

# IEEE ELECTROMAGNETIC COMPATIBILITY SOCIETY NEWSLETTER



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ROBERT D. GOLDBLUM, *Editor*

## MESSAGE FROM THE PRESIDENT



WARREN KESSELMAN  
PRESIDENT, EMC SOCIETY

Your Society's 1994 Symposium was rated as excellent by most attendees. To you who attended, my thanks for your participation and contributions toward making it another successful event. On behalf of the Board of Directors, I give sincere thanks to the Chicago Symposium Committee for a job well done.

Several symposium attendees made a special effort to tell me that the symposium's technical program was excellent. I believe their intent was to convey approval of the overall structure of the program; that is, quality papers, workshops, experiments and poster session. The combined thrust was a more practical information exchange. That focus was in response to your input on previous symposium questionnaires. (Your Board of Directors does read your comments.) Also, the symposium committee used the

services of the Society's Technical Committees to review all papers submitted and to help structure a balanced program.

Planning and conducting our annual conference is a huge team effort. While the bulk of the work falls on the local sponsoring Chapter, there is opportunity for broader Society membership involvement, for example, the Board of Directors' Conference Committee, Technical Advisory Committee and Education Committee. If you read my previous Newsletter messages, you are aware that one of my objectives is to encourage you to become involved in your Society's operations. In this message, I'd like to concentrate on the Technical Advisory Committee (TAC). Hopefully, some of you may be motivated to serve and contribute your technical expertise to the advancement of knowledge.

Your TAC, chaired by Wilf Lauber of Canada, currently has nine Technical Committees (TCs). The scope of the TAC is to promote the technical advancement of the IEEE EMC Society as a whole and in particular: to coordinate the operations of the various Technical Committees; to propose to the Board of Directors the formation, and, where appropriate, the dissolution of Technical Committees; and, to monitor technical activities of other organizations

## RESULTS OF THE BOARD OF DIRECTORS ELECTION BALLOT

A ballot for the election of six members to the IEEE Electromagnetic Compatibility Society Board of Directors was issued on July 29, 1994. The ballots returned have been counted, and the following candidates have been elected for a three-year term beginning January 1, 1995:

William G. (Bill) Duff  
W.G. (Bill) Gjertson  
Todd H. Hubing  
Thurman J. (Bill) Ritenour  
Donald L. Sweeney  
Kimball Williams

We wish the newly-elected members of the Board of Directors success and thank all candidates for their willingness to serve and for permitting their names to be included on the ballot.

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## EDITORIAL



**ROBERT D. GOLDBLUM**  
EDITOR

It has occurred to me that while editing this newsletter for over 27 years, I have missed many opportunities to voice my opinion through an editorial. Of course, 27 years ago I was just a boy, and my youthful shyness fostered the fear of embarrassment and concern that I would upset someone, especially while I was still in the job market. Now that I'm not as worried, there is a

medley of topics which I would like to discuss, but I will compile my list and choose only those which are most timely and relevant to the EMC Society. Possibilities include peace breaking out all over, IEEE *Spectrum's* ethics in advertising, and the Joint Spectrum Center.

### WHERE HAVE ALL THE TEST LABS GONE?

Many trade magazines have been featuring technical articles on the new European EMC regulations. At first, emphasis was placed on the general regulations covering various EMI controls on electromagnetic emissions and susceptibility. Then many articles addressed laboratory certification for European testing and exaggerated the roles of competent bodies. "What is a competent body?" you ask. Probably someone sitting behind a desk somewhere equally as competent as a grandfathered NARTE certified engineer, like me. The European regulations for EMC are only temporary. Some are not yet adopted, but all will eventually be made obsolete through the development of EMI regulations for specific product categories. (This is another topic into which I would like to delve more deeply in a future editorial.)

Those who think that MIL-STD-461D and MIL-STD-462D are on the wane may be premature in writing the obituaries for these standards. The Government, through the formation of the Joint Spectrum Center, has centralized its E<sup>3</sup> standardization program. Several professional societies have joined the Government in its attempt to vitalize its E<sup>3</sup> standards through the issuance of their own military environment EMI specifications. (A rose by any other name . . .) Therefore, it is likely that the need for EMI receivers, shielded anechoic chambers, military test antennas and all the other wonderful equipments required to perform tests in accordance with MIL-STD-462 will be around for a long time to come.

Together, the continued evolution of the European EMC criteria and military EMC state-of-the-art test methodology will force full-capability test laboratories to allocate considerably more capital. My message for the military test houses: don't throw in the towel yet; be

*Continued on page 7*

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### IEEE EMC SOCIETY NEWSLETTER PUBLICATION SCHEDULE

#### PUBLICATION DATES

February  
May  
August  
November

#### EDITORIAL DEADLINES

December 15  
March 15  
June 15  
September 15

Editorial Contributions for the February issue should be received by December 15.

#### BACK ISSUES OF THE EMC SOCIETY NEWSLETTERS ON MICROFICHE

We still have a few sets of the microfiche copies of the back issues of the IEEE EMC Society Newsletters from the present to 1956 when it was called 'Quasies and Peaks.' The price is \$25.00 postpaid. If you would like to have one of these sets you can order it from: Dr. Greater L. Smith, EMC Society Historian, 2 Jonathan Lane, Bedford, MA 01730.

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**TODD HUBING**  
ASSOCIATE EDITOR

If I flap my arms up and down really fast in just the right way, I can fly (at least in my dreams). My wife, who once read a book on dream interpretation, assures me that the ability to fly is a common element in the dreams of many people. She says it indicates that I have lofty goals, but I think that my flying dreams are related to my work as an EMC engineer. Let me explain.

Most people who can fly in their dreams probably move through the air like an angel or perhaps more like superman. I can only fly short distances, with a great deal of effort, and I look ridiculous when I do. What's more significant (I think) is that in my dreams I am the only one who can fly. The other characters in my dreams don't bother to learn how to fly because they already "know" that it is impossible.

As EMC engineers, the greatest asset we have when it comes to EMC problem solving is our experience. No matter how many courses we have taken, no matter how many papers we have read, there is no substitute for the knowledge gained working on real EMC problems. Unfortunately, experience can also be an EMC engineer's greatest liability. This is because conclusions drawn from experience are not always correct. As we gain more experience, we gain confidence, insight and competence, but we also collect a few false notions along the way. The more experienced we become, the easier it is to dismiss the naive ideas

of those who are less experienced, particularly as we watch them make the same mistakes we once made many years ago.

Around the turn of the century, there was a great debate among physicists about whether light was a particle or a wave. The particle idea was the early favorite, but as more experiments were done, it became clear to most physicists that light was indeed a wave. In 1905, a young researcher named Albert Einstein published a paper describing another particle theory of light. Needless to say, the paper was not particularly well received. The experienced physicists of the day had been down that road. They were familiar with the shortcomings of particle theories and they "knew" that light was a wave. About twenty years later, after turn-of-the-century physicists were gradually replaced by those physicists who had still been young and naive back in 1905, Einstein was awarded the Nobel Prize in Physics for his quantum theory of light.

At the EMC Symposium in Chicago, several papers were presented outlining new ideas in the areas of shielding, decoupling, EMC testing, spread spectrum clocks, and EMC applications of fuzzy logic. Any experienced EMC engineer can give you a dozen reasons why each of these new ideas isn't practical or won't work. Yet, in a few years some of these ideas will no doubt make a significant impact on the electronics industry.

As experienced EMC engineers, we must work harder to remain open to new ideas, even those that seem impractical at first. We must continue to experiment even when we think we know the outcome. Above all, in a rapidly changing world, we can't become too attached to any particular theory or technique, even when it has served us well over the years.

Circuit technologies are changing. Frequencies are changing. The rules

are changing. We must be ready for change. How can you help to prepare your company for the EMC challenges of the next century? Well, next time you are interviewing applicants for an engineering position, ask them if they think it is possible to fly by flapping their arms up and down really fast. If they say "No," compliment them on their knowledge of aerodynamics and human physiology. If they say, "I don't know, but I'd be interested in investigating that possibility," HIRE THEM!

### CHICAGO

Congratulations to Bob Hofmann and the Chicago Chapter for hosting a flawless symposium in August. A lot of work on the part of many volunteers goes into the planning and preparation for an event this large. This was one of the best-planned, most interesting, and enjoyable conferences that I have ever attended.

### BALTIMORE/ANNAPOLIS

Charles Gaston reports that the Baltimore/Annapolis chapter met at the Naval Academy Officers' Club on May 17th. New officers were elected during this meeting. Ted Hanwood of CSC is the new chairman, Vil Arafles of DoD is the vice chairman, Fred Kirby of EMC Technologists is the treasurer, Chuck Gaston of DoD is the secretary, and Joe Flynn of CSC is the program chairman.

Bob Caruthers presented an excellent talk on the re-allocation of a total of 200 MHz of frequency spectrum from the Federal government to civilian use. The bill, TITLE VI, OBRA-93, was authored by Rep. John Dingel and was passed August 10, 1993. All of the 200 MHz was taken from the spectrum between 1390 and 5000 MHz. The re-allocation of these frequencies has the ostensible goal of spurring U.S. competitiveness and growth. Allocation of licenses for these frequencies is expected to result in a

total of \$7.4 billion dollars income for the Federal government.

#### LOS ANGELES

The Los Angeles chapter of the EMC Society met in July at the home of Janet O'Neil for a summer social. It was a beautiful balmy evening. Chapter members and guests enjoyed a "Fiesta" barbecue of sizzling fajitas with, of course, bottomless margaritas made with Janet's secret recipe. It was a good opportunity to relax and socialize.

Kicking off the 1994/1995 chapter year, the September meeting featured a "New Product Forum" where five vendors discussed new EMC products. Participating in this informative meeting were Joe Fischer of Fischer Custom Communications, who performed a "full blown test" - a CS115 demonstration to MIL-STD-462D; Fernando Mendoza of Rantec, who elaborated on their new Ferrosorb absorber material; Carl Smith representing Haefely, who showed their new PEFT Jr. - a new electrical fast transient (EFT) generator for IEC 801.4 testing; Doug Hunter of Dynamic Sciences, who introduced the DSI-200 "Automated EMI Test System" with its new data acquisition EMIT mode; and Vladimir Kraz of Credence Technologies, who presented the ScanEM - a handheld, battery operated near-field electromagnetic field detector. Several chapter members couldn't resist purchasing this particular "gizmo" after the meeting, for their gizmo collections. It was a fast-paced meeting as each vendor had the floor for just fifteen minutes. However, before and after the meeting, product displays were available for review on the bench tops provided in the EMI Test Lab at TRW, so there was plenty of opportunity for hands-on activity.

#### ROCKY MOUNTAIN

The Rocky Mountain Chapter of the IEEE EMC Society presented its Fourth Annual Regional Symposium on Electromagnetic Compatibility.

This one-day symposium was held on June 10, 1994, at the National Institute of Standards and Technology in Boulder, Colorado.

George Trejo reported that an attendance record was set. Fifty-four people from twenty-one companies attended the program, which comprised twelve technical papers.

The chapter held elections prior to the start of the symposium. Officers elected were:

##### Chair

George M. Trejo  
Hewlett-Packard  
(303)350-4113

##### Vice-Chair

William Ritenour  
StorageTek  
(303)673-7096

##### Sec./Treas.

Brent DeWitt  
TUV Product Service  
(303)786-7999

The chapter meets bimonthly on the second Tuesday of the month.

#### SAN DIEGO

Scott Davies, Chairman of the San Diego Chapter, reports that they had a meeting on September 21st. There were 28 people in attendance to hear

Mr. Michael Cole, a local EMC expert. Michael's topic was "PC Board Level EMC Design."

#### SANTA CLARA VALLEY

The Santa Clara Valley Chapter held its annual Social and Planning Session on Tuesday, September 13th at the Bold Knight Restaurant in Sunnyvale. The purpose of this event is to promote interaction and discussion about useful topics for the technical sessions to be held during the upcoming season.

#### SEATTLE

Congratulations to the Seattle Chapter for winning the 1994 Best Chapter Award. This award was presented at the IEEE EMC Symposium in August.

#### SOUTHEASTERN MICHIGAN

Ray Sasinowski, Chairman of the Southeastern Michigan Chapter, reports that Professor Tom Van Doren of the University of Missouri-Rolla was the featured speaker at their August 16th meeting. The topic of his presentation was "Reducing Printed Circuit Board DC Bus Noise." Professor Van Doren raised questions on proper decoupling capacitor placement and sizing. The discussion covered current PCB decoupling techniques and probable



*Rachel and Gurdip Saran enjoy a pleasant evening at the LA Chapter summer social.*

Photo courtesy of Janet Nichols O'Neil



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techniques of the future. This was the second time Professor Van Doren spoke to the Southeastern Michigan chapter (the first time was last March), and once again his talk prompted a lively discussion.

On September 8th, the Southeastern Michigan Chapter and the General Motors Institute IEEE student branch held a joint meeting. The goal of this meeting was to introduce the students to the EMC engineering profession. This was part of the chapter's "Outreach and EMC Awareness" program promoting the IEEE EMC society to local colleges. The meeting started with Vice-Chapter Chairman Kimball Williams giving an overview and history of EMC. Next, Don Seyerle of General Motors' corporate EMC facility performed an experiment using actual production parts to demonstrate how radiated emissions from a circuit module could lead to customer dissatisfaction and loss of vehicle sales. Ray Sasinowski, Chapter Chairman, wrapped it up by describing the overall goals of the IEEE EMC society and discussing how the IEEE can contribute to a member's professional growth. Dennis Barberi, activities chairman, and each of the speakers answered many questions from the students. As word of the presentation reaches more IEEE student branches, the Southeastern Michigan chapter is getting more requests to do this EMC overview.

#### **TOKYO**

Congratulations to the Tokyo Chapter for organizing the highly successful 1994 International Symposium on EMC, which was held last May in Sendai, Japan. The symposium was chaired by Professor T. Takagi and co-chaired by Professor T. Yoshino. There were 544 participants in attendance to hear 210 papers presented by authors from 22 countries.

#### **WASHINGTON/ NORTHERN VIRGINIA**

On March 17, 1994, Jeffery Horlick of NIST gave a presentation to the Washington/Northern Virginia chapter on the EMC implications of ISO-9000. The presentation centered on the emergence of technology on an international scope and the new requirements for competing on a global scale. The status of acceptance and specification of ISO-9000 criteria within U.S. organizations was presented, and guidance was given on obtaining information on ISO-9000 compliance. Mr. Horlick was assisted in his presentation by Gerry Johnston of Ogden Government Services.

The March chapter meeting featured Commander J.E. Grause of the U.S. Navy Joint Electromagnetic Interference (JEMI) Task Force. Commander Grause gave a presentation on the JEMI Task Force efforts to assess EMI performance in the Persian Gulf and other theaters of operations. He also described the newly formed Joint Spectrum Center, which will be a Tri-Service DoD EMC organization, and will absorb the Electromagnetic Compatibility Analysis Center (ECAC) and other related EMC organizations in the DoD.

Robert Goldblum, CEO of R&B Enterprises, was the featured speaker at the April chapter meeting. His presentation on the future of MIL-STD-461D and MIL-STD-462D described in detail the many changes in test criteria, instrumentation, facilities, and measurement techniques implicit in these new EMC standards.

On April 21st, a field trip to the EMC Test Facility at the NASA Goddard Space Flight Center was held. Attendees were shown the various laboratories at Goddard by Ted Dyer of NASA and Tony Cesko of NSI Technology. The tour included the NASA Spacecraft Magnetic Test Facility, including a 40-foot

Helmholtz coil system, a new 1.3 million cubic foot laminar flow, a Class 10,000 clean room (where the Hubble Telescope repair mission was assembled and tested), and two shielded EMC enclosures, one of which was recently converted to a semi-anechoic facility with ferrite tiles and foam wedges.

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#### **MESSAGE FROM THE PRESIDENT . . .**

*Continued from page 1*

with the view of making recommendations to the Board of Directors on any required coordination of those activities with activities within the Society. The TAC Chair and TCs operate under the Director of Technical Services of the Board of Directors. The scope of each TC is to promote activities in its area of technical competence by: a) generating and reviewing papers for the EMC Transactions and symposia, b) organizing and operating special sessions and tutorials at EMC symposia, c) developing standards in its field, and d) evaluating the "state of the art" in its field. Each TC also consists of working groups of experts. It is highly desirable to have representation from manufacturers, users and those with general interest in their area of competence.

The current nine TCs are: EMC Management (TC-1), EMC Measurements (TC-2), Electromagnetic Environments (TC-3), Interference Control (TC-4), High Power Electromagnetics (TC-5), Spectrum Management (TC-6), Nonsinusoidal Fields (TC-7), Product Safety (TC-8) and Computational Electromagnetics (TC-9). All EMC Society members are eligible to apply for membership in one or more TC. A written application to the TC Chairman is all that is required. For projects requiring special technical contributions not readily available within our Society membership, this TC Chair may approve non-Society committee members. If you desire more information on the TAC/TCs, please contact Wilf Lauber (613-998-2377).

In closing, I'd like to remind you that all Board of Director (BoD) meetings are open to the membership. I hope to see you at one soon.



**DICK FORD**  
ASSOCIATE EDITOR

The second EMCS Board of Directors (BoD) meeting of 1994 was held at the Hilton Palmer House in Chicago, IL. This meeting coincided with our 1994 IEEE International EMC Symposium, 22-26 August. In accordance with recent practice for our meetings at the symposium, the meeting was held in two parts: on Monday morning and Thursday evening. All directors were present, though not all were able to attend the entire meeting due to competing duties attendant to the symposium. Also present were **Len Carlson**, Director of Communications, **Kimball Williams**, Education Committee chairperson, **Todd Hubing**, **Risa Sato**, **Mark Montrose**, **Moto Kanda**, **Scott Davis**, **Fred Heather**, **Chet Smith**, **Takeo Yoshino**, **John Rohrbaugh** and **John Howard** (as well as several other society members/symposium attendees who dropped in for brief periods). The meeting was chaired by EMCS President **Warren Kesselman**.

Highlights of the Directors' reports are as follows:

### AWARDS

A near record number of awards were voted this year (see photos on pages 12-13).

### MEMBERSHIP

**Dave Staggs** reports that EMCS membership in June was 4,155, a 2.54% growth over the previous June,

making our Society the third fastest growing Society! In fact, our Society has doubled in size in the last decade.

### CHAPTERS

There are currently 38 chapters worldwide, of which 27 are in the U.S. Active new chapter formation activity exists in seven locations: Boca Raton, FL (**Vichate Ungvichian**), Oak Ridge, TN (**Paul Ewing**), Cleveland, OH (**Debra deRusha**), Rochester, NY (**Rodney Baggott**), India (**Kundapur R. Kini**), Sao Paulo, Brazil (**Carlos Morato**) and Madrid, Spain (**Antonio Martin y Grau**). We look forward to soon welcoming these areas to active EMCS Chapter status. **Dave Hanttula** announced that he will be stepping down as chair of the Distinguished Lecturers Program (he resumed this role on a temporary basis after the tragic death of **John Adams**). The Society is soliciting nominations for this chair.

### STANDARDS

**Don Heirman** reports that PI 1140 has been published, and he extends a "well done" to **Dheena Moongilan**, **Steve Berger**, **Dave Traver** and the other members of the committee for an IEEE Standard Procedure for the Measurement of Electric and Magnetic Fields from Video Display Terminals (VDTs) from 5 Hz to 400 kHz. **Jose Perini** was confirmed as W/G Chair of P1128 - RF Absorber Evaluation.

### TRANSNATIONAL

The IEEE is now offering inexpensive medical insurance to cover members when outside their country. Data indicate that accidents or illnesses "out-of-country" typically incur significant costs not covered by traditional policies. The EMCS BoD approved a motion to provide blanket coverage for "eligible" EMCS members.

### REPRESENTATIVE ADVISORY COMMITTEE (RAC)

**Joe Butler**, RAC Director, presented a comprehensive report. I've acted in an informal liaison role between EMCS and the Applied Computational Electromagnetics Society (ACES). Joe recommended, and the BoD accepted, that this role be formally included under the RAC. The BoD approved ASTM D09.12.14 as a RAC entity with **Drew Peregrin** as representative. Also the IEEE committee on metric policy will now be under RAC with **Ed Bronaugh** as representative.

### PACE

**Al Mills** is stepping down as PACE coordinator. He recommends a three-person committee for future PACE work. Nominations are being solicited. There have been a number of changes in IEEE-USA. COMAR (Committee on Man and Radiation) has been combined with Health Care Policy. Engineering R&D has been combined with DoD R&D (which should lessen my workload because I represent EMCS on both committees). A newly revised (August '94) Policies and Procedures has been produced for RAC. Joe also nominated **Leo Makowski** to be his replacement as RAC chair, effective immediately. The BoD concurred.

### TECHNICAL ADVISORY COMMITTEE (TAC)

**Wilf Lauber** has replaced **Jim Randa** as Chair of TC-3 but will be stepping down as overall TAC chair early next year. **Craig Grimes** has replaced **Akhlesh Lakhtakia** as Chair of TC-7 (non-sinusoidal fields).

### EDUCATION

There was a great deal of activity by the Education committee (much more than can be discussed in this column). A number of meetings were held during the symposium.



The symposium experiments booth was staffed for the week for the second year under **Andy Drozd's** leadership. A new tutorial session for the symposium was held under **Maqsood Mohd's** leadership. Both were well received by the attendees. Discussions led by **Kimball Williams** at the BoD meeting on these and other issues ran nearly ninety minutes! New efforts are planned for Internet and new directions described for CAEME (Computer Aided EM Education). The BoD approved efforts to begin the process to change our bylaws to combine Student Activities under the Education Committee. Video taping was accomplished as planned (see details in my last column).

#### **NARTE (NATIONAL ASSOCIATION OF RADIO TELECOMMUNICATIONS ENGINEERS)**

Activity continues at a healthy pace. **Jim Whalen** held a successful symposium workshop on taking the NARTE EMC exam. Efforts continue on "digesting" the 10,000 questions contributed by the NARTE "grandfathers." Four thousand questions have been groomed and entered into the data bank. Two thousand questions are pending final review. Volunteers are urgently needed to help with this work. (Contact **Claire Wyatt**, SENTEL Corp., 225 Reinekers Lane, Suite 500, Alexandria, VA 22314.)

#### **COMMUNICATION DIRECTOR REPORT EMC Transactions**

**Moto Kanda** notes that two special issues are being considered: EMI Metrology and ESD. Additional details will be presented to the BoD in the near future.

#### **HISTORY**

**Chet Smith** continues efforts to store EMCS archival material using the

latest technology. He notes that prices for CD-ROM have dropped dramatically over the past few years (from \$50K to about \$15K for our back issues of symposium records).

#### **FUTURE SYMPOSIA**

A detailed brief was given on next year's symposium in Atlanta, GA. Note that some early promo material had the dates wrong. The correct dates are 14-18 August '95. **Norm Violette** was assigned an action item to review the existing procedures regarding conferences and symposia (especially for co-operating entities) and to make recommendations for any needed changes to EMCS policies.

#### **LONG RANGE PLANNING**

**Bill Gjertson** presented the updated EMCS long-range plan. Our next meeting will be at IEEE headquarters and will include a "retreat" on long-range planning.

#### **TREASURER**

**Andy Podgorski** reported that Headquarters now wants three-year financial planning (which will influence overall long-range planning). He reported that EMCS continues in excellent financial health. Reserves were \$526K on Dec 31, '93. This is a 28% increase in just one year (the largest one-year growth in our history)! Because of this surplus, the BoD was able to approve the largest annual budget proposal in our history, \$547K (up nearly \$100K over last year), yet still meet our strict guideline tests for continued fiscal health.

As usual, **Janet O'Neil**, EMCS Secretary, will be happy to provide additional details on the happenings at this (or any other) BoD meeting. Happy Holidays and best wishes for the new year.

**EDITORIAL . . . Continued from page 2**

prepared for a resurgence of military E<sup>3</sup> requirements since the military E<sup>3</sup> environments are for real. My advice to those who are totally dedicated to the European test markets: don't give up your night jobs. It is a market which is in constant flux, and to me, offers a very unsure future.

I don't intend to overshadow the fine articles that our Point and Counterpoint Associate Editor, **Anthony Zimbalati**, has prepared over the years, nor do I profess to have his philosophical perspective or his unique ability to stir controversy. As you have written to Tony in response to his articles, feel free to write to me. If your response is professional and the language is clean, I may print it in a future newsletter, depending upon space availability.

**CALL  
FOR  
PAPERS**

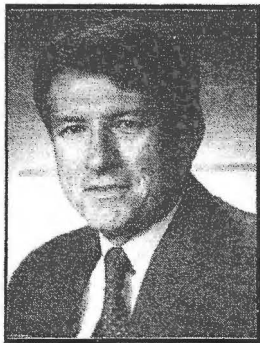
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**JOSEPH BUTLER**  
ASSOCIATE EDITOR

### IEEE TECHNOLOGY POLICY COUNCIL COMMITTEE ON MAN AND RADIATION (COMAR)

**Dan Hoolihan, Representative**

This committee continues work on several new and revised position statements as follows: HDTV, CRT Displays, High Peak Power Pulsed Fields, RF/Microwave Fields, and an RF Dosimetry Tutorial. Due to an IEEE-USA reorganization, as of January 1, 1995, COMAR will be merged with the Health Care Engineering Policy Committee into a new Health Care Technology Committee. At the most recent COMAR meeting on July 28, 1994, COMAR members voted to allow COMAR Chairman Eleanor Adair to pursue interest by the IEEE Engineering in Medicine and Biology Society in having COMAR as a technical committee. In doing so, the members of COMAR felt that the issues in which COMAR is active should not be managed by any committee with a broader assignment than COMAR now has.

### IEEE TECHNOLOGY POLICY COUNCIL COMMITTEE Aerospace R&D

**Len Carlson, Representative**

Major activity this reporting period had to do with the committee review of Senate Bill S.1881, titled "NASA Technology Investment Act of 1994," which was introduced by Senator John D. Rockefeller IV and Senator Conrad Burns. The purpose of the bill is to strengthen the link between NASA programs and economic growth and jobs for Americans. The

bill is divided into two titles. Title 1 establishes NASA's role in technology investment. Title II requires the U.S. to assess aeronautics facilities worldwide and prepare a strategy for developing world class aeronautics testing facilities. One of the key provisions amends the National Aeronautics and Space Act of 1958 by requiring that aeronautical and space activities be conducted to contribute to economic growth, competitiveness and productivity. This bill is intended to support NASA's effort to change the way it does business and become more relevant to the economy.

Also, IEEE-USA is planning to reorganize into a more efficient organization. It will not affect the Aerospace R&D Committee, but it will affect its parent organization, Technology Policy Council (TPC). The Competitiveness Committee will become a TPC committee, the Defense and Engineering R&D Policy Committees will merge, and the COMAR and Health Care Policy Committees will merge into a new committee.

### SAE AUTOMOTIVE EMI & EMR COMMITTEES

**Ed Bronaugh, Representative**

These committees have published several parts of new J551 and J1113 standards. All parts are practically identical with ISO and CISPR versions on the same subjects. The European Automobile Manufacture Association is trying to get "watered-down" versions accepted by Cenelec. This may be a problem.

### SAE EMR STANDARDS COMMITTEE Integrated Circuits EMC Task Force

This task force, formed in 1991, has been developing SAE J-1752, "Electromagnetic Compatibility Measurement Procedure for Integrated Circuits." This standard will address radiated emissions and immunity of IC's from 1 MHz to 18 GHz.

### SAE AE-4 ELECTROMAGNETIC COMPATIBILITY

**David Graham, Representative**

SAE Committee AE4 is in the process of releasing Aerospace Recommended Practice (ARP) documents on system EMC compatibility, filters, and spectrum analyzer use. Subcommittee 4P members are involved in a major effort to define EMC gasket test methods in conjunction with the IEEE P-1302 committee. A review and update of ARP 1972 (Recommended Test Methods) is underway. Subcommittee AE4R is completing its work with respect to the FAA inquiries concerning HIRF. Subcommittee AE4L is actively involved in revising the lightning "Orange Book" (AE4L-87-3, Rev. C) and RTCA/DO-160C (Section 22-Lightning Induced Transient Susceptibility) in cooperation with WG-31 to reflect the latest information on lightning.

### ANSI C63 AND CISPR A&G

**Don Heirman, Representative**

CISPR A&G report that both of these committees will be meeting in Beijing in October to discuss Publications 16 and 22/24 progress. The impact on the EMCS is that there will be internationally harmonized emission and immunity standards that incorporate most ANSI C63.4 measurement methods for emissions, but do not adopt any immunity documents per se that are totally harmonized even with the latest MIL-STD-461/461D versions. Performance degradation criteria for CW and transient immunity measurements, such as ESD, fast transients/bursts, surges, etc. as they apply to information technology equipment (CISPR Pub 24), are top on the priority list. At least twenty different products from telephones to computers were identified as candidates for such criteria specifications.



**RADIO TECHNICAL COMMISSION FOR AERONAUTICS (RTCA) SC 135 & 177****Rick Gaynor, Representative**

The committee, RTCA SC 135, "Environmental Conditions and Test Procedures for Airborne Equipment," met in May 1994 and discussed proposed changes to Sections 8, 20, 21 and 22 of RTCA/DO-160C. These discussions will lead to a planned issue of DO-160D at the beginning of 1996.

Special Committee 177, "Test Criteria and Guidance Relative to Portable Electronic Devices (PEDs) Carried Abroad Aircraft," met in June. Between April and June of 1994, twelve PED incident reports have been received by RTCA. As of this date twenty-five PEDs have been bench-tested. Aircraft level testing is being coordinated with Delta and American airlines. This testing would address a B747-400 and possibly a B-757 and a Gulfstream G-IV. Medical equipment will be examined by this committee as well.

**AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM) ASTM D09-12.14 ELECTROMAGNETIC SHIELDING****Drew Peregrin, Representative**

Recognizing that the ASTM is now developing new standards in the area of EMI gasketing, it is appropriate for the EMCS to establish a formal liaison. Specifically, D09.12.14 is working on revisions to ASTM D4935 (Standard Test Method for Measuring the Electromagnetic Shielding Effectiveness of Planar Materials). These revisions include a modified fixture to test RF shielding gaskets. Three new proposed standards have recently been introduced into the committee for discussion: the slotted aperture radiated RF shielding test method; a transfer impedance test method for RF shielding gaskets; and a long-term reliability test method for RF shielding gaskets and materials.



**KIMBALL WILLIAMS**  
ASSOCIATE EDITOR

**EMCS AND NARTE**

Most of us who are NARTE-EMC-certified engineers and technicians are also members of the IEEE EMC Society. The alliance is a natural one. The EMCS is devoted to improving the conditions of its members in their work in EMC, and NARTE is devoted to certifying that its members are trained and suited for the EMC profession.

Part of the process of verifying the credentials of prospective NARTE members is the written examination. The questions used for the exam are, by and large, contributed by members of the EMCS for that purpose. Once the questions are presented to NARTE, they must be ranked and then evaluated for their suitability.

Therein lies a task that needs to be accomplished. The NARTE question pool is currently in the hands of Ms. Claire Wyatt. Ms. Wyatt is a capable administrator, but she lacks the technical background to evaluate EMC examination questions. Claire has asked the EMCS members to evaluate the question pool. There are several categories of questions, and volunteers may elect to evaluate questions from one or multiple technical categories.

So..... Volunteer!

When you get in touch with Claire, she will send you a group of questions for evaluation along with instructions as to how to conduct the

evaluation, and a self-addressed stamped envelope in which to return the questions. When you have completed the review of that set, return them to Claire and she will send you another. What could be easier?

Contact Claire via mail, fax, phone or e-mail and give her your information. She will follow up with all that you need from there. She is a nice lady; you will enjoy working with here.

Claire Wyatt

Sentel Corporation

225 Reinekers Lane, Suite 500

Alexandria, VA 22314

PH (703) 739-0084

FAX (703) 739-6028

e-mail CWYATT@nccs-evax.navy.mil

**THE INTERNET CONNECTION**

Several new additions have been made to the EMC INTERNET anonymous file transfer protocol (ftp) site which is graciously provided to us by Todd Hubing on the computers at the University of Missouri at Rolla. Now you can download the complete EMC abstracts to your PC in less than five minutes and search them at your leisure. We are now looking for WAIS software to permit "on line" searching capability in the future. The current listing of EMCS BoD and standing committee chairs is also available as a download file.

Our intention is to maintain the site with those documents that are of general interest to the society as a whole and to EMC education in particular, so that the latest versions will only be as far away as your PC and its INTERNET connection. If you know of documents to which having immediate access would benefit the society members, please let us know and we will try to accommodate your requests. To arrange to put documents into the ftp site, contact Todd Hubing at: thubing@ee.umn.edu

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To acquire a document, utilize the File Transfer Protocol (FTP). Use the following to log in and move through the directory structure to where the documents are located.

At your internet prompt, "Enter" ftp emclab.ee.umn.edu.

Note: Lower case letters are **essential**. When the system recognizes your request, it will ask for your Name: "Enter" anonymous. The system will request a Password: "Enter" guest

When you are admitted, use commands "ls" to list directory contents, and "cd" to move into the subdirectories you see listed. A bit of experimentation should get you nicely around the system. The bulk of what you will probably be interested in will be in the \pub\ieee sub directory.  
Happy Hunting!

#### **IEEE/ABET PROGRAM EVALUATORS**

We have received a call from the IEEE Educational Activities Board (EAB) inviting engineering professionals from industrial, government and academic sectors to serve as Program Evaluators to assist in accrediting Electrical Engineering and Electrical Engineering Technology programs at U.S. colleges.

Selected applicants attend a one-day evaluator training session provided by the IEEE, which explains the IEEE/ABET accreditation process. Following training, the evaluator will assist with one program evaluation; evaluations take place each fall and are generally two to three days in length.

The deadline for submission of completed applications is November 15, 1994. However, applications are always accepted and retained for future consideration. To nominate

yourself or others contact:  
Angela Wyckoff, Accreditation  
Administrator  
IEEE Educational Activities  
445 Hoes Lane, P.O. Box 1331  
Piscataway, NJ 08855-1331  
PH (908) 562-5484  
FAX (908) 981-1686  
e-mail a.wyckoff@ieee.org

#### **LIAISONS**

There are some natural relationships between the EMCS and some of the other societies of the IEEE. For example, those between the EMC Society and the Microwave Society, the Antennas & Propagation Society and the Computer Society come to mind right away.

Within the EMCS Education Committee we feel it may be advantageous to establish some formal linkage between other societies' educational functions and our own. To that end we are seeking those who are already active members of other societies as well as the EMCS who would act as liaisons between the societies. The actual duties and responsibilities of such a liaison position are still quite vague as we begin to explore what can or should be communicated. At a minimum, I would think that keeping both sides of the communications link informed of each others' activities and actions would be a good place to start.

If this sounds interesting, and you think you might like serving as a liaison to one of the other societies, please contact me:  
Kimball Williams  
Eaton R&D  
26201 North Western Highway  
Southfield, MI 48037  
PH (810) 354-2845  
FAX (810) 354-2739  
e-mail k.williams@ieee.org

## **1995 INTERNATIONAL AEROSPACE AND GROUND CONFERENCE ON LIGHTNING AND STATIC ELECTRICITY**

The National Interagency Coordination Group (NICG) announced the 1995 International Aerospace and Ground Conference on Lightning and Static Electricity to be held in Colonial Williamsburg, Virginia from 26-28 September 1995. The NICG consists of research experts from the United States Navy, U.S. Airforce, U.S. Army, Federal Aviation Administration (FAA), National Aeronautics and Space Administration (NASA), and the National Oceanic and Atmospheric Administration (NOAA), in association with the Florida Institute of Technology.

This international conference will bring together the latest scientific information on the protection of helicopters, aircraft, aerospace vehicles, ships, ground facilities, and commercial activities against the hazards caused from lightning and static electricity. The conference goal is to exchange ideas and gather important information that will serve the practical needs of academia, industry, and government to successfully resolve critical issues.

The Chairman of the NICG's 1995 Conference is Anthony J. Iacono from the U.S. Naval Air Systems Command. For further information about the 1995 Aerospace and Ground Conference on Lightning and Static Electricity, contact the conference coordinator, Mr. Sam Frazier, at (301) 826-3868, or FAX (301) 826-3871.



## ***EMC SOCIETY CONTINUES TO GROW***

*Note:* S.S. Ahmed was incorrectly listed in the Spring Newsletter. He is from Dhaka, Bangladesh.

Welcome to these new members:

Ahmad Ahmad  
Banias, Syria

Koray M. Akkaya  
Ankara, Turkey

Farini Amedeo  
Milano, Italy

Vishal Arora  
Phoenix, AZ

Wang Baikuan  
Singapore

Mark L. Baxendale  
Hessen, Germany

David R. Blake  
Bear, DE

Mark R. Briggs  
York, England

Jae Seong Chang  
Korea

Sooliam Coi  
Malaysia

Ranjit K. Das  
Moorestown, NJ

James M. Drozd  
Durham, NC

Michael A. Fornatoro  
Warren, MI

Robert K. Gruve  
Daytona Beach, FL

Bahram Hajian  
Fremont, CA

Ken Hollingshead  
Okemos, MI

Perry A. Holman, Jr.  
Freeport, IL

David Huang  
Santa Monica, CA

Alan Johnson  
Lancaster, England

Takumi Karasawa  
Chiba, Japan

Haris A. Khan  
Wayne, NJ

Antonio Morini  
Ancona, Italy

Koenraad Mouthaan  
Delft, Netherlands

Jayjaehwan Nam  
Lexington Park, MD

Umesh D. Navsariwala  
Lexington, KY

Haoi The Ngo  
Cleveland, OH

James C. Nicholson  
Akron, OH

Victorio A. Ochave, Jr.  
Quezon City, Philippines

William J. O'Brien  
Simi Valley, CA

Elisete Ternes Pereira  
Santa Catarina, Brazil

Jose J. Rivera-Nieves  
Naranjito, PR

Luiz Rodriguez  
Tampa, FL

Paul M. Rostek  
Escondido, CA

Aron Rozenberg  
Detroit, MI

Frank Sabath  
Paderborn, Germany

Michael Schieller  
Remscheid, Germany

Mohamed M. El Sherbiny  
Ontario, Canada

Harlan C. Synder  
Saratoga, CA

Ross A. Speciale  
Redondo Beach, CA

Johannes Spiegelaar  
Delft, Netherlands

James M. Stacchi  
Boston, MA

Frederick J.  
Studenberg  
Melbourne, FL

Ana M. Vukovic  
Yugoslavia

Joseph B. Woodworth  
Bellingham, MA

Kwok Ming Wong  
Hong Kong

## ***RESULTS OF THE BoD ELECTION BALLOT***

A ballot for the election of six members to the IEEE Electromagnetic Compatibility Society Board of Directors was issued on July 29, 1994. The ballots returned have been counted, and the following candidates have been elected for a three-year term beginning January 1, 1995:

William G. (Bill) Duff  
W.G. (Bill) Gjertson  
Todd H. Hubing  
Thurman J. (Bill) Ritenour  
Donald L. Sweeney  
Kimball Williams

We wish the newly-elected members of the Board of Directors success and thank all candidates for their willingness to serve and for permitting their names to be included on the ballot.



*Dave Staggs. Honored for his work as Chapter Coordinator.*

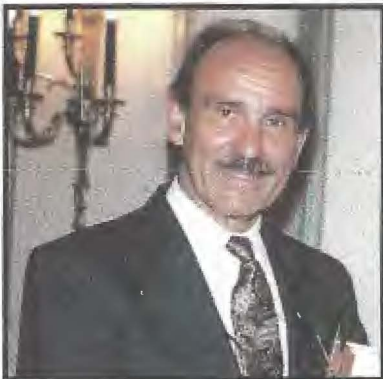
## GLIMPSES OF THE 1994 IN ELECTROMAGNETIC CH



*Fred Heather. Recognized for organizing the EMCS Chapter in Southern Maryland.*



*Elya Joffe (second from left), enjoyed dinner with his daughter Tami-Lee, Chris Kendall (second from right) and Les Polisky (right).*



*Dr. Jose Perini.  
IEEE Fellow Award Recipient.*



*Dr. Jim Whalen (standing) hosts a trial NARTE Exam workshop. Over a dozen brave souls volunteered to take the four-hour exam. Shown here (left to right): Jerry Sawyer, Eric Parent, Marlene Skopec and Hoai T. Ngo.*



*Zorica Pantic-Tanner. Recipient of Achievement Award for developing "Intro to EMI" course at San Francisco State University*

Photos courtesy of Dick Ford.



# INTERNATIONAL SYMPOSIUM ON IC COMPATIBILITY CHICAGO



*"This is the spouse's lounge! Don't you dare take that coffee!" Left to right are John Meyers (the villain), Helen Bloom, Terry Ford, Gerry Bronaugh, and Lois Heirman (the accuser).*



*John Howard. Recipient of Achievement Award for presenting EMI course at San Francisco State University.*



*Mike Hatfield. Winner of Richard R. Stoddard Award for Outstanding Performance for work on mode-stirred chambers.*



*The evening on the lake on the Spirit of Chicago was an outstanding success. Tom Chesworth waves to the camera before boarding.*



*Al Mills. Recognized for work as Pace Coordinator.*



**J.L. NORMAN VIOLETTE**  
ASSOCIATE EDITOR

**BOOK REVIEW**  
**ELECTROMAGNETIC INTERFERENCE**  
**REDUCTION IN ELECTRONIC**  
**SYSTEMS**

by **JEFFREY P. MILLS**  
**PTR PRENTICE-HALL, INC. 1993**  
**LIST PRICE: \$51.00**

This 258-page, 12-chapter book contains 112 clear illustrations of a variety of EMI/EMC topics. It assumes academic course prerequisites including one year of basic electromagnetic fields and transmission lines, and is intended for use as a textbook for a one-semester senior-level or first-year graduate course in EMC. It presents EMC concepts "in an analytical fashion" based on fundamental electromagnetic theory, correlated with the more familiar circuit theory.

**CONCERN FOR EMC**

A basic background concerning EMI problems is provided in this chapter, including characteristics of sources, radiated field and conducted coupling, and the range of consequences as a result of degraded performance of susceptible victims. Intentional and unintentional sources of EMI are identified, as are the recent developments of needed regulations.

**METHODS OF EMI ANALYSIS**

The methods described in this chapter begin with the basic concepts of how the EMI is generated. A three-wire interference problem is used as an example of a simple

coupling situation formulated by circuit concepts. Electric and magnetic field patterns applicable to the three-wire problem are illustrated to introduce the electric and magnetic field coupling approach.

**ELECTRIC & MAGNETIC COUPLING**  
**BETWEEN NEARBY DEVICES**

This chapter illustrates coupling between two signal wires having a common ground return. In the development of the analysis, electric fields are represented by capacitors and the magnetic field as inductors in developing a low frequency model. The problem is then formulated in terms of "lumped" capacitor and inductor circuit coupling elements and impedances. Loop equations are then developed and used to illustrate the generation of a noise voltage from one circuit loop to another, first for capacitive coupling and then inductive coupling. An application of the magnetic vector potential is illustrated to determine the circuit inductance.

**SHIELDING OF CABLES TO REDUCE**  
**CAPACITIVE & INDUCTIVE COUPLING**

Following the development of the preceding chapter, shielding techniques are illustrated to reduce capacitive and inductive coupling. The effectiveness of shields is demonstrated by developing equivalent circuits based upon the electric and magnetic field concepts. The effect of shield resistance on the coupled noise magnitude is formulated, as are the causes and effects of leakage magnetic flux. The concept of shield transfer impedance as a function of frequency is introduced. Stray current return paths are introduced, along with the definition of differential mode and common mode currents. Extensive circuit equations are formulated to determine the respective currents and noise voltages. Techniques for the reduction of common mode current by increasing common mode impedance are presented. The

application of balanced circuits is illustrated. The use of experimental measurements is suggested to verify equations.

**GROUNDING OF**  
**MULTIPLE-CHASSIS SYSTEMS**

Signal ground connections and current flow paths are addressed and defined. The procedures and techniques essentially follow the development of Chapter 4. The importance of minimizing the areas of signal loops is emphasized to minimize coupling via magnetic flux leakages. Controlling the path of return currents and techniques to minimize coupling are discussed. Circuit grounding to enclosure cabinets and the proper grounding of cable shields are illustrated. Noise voltages due to the presence of distributed parasitic capacitance and stray ground current paths are presented. Safety ground connections and possible consequences due to fault currents in improperly grounded systems are discussed. The use of RF chokes acting as common mode chokes in safety grounds is described.

**LAYOUT & GROUNDING OF**  
**PRINTED WIRING CARDS**

This chapter begins by introducing inductive and capacitive coupling on a printed wiring card (PWC). Physically, high current circuits should be separated from circuits sensitive to low voltages. Circuits with different voltage and current levels and different frequencies are classified into five types for the purpose of grouping and layout on a PWC. Interconnection techniques between circuit types are discussed and illustrated. The importance of properly controlling the current return path is demonstrated by using basic magnetic field coupling concepts which also illustrate the effectiveness of strip line conductor configuration and the solid ground plane as a return path. The proper layout of a ground grid to approximate a ground plane is discussed. Electric and magnetic

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field patterns in the vicinity of PWC components are illustrated.

Power distribution techniques, often taken lightly, are analyzed and developed to assure proper operation. Equations are presented for determining circuit impedance parameters, including the value of decoupling capacitors and the effects of circuit resonances.

### **FREQUENCY SPECTRA OF UNINTENTIONAL RADIATION SOURCES**

The frequency content of unintentional sources varies depending upon the type of circuit and speed of the components. This chapter addresses the characteristics of emissions and how to specify these emissions with respect to frequency using Fourier transform and series techniques leading to spectral analysis. Equations are used to illustrate the development of functional expressions and quantification units. Techniques illustrate how to deal with multiple noise sources, the spectrum of digital random processes, and the representation of the spectral density of a random digital signal.

### **RADIATION COUPLING BETWEEN DISTANT DEVICES**

Maxwell's equations form the basis for this chapter which addresses far-field coupling. Solutions to these equations are based upon the concept of *time retardation* of propagating waves to develop expressions for radiated electromagnetic waves, and the concept of wave impedance using the electric dipole model. The superposition of multiple electric sources is presented using multiple co-located electric dipole sources. A similar development is presented for solution of Maxwell's equations for magnetic sources, including the superposition of multiple magnetic sources. Magnetic and electric field source characteristics are presented to conclude the chapter, which also contains the applied math necessary

to solve the typical electromagnetic field problems presented herein.

### **CABINET SHIELDING TO REDUCE RADIATED COUPLING**

Shielding is deemed necessary whenever source radiation levels and/or receptor sensitivities cannot be sufficiently reduced. Three ways that a shield effects an electromagnetic field are described: absorption, reflection, and redirection due to the magnetic permeability of the shield material. Equations are developed to describe absorption and reflection loss in non-magnetic shields. The diversion of low frequency magnetic fields by high permeability shields is described and illustrated.

### **EFFECTS OF SHIELD APERTURES**

The flow of current in shields and in the vicinity of round and narrow slot apertures is described, followed by slot antenna theory as a function of the effects of frequency, wavelength, and slot dimensions compared to a half wavelength. The critical dimensions of apertures that affect shield penetration, and the use of waveguides beyond cutoff to provide attenuation for unavoidable apertures are described.

### **SHIELD PENETRATION BY WIRES AND CABLES**

This chapter discusses the correct and incorrect ways to penetrate a shield by wires and cables. An analysis is presented of wires and cables as they react as antennas in the vicinity of electromagnetic fields. Essentially, an untreated conductor passing freely through a hole in a shield freely conducts RF currents in and out of the shield through the hole. Common mode currents and accompanying radiation results. Proper ways to penetrate a shield are presented: the treatment of power and low frequency leads, and the treatment of high frequency leads. Techniques include the use of bypass capacitors, feedthrough filters, RF

chokes, and ferrite sleeves. The application of properly configured shielded cables ends the chapter.

### **EMC REGULATIONS AND MEASUREMENTS**

This chapter covers civilian (commercial) regulations and U.S. military standards. The basic measurement of radiated emissions is described, including equipment and test site calibration. The measurement of conducted emissions concludes the chapter.

### **APPENDIX**

The Appendix contains answers to problems assigned at the end of each preceding Chapter.

### **BIBLIOGRAPHY**

A short bibliography followed by an index concludes the book.

### **SOLUTIONS MANUAL**

A *Solutions Manual* can be obtained which provides detailed solutions of the problems at the end of each chapter.

### **SUMMARY**

The book is well written and follows the intent stated in the Preface, i.e., the material is treated from a basic concept approach based heavily upon fundamental electromagnetics and circuit theory. It contains the associated mathematics (differential equations, vector calculus) at a level typically found in an undergraduate course in electromagnetic fields. It is recommended as an undergraduate textbook for electrical engineers or for practicing EMC engineers who may desire to revisit (or learn anew) basic applied field concepts to formulate and understand EMI situations. The examples and many problems at the end of each chapter, including answers and (optional) solutions, serve as solid reinforcement of the material covered in the text within the respective chapters.



# EMI TEST CENTER FOR WIRELESS DEVICES

(Source: *Microwaves & RF*,  
June 1994)

Concerned about how electromagnetic interference (EMI) affects wireless communications equipment, four of the largest wireless communications equipment and service suppliers have established the Center for the Study of Wireless Electromagnetic Compatibility at the University of Oklahoma (Norman, OK) to assure that microprocessor-based products are electromagnetically-compatible with other electronic products, especially medical devices. The companies supporting the new center are AT&T, McCaw Cellular Communications, Motorola, and Southwestern Bell Mobile Systems. They have already pledged \$250,000 to the project. However, the final budget is expected to be much higher than that. The center evolved out of meetings and discussions initiated as a result of reports from the U.S., Canada and Europe that hospital equipment and other microprocessor-based devices appear to be affected by various kinds of equipment that emitted electromagnetic signals. The hospital equipment included apnea monitors, anesthetic gas monitors, blood warmers and inter-aortic balloon pumps. A few hospitals have already banned or restricted the use of wireless devices as a result. The center will be headed by Hank Grant, the director of industrial engineering at the university and a former director of the National Science Foundation (NSF). Currently, there are no standards in the U.S. requiring manufacturers of medical and other devices containing microprocessors to shield the chips against EMI; such standards already exist in Europe.

## EMCABS



**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.

**APPROXIMATION AND ACCURACY OF SHIELDING EFFECTIVENESS  
CALCULATED BY SHEET RESISTIVITY**

H. Nagao, A. Nishikata, and Y. Shimizu

Tokyo Institute of Technology

Proceedings of 1994 International Symposium on Electromagnetic Compatibility (EMC'94/SENDAI)  
17-19 May 1994, pp. 104-107

**EMCABS: 01-11-94**

*Abstract:* Simple approximate formula for shielding effectiveness, which was derived from sheet resistivity of shielding materials, is presented. The results for plane wave shielding were compared with Schelkunoff's formula by numerical calculation. For near-field, however, shielding effectiveness calculated from Schelkunoff's formula or sheet resistive approximation cannot correspond to rigorous value. In this paper, the correction factors are shown. By using these correction factors, the rigorous shielding effectiveness, which involves a complex integral, can be easily calculated with good accuracy from Schelkunoff's formula or sheet resistive approximation.

*Index Terms:* Shielding effectiveness, near-field measurements

**TRIPLE-TEM CELL; A SIMPLE DEVICE FOR IMMUNITY TESTING**

F. B. J. Leferink

Hollandse Signaalapparaten B.V.

Proceedings of 1994 International Symposium on Electromagnetic Compatibility (EMC'94/SENDAI)  
17-19 May 1994, pp. 455-459

**EMCABS: 04-11-94**

*Abstract:* In this paper an improved TEM cell, the Triple-TEM cell, is described. By means of the Triple-TEM cell a test object can be tested for radiated immunity in three polarization directions over a huge frequency range and a relative large volume without changing the test setup. Measurement results are presented, and experience with immunity tests on pacemakers and automobile electronics proves that the Triple-TEM cell results in cost-effective radiated immunity testing. The Triple-TEM cell has not been patented.

*Index terms:* TEM cell, immunity testing

**PREDICTION OF NEAR-FIELD ELECTROMAGNETIC EMISSION FROM  
A DIGITAL CIRCUIT BOARD BASED ON RESONANCE  
CHARACTERISTICS**

O. Wada (1), T. Miyashita (1), R. Koga (1), and R. Sano (2)

(1) Okayama University and (2) Fukuyama University

Proceedings of 1994 International Symposium on Electromagnetic Compatibility (EMC'94/SENDAI)  
17-19 May 1994, pp. 304-307

**EMCABS: 02-11-94**

*Abstract:* A simulator to predict electromagnetic emission from a digital circuit is under development. Its simplified procedure makes it possible to be applied to circuits of practical scale. Measured and calculated EM noise spectra demonstrate that the spectrum of EM noise can be characterized by the resonance of a circuit.

*Index Terms:* Shielding effectiveness, near-field measurements

**ANALYSIS OF A BICONICAL ANTENNA FOR EMC MEASUREMENTS**

K. Gyoda, A. Nishikata, T. Shinozuka, and A. Sugiura

Communications Research Lab., MPT

Proceedings of 1994 International Symposium on Electromagnetic Compatibility (EMC'94/SENDAI)  
17-19 May 1994, pp. 755-758

**EMCABS: 05-11-94**

*Abstract:* Broadband antennas such as biconical antennas are widely used in automatic EMI measurements, but these types of antennas have scarcely been investigated so far. Therefore, a numerical analysis is performed on a biconical antenna by using method of moments. This paper presents calculation results of the input impedance, current distribution, height pattern of received voltage and antenna factor. Measurement results of the height pattern and antenna factor are also presented and they show very good agreement with calculated results.

*Index terms:* EMC measurements, broadband antennas

**IMPROVEMENT FOR TEM CELL WITH INNER TERMINATOR (PART 1)-  
DESIGN CONCEPT**

K. Osabe (1) and A. Maeda (2)

(1) Matsushita Comm. Industrial Co., Ltd. and (2) Maeda Associates, Inc.

Proceedings of 1994 International Symposium on Electromagnetic Compatibility (EMC'94/SENDAI)

17-19 May 1994, pp. 441-444

**EMCABS: 03-11-94**

*Abstract:* This paper describes the design concepts of a very large new TEM cell that has a terminator inside of the enclosure and adopts gently curved structures at the transition area from the throat zone to the working zone. It has been experimentally verified by time-domain analysis that this newly design TEM cell is better able to suppress reflection at structure discontinuities compared with the conventional type TEM cell.

*Index Terms:* TEM Cell, measurements, instrumentation design

**OPTICAL-BIAS-CONTROLLED AND TEMPERATURE-STABILIZED  
ELECTRIC FIELD SENSOR USING NACH-ZEHNDER  
INTERFEROMETER**

R. Kobayashi and H. Kumabara

NIT Telecommunication Networks Lab.

Proceedings of 1994 International Symposium on Electromagnetic Compatibility (EMC'94/SENDAI)

17-19 May 1994, pp. 759-762

**EMCABS: 06-11-94**

*Abstract:* This paper describes an electric field sensor which can control the optical bias angle and improve the temperature draft of sensitivity. The optical bias angle is controlled by applying a suitable stress to the LIN60\_3 substrate, and the temperature draft is reduced by inserting a Si semiconductor layer between the electrode and the SiO<sub>2</sub> buffer layer. The optical bias angle can be changed from 40° to 90°, and the temperature draft of the insertion loss is within 2(dB) over a temperature range from 0° to 40°.

*Index terms:* Optical sensors, measurements

## EMC SOCIETY CONTINUES TO GROW

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*Note:* S.S. Ahmed was incorrectly listed in the Spring Newsletter. He is from Dhaka, Bangladesh.

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**MEASUREMENT OF ANTENNA FACTOR OF DIPOLE ANTENNAS ON A GROUND PLANE BY 3-ANTENNA METHOD**

**EMCABS: 07-11-94**

H. Iida, S. Ishigami, and I. Yokoshima

The University of Electro-Communications

Proceedings of 1994 International Symposium on Electromagnetic Compatibility (EMC'94/SENDAI)  
17-19 May 1994, pp 778- 781

*Abstract:* A measurement method of the antenna factor of the dipole antenna for EMI measurements can be studied theoretically and experimentally. A 3-antenna method based on near-field measurements is adopted. Near-field transmission characteristics between the transmitting and the receiving dipole antennas are analyzed by using the EMF method, where sinusoidal current distributions are assumed. It is shown that antenna factors can be obtained from measured values of transmission constants between two antennas in the near-field area of arbitrary heights of each antenna.

*Index terms:* Antennas, measurements

**SIMPLIFIED DIGITAL CIRCUIT MODEL TO PREDICT PEAK PROFILES OF ELECTROMAGNETIC NOISE SPECTRA**

**EMCABS: 08-11-94**

T. Hashimoto, N. Kagawa (1), O. Wada, R. Koga (2), and H. Sano (3)

(1) Fukuyama University, (2) Okayama University and (3) Fukuyama University

EMCJ meeting, Kikai-Shinko-Kaikan, Tokyo

8 March 1994, EMCJ93-84

*Abstract:* A simplified equivalent model of a digital printed circuit including CMOS ICs is proposed to predict spectral peak profile of EM noise from an IC package. Resonance frequencies and the Q factors dominate the profile of EM spectral peaks. The calculated resonance frequencies of DIP and SOP ICs coincide with the measured.

*Index terms:* EM emission, prediction of noise spectra, resonance, IC package

**MEASUREMENT ON THE PERCEPTION THRESHOLD OF MAGNETOPHOSPHENES: COMPARISON OF THE THRESHOLDS FOR SINUSOIDAL AND NON-SINUSOIDAL MAGNETIC FIELDS**

**EMCABS: 09-11-94**

G. Ogura, M. Taki (1), Y. Amemiya (2), A. Aimoto (3), and Y. Kaminura (4)

(1) Tokyo Metropolitan U., (2) Kanazawa Inst. Tech., (3) Fukuyama University, and (4) Otsunomiya U.

EMCJ meeting, Kikai-Shinko-Kaikan, Tokyo

28 April 1994, EMCJ94-3

*Abstract:* Threshold of sensation of magnetophosphenes is measured for both sinusoidal magnetic field and for sawtooth waveform magnetic field. The latter is encountered in the leakage magnetic field in the vicinity of visual display terminals (VDT). The result shows that the threshold values in terms of rms are almost the same for both waveforms. It is shown that guidelines based on stimulation effect of sinusoidal induced current are applicable to the magnetic fields around VDT in spite of the nonlinear nature of the phenomenon.

*Index terms:* Magnetic fields, sawtooth waveform, magnetophosphene

**EQUIVALENT PERMITTIVITY ANALYSIS OF PERIODIC WEDGE-TYPE ABSORBER USING TRANSMISSION MODE APPROXIMATION**

**EMCABS: 10-11-94**

T. Aoyagi, A. Nishikata and Y. Shimizu

Tokyo Institute of Technology

EMCJ meeting, Kikai-Shinko-Kaikan, Tokyo

28 April 1994, EMCJ94-4

*Abstract:* Multi-layer wave absorber with wedge structure shows wide frequency characteristic. The wedge structure has to be calculated for designing multi-layer wave absorber. Equivalent permittivity has been used to calculate a wedge structure. However, periodic length of wedge structure was not considered in an old uniform approximation. In this study, transmission mode approximation is proposed, taking into account the periodic length of wedge structure. By this approximation the equivalent permittivity which is considered periodic length of dielectric material and polarization is calculated by propagation constants. The differences of equivalent permittivity between both approximations are notable at higher frequency. The differences of equivalent permittivity are also shown in contour maps.

*Index terms:* Wave absorber, wedge structure, periodic length, equivalent permittivity, transmission mode approximation

**SITE ATTENUATION MEASUREMENT USING SPHERICAL DIPOLE ANTENNA**

**EMCABS: 11-11-94**

K. Murakawa, M. Takahashi, H. Ohashi, and M. Tokuda

NTT Telecommunication Networks Lab

EMCJ meeting, Kikai-Shinko-Kaikan, Tokyo

28 April 1994, EMCJ94-7

*Abstract:* Measurement technique of site attenuation for test site using a spherical dipole antenna is discussed. By using the spherical dipole antenna, the site attenuation can be precisely evaluated compared with the tuned type antennas, because of non-use of cables.

*Index terms:* Site attenuation, spherical dipole antenna, measurement method

**INFLUENCE ON THE TRANSMISSION CHARACTERISTICS OF A SLOT MADE ON THE GROUND CONDUCTOR OF MICROSTRIP LINE**

**EMCABS: 12-11-94**

T. Kubota, H. Nakano, K. Koshiji, and E. Shu

Science University of Tokyo

EMCJ meeting, Okayama University (Okayama)

3 June 1994, EMCJ94-8

*Abstract:* In a multi-layer printed circuit, through-hole clearances made on the ground conductor may often intersect with each other and form a slot. Existence of these slots may change the return path of the current and therefore deteriorate the transmission characteristics of the line. In this report, the transmission characteristics of a microstrip line with a slot of various dimensions on the ground conductor were measured, and the equivalent circuit parameters for the slot were evaluated from the measured results.

*Index terms:* Slot, microstrip line, ground conductor, through-hole

# EMC COUNCIL DIRECTIVE, LAW AND STANDARDS

(Source: *Rheinland World News, The International Journal of Safety & Standards, Trends & Information*, July/August 1994)

Continuing its program of providing a comprehensive base of harmonized standards approved under the electromagnetic compatibility (EMC) directive (89/336/EEC, 92/31/EEC), the European Union (EU) has published references of 13 newly-approved standards or approved updates to existing standards (refer to Table 1).

The latest list of approved standards forms part of an extensive program by CENELEC to cover all EMC issues with harmonized standards before CE marking under the EMC directive becomes mandatory in the beginning of 1996. The program uses a base of four generic standards to lead into product-specific or sector-specific standards. Three of the four generic standards are now approved, and the fourth is due to be completed this summer. A full list of product categories covered by the program is available.

"Approved" standards in this context provide a presumption of

conformity to the requirements of the EMC directive and the related EMC laws. A product complying with an approved standard or standards covering all electromagnetic compatibility aspects of that product can be marked with the CE marking. After declaring the conformance, the product can be placed on the market and taken into service. Products placed on the market before the end of the transition period until December 31, 1995, can also alternatively be in compliance with national regulations which have been in force since June 30, 1992. In Germany, such a national regulation is the "law concerning the operation of high frequency equipment," with executing decrees as Vfg. 1045/1984, 1046/1984, 242/1991, 143/1991. Placing [a product] on the (German) market is allowed after sending a declaration according to these decrees to the Federal Approvals Office for Telecommunications (BZT). All products "placed on the (European) market" after December 1995, must comply with the EMC directive, even if the same kind of product has also been in compliance with the old regulations and has been sold in Europe before.

"Placing on the market" can be:

- Alteration of the ownership: a manufacturer (or his authorized representative, or an importer) alters the ownership of a product or the product itself to the end-user or consumer, or to somebody who will offer the product to the end-user or consumer.
- A product will be offered directly to the end-user or consumer.
- A product will be taken into service after being imported by the consumer/end-user.

Placing on the market is independent of the date of manufacturing. Placing on the market involves each sample of a production series. The old national regulations can be applied for a lot of specific products placed on the market before 1996, but all units of the same product series placed on the market after 1995 must fulfill the EMC requirements.

This article is based on information from the Commission of European Union and an article "Electromagnetic Compatibility: More Approved Standards," published by Single Market Ventures, Europe-link service ref. 943/04.

EN REFERENCE	TITLE	PUBLISHED
EN 50065-1 AM1	Signaling on low-voltage electrical installations in the frequency range 3 to 148.5 kHz. Part 1: general requirements, frequency bands and electromagnetic disturbances.	2/19/92, 2/17/94
EN 50081-1	Electromagnetic compatibility generic emission standard. Part 1: residential, commercial and light industry.	4/10/92
EN 50081-2	Electromagnetic compatibility generic emission standard. Part 2: industrial environment.	2/17/92
EN 50082-1	Electromagnetic compatibility generic immunity standard. Part 1: residential, commercial and light industry.	4/10/92
EN 55011	Limits and methods of measurement of radio disturbance characteristics of industrial, scientific and medical (ISM) radio frequency equipment.	2/19/92
EN 55013 AM11	Limits and methods of assessment of radio disturbance characteristics of broadcast receivers and associated equipment.	2/19/92, 2/17/94
EN 55014	Limits and methods of measurement of radio interference characteristics of household electrical motor-operated and thermal appliances, portable tools and similar electrical apparatus.	2/19/92, 2/17/94
EN 55015	Limits and methods of measurement of radio disturbance characteristics of electrical lighting and similar equipment.	2/19/92, 2/17/94
EN 55020	Immunity of broadcast receivers and associated equipment.	2/19/92, 2/17/94
EN 55022	Limits and methods of measurement of radio interference characteristics of information technology equipment.	2/19/92
EN 60269-1AM1	Low-voltage fuses. Part 1: general requirements.	2/17/94
EN 60282-1	High-voltage fuses. Part 1: current-limiting fuses.	2/17/94
EN 60555-2	Disturbances in supply systems caused by household appliances and similar equipment. Part 2: harmonics.	2/19/92
EN 60555-3	Disturbances in supply systems caused by household appliances and similar equipment. Part 3: voltage fluctuations.	2/19/92
EN 60687	Alternating current static watt-hour meters for active energy (classes 0.2 S and 0.5 S).	2/19/92
EN 60945 AM1	Marine navigational equipment. General requirements. Methods of testing and required test results.	2/17/94
EN 61036	Alternative current static watt-hour meters for active energy (classes 1 and 2).	2/17/94
EN 61037	Electronic ripple control receivers for tariff and load control.	2/17/94
EN 61038	Time switches for tariff and load control.	2/17/94

Table 1. Standards Providing A Presumption of Conformity to Directive 89/336/EEC (EMC)

# EVALUATION OF TVSS IN ACCORDANCE WITH IEEE C62.41-1991 RECOMMENDED PRACTICE

UL has announced a new optional Classification Program for UL subscribers to the Listing Service for Transient Voltage Surge Suppressors (TVSS). Subscribers having Listed TVSS may submit their products for evaluation and Classification in Accordance with IEEE

**Recommended Practices on Surge Voltages in Low-Voltage AC Power Circuits, IEEE C62.41-1991**, to verify that transient voltage surges do not exceed suppressed voltage ratings specified by the manufacturer, when subjected to the **"Standard Surge-Testing Waveforms"** described in IEEE C62.41-1991 using the test procedures specified in the Standard for Transient Voltage Surge Suppressors, UL 1449.

This Classification Program is an optional service that is available as an adjunct to UL's Listing service for TVSS.

## BACKGROUND

Transient voltage surge suppressors are currently tested to verify that transient voltage surges are limited to the maximum amplitude specified by the manufacturer when subjected to a single type of surge-testing waveform as specified in UL 1449. The waveform is similar to one of the standard surge-testing waveforms described in IEEE C62.41-1991 and is the only waveform required for Listing. TVSS are required to be provided with a suppressed voltage rating (SVR) marked on the product.

Testing in accordance with UL 1449 is intended to confirm that a TVSS is capable of suppressing transient overvoltages. The sole purpose of the marked suppression rating, determined in accordance with UL 1449, is to provide independent information on the "output" response of a TVSS when subjected to a single surge-testing waveform. However, the surge-testing waveform in UL 1449 is only one of a number of waveforms that could be

encountered. IEEE C62.41-1991 describes other standard surge-testing waveforms including 100 kHz ring wave and combination waves of several different voltage and current amplitudes.

## TEST PROGRAM

Manufacturers may request UL to verify "Suppressed Voltage Ratings" using the **"Standard Surge-Testing Waveforms"** described in IEEE C62.41-1991 on listed transient voltage surge suppressors. Testing is limited to one or more of the modes (pairs of terminations) evaluated in the listing investigation.

The standard surge-testing waveforms are as follows:

"Standard 1.2/50  $\mu$ s - 8/20  $\mu$ s Combination Wave"  
"Standard 0.5  $\mu$ s - 100 kHz Ring Wave"

UL's Classification service will include a "Listing/Classification Page" that contains information identifying the SVR obtained as a result of testing using the various "Standard Surge-Testing Waveforms" of IEEE C62.41-1991. Products "Classified in Accordance with IEEE C62.41-1991 Recommended Practice" will be evaluated for suppressed voltage rating (SVR) and, if requested, endurance, as follows:

SVR - Tests to determine the SVR using the standard surge-testing waveforms of IEEE C62.41-1991 will be conducted using the test procedures specified in UL 1449 except as follows:

- The duty cycle portion of the testing is conducted at the fall peak voltage and current values.
- The suppressed voltage rating (SVR) is equal to or greater than the highest suppressed voltage measured. The voltage level will

be as specified in Table 37.1 of UL 1449, for suppressed voltage ratings not exceeding 6000 V, or as specified in the table below, for suppressed voltage ratings exceeding 6000 V, that is equal to or greater than the suppressed voltage measured during testing.

Maximum Measured Suppressed Voltage $V_{pk}$	SVR
6001 V - 8000 V	8000 V
8001 V - 10000 V	10000 V
10001 V - 12000 V	12000 V
12001 V - 15000 V	15000 V
15001 V - 20000 V	20000 V

- The tests will be conducted with minimum 6 inches of leads exiting from the enclosure, in accordance with the manufacturer's instructions, for all "hard wired" permanently connected devices.
- The suppressed voltage rating table, as determined in the Classification evaluation, will have to be marked on or provided with the product.

**Endurance** - Where the number of surges of endurance is indicated in the Classification, the sample, while energized, was subjected to the specified number of surges of the specified surge testing waveform, with a minimum of 30 seconds between surges. The suppressed voltage measured following the endurance testing is required not to deviate from the "as-received" value by more than 10%. Endurance testing is performed in increments of 1000 applications. (eg; 1000, 2000, 3000, 4000, etc.)

For more information on the program, contact George Mauro, Underwriters Laboratories Inc., 1285 Walt Whitman Road, Melville, NY 11747-3081.

Tel: 516-271-6200 (Ext. 22570).



## ***EOS/ESD SYMPOSIUM***

The seventeenth annual symposium dealing with electrical overstress (EOS) and electrostatic discharge (ESD) effects is being sponsored by the ESD Association in cooperation with the IEEE. The symposium will be devoted to the fundamental understanding of electrical transients and electrical overstress, and the application of this knowledge to the solution of problems in military, industrial, computing and communication, consumer and automotive electrical components, as well as in systems, subsystems and equipment. Although historically the symposium has focused on preventing damage to sensitive components in the solid-state electronics industry, quality contributions relating to EOS/ESD are actively solicited from other industries including manufacturing and biomedical.

The deadline for submission of abstracts, 500-word summaries and figures (optional) is January 18, 1995. For more information contact:

Technical Program Chairman  
Robert G. Renninger  
AT&T Bell Labs, Rm. 1A-201  
600 Mountain Ave.  
Murray Hill, NJ 07974  
Phone (908)582-4122

## ***CALL FOR PAPERS***

A call for papers has been issued for the Ninth International Conference on Antennas and Propagation (ICAP 95). The conference is scheduled for April 4 to 7, 1995 at the Technical University of Eindhoven, The Netherlands, and is sponsored by the Electronics Division of the Institution of Electrical Engineers.

## ***EMV' 95***

The first international Exhibition of Workshops on Electromagnetic Compatibility (EMC) in Industry and Skilled Trade has been scheduled for April 25-27, 1995. The symposium will be held at the Spectrum Exhibition and Conference Centre, Dresden, Zellescher Weg 17, Germany.

The program will include an industry exhibition and workshops.

Attendees are expected to be highly-qualified and knowledgeable industry personnel from the fields of production, development, industrial, technical and trade management. Production and quality assurance engineers, scientists, management consultants, distributors, and government representatives are also expected.

For more information contact:  
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Tel: +49-711-61946-71  
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For more information contact:  
ICAP '95 Secretariat  
Conference Services  
The Institution of Electrical Engineers  
Savoy Place, London, WC2R 0BL  
Tel: +44 71 344 3577/5478.  
Fax: +44 71 497 3633.

## ***EMC 95***

The 2nd International symposium on Electromagnetic Compatibility and Electromagnetic Ecology (EMC-95) will be held 26-30 June 1995 at the St. Petersburg State Electrotechnical University.

The goals of the symposium are to:

- Exchange scientific and technical achievements, research results and experience of problems of electromagnetic compatibility and electromagnetic ecology (EMC and EME), technical and biological aspects.
- Join specialists' efforts in EMC and EME field for intensification of scientific research and realization of technical developments.
- Develop conceptions, methods and means of education in EMC and EME fields.
- Interpret history and perspectives of radio development in different countries of the world in the light of radio centenary jubilee.

For more information contact Dr. William Duff at (703)914-8500 or Prof. Popov str. 5, Electrotechnical University, EMC-95, St. Petersburg 197376, Russia. Phone: (812)234-89-67. Fax: (812)234-15-43.

## ***CALENDAR 1994***

December 5-9  
**1994 INTERNATIONAL  
SYMPOSIUM ON EMC**  
Reboucas Convention Center  
São Paulo, Brazil  
Fax: 55 11 2127216

## 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
- 2000** Washington, DC  
Bill Duff  
(703)914-8450

## EMCS COOPERATING SYMPOSIA

- 1995** Zurich, Switzerland  
March 7-9  
Dr. Gabriel Meyer  
FAX: (411) 262 0943
- 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

The following calendar is compiled by the IEEE Technical Activities Department for its volunteers and is composed of information received on Society administrative meetings as well as other IEEE Boards and Committees. It does not purport to be a complete set of information. Most meetings are open only to Board/Committee members. Any appropriate meeting information to appear in the Administrative Meetings Calendar should be sent to:

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IEEE  
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Fax: (908)562-1571  
E-mail to [m.desarle@ieee.org](mailto:m.desarle@ieee.org).

November 11-12  
**EMC SOCIETY BoD**  
IEEE  
Piscataway, NJ  
Janet O'Neil: (301)973-8757

November 17-19  
**TAB MEETINGS**  
Bonaventure Spa and Resort  
Ft. Lauderdale, FL  
Paula Dunne: (908)562-3919

January 13-15  
**IEEE BOARD RETREATS**  
Marco Beach Hilton  
Marco Island, FL  
Laura Wolf: (908)562-3989

January 13-14  
**TAB SPARC/MANAGEMENT COMMITTEE RETREAT**  
Marco Beach Hilton  
Marco Island, FL  
Kathie Colapietro: (908)562-3921

January 15-17  
**OI RETREAT**  
Marco Beach Hilton  
Marco Island, FL  
Henry Shein: (908)562-3988

January 17  
**IEEE EXECUTIVE COMMITTEE MEETING**  
Marco Beach Hilton  
Marco Island, FL  
Julie Cozin: (908)562-3984

March 1-4  
**TAB MEETING SERIES**  
and  
March 4  
**TAB MEETING**  
Calgary, Canada  
Paula Dunne: (908)562-3919

March 2  
**TAB GOVERNANCE WORKSHOP**  
Calgary, Canada  
Jayne Cerone: (908) 562-3908

March 5-6  
**IEEE BOARD OF DIRECTORS**  
and  
March 6  
**IEEE EXECUTIVE COMMITTEE**  
Calgary, Canada  
Julie Cozen: (908)562-3984

May 20  
**CPMT OPERATING COMMITTEE**  
and  
May 21  
**CPMT BOARD OF GOVERNORS**  
Caesars Palace  
Las Vegas, NV  
Dennis R. Olsen: (602)413-5034

August 12-19  
**IEEE EXECUTIVE COMMITTEE MEETINGS**  
Australia & New Zealand  
Julie Cozin: (908)562-3984

December 13-14  
**IEEE BOARD OF DIRECTORS**  
and  
December 14  
**IEEE EXECUTIVE COMMITTEE MEETING**  
Monterrey, Mexico  
Julie Cozen: (908)562-3984

## 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.

**PATTON & ASSOCIATES, 4718 W. El Caminito Drive, Glendale, AZ 85302**

Telephone: (602) 934-5458 FAX: (602) 242-7700

Worldwide Telecommunication Design Assistance and Agency Submittal

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