of the business of making and launching space vehicles and turn that operation over to industry which could do it more efficiently and cheaply. They would, however, continue to allow NASA to train astronauts and perhaps still define the missions. A new business entity

would be defined to build and maintain the hardware without interfering oversight from NASA. This sounded like an interesting prospect, except I couldn't help wondering what would happen to standardization as such, and the NASA EMC standards in particular. Could projects as large as a space station be developed without an EMC standard? We know that the FAA has RTCA DO-160C for commercial aircraft and that the major aircraft manufacturers have their own proprietary EMC standards. It is logical to assume, therefore, that the new entity would have to prepare its own "proprietary" EMC standard, which would probably be a derivative of all others, including MIL-STD-461/2.

After Secretary of Defense Perry's directive effectively canceled all military standards, the Navy has successfully saved MIL-STD-461/2, for two years at least, by having it defined as an environmental standard and gaining an exemption. The Air Force was able to save MIL-STD-461 only in the same way, but to date, the Army is not known to have even tried. The entire industrialized world uses MIL-STD-461/2 in one form or another in order to achieve system compatibility. In essence, MIL-STD-461 served as the world's EMC standard bearer, and if it is not maintained by the Department of Defense, what in the world are we going to do?

Wouldn't it be nice if we had an international EMC standard which could be accepted and used worldwide? This could provide common test methods, common instrumentation and comparable test data. This has been the biggest advantage of MIL-STD-461/2 even though some have deviated. With limited scope and purpose, the FCC issued Rules and Regulations to control EMI which required entirely different test equipment and facilities than MIL-STD-462. The European Union is far from harmonizing EMC standards since their scope and application is both limited and focused. Many of their test methods are archaic and the data would be very difficult to use in a system EMC analysis such as would be required by NASA or its successor.

We need an internationally accepted EMC standard which could be used to fulfill all needs. It should receive the endorsement of the FCC, FDA, DoD, FAA, SAMA,

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IEEE EMC SOCIETY NEWSLETTER PUBLICATION SCHEDULE

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May
August
November
February

EDITORIAL DEADLINES

March 15
June 15
September 15
December 15

Editorial Contributions for the May issue should be received by March 15.

BACK ISSUES OF THE EMC SOCIETY NEWSLETTERS ON MICROFICHE

We will have a few sets of the microfiche copies of the back issues of the IEEE EMC Society Newsletters from the present to 1955 when it was called "Quasars and Peaks". The price is \$25.00 postpaid. If you would like to have one of these sets you can order it from: Dr. Chester E. Smith, EMC Society Historian, 2 Jonathan Lane, Bedford, MA 01730.

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TODD HUBING
ASSOCIATE EDITOR

Just last week while I was talking to my mom on the telephone, it occurred to me that she doesn't really understand what I do for a living. She knows that I call myself an EMC engineer, but what is that? An EMC engineer is not like a dentist or a high school teacher. EMC engineers do not advertise in the yellow pages and they don't appear in movies or on television. How do I convey to my mom the importance of my profession? How do I make her aware of the exciting challenges that EMC engineers face?

I told my mom that I spent most of last week modifying the design of a data communications board to reduce radiated emissions by 20 dB. She said, "That's nice. (I could have said 200 dB and gotten the same reaction.) I told her the original design stopped working when it detected small glitches in the input signal but the modified design was immune to thousand-volt transients. She said, "Hmmm."

What I need are some examples of common EMC problems that my family can relate to. After all, EMC is more than meeting specs. EMC engineers make things work in the real world. Unfortunately, coming up with examples of everyday EMC problems that my mom can recognize is not easy. She doesn't own a computer and doesn't live near any radio towers.

Several days ago, I called to ask if she ever saw "snow" on the TV screen when she vacuumed. It was difficult to communicate with her because we could both hear another

telephone conversation on the line, apparently in Chinese. She thought I was asking about the weather. She told me they hadn't had any snow for two weeks and that she didn't watch TV when she vacuumed. So much for that idea. Somehow, somewhere there must be an EMC problem to which my mom can relate.

I heard there was going to be a network news special on EMC so I called my mom and told her to watch it. This seemed like the perfect opportunity to show her what I do for a living. TV news programs can make any topic seem exciting and important. I couldn't wait to see what they had to say about EMC. Since I was going to be out of town, I arranged to record the show. Unfortunately, a power flicker reset the programming on my VCR, so I missed it. My mother also missed it because the neighbor's new computer was causing the sound on her TV to fade in and out. Normally, when this happens she drives over to my Aunt Helene's house to watch TV. But her new car hasn't been running properly ever since she had that wireless security system installed. Not that it would have made a difference. Just as the program was starting, a low-flying plane triggered her automatic garage door opener, allowing the dog to escape. (She's had to keep the dog in the garage ever since lightning took out her electronic fence.) Another opportunity missed.

I guess I'll just have to live with the fact that some people never encounter EMC problems and that my mom may never fully appreciate what I do for a living. Oh well, at least I can feel good knowing that I am in a profession that is exciting, challenging and important. I may not be able to discuss it with my mom, but there are plenty of professional EMC engineers at chapter meetings and symposia that really enjoy talking about EMI, ESD, transients and similar topics. And as a profession, we must be doing a pretty good job. Otherwise, there would be a lot more EMC problems

plaguing the typical, everyday user of consumer electronic products - like my mom.

LOS ANGELES

Once again, I would like to thank Janet O'Neil for keeping us up-to-date on the activities of the Los Angeles chapter.

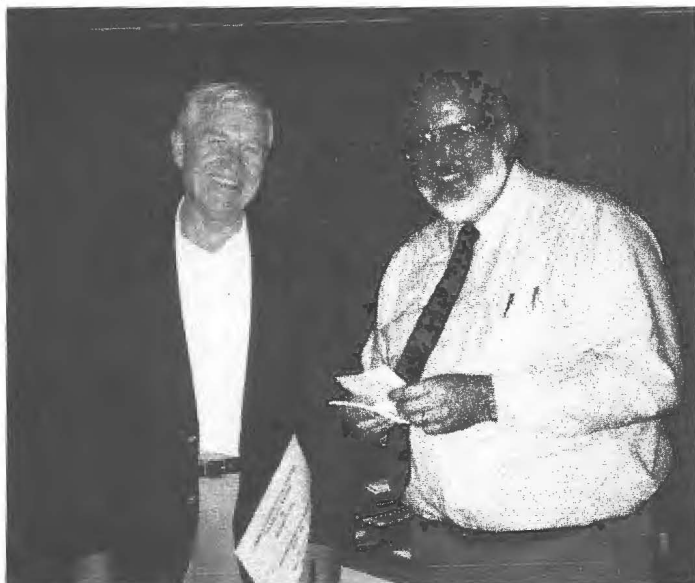
During the fall season, the Los Angeles chapter of the EMC Society presented speakers Daryl Gerke of Kimmel Gerke Associates, St. Paul, Minnesota, and Don Weber of Electromagnetic Engineering Technology, Seattle, Washington.

In October, Daryl presented a lighthearted approach to FCC and VDE testing. His presentation was titled "How to Fail FCC and VDE Testing in 20 Easy Steps." Daryl didn't know he would be speaking to a very knowledgeable audience! From the twisting and turning, not to mention the audible sighs and sideways glances, you could tell that many were very familiar with the 20 "easy" steps. Nevertheless, many took to heart Daryl's unique "Design for Failure" approach which offers three distinct advantages: 1) it saves on component costs, 2) it offers visibility with upper management, and 3) it leads to career mobility!! Some of Daryl's 20 easy steps included selecting the fastest components available (fast rise times look great on scopes), using the fastest clock that you can (triple the clock rate and gain 10 dB), being stingy with bypass capacitors (better yet, avoid them altogether), avoiding ferrites like the plague (since ferrites are lossy, they absorb energy you're trying to generate and radiate), using long pigtailed if forced to use shields (to defeat the shielding), using plastic connectors (they're cheap and can possibly eliminate a good RF ground), avoiding power-line filters (everyone knows that power lines only carry 50 or 60 Hz), and painting everything (this assures no accidental metal contact can occur which almost guarantees <20 dB of

Continued



Professor Alan McCurdy (left) from the University of Southern California and Professor Mahmoud Fawzy Wagdy (right) of California State University, Long Beach attend their first LA EMC chapter meeting to gather information on "real world" EMC which they can share with their students.



Speaker Daryl Gerke (right) checks his crib sheets for the answer to LA chapter member Joe Fischer's (left) question on how you can exceed both conducted and radiated emission limits at the same time by building your own switching power supply.

shielding). Finally, Daryl offered the sage suggestion "Never ask for help or advice." In all seriousness, this lighthearted "Design for Failure" approach really hit home with the audience. By looking at EMI emissions with a design-to-fail, instead of a design-to-pass, mentality, the presentation was funny and really "sunk in."

November's meeting featured Don Weber who spoke on "Real-World EMC Problems and Practical Solutions." This was a joint meeting with the Orange County Chapter. Don presented four different scenarios involving EMC

problems and offered their respective practical solutions. Each scenario was followed by an interesting slide show which really brought the topic to life. The scenarios involved a mode-tuned open strip line within an anechoic chamber for EMC testing (0-30 MHz) of automobiles, ship-loading cranes which caused electrical shocks to personnel, dairy farm EMI and the impact on milk production, and a highway construction project plagued by equipment failures. The slides of the highway project in Hawaii were particularly dramatic and beautiful. While each problem was unique, each solution was practical. This was especially evident as the mode-tuned open strip line *within* an anechoic chamber for EMC testing of automobiles over an extended frequency range was a combination of technologies not previously applied to EMC measurements.

For more information on these topics, please contact Daryl Gerke directly at (612) 330-3728 or Don Weber at (206) 431-9002.

Before breaking for the holiday season, Chapter Publicity Chairman Janet O'Neil shared the good news that she is expecting a baby girl in April. Janet relayed that the EMC Society Board of Directors, of which she is secretary, had suggested a worthy name for a baby girl. In keeping with the engineering "slant" given the name of Janet's son Henry, (short for micro henry, of course), the winning choice for a baby girl was Milli (short for milli amp, of course). The runner-up name was Tessie (short for, you guessed it, Telsa). This was suggested by concerned Board members who thought micro Henry might experience identity problems later in life caused by sister Milli amp, whose name technically outranked his by definition.

Photos courtesy of Janet Nichols O'Neil

CENTRAL NEW ENGLAND

John Clarke, secretary of the Central New England chapter, reports that the October meeting featured Tom Mahr of Voltech, Inc. who gave a "Canadian Perspective IEC 555 Part 2 and Part 3 Test Seminar." The seminar provided a demonstration of IEC 555 Part 2 and 3 testing of a photocopier. A complete walkthrough of the test requirements and test methodology for both steady state and fluctuating harmonics, as well as the effects of fluctuating voltage and flicker were described and demonstrated.

At the November meeting, Timothy Dwyer of TUV Rhineland Inc. gave a talk titled "European Community EMC Requirements and Testing." EC markets for electronic and electrical equipment require emissions and immunity capabilities which differ from those mandated by the FCC in the U.S. The discussion dealt with compliance testing for EC markets and related issues.

LONG ISLAND

I had the pleasure of meeting Bob Berkovitz, chairman of the Long Island chapter, at the November Board of



Speaker Don Weber (right) gives LA chapter member Larry Toller (left) a few pointers on practical solutions to EMI problems.

Directors meeting. He brought me up to date on their recent activities. In October, the Long Island chapters of the EMC, Antennas and Propagation, and Aerospace and Electronics Societies jointly sponsored a talk by Edward Aslan of Loral Microwave NARDA. Mr. Aslan spoke about "Radiation Hazard Standards and RF Measurement Methods." He presented a brief history of safety-level standards and the evolution of the present protection guide. His talk also described instruments and measurement techniques to comply with these standards.

In December, Edward Dorsey of NYNEX presented a brief overview of cellular communications and the evolution from analog FM to the various proposed forms of digital communications. He described frequency re-use, cell splitting and hand-offs. His presentation covered radio propagation, cell site design and mobile switching centers. He also discussed the issues of cellular fraud and health concerns.

PIKES PEAK

The new Pikes Peak chapter held its first meeting on December 5th with 23 people in attendance. The organizer of the local chapter, John Will from JAYCOR, was also the speaker at this first meeting. His talk was titled "EM Technology for Law Enforcement - JAYCOR's auto-arrestor." The talk seemed to be of interest to all attendees, and it is the chapter's intent that future talks will also be of interest to a wide variety of individuals — not just those in EMC. Several people have voiced an interest in presenting talks ranging from corporate perspectives of EMC to the use of reverberation chamber technology.

Officers were also elected at the December meeting. The new chair is John E. Will of JAYCOR. The vice chair is Gustav J. Freyer of USI. The new secretary/treasurer is James A. Youngman of JAYCOR.

SANTA CLARA VALLEY

Mr. William Parker, an EMC Society Distinguished Lecturer, was the featured speaker at the October

meeting of the Santa Clara Valley chapter. Bill is an independent EMC consultant. His talk was on "Solving Conducted Emissions and Susceptibility Problems" and described common-sense methods for fixing conducted EMI problems.

The November meeting featured John Howard, who gave a presentation titled "A Path to Printed Circuit Board Peace." His talk focused on a variety of techniques to control unwanted emissions from modern printed circuit board designs.

"Design and Synthesis of Compact Absorber for EMC Chamber Applications" was the title of Tom Ellam's presentation to the Santa Clara Valley chapter at their December meeting. Mr. Ellam is an engineering manager at Rantec Microwave and Electronics. His talk described the development of hybrid absorbers to meet ANSI C63.4 site attenuation and IEC 801-3 field uniformity requirements. These hybrids use ferrite tiles and multilayered, carbon-loaded dielectric cones.

In January, EMC Society Distinguished Lecturer Lee Hill returned to the valley to give a presentation titled "Impact of PWB Ground Plane Gaps on Inductance and Radiated EMI."

SEATTLE

Len Carlson, Director of Communications for the IEEE EMC Society, gave a talk on the IEEE Technical Activities Board and EMC Society plans at the October meeting of the Seattle chapter. In December, the chapter held a joint meeting with the Power Electronics Society. The speaker was Art Brockschmidt. He gave a talk about power systems, their problems (including EMC) and what was done to correct them. Both Art and Len are with Boeing.

SOUTHEASTERN MICHIGAN

Many thanks to Ray Sasinowski, chair of the Southeastern Michigan

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DICK FORD
ASSOCIATE EDITOR

The third (and last) EMCS Board of Directors (BoD) meeting of 1994 was held at IEEE's headquarters in Piscataway, NJ on November 11, 1994. It was part of a two-day event, the second day of which was an EMCS BoD Planning Retreat. The following directors were in attendance: **Warren Kesselman** (presiding), **Len Carlson**, **Don Clark**, **Bill Duff**, **Bob Hofmann**, **Dan Hoolihan**, **Todd Hubing**, **Bill Gjertson**, **Al Mills**, **Jim Muccioli**, **Janet O'Neil**, **Henry Ott**, **Andy Podgorski**, **Bill Ritenour**, **Don Sweeney**, **Norm Violette**, **Kimball Williams**, and myself. **Bob Berkowitz** also attended as a representative of the Long Island EMCS Chapter.

Highlights of the meeting and Directors' reports are as follows: President Kesselman welcomed the newly elected Board members, **Kimball Williams**, **Todd Hubing**, **Don Sweeney**, **Bill Duff** and **Bill Ritenour**, as well as the re-elected **Bill Gjertson**. **Bill Duff** has returned to the Board after a hiatus. **Bill Ritenour** was appointed to fill out the unexpired portion of **Dr. Akaio's** term, and now sits as a member in his own right. A number of IEEE headquarters staff members visited and addressed the meeting. **Charles Stewart** was introduced as the IEEE ombudsman. He invited any Society members with concerns about the functioning of the Institute to phone him at (908)562-5404 or fax him at (908)981-0721.

MEMBERSHIP

Dave Staggs reported that membership reports have temporarily become a victim of the IEEE headquarters' computer changeover. There is no data since my last report.

CHAPTERS

With the addition of new chapters from Germany and Pikes Peak, CO, the Society has reached its goal of forty chapters! In addition, the Chicago Symposium has engendered chapter formation activity in Beaverton, OR, Johnson City, NY, Newtown, CN, and Newburg, OR, as well as Taiwan. The Society continues to solicit nominations to replace **Dave Hanttula** as Distinguished Lecturer chair. In the meantime he reported four new applicants for Distinguished Lecturer, **Hugh Denny**, **Norm Violette**, **Todd Hubing** and **Franz Gisin**, and growing activity for the lecturers.

Chet Smith, EMCS Historian, reported that all the back issues of the EMCS Symposium conference records are now on microfilm and are archived at the Georgia Tech Research Institute and at the Center for the History of Electrical Engineering at Rutgers University. Chet reported that he continues to pursue the CD-ROM technology as the future for Society archiving. He also asked, "Does anyone know where the Society's Microfilm reader/projector is?" It was used at the Symposiums in Cherry Hill and Anaheim and was supposed to be used in Dallas and Chicago. Anyone with information should phone Chet at 617-275-0598.

SYMPOSIA

The proposed budget for the Atlanta symposium was submitted to the BoD for approval. Registration fees are up about 25% mainly because social function costs are up dramatically (nearly double those in Dallas). Exhibitor fees were held the same as Dallas and Chicago (\$1200).

The budget was approved with little discussion (**Bob Hoffman** dissented due to the large increase in registration costs). **Henry Ott** made motions addressing the distribution of symposium attendee lists, exhibitor badging and attendee video taping of conference events. All three motions were approved by the BoD with little or no discussion. As Society photographer, I moved to table the motion on video taping of conference events. The motion to table failed for lack of a second and the BoD then approved a blanket policy which forbids videotaping by any symposium attendees.

TRANSACTIONS

Moto Kanda submitted a request for approval for a special edition for 1996 on EMC research in Italy. It would be guest-edited by **Prof M.D'Amore** from the University of Rome.

TRANSNATIONAL

EMCS had booths at the IEE EMC symposium in Manchester, UK September 5-7 staffed by **Ferdy Mayer**; the Brazilian EMC Symposium, Sao Paulo, December 5-9, staffed by **Jose Perini**; and the EMC Symposium in Rome Italy, September 12-14 staffed by **Moto Kanda**.

PACE

Al Mills submitted his last report to the BoD as he goes into retirement. It covered the '94 IEEE PACE Conference and Workshop held in Phoenix last Labor Day weekend (see PACE article on page 21). President Kesselman thanked Al for his yeoman service and wished him the very best in retirement.

MEMBER SURVEYS

I took over this effort from **Bill Johnson** last year. I presented a detailed report on the survey taken at the Chicago symposium. I'll be



Photo courtesy of Dick Ford

Newly elected IEEE EMCS Board of Directors members. L to r: Kimball Williams, Todd Hubing, Bill Duff, Don Sweeney, and Bill Ritenaur.

comparing EMCS data with IEEE data and will have an article in the next newsletter.

STANDARDS

Don Heirman presented a detailed report from **Dave Traver**, EMC Standards Secretariat, on the status of EMCS standards and the minutes of their recent standards meeting. A number of standards will be up for review in 1995 and many subcommittees are in need of help. Contact Don at (908)834-1801 or Dave for more details.

EDUCATION

Activity continues at a hectic pace under **Kimball William's** chairmanship. There are now ten subcommittees in the Education Committee: Experiments, Symposium Demonstrations, University Grants, Internet, Outline & Abstracts, Publications, Tutorials, Student Activities, NARTE and CAEME. **Maqsood Mohd** (Publications) reported that IEEE has confirmed that there are no problems with committee plans to get symposium papers (in some cases updated) wider publicity/circulation

by facilitating secondary publication in journals and technical publications. There is an IEEE fee, but it's only \$25/page and it accrues to our Society. **Jim Muccioli** (Student Activities) reported that a student paper contest is being planned for the 1996 symposium. Based on the excellent attendance at his Chicago workshop, **Jim Whalen** will again hold his "Preparing for the NARTE Exam" at the Atlanta Symposium. Plans for producing video tapes of education activities, specifically EMC demonstrations, continue. The product will be based on tapes I took in Chicago and additional taping being planned. **Tom Van Doren, Jim Drewniak, and Todd Hubing** have proposed that the tapes focus on four particular demonstrations, "Path of Least Resistance," "Cross Talk Between Signal Paths," "High Speed Pulses on Transmission Lines," and "Radiated EMI." The list is tentative but high activity levels continue on this as well as several other Education subcommittees.

As usual, **Janet O'Neil**, EMCS Secretary, will be happy to provide additional details on the happenings at this (or any other) BoD meeting.

industry, and all other U.S. regulatory agencies. Ultimately, it would receive the endorsement of international organizations such as the CSA, BSE, EU, VDE, and others. There would be uniformity in test instrumentation and test methods. Only the limits and applicability would vary depending upon the application. This would be a worthwhile effort by the U.N. and even the World Health Organization. It could be mandated by GATT and be applied and tailored according to preset definitions and be distributed and applied by CD-ROM and future technologies. It would be voluminous, yet simple to apply. It would be all-encompassing and would result in accurate and repeatable data throughout the world.

To start, we must involve the IEEE EMC Society since it is in fact, an international society. Then we must encourage ANSI, SAE, and EIA to join in their EMC standards activities. The EU and other international organizations addressing EMC must also get involved, as should all U.S. Government agencies. Is this an impossible dream? What do you think?

THE PRESIDENT'S MEMORIAL AWARD

The President's Memorial Award, our Society's most prestigious award, honors the memory of a recently deceased Society member by granting a scholarship of up to \$2000 to a worthy graduate or undergraduate studying in an EMC-related technical field.

Through donations from individuals and corporations, the award links the Society's past, present and future. The EMCS President, after advice and consent from the BoD, announces whether the award will be made for the year and charges the Awards Committee to select the scholarship recipient.

For more information or to nominate scholarship candidates contact the President of the EMC Society.



JOSEPH BUTLER
ASSOCIATE EDITOR

IEEE COMMITTEE ON MAN AND RADIATION (COMAR)

Dan Hoolihan, Representative
Advisory Committee (RAC)

Representative

COMAR, previously an IEEE Technology Policy Council, has recently been annexed by the IEEE Engineering in Medicine and Biology Society (EMBS) as one of their technical committees. COMAR's entity position statements, now to be called technical information statements, will be published in the *Engineering in Medicine and Biology Magazine*.

IEEE TECHNOLOGY POLICY COUNCIL COMMITTEE

Engineering and Defense R&D
Dick Ford, RAC Representative

The recent activities of this TPC have centered around the future of DoD Laboratories. A draft position statement has been prepared by Dick Ford.

APPLIED COMPUTATIONAL ELECTROMAGNETICS SOCIETY

Dick Ford, RAC Representative

Dick Ford is participating in discussions with ACES about helping them to improve exhibitor participation at their annual Monterey, CA symposium.

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE), AUTOMOTIVE EMI AND EMR COMMITTEES

Ed Bronaugh, RAC Representative

A proposal has been put forward to combine the separate automotive EMI and EMR committees into a single group. Since a sizeable percentage of people serve on both committees, this proposal makes good sense considering that both committees address EMI and EMR issues. The IC Task Force under Jim Muccioli would also be included in this combination. Work on both SAE J1113 and J551 continue at present.

ANSI C63 AND CISPR A&G

Don Heirman - RAC Representative

Within C63 the 1995 edition of C63.4 (Emission Measurement Procedures) is undergoing preparation. This document may include a reference to EMCS IEEE STD 475 for measurement of field disturbance sensors. The government's Tri-Service MIL-STD-461 EMI Committee is considering standards such as C63.4 and C63.12 for military Commercial off the Shelf (COTS) procurements.

Within CISPR A working group, the second part of CISPR Pub 16 on general methods of measurements for emissions and immunity is about to be published in 1995. Work is continuing on antenna factor and emission test site validation so as to include them in Pub 16. The meeting that addressed this material was held in Beijing, China in early October 1994.

In CISPR G, the third edition of Pub 22 is well on its way towards realization. This will look very similar to ANSI C63.4 - 1992 with the exception of the addition to Pub 22 of

measurements of telecom port emissions between 150 kHz and 30 MHz. Work on Pub 24 on ITE immunity continues with a draft outline presented at the meeting in Beijing, China in early October 1994.

SOCIETY OF AUTOMOTIVE ENGINEERS SAE-AE4 EMC

David Graham, RAC Representative

SAE Committee AE4 is continuing efforts on the release of Aerospace Recommended Practice (ARP) on system EMC compatibility, filters, and spectrum analyzer use. The subcommittee 4P work on gasket test methods, in conjunction with the IEEE P-1302 committee, continues. The updating of ARP 1972 (Recommended Test Methods) has begun with recommended changes to be created and circulated for committees by March 1995. Subcommittee AE4R's work on HIRF is largely completed. Subcommittee AE4R continues its work on trying to define the High Intensity Radiated Fields (HIRF) environment for helicopters. Subcommittee AE4L continues the revision of the Lightning "Orange Book" (AE4L-87-3, Rev. C) and RTCA DO 460C, Section 22, in cooperation with WG-3L to reflect the latest information on lightning.



KIMBALL WILLIAMS
ASSOCIATE EDITOR

EDUCATION COMMITTEE CONFIGURATION & INTERESTS

At the last two meetings of the Board of Directors (BoD) of the EMC Society, Jim Muccioli and I put forth a request that the Student Activities Committee which Jim chairs and the Education Committee be combined into a single entity under the banner of the Education Committee. Jim and I have been working together for the past two years (Jim is the current vice-chair of the Education Committee) on efforts which are aimed at furthering the interests of both groups.

With this request moving forward within the BoD, I felt that a discussion of the vision of the expanded role of the Education Committee was in order for the members of the Society. To that end, I have outlined the current activities of the Education Committee below and indicated those areas where future work will be needed to address the expanded role as we perceive it at this time.

At some time during the next year it would be wise for the Education Committee to review its charter with this expanded role in mind to be sure that we have a clear and unambiguous philosophical base for our activities.

MEMBER TECHNICAL CURRENCY

While the continuing education of the members of the EMC Society has always been a directive for the

Education Committee, we have never had a serious concern for this area of our work due to the excellent efforts of the Technical Committees within the Society. Every symposium has seen a set of well-presented and well-attended workshops put on by the Technical Committees, which do about as much as can be done to keep members informed of the state of technology.

In the recent past the Education Committee has only identified one area (fundamentals for new engineers entering the EMC field for the first time) that we felt we could contribute to with a workshop of our own.

As long as these contributions by the Technical Committees continue, I don't see any additional useful role that the Education Committee can play in this area. However, if someone is aware of something that we should be doing for member technical education that we have overlooked, please let us know.

PUBLIC AWARENESS

The Outline and Abstract Subcommittee has prepared a generic talk for presentation to non-engineering groups and should have a set of slides and/or overheads along with video supporting materials for use by EMCS members ready for distribution after the next symposium. The intent is to help our Society members become ambassadors to the general public for EMC, the EMCS and the IEEE.

UNIVERSITY AWARENESS

The Student Activities Subcommittee took the second document prepared by the Outline and Abstract Subcommittee which is directed at university undergraduates, and has been using it to work out the bugs and refine the format by making presentations to IEEE student chapters. At each presentation the

student chapter chair is presented with a copy of the EMCS Education Manual.

At least one member of the faculty of the institution has attended these presentations, and so far, all of the comments that have been received have been supportive and complimentary.

Packages of the materials for university presentations should be available for distribution to members sometime after the next symposium.

STUDENT (UNIVERSITY) ACTIVITIES/SUPPORT

We are moving forward with plans to increase promotion of the President's Scholarship award for students in the EMC discipline as well as plans to sponsor students to present EMC papers on a regular basis at the symposium.

We will continue to present a paper section in EMC education on a regular basis (every two or three years) at the symposium to bring our members up to speed as to the status of cutting edge education activities.

CAEME SUPPORT

We continue to support the work of the Computer-Aided Electromagnetic Education (CAEME) organization. This year we have taken a more active role in assisting CAEME to define a selected set of computer simulations which will work hand-in-hand with the traditional Emag Field Theory course to aid students in assimilating this fundamental information on a "gut feel" level.

In addition, we are working to develop a set of video tapes which will capture the EMC experiments in a way that would allow them to be used as an adjunct to Emag Field Theory courses and to provide the student with an introduction to EMC

Continued on page 10

EMCS EDUCATION COMMITTEE . . .

Continued from page 9

concepts, along with an awareness of the "relevance" to practical electronics of the theory being studied.

IEEE EDUCATION ACTIVITIES BOARD

A little over two years ago I began to explore ways in which the IEEE Education Activities Board (EAB) and the EMCS Education Committee could work together for our mutual benefit. I regret to say that so far, there has been no helpful linkage coming out of this exploration. However, I will continue to pursue this connection until I am sure that I have exhausted all possibilities.

OTHER SOCIETY COOPERATIONS

This year we have begun an active effort to establish linkages between the EMCS education activity and the education activities of our sister societies. This is another exploratory operation which is just at the initial stages. As such it has only potential at this point and little significant progress can be reported as yet. However, we have high hopes that there will be areas of mutual benefit that we may be able to establish. As developments proceed, I will update everyone on the progress.

If any of these activities sounds like it is something that you would like to take part in, please contact me at: Eaton R&D

26201 North Western Highway

Southfield, MI 48037

PH (810) 354-2845

FAX (810) 354-2739

e-mail k.williams@ieee.org

I will be more than happy to put you in direct touch with the chairman of the subcommittee that is working on this area of EMC Education.



REINALDO PEREZ
ASSOCIATE EDITOR

**SPECIAL ISSUE ON ELECTROMAGNETIC
COMPATIBILITY, PHILIPS JOURNAL OF
RESEARCH, VOL. 48, NO. 1 & 2, 1994.**

**R. F. MILSOM, K. J. SCOTT, P. R. SIMONS,
J. R. BERGERVOET, M. J. COENEN, R. DU
CLOUX, G. P. J. F. M. MAAS, AND
A. J. H. WACHERS**

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*Acknowledgment: Thanks are
expressed to the Editor, Dr. M. H.
Vincken (Philips Research Lab,
Eindhoven, The Netherlands) for
facilitating a copy of this manuscript.*

In January 1994 the Philips Journal of Research dedicated a special issue to the subject of electromagnetic compatibility with emphasis on the EMC issues that relate to printed circuit board (PCB) design. The objective was to introduce Journal readers to the research at Philips Lab concerning the area of incorporating EMC design tools in the development of PCBs.

This journal consists of five chapters, each of which is a research paper. The first two and last papers in the journal are theoretical treatments of the computational electromagnetic technique known as the Boundary Element Method (BEM) which is a particular form of the Method of Moments. These three papers deal with different aspects of a BEM code being developed at Philips known as FASTERIX, an EMC tool which is being used in the design of PCBs.

The fourth paper addresses the important role of common-mode currents on cables connected to printed wiring boards (PWB) and other equipment. This paper shows how parasitic capacitances and inductances significantly affect the coupling between cables and noise-emitting devices within the PWB. The paper also shows how to calculate some of these parasitic capacitances and inductances. The fifth (and last) paper deals with test methods for emissions and immunity of PWBs and integrated circuits (IC). We will now review each paper in more detail.

The first paper is titled "Reduced Equivalent Circuit Model for PCB." The paper discusses the capabilities of the aforementioned EMC tool known as FASTERIX. The tool has been under development at Philips for several years and its purpose is to aid in the design of PCBs such that EMC is considered in the design and developmental stages. This paper can be interpreted as a simplified "user manual" for FASTERIX, except that it only covers the theory. Let's talk a bit about the code.

FASTERIX is an EMC tool that uses a quasi-static approximation of the BEM. The main objective of the code is to generate an equivalent lumped-parameter representation (capacitors, inductors, resistors) of all actual interconnects of any arbitrary layout in a PCB. The results of this code are then "dumped" into a SPICE-like circuit analysis program for a complete simulation of a typical PCB. This is a recent trend in the development of electronic design automation (EDA) tools. Most commercial tools for electronic design are incorporating the modeling of interconnects, pins, and connectors as integral parts of the SPICE simulation of electronic components (i.e. diodes, transistors, gates, etc.). This is being done to assure signal integrity, especially at higher frequencies. However, the degree of accuracy at which such

modeling is being done varies among the different EDA tools. Variations range from simple approximations of transmission lines and crosstalk among microstrip traces to the use of some form of computational electromagnetic front ends. Often such decisions are driven by market forces, the practical needs of the users, and the computing resources. Notice that in FASTERIX a quasi-static approximation of the BEM is used which is good for small size interconnects (small compared to wavelength); hence, in a typical PCB this is a fair assumption. In the BEM the solution for the current density $J(r)$ and charge density $p(r)$ on the conductor surface are expanded over basis functions. Normally these will result in large matrix operations. However, FASTERIX implements a "reduced" circuit model approach in which the scalar potential $\phi(r)$ is treated as the unknown (rather than the current and charge densities). The solution for $\phi(r)$ is expanded over a new set of basis functions. Vector potential, current density and charge density basis functions are derived from this original set. This procedure works if $\phi(r)$ is independent of r (electrically small conductors), hence $\phi(r)$ can be expanded using a small set of basis functions. The paper elaborates on how to determine the basis functions (scalar and vector potential). The Green function used is a quasi-static one. The electric and magnetic fields are determined using the common relationship between fields and potential. Boundary conditions are applied (for E and H) to accurately solve for the scalar potential. The paper shows how the above analysis yields an equivalent admittance matrix model for the interconnects and how this matrix can be further used to derive a lumped equivalent representation of frequency independent components. The chapter ends with a more detailed explanation of how the basis functions which are used in the evaluation of LRC components are derived.

The computation of capacitance, inductance and resistance in the equivalent circuit model consumes the majority of the CPU time in the FASTERIX program. This time depends also on the time consumed in evaluating the scalar potential from a particular charge distribution. The charge distribution, however, is proportional to the number of terms in the image series used to obtain the potential. The second paper, "Efficient Image Theory for Electromagnetic Field Modeling in PCB," describes three techniques for speeding up the computation of scalar potentials by reducing the number of terms needed in the image series. The improvements are most effective when the original infinite series are slowest to converge.

Concluding the theoretical exposition of FASTERIX is the last (fifth) paper in the book, "Quasi-Static Boundary Element Method for EM Simulation of PCB." In this chapter the theory of BEM is developed from Maxwell's equations and "tied" into the development of equivalent circuit models using a Norton representation of the interconnect systems. The Norton model is described in terms of voltages and currents at its ports. The determination of the equivalent circuit model (Norton parameters) is based on the solution of boundary value problems formulated in terms of mixed potential electric field integral equations which are discretized and solved quasi-statically.

As well as theory, this journal issue covers two papers on experimental work in EMC measurements. The third paper, "EMC Measurements and Models Connecting the System Level with the Module Level," shows how common-mode currents in cables are caused by parasitic coupling of electrical signals on a PCB (the major source of radiated EMI in computing devices). The paper shows that even small

quantities of capacitances (femtopharads) and inductances (picohenries) are enough to produce the common mode currents. A general approach is shown which describes these effects in an accurate manner. An example of a PWB is used to validate these assertions. The paper proposes a model described as the "surface field method" to account for the coupling between a PWB and its attached cables. It is shown how to calculate some of these parasitic components.

The fourth and largest chapter in the book is titled "EMC Workbench: Testing Methodology, Module Level Testing and Standardization." The paper presents testing methods for evaluating PWB for both conducted emissions and immunity in the 150 kHz to 1 GHz region, and shows how these derived parameters are also related to radiated emissions. The test procedure concentrates on the driving sources of common-mode current. Differential-mode currents are considered implicitly as a result of ground impedance transfer. The test procedure calls for a Faraday cage and provides constraint when evaluating subsystems on a single PWB containing several ICs. As not all ICs on a PWB have a direct interface to outside points, the procedure describes how to select test points and coupling/decoupling networks to evaluate the ICs in the normal working environment. The paper describes the relationship between this proposed evaluation method of PWB and existing test methods. An important part of this paper is a verification procedure of test equipment to be used with the presented evaluation method.

This special issue of the Philips Journal of Research is recommended reading for those involved in designing PWBs with EMC in mind. In this editor's opinion the paper on emission/immunity testing and evaluation is particularly useful and practical.

EMC PERSONALITY PROFILE



DR. GEORGE COSTACHE

George graduated from the Polytechnic Institute of Bucharest, Romania, in 1966 with a degree in Electrical Engineering. He obtained his doctoral degree from the same institution in 1974 in the field of theoretical electromagnetics.

In 1976 he emigrated to Canada and worked with Dr. A. Wexler in numerical techniques applied to electromagnetics in the Department of Electrical Engineering, University of Manitoba, Canada. In 1977 he had the opportunity to apply his theoretical knowledge to electromagnetic interference and compatibility problems when he was hired by Mr. Stan Xavier to work with the EMC group at Bell Northern Research, Ottawa, Canada.

For eight years he worked primarily with telecommunication EMC standards with Stan Xavier and Dick Goulette and was involved in research related to electromagnetic emissions from electronic equipment and in research related to electrostatic discharge (ESD). During this time he developed computer models based on numerical techniques such as the Finite Element Method to simulate EMC problems related to crosstalk on printed circuit boards, electromagnetic emissions from electronic equipment, and shielding effectiveness for arbitrary geometries of equipment enclosures.

During his stay at Bell Northern Research, George was exposed to very interesting practical work related to products and the broad field of electromagnetic compatibility. Together with Dick Goulette and Stan Xavier, he was involved in teaching courses on EMC to the telecommunications industry.

In 1985 he joined the Department of Electrical Engineering, University of Ottawa, Canada, where he started teaching a graduate course on EMC with Dr. P. Bhartia. He was also involved in teaching short courses on numerical techniques at George Washington University and he gave numerous invited lectures on EMC in Japan, Switzerland and Italy.

He has taught electromagnetics and numerical techniques applied to electromagnetics for more than 24 years and has made original contributions to the solution of skin-effect problems and electromagnetic transient phenomena. His main interest is in numerical techniques, such as finite-element analysis and moment methods, and their application to interference problems in steady-state and time-domain applications. He has done research in electromagnetic interference and compatibility and brought contributions to the time domain approach to address transients, ESD, electromagnetic pulse and lightning



WILLIAM G. DUFF
ASSOCIATE EDITOR

and their impact on digital systems. He has developed software programs and numerical techniques using methods such as finite elements, moment method and finite differences to solve electromagnetic interference problems.

Currently, he is Professor and Chairman, Department of Electrical Engineering, University of Ottawa, Canada. He is also a consultant in EMC for the telecommunication industry.

Author or co-author of over 90 technical papers and reports, Dr. Costache is an associate editor of the IEEE Transactions on Electromagnetic Compatibility. He is also a member of the editorial review boards of COMPEL, the International Journal for Computation and Mathematics in Electrical and Electronics Engineering, the International Journal of Numerical Modeling, Electronic Networks Devices and Fields, and the IEEE Transactions on Microwave Theory and Techniques. He is a registered Professional Engineer in the Province of Ontario, Canada. He has served as vice-chairman and treasurer of the IEEE Ottawa Chapter and has been involved in IEEE student-related activities.

CHAPTER CHATTER . . .

Continued from page 5

chapter for providing the following report. At the October chapter meeting Kimball Williams, Senior EMC Engineer for Eaton Corporation, NARTE Certified EMC Engineer, EMC Society Education Committee Chairman, and member of the National EMC Society Board of Directors, presented a software-based technique to prevent electronic micro-based equipment from being "locked up" due to electromagnetic interference.

Sensitive electronics are being placed in harsh environments to control and monitor critical operations, making it more likely that the electronics will be exposed to EMI. Kimball's software is uncomplicated and cost-effective. Everyone enjoyed Kimball's paper on this important EMC concept.

On Wednesday, November 9th, the Southeastern Michigan chapter and the University of Michigan-Dearborn IEEE student branch held a joint meeting. This is part of the S.E. Michigan EMC Society Outreach and EMC Awareness program promoting the IEEE EMC Society to local colleges. Vice-chair Kimball Williams gave an overview and history of EMC, describing how it affects our everyday life. Several EMC case histories were discussed. Questions from the students were answered and hopefully their minds were opened to the pitfalls of circuit design without considering EMC issues. Don Seyerle of General Motors' corporate EMC facility performed an entertaining and informative radiated emissions experiment.

TWIN CITIES

The Twin Cities chapter held its 9th annual Minnesota EMC Event in October. The show was quite successful and well-attended. Lee Hill of Silent Solutions was the featured speaker. His talk titled "The Impact of Segmented PWB Ground Planes on Inductance and Radiated EMI" was very well received. Lee is an IEEE EMC Society Distinguished Lecturer.



WILLIAM H. MCGINNIS
ASSOCIATE EDITOR

Following are abstracts of papers from previous EMC Symposia, other conferences, meetings and publications.

EMCAB COMMITTEE

Mike Crawford, Consultant
Bob Hunter, Consultant
Yoshio Kami, Univ. of Electro-Communications
Sha Fei, EMC Research Section, N. Jiatong Univ., Beijing, China
Ferdy Mayer, L.E.A.D., Maisons, Alfort, France
Diethard Hansen, Euro EMC Service, Berlin
Perry Wilson, EMC Baden, Ltd., Switzerland
Heinrich Garn, Austrian Research Center
Atanas Lazarov, Technical University of Sofia, Bulgaria

"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 or papers. If the library you visit does not own the source document, the librarian can probably request the material or a copy from another library through interlibrary loan, or for a small fee, order it from NTIS or DTIC. Recently it became clear that EMCABs were more timely than publications which were being listed in data files. Therefore, additional information will be included, when available, to assist in obtaining

desired articles or papers. Examples are: IEEE, SAE, ISBN, and Library of Congress identification numbers.

Also, the steering staff of the Japan Technical Group and the EMC-J Tokyo chapter have offered to act as a central point for requests of papers abstracted here. Most of the papers will be available in Japanese only. The steering staff will assist in routing your request to the author(s) but will not translate the papers. The contact person is Prof. Yoshio Kami, the University of Electro-Communications, 1-5-1, Chofugaoka, Chofu-Shi, Tokyo 182, Japan. Abstracts of papers from EMC-J will be clearly identified.

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

As the EMC Society becomes more international, we will be adding additional worldwide abstractors who will be reviewing articles and papers in many languages. We will continue to set up these informal cooperation networks to assist requesters in getting the information or contacting the author(s). The library at Southwest Research Institute, 6220 Culebra Road, San Antonio, Texas, 78228-0510 has agreed to catalog, shelve, and have available for interlibrary loans proceedings from symposia and meetings which are donated to the library. Any such donations can be sent to me at the above address and I will review them for suitable articles and then forward them to the SWRI library. We are particularly interested in symposium proceedings which have not been available for review in the past. Neither the abstractors nor myself have a budget for acquiring proceedings; we rely on those we receive through attendance at symposia and from various subscriptions. Thank you for any assistance you can give to expand the EMCS knowledge base.

<p>TECHNOLOGY INNOVATION "THE INDUSTRY HIGH WIRE WALK" J. Gormley and W.A.Schink Ford Motor Co. Proceedings of the 1994 International Congress on Transportation Electronics, Dearborn, MI ISBN 1-56091-548-X, Library of Congress cat. card #: 94-67471, IEEE cat #: 94CH35729 17-19 October 1994, pp. 1-11</p> <p><i>Abstract:</i> Development of creative and innovative products is critical to success and long-term survival in the global automotive market. Technology innovation requires a balance of technology and customer needs. This paper suggests improvements along with enablers, such as the systems engineering approach, to effect improvement. A predictive process to assess the merits of innovations is described with examples.</p> <p><i>Index terms:</i> Technology innovations, automotive electronics</p>	<p>EMCABS: 01-03-95</p>	<p>INTERNATIONAL MANDATORY PRODUCT STANDARDS Donald N. Heirman (1), Steven M. Crosby (2), and Douglas C. Smith (2) (1) AT&T Bell Laboratories, Holmdel, NJ; (2) AT&T Bell Laboratories, Middletown, NJ AT&T Technical Journal; Vol. 72, March, April 1993, pp. 25-40 <i>Abstract:</i> This paper surveys the mandatory international standards for equipments, with emphasis on Information Technology Equipment (ITE) and Telecom Terminal Equipment (TTE). It follows an earlier paper by Heirman that was previously abstracted. CISPR Publication 22 emission limits at telecom ports are reviewed. Generic immunity standards that will be replaced by product standards are discussed. Common Technical Regulations (CTR) pursuant to the TTE Directive are discussed. The criteria for Notified Bodies are reviewed and compliance approaches are analyzed. Specific design techniques for meeting immunity and emissions requirements are presented; these include clock distribution, signal traces, and power and ground planes in multilayer PWBs, cables, enclosure openings, use of ferrites, ground switches for PWBs, and segregation of high frequency circuits.</p> <p><i>Index terms:</i> EMC directive, compliance approaches, telecom terminal equipment directive, design for immunity and emissions control at system level and at PWB level, Quality Systems (QS) role, RF immunity, ESD immunity, fast transients, ground noise</p>	<p>EMCABS: 04-03-95</p>
<p>NEW STAGE OF AUTOMOTIVE ELECTRONICS Tsuneo Takahashi Honda R&D Co., Ltd. Proceedings of the 1994 Int'l Congress on Transportation Electronics, Dearborn, MI ISBN 1-56091-548-X, Library of Congress cat. card #: 94-67471, IEEE cat #: 94CH35729 17-19 October 1994, pp. 23-32</p> <p><i>Abstract:</i> Applications of advanced electronics are expected to expand from simple car-oriented systems to systems that integrate individual cars into traffic management systems such as IVHS. This paper reviews the history of car electronics with examples of introduced electronics technologies, proposes future developing technologies, and a new era of automotive electronics from the viewpoint of "enablers and inhibitors."</p> <p><i>Index terms:</i> Technology development, automotive electronics</p>	<p>EMCABS: 02-03-95</p>	<p>THE FUTURE OF AIRBAG CONTROL SYSTEMS Hans Spies Temic Proceedings of the 1994 Int'l Congress on Transportation Electronics, Dearborn, MI ISBN 1-56091-548-X, Library of Congress cat. card #: 94-67471, IEEE cat #: 94CH35729 17-19 October 1994, pp. 61-69</p> <p><i>Abstract:</i> The demand for high performance, reliability and lower cost will impact the design of airbag control systems. Higher levels of integration will reduce the component count to single chip solutions, improving the reliability of the controller. New accelerometer technology will lead to the integration of the sensor into the signal conditioning device. Finally, the advent of new safety management systems will provide further cost reductions and drive innovations in the area of autodidactic passenger protection systems.</p> <p><i>Index terms:</i> New technology, automotive electronics</p>	<p>EMCABS: 05-03-95</p>
<p>NIST HANDBOOK 150, NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM (NVLAP), PROCEDURES AND GENERAL REQUIREMENTS J.L. Cigler and V.R. White, Editors U.S. Dept. of Commerce, NIST, Bldg. 411, Room A162, Gaithersburg, MD; Stand-alone document <i>Abstract:</i> This handbook includes Part 285 of Title 15 of the U.S. Code of Federal Regulations (CFR) for NVLAP policies and procedures. It places all of the general accreditation requirements in one place. Subpart D (which is new to the NVLAP requirements) includes requirements for calibration laboratories that desire to become accredited under the NVLAP program. It includes language of ISO Guide 25 as interpreted in ANSI/NCSL-1¹ for the assessment of quality systems for the control of Measuring and Testing Equipment (M&TE). That in turn is based on the requirements of MIL-STD-4566A. This handbook is useful for those involved in establishing laboratory accreditation programs as well as those using the services of such laboratories.</p> <p>¹National Conference of Standards Laboratories (NCSL).</p> <p><i>Index terms:</i> NVLAP Program procedures and requirements, conformity assessment for testing and calibration laboratories, quality systems, international acceptance of laboratory measurements</p>	<p>EMCABS: 03-03-95</p>	<p>SEMICONDUCTOR POWER TECHNOLOGY FOR ELECTRIC VEHICLES S. Sato and T. Sugimoto Toshiba Corp. Semiconductor Engineering Center Proceedings of the 1994 Int'l Congress on Transportation Electronics, Dearborn, MI ISBN 1-56091-548-X, Library of Congress cat. card #: 94-67471, IEEE cat #: 94CH35729 17-19 October 1994, pp. 79-90</p> <p><i>Abstract:</i> Key components for electric vehicles are considered, including high efficiency high power battery, high efficiency motor and its control system. The best suited power semiconductors for electric vehicle inverter application, IGBT (insulated Gate Bipolar Transistor) is compared and discussed in conjunction with alternative devices. The next technical trends for IGBT modules are also discussed.</p> <p><i>Index terms:</i> Electric vehicles, EMI considerations</p>	<p>EMCABS: 06-03-95</p>

PHASE VARIATION DEPENDENCIES ON SUPERPOSITION OF RADIATED INTERFERENCE IN TELECOMMUNICATIONS EQUIPMENT

M. Takahashi, K. Murakawa, H. Oohashi, and M. Tokuda
NTT Telecommunication Networks Labs.)
EMC-Japan meeting at Kikai-Shinko-Kaikan, Tokyo
May 7, 1994, EMCJ94-21

Abstract: In this paper, the relation between phase variation in the harmonics and characteristic of superposition of radiated interference is discussed. Therefore, if the amount of phase variation is over 180 degrees, characteristic of superposition agrees well with power sum within 4dB, and it agrees with characteristics of superposition of radiated interference in PBX within 5dB.

Index terms: Radiated interference, phase variation, harmonics, superposition

EMCABS: 07-03-95

APPLICATION OF COMPLEX ANTENNA FACTOR TO NEAR-FIELD

R. Gokita, S. Ishigami, and T. Iwasaki
Univ. of Electro-Communications
EMC-Japan meeting at Tohoku University
October 21, 1994, EMCJ94-36

Abstract: The near-field application of the complex antenna factor defined in the far-field for a monopole antenna is discussed. From the experimental result, it is revealed that the complex antenna factor can apply within 2 dB error over 2 GHz, for an antenna distance of 2 to 8 cm and in a frequency range of 10 MHz to 6 GHz for the distance of over 5 cm.

Index terms: Complex antenna factor, near-field, monopole antenna

EMCABS: 10-03-95

ON THE APPROXIMATE VALUE OF THE NEAR-FIELD SHIELDING EFFECTIVENESS

T. Yamaguchi, and Y. Amemiya
Kanazawa Institute of Technology
EMC-Japan meeting at Kikai-Shinko-Kaikan, Tokyo
May 7, 1994, EMCJ94-25

Abstract: In this paper, the shielding effectiveness in near fields is considered; the approximate values are presented in comparison with the rigorous value derived analytically from electromagnetic theory.

Index terms: Shielding effectiveness, near field, dipole

EMCABS: 08-03-95

NUMERICAL CALCULATION OF SPECIFIC ABSORPTION RATE IN TWO-DIMENSIONAL MODELS OF MAN LOCATED NEAR CORNER REFLECTOR FOR MICROWAVE EXPOSURE

T. Kitaide, S. Kuwano, and K. Kokubun
Nihon University
EMC-Japan meeting at Tohoku University
October 21, 1994, EMCJ94-38

Abstract: Two-dimensional models of circular and elliptic cylinders are used to estimate the specific absorption rate of man located near right-angled corner reflector for TE-microwave exposure. The method of imaging combined with mode-matching and the finite-difference time-domain method are applied to the model calculation of circular and elliptic cylinders, respectively. The results show that the average SAR is several times higher than one in free space.

Index terms: biological effect, SAR, corner reflector, microwave exposure

EMCABS: 11-03-95

ANALYSIS OF PYRAMID ELECTROMAGNETIC WAVE ABSORBER

H. Anazai, Y. Naito, T. Mizumoto
Tokyo Institute of Technology
EMC-Japan meeting at Kikai-Shinko-Kaikan, Tokyo
September 13, 1994, EMCJ94-27

Abstract: A modified approximate method is proposed as an analytical method of the pyramid type electromagnetic wave absorber for the oblique angle of incidence. This new method has applied multi-layered plate model with equivalent anisotropic permittivity. The method was compared with numerical simulation and experimental results.

Index terms: pyramidal EM absorber, oblique angle of incidence, synthesized capacitance model, spatial network method

EMCABS: 09-03-95

REMOTE ENTRY AUTHENTICATION AND SECURITY

Alan Finn, Robert LaBarre, and Roger Carroll
United Technologies Research Center
Proceedings of the 1994 Int'l Congress on Transportation Electronics, Dearborn, MI
ISBN 1-56091-548-X, Library of Congress cat. card #: 94-67471, IEEE cat #: 94CH35729
17-19 October 1994, pp. 503-508

Abstract: This paper presents the issues associated with remote entry authentication for the automotive industry. Authentication is the process of validating the source of a remote entry command; it is an essential part of vehicle security. Early remote entry systems used fixed user identification codes for authentication. Fixed codes may be intercepted and played back, therefore current systems use continuously changing codes. The design of a secure remote entry product depends on the number and type of security threats. Various threats and their consequences are reviewed.

Index terms: RF remote entry, cryptographic attacks

EMCABS: 12-03-95

IEEE EMC SYMPOSIUM SPECIAL SESSION: EMC EXPERIMENT DEMONSTRATIONS, CHICAGO TO ATLANTA

ANDREW DROZD,
SUBCOMMITTEE CHAIR
EMCS EDUCATION COMMITTEE

It is my pleasure to announce that the Special Session Exhibit, which showcased a series of EMC experiments at last August's EMC Symposium in Chicago, was again a tremendous success! This was the second such exhibit of its kind sponsored by the EMCS Education Committee. Recall that we launched the Special Session at the 1993 EMC Society Symposium in Dallas. After "test driving" the new session for the past two years, it has become apparent that this popular event will continue to be in demand at future symposia. According to the general consensus in Chicago, the Special Session Exhibit added a desirable "extra dimension" to the symposium format.

The exhibit demonstrated experiments that illustrate important EMC concepts and principles. The demonstrations were also aimed at illustrating the type of test equipment needed and how fairly simple hardware can be effectively used to perform EMC measurements. The actual experiments were conducted by internationally-recognized leaders in electromagnetics.

I would like to briefly recap what transpired in Chicago, provide a preview of what's coming in Atlanta, and thank those behind the scenes who have continued to support our commitment to, and goals for, promoting EMC education.

Those who "participated" in or watched the experiment demonstrations in Chicago may have noticed that several of the demonstrations were based directly on experiments documented in the

"EMC Education Manual: Experiments and Demonstrations in Electromagnetic Compatibility," prepared by the EMCS Education Committee, and edited by Henry Ott and Clayton Paul. Several invited experiments, not included in the present manual, were also demonstrated. These additional experiments were selected based upon their innovative approaches and potential contributions to EMC education.

In Chicago, a total of ten experiments were demonstrated over the course of the three main days of the symposium:

"High Frequency Parasitics and Non Ideal Behavior of Circuit Components" by Dr. James J. Whalen, Department of Electrical & Computer Engineering, State University of New York at Buffalo.

"Some Consequences of EMI Properties of Passive Components" by Dr. Jasper J. Goedbloed, Philips Research Labs, Eindhoven, the Netherlands.

"Electromagnetic Leakage Through Seams" by Richard Mohr, R. J. Mohr & Associates Inc.

"Testing the Shielding Quality of EMI Gaskets and Gasketed Joints" by George M. Kunkel, Spira Manufacturing Corporation.

"Magnetic Field Shielding: The Effect of High Permeability or Induced Eddy Currents on Applied Magnetic Fields (40 Hz-100 kHz)" by Dr. Tom Van Doren, Department of Electrical Engineering/EMC Lab, University of Missouri-Rolla.

"Path of Least Impedance: Illustrating the Importance of Wire Inductance Over Resistance When Determining Current Paths at High

Frequencies" by Dr. Tom Van Doren and Dr. Todd Hubing, Department of Electrical Engineering/EMC Lab, University of Missouri-Rolla.

"Crosstalk and Shielding: The Effect of Grounding a Cable Shield on Reducing Inductive and Capacitive Crosstalk" by Dr. James L. Drewniak and Dr. Sha Fei, Department of Electrical Engineering/EMC Lab, University of Missouri-Rolla.

"Common and Differential Mode Currents and Filtering" by Lee Hill, Silent Solutions.

"EMI Noise Demonstration and Measurement" by Dr. Maqsood A. Mohd, Sverdrup Technology and Mohammed Issa, Tybrin Corporation.

"Magnetic-Field Coupling of Current Loops" by Dr. Jasper J. Goedbloed, Philips Research Labs, Eindhoven, the Netherlands. This was an encore presentation of a very interesting experiment first demonstrated in Dallas — back by popular demand!

Ours was certainly not a passive exhibit. I intentionally used the word "participated" above when referring to passersby who thought they would just be looking in on the various demonstrations. When opportunities struck, many casual observers were often drawn into active participation, and became involved in conducting the demonstrations. (Many were quite willing to volunteer their expert opinions as well!) The presenters had planned for, and encouraged, this sort of interaction. It was a nice touch which added a lively, animated feature to the exhibit. Great job!

All in all, attendees responded favorably to the exhibit when polled during and

Continued on page 20

**INCORPORATION OF RADIO TRANSPONDERS INTO
VEHICULAR ON-BOARD DIAGNOSTIC SYSTEMS**

EMCABS: 13-03-95

Mark A. Carlock

California Air Resources Board

Proceedings of the 1994 Int'l Congress on Transportation Electronics, Dearborn, MI
ISBN 1-56091-548-X, Library of Congress cat. card #: 94-67471, IEEE cat #: 94CH35729
17-19 October 1994, pp. 111-114

Abstract: On-Board Diagnostic Systems (OBDS), will monitor emissions critical components and activate a malfunction indicator light (MIL) when a failure or drift in calibration is likely to result in emissions that exceed 1.5 times a vehicle's applicable standards. This paper addresses the feasibility of incorporating radio transponders into the OBD systems that are capable of transmitting fault codes in order to minimize the time between detection and repair.

Index terms: RF transmitters, GPS

**AUDIO AND COMMUNICATIONS:
THE MERGER OF ENTERTAINMENT AND INFORMATION**

EMCABS: 16-03-95

William C. Spelman

Delco Electronics Corp.

Proceedings of the 1994 Int'l Congress on Transportation Electronics, Dearborn, MI
ISBN 1-56091-548-X, Library of Congress cat. card #: 94-67471, IEEE cat #: 94CH35729
17-19 October 1994, pp. 261-268

Abstract: The explosive growth of entertainment and information sources is creating an exciting transformation of mobile audio and communications systems. As government and industry openly discuss emergence of the information superhighway, vehicle manufacturers and the electronics industry are faced with the challenge of converting new sources of information into distinctive and valued products that bring excitement, productivity, safety and "fun" to the driving experience. Mobile audio and communications products are being merged to incorporate new levels of sophistication and consumer value.

Index terms: communications, PCS, navigation systems

**ELECTRIC UTILITY INFRASTRUCTURE IMPLICATIONS OF
WIDESPREAD EV USE**

EMCABS: 14-03-95

Diana O. Wittenberg

Southern California Edison

Proceedings of the 1994 Int'l Congress on Transportation Electronics, Dearborn, MI
ISBN 1-56091-548-X, Library of Congress cat. card #: 94-67471, IEEE cat #: 94CH35729
17-19 October 1994, pp. 167-178

Abstract: This paper assesses impacts of widespread use of electric vehicles (EVs) on electrical demand and power quality in Southern California Edison's electric system. This paper also briefly describe electromagnetic interference (EMI) and electric and magnetic field (EMF) characteristics of EVs.

Index terms: EMI, EMF, electric vehicles

RADAR BASED VEHICLE COLLISION WARNING SYSTEM

EMCABS: 17-03-95

Jerry D. Woll

Eaton VORAD Technologies, Inc.

Proceedings of the 1994 Int'l Congress on Transportation Electronics, Dearborn, MI
ISBN 1-56091-548-X, Library of Congress cat. card #: 94-67471, IEEE cat #: 94CH35729
17-19 October 1994, pp. 293-298

Abstract: This paper presents a technical discussion of radar based automotive collision warning systems, the worldwide radar frequency allocation versus technology issues and discusses driver and vehicle experience based on actual customer utilization of the only radar collision warning system presently in production and on the road. The general operation of radar based systems is discussed. The severe design issues resulting from the lack of worldwide standards for automotive radar systems with respect to operating frequency, bandwidth and radiated power are discussed.

Index terms: Vehicle radar

**CANDIDATE TECHNOLOGIES FOR AN AUTOMATED
COLLISION NOTIFICATION SYSTEM**

EMCABS: 15-03-95

R.L.Yuan, R.W.Newman, S.E. Young, and E.D.Holm

The John Hopkins University Applied Physics Lab.

Proceedings of the 1994 Int'l Congress on Transportation Electronics, Dearborn, MI
ISBN 1-56091-548-X, Library of Congress cat. card #: 94-67471, IEEE cat #: 94CH35729
17-19 October 1994, pp. 187-194

Abstract: Mature and emerging technologies for crash detection, vehicle location, and mobile communications are evaluated to assess the feasibility of developing as automated collision notification (ACN) system. Key technologies that can support ACN include micromachined accelerometers for crash detection, satellite based radio navigation systems, terrestrial telephone and low-earth orbit satellites for mobile communication.

Index terms: communications, GPS, GEO, LEO

COLLISION AVOIDANCE TECHNOLOGIES

EMCABS: 18-03-95

Mitsuo Kawai

Toyota Motor Co.

Proceedings of the 1994 International Congress on Transportation Electronics, Dearborn, MI
ISBN 1-56091-548-X, Library of Congress cat. card #: 94-67471, IEEE cat #: 94CH35729
17-19 October 1994, pp. 305-316

Abstract: Automobile manufacturers have been developing technologies to increase the field of vision and to enhance the basic maneuverability of vehicles to ensure safe driving. Moreover, efforts to develop technologies to support the driver's recognition, judgement and operation in a more positive manner are becoming increasingly active, in line with the recent intensified needs for safety, and advances in computation/information processing systems that have been developed over the past years. This paper provides an overview of the status quo of vehicle collision avoidance technologies, and discusses the technological and social issues for the practical applications of such technologies.

Index terms: laser radar, microwave radar

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CALL FOR BoD NOMINATIONS

Nominations are now being accepted for candidates for the IEEE EMC Society Board of Directors. In accordance with the Bylaws nominations may be made by petition or by the Nominations Committee. Petitions shall carry a minimum of 15 names of Society members in good standing (dues paid), excluding those of students. Nominees should possess professional stature and significant technical skills in electromagnetic compatibility. They must have adequate financial support outside the Society and have the approval of their organizations or employers to actively participate. Duties include attendance at three or four Board meetings a year and participation on committees, both of which require telephone, fax and mail communications. Nominees must be full members of the IEEE and members of the EMC Society. Elected Directors must serve a three-year term starting January 1, 1996. Attendance at the last meeting of the 1996 year is also desirable. No member can serve more than two consecutive three-year terms, including partial terms. All nominees are required to submit a biographical summary to the Nominations Chairman for inclusion on the ballot. The summary must not exceed a one-half typewritten page and must be in the following format:

First paragraph	Name, title, place of employment, educational background.
Second paragraph	Technical and professional experience.
Third paragraph	IEEE service and activities including offices, committees, etc.

Please submit petitions and biographical summaries to the Nominations Chairman:

H. R. Hofmann
Nominations Chairman
AT&T Bell Labs - Room 2B-220
2000 N. Naperville Road
Naperville, IL 60566-7091
Telephone: 708-979-3627
Fax: 708-979-5755

Submissions must be postmarked no later than May 30, 1995.

Information can be obtained from Mr. Hofmann or any member of the BoD.

**NOMINATION PETITION
ELECTROMAGNETIC COMPATIBILITY SOCIETY
BOARD OF DIRECTORS**
(Nomination guidelines given on facing page.)

I. **NOMINEE'S NAME:** _____

MEMBERSHIP NUMBER: _____

ADDRESS: _____

PHONE: _____

II. **BIOGRAPHICAL SUMMARY:** Attach Typed Copy

III. **SIGNATURES:** (Minimum of 15 names) We, the undersigned, all of whom are current IEEE Electromagnetic Compatibility Society (EMCS) members in good standing, nominate the above-mentioned person to serve on the EMCS BoD for a three-year term beginning January 1, 1996.

	MEMBER'S NAME (PRINT)	SIGNATURE	MEMBERSHIP NUMBER
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13.	_____	_____	_____
14.	_____	_____	_____
15.	_____	_____	_____

after the Chicago Symposium. Nearly everyone polled expressed satisfaction with the experiments and format, as well as the team of presenters, the test setups, and the professional quality of the demonstrations. The only suggestions, and constructive ones at that, were that efforts should be made in advance of the demonstrations to ensure proper test equipment operability, and that the exhibit should be set up in an area which enhances its visibility.

As to the setups and instruments, we unexpectedly ran into problems during two of the demonstrations because of inoperative test equipment. The problems were attributed to improper calibration and subsequently corrected on-site with the assistance of the equipment providers. Certain other problems related to the test fixtures were unavoidable. Everyone did their best to either work around or directly address the problems. This had a positive result as well in that bystanders volunteered their expertise to help us troubleshoot.

As to location, we are working to secure prime "real estate" for future exhibits. Based on these responses, a few more lessons were learned that will help us to improve upon the overall quality of the exhibit for Atlanta and beyond. Your voices were heard!

Some acknowledgments are in order. First, I want to thank last year's presenters. Each of them did an excellent, very impressive job. I also want to express my deep thanks and appreciation to the equipment suppliers who loaned us their high-tech hardware and provided on-call support when it was needed. We simply could not have conducted the Special Session without them.

In particular, I want to acknowledge: Al Wilcox and Dennis Handlon of Hewlett-Packard in Santa Rosa, CA and Mike Bechtold, Harry Rosenberg and Jack Rozwat of Hewlett-Packard in the Chicago area; Jack Cowper of

Tektronix/Rohde & Schwartz Inc. in Beaverton, OR and Tektronix representative Jeff Solomon of Albany, NY; and Chris Evelo of Fluke Corporation in the Chicago area. Each provided us with an arsenal of state-of-the-art equipment (spectrum and network analyzers, oscilloscopes, voltmeters, plotters and interface cables, etc.). I encourage anyone with special EMC test equipment needs or related questions to contact these individuals for guidance. They are true professionals and fine people to work with!

Finally, my compliments and thanks to members of our Society and the Symposium Committee who have helped in the past and to those who continue to make our exhibit a success. This includes our Subcommittee, consisting of Dick Ford, Guy Goodlett, Maqsood Mohd, Jim Muccioli, Bob Nelson, Clayton Paul, and Don Weiner, and of course, Kimball Williams, EMCS Education Committee Chair.

I also appreciated all of the background support provided by Chicago Exhibit Committee Co-chairs Dale Svetanoff and Mike Bechtold; Bob Hofmann, Chicago Symposium Chair; President Warren Kesselman; and Director of Technical Services, Joe Butler. I also look forward to working with Atlanta Symposium Chair John Rohrbaugh and Exhibits Chair Herb Zajac for our upcoming exhibit.

That brings me to Atlanta and this year's agenda. Some experiments that we are tentatively hoping to include are: "Rusty Bolt Demonstrator," based on an experiment developed by Ray Elsner.

"Noise Measurement by Induction", based on a demonstration devised by Douglas Smith.

"Common-Mode Currents and Radiated Emissions of Cables," based on an experiment developed by Clayton Paul.

"The Effect of Circuit Impedance on Field-Coupled Crosstalk," based on a demonstration devised by Thomas Jerse.

"EMI Commercial Testing for the Novice," based on a set of experiments devised by Sean Sheedy.

"Printed Wire Assembly Grounding & Radiation Measurement Demonstration," based on an idea developed by Steve Iskra.

We may also repeat one or two experiments related to magnetic field shielding and coupling which were very well received at last year's exhibit.

As always, I welcome your thoughts, comments and suggestions as we prepare for this year's Special Session Exhibit and beyond. If you have ideas for an interesting experiment and want to discuss it, please feel free to contact me at: ANDRO Consulting Services
P. O. Box 543
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(315) 336-4466 (eve.)
e-mail: andro1@aol.com

In conclusion, the Education Committee recognizes the architects associated with the IEEE EMCS who originated the concept for the Special Session and helped promote it at the top ranks of the Society.

I'll see you in Atlanta!

1994 PACE CONFERENCE AND WORKSHOP

A. H. MILLS

The conference theme, "Challenges, Strengths and Opportunities," addressed the rapid growth and changes taking place in communications Technology.

Over 200 people, including members of the IEEE Board of Directors, members of the United States Activities Board, PACE representatives from sections, councils, regions, divisions and societies and guests attended the 1994 PACE Conference and workshop in Phoenix, Arizona during the Labor Day weekend. The theme of the conference was "Challenges, Strengths, and Opportunities."

Ms. Celia Desmond, vice president of member affairs, IEEE Communications Society, opened the conference with a keynote speech on "Information Networking in the Nineties." The need to communicate with any person, any time, anywhere, in any form has produced new products and services in the communications industry. Physical proximity is no longer required. The rapid growth of communications technology will provide new jobs. Social, environmental, business and regulatory issues will arise which must be resolved. Local and international marketplace needs will require new communication infrastructures.

Globalization produces challenges, according to Ms. Edith Holleman, Council to the House Science, Space and Technology Committee. Global competition puts a strain on the standard of living in the United States. U.S. engineers are competing for jobs that are going to China,

India, Malaysia, the Ukraine and other countries where engineers are willing to work for considerably less than American engineers. Solutions to these problems are not evident. Ms. Holleman said that free trade or more training are not the answers. Engineers were encouraged to organize in order to improve their working and living conditions.

Other issues covered in the workshops were engineering employment and immigration in the 1990s, pre-college education, consultants' networks, the entrepreneurship option for starting your own business, e-mail for IEEE members, retirement security for engineers, and public concern for the effect of radiation exposure.

The three candidates for the IEEE 1995 presidential election were introduced and given an opportunity to respond to questions and address issues. These candidates were Charles Alexander, Donald Bolle and Wallace Read.

The four plenary sessions plus the presentations by Ms. Desmond and Ms. Holleman were videotaped. Copies of these tapes are being distributed to divisional PACE coordinators and to section chairmen and will be available for use on a loan basis. Mr. Julian (Jay) Forster is the Division IV PACE Coordinator. If you need help in arranging for a loan of these videotapes, please contact Al Mills at (619) 463-2123.

IEEE MEMBERS ELECTED TO FELLOW GRADE

The following members of the IEEE EMC Society have been elected to Fellow grade as of January 1, 1995. Congratulations to all!

Dr. George Costache
8 Blueridge Court
Nepean Ontario K2J 2J3 Canada
For leadership in the application of the finite element method to the predictions of crosstalk on printed circuit boards.

Mr. Hugh W. Denny
2528 LaVista Road
Decatur, GA 30033
For the advancement of technology to minimize electromagnetic interference through improved electrical and architectural design practices.

Dr. Jacques J. Gavan
Electrical Engineering Dept., CTEH
52 Golomb Street, P.O. Box 305
Holon, Israel
For contributions to the solution of cosite electromagnetic interference problems in communication systems and to electromagnetic compatibility education.

Dr. Per-Simon Kildal
Dept. of Microwave Technology
Chalmers University of Technology
S-41296 Gothenburg, Sweden
For contributions to the design, analysis, and understanding of reflector antenna systems.

Dr. Raymond J. Luebbers
Dept. of Elec. Eng., East Building
Pennsylvania State University
University Park, PA
For contributions to computational electromagnetics.

Dr. Ronald J. Pogorzelski
1133 Nirvana Road
Sanat Barbara, CA
For contributions to the techniques of analytical and computational electromagnetics.

EMC'94 ROMA – INTERNATIONAL SYMPOSIUM ON EMC

The first International Symposium on EMC in Italy took place at the Faculty of Engineering, University of Rome "La Sapienza," September 13-16, 1994. The Symposium was organized by the University of Rome "La Sapienza" and AEI - Associazione Elettrotecnica ed Elettronica Italiana. Sponsors were URSI - International Union of Radio Science, CNR - National Research Council, ENEA - Italian Agency for New Technology, Energy and the Environment, Telecom Italia and Italferr-Sis. T.A.V. IEEE North Italy Section and IEEE Central and South Italy Section were cooperating agencies. The EMC '94 ROMA Secretariat registered 368 participants from 30 countries.

The International Steering Committee (ISC) of EMC'94 ROMA was headed by M. D'Amore, Chairman, P. Bernardi, Vice-Chairman, M. Feliziani, Secretariat.

More than 250 summary papers were submitted for presentation to EMC'94 ROMA by authors from 34 different countries. Each summary was reviewed by two members of the ISC, experts in the subject of the paper and with a different nationality from that of the author. In the final program 178 technical paper presentations were scheduled: 98 presentations in oral sessions including 5 invited papers and 80 presentations in poster sessions. The papers have been published in a two-volume, 881-page symposium proceedings.

In order to promote a wide participation, only two parallel oral sessions were scheduled in the technical program. The oral presentations were subdivided into 16 oral sessions on the following EMC subjects: human exposure to

EM fields, lightning, anechoic chambers & TEM cells, cables, standards and regulations, EMC standard testing, testing vs. modelling, numerical modeling, field-excited transmission lines, EMC education, interconnecting and packaging structures, PCBs and chip design, EMC automotive, railway systems, power systems, and shielding. The final program included an invited opening session titled "EMC Strategies: Industrial and Research Perspectives" with the participation of F.M. Tesche, M. Kanda, G. Goldberg and B. Audone. The poster presentations were scheduled in the afternoon without overlapping with the oral sessions and were subdivided into the following sessions: antennas & communication systems, measurement and instrumentation, EMI in power apparatus and systems, harmonics and power electronics, biological interactions, EM environment, propagation and coupling in TIs, transients, EMC industrial and space applications.

In order to encourage discussion and participation during the sessions, ITEL 500.000 awards for oral presentation of the best paper and poster presentation of the best paper were established. The best papers were selected during the symposium by the ISC members and the session chairmen on the basis of content, presentation and discussion. After a ballot at the end of the symposium, the Oral Presentation Best Paper Award was given to F. Maradei, University of Rome "La Sapienza," Italy for the paper "A Procedure for Numerical Solution of Field-excited Nonuniform Transmission Lines," and the Poster Presentation Best Paper Award was given to D. O. Wendt and J. L. ter Haseborg,

Technical University of Hamburg-Harburg, Germany, for the paper "Radiation Losses Representation in the Transmission Line Theory (TLT)."

All the activities related to the symposium took place around the antique cloister inside the faculty building, which is located near the Colosseum and the archeological sites of Rome. The social program included a reception at the Campidoglio, the City Hall of Rome, and a banquet at the Casina Valadier at Pincio. Interesting tours were organized to visit some well-known areas of the city.

For further information and/or to order the Symposium Proceedings, please contact: EMC'94 ROMA Secretariat, Department of Electrical Engineering, University of Rome "La Sapienza," Via Eudossiana 18 - 00184 Rome - Italy. Tel. +39 6 44585809; Fax. +39 6 4883235.

WORLDWIDE EMC STANDARDS

Presented by members of the IEEE EMC Society at the Tenth International Zurich EMC Symposium in March 1993, Worldwide EMC Standards comprises tutorial papers. Articles address military and commercial EMC standards, international standards, EMC education, and EMC requirements for ISM. The cost is \$20.

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EMC-S 1995 PLANNING CALENDAR

(AS OF 12/1/94)

- Mar. 1-4 TAB, Calgary, Canada
 Mar. 2 TAB Governance
 Workshop, Calgary,
 Canada
 Mar. 31- BoD, Austin, TX
 Apr. 1
 Apr. 10-11 TAB Finance Workshop,
 Piscataway, NJ
 Jun. 21-24 TAB, Washington, DC
 Aug. 12 EXCOM, Atlanta, GA
 Aug. 13 BoD, Atlanta, GA
 Aug. 14-18 Symposium, Atlanta, GA
 Aug. 17 BoD, Atlanta, GA
 Nov. 9/10 BoD, Phoenix, AZ
 Nov. 9-12 TAB, Phoenix, AZ

EMV '95

EMV '95 will be held in Dresden, Germany from April 25 to 27, 1995. The conference is sponsored by the IEEE. For more information, contact Bettina Burth, MESAGO, Messe & Kongress GmbH, Rotebuhlstr. 83-85 Stuttgart. Fax: (0711) 6 19 46-98.

INCEMIC

A Call for Papers has been issued for the Fourth International Conference on Electromagnetic Interference and Compatibility (INCEMIC). The conference will be held from December 6 to 8, 1995, in Madras, India. For information, contact Mr. K.R. Kini, SAMEER Center for Electromagnetics, CIT Campus, 2nd Cross Road, Taramani, Madras 600 113 India. Fax: (91-44) 2352938.

EMC NEWSLETTER

Safety and EMC is a newsletter on EMC research development and testing. The publisher is ERA Technology, a not-for-profit organization located in the U.K. For more information on the newsletter contact Sarah Begley, ERA Technology Ltd., Cleeve Road, Heatherhead, Surrey KT22 7SA, England, or fax +44 (0) 1372 367099.

EMCS SYMPOSIA SCHEDULE

- 1995 Atlanta, GA: August 21-25
 Marriott Marquis Hotel
 John Rohbaugh
 (404)894-8235
 1996 Santa Clara, CA: August 19-23
 Santa Clara Convention Center
 Doubletree Hotel
 David Hanttula
 (415)390-1071
 FAX: (415)962-9439
 1997 Austin, TX: August 18-22
 Austin Convention Center
 Hyatt Hotel
 John Osburn
 (512)835-4684
 1998 Denver: August 9-14
 Radisson Hotel
 1999 Seattle, WA: August 2-6
 Westin Hotel
 Bill Gjertson
 (404)793-0680
 2000 Washington, DC
 Bill Duff
 (703)914-8450

EMCS COOPERATING SYMPOSIA

- 1997 Shenzhen, China:
 May 21-23
 1999 Japan: May 15-17
 U.K: Biannually, even years, in September.
 Wroclaw: Biannually, even years, in June.
 Zurich: Biannually, odd years, in March.

ADMINISTRATIVE MEETINGS

June 11-13
**STANDARDS BOARD
 COMMITTEES**
 and June 14
STANDARDS BOARD MEETING
 duRhone Hotel, Geneva, Switzerland
 Terry duCourcelle: (908)562-3807

August 12-19
IEEE EXCOM MEETINGS
 To be announced
 Australia & New Zealand
 Julie Cozin: (908)562-3984

December 10-11
**STANDARDS BOARD
 COMMITTEE**
 and December 12
STANDARDS BOARD MEETING
 Fiesta Americana
 Monterrey, Mexico
 Terry deCourcelle: (908) 562-3807

December 11
IEEE INFORMATION SESSION
 Fiesta Americana
 Monterrey, Mexico
 Julie Cozin: (908) 562-3984

December 12
USAB MEETING
 Fiesta Americana
 Monterrey, Mexico
 Linda Hall: (202) 785-0017

December 12
IEEE ASSEMBLY
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 Monterrey, Mexico
 Julie Cozin: (908) 562-3984

December 13
IEEE SOCIAL
 Fiesta Americana
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December 13-14
IEEE BOD
 and December 14
IEEE EXCOM MEETING
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Editor's Note: Wouldn't it be nice if we were all employed by the IEEE so we could visit these exotic locales, all expenses paid?

INSTITUTIONAL LISTINGS

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

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