

IEEE EMC SOCIETY

NEWSLETTER

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JANET O'NEIL, Editor



Photo by: Dan F. Martin Photography & Graphics

Donald N. Heirman (L), recipient of the 1997 IEEE Charles Proteus Steinmetz Award, with IEEE Immediate Past President Wallace Read (R) at the "Austin Style Gala" in Austin, Texas.

Heirman Receives IEEE Field Award

The traditional Wednesday evening Symposium get together was very special this year in Austin. It was titled "Austin Style Gala" and it was a grand affair. Not only were the guests treated to a sit down dinner with live entertainment, but the immediate past President of the IEEE, Wallace S. Read, was in attendance. This was the first time a President of the IEEE spoke personally at an EMC Society Symposium. Mr. Read was there to present the 1997 IEEE Charles Proteus Steinmetz Award to Donald N. Heirman. This is a prestigious IEEE Field Award and it is presented annually to an individual for major contributions to the development of standards in the field of electrical and electronics engineering. The Award consists of a bronze medal, certificate

and five thousand dollars, and is sponsored by the IEEE Standards Board. Mr. Heirman is the first member of the EMC Society to receive an IEEE Field Award.

In his remarks to the audience, Mr. Read first commented upon the IEEE and his role as President. He acknowledged that the IEEE is a complex international organization of 315,000 members, 70 percent of whom reside in the United States. At current rates of growth, this percentage ratio will reach 50/50 early after the turn of the century. He noted that the IEEE is writing new bylaws which will enable the various entities within the organization to work with more authority at the grass roots level. The IEEE looks to the EMC Society and its sister societies to keep it in a leadership position

IEEE ELECTROMAGNETIC COMPATIBILITY SOCIETY NEWSLETTER

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IEEE Immediate Past President Wallace Read (L) shares the excitement with Lois and Don Heirman prior to the gala. During his presentation of the award, Mr. Read acknowledged Lois's role in supporting Don in his volunteer work over the years. Lois, take a bow!

worldwide. When asked about the life of an IEEE President, Mr. Read commented that during his term of office in 1996, he was at home in Newfoundland, Canada, for 91 days. The balance of his time was spent traveling to all corners of the earth where IEEE members reside. He jokingly said that during this time his wife learned a new four letter word - IEEE!

Mr. Read spoke with great fondness for the IEEE, the organization and his position as President, as well as for the many volunteers who are at the heart of the IEEE's success. He took pleasure in recognizing one particular outstanding volunteer, Don Heirman. It was interesting to learn that the only time the IEEE President cannot dictate the timing and location of a meeting is on an occasion such as the gala. The award winner specifies the date and location of the award presentation and the IEEE President has to be there. In selecting Mr. Heirman as the award recipient, on behalf of the IEEE Board of Directors, Mr. Read said that in IEEE Standards circles Mr. Heirman is known and respected for the time and energy he puts into every task. For example, he is known for his innovative contributions to international standards on EMC measurements and test facilities. As a result of his efforts, the ANSI C63.7 series, which is used as the international reference in constructing and validating EMC emission test sites, is one of the most highly regarded in the community. He chairs or is principal contributor to international standards organizations as a member of the IEEE Standards Board, chairman

of the IEEE EMC Society Standards Committee, chairman of two subcommittees of ANSI Accredited Standards Committee C63 (EMC), member of the Executive Committee of the US National Committee of the International Electrotechnical Commission (IEC), and US technical expert for the Special International Committee on Radio Interference (CISPR). He has his Masters and Bachelors Degrees in Electrical Engineering from Purdue University and he is a retired US Navy Commander in the Research Reserves Program.

In his acceptance speech, Mr. Heirman discussed the history of standards within the EMC Society: "Since the early 80s when we had five standards dating back to the 60s and around 3,500 members, we have increased our standards activity to well over a dozen standards and projects, have updated the original five standards to 90s technology, and we now have some 4,500 members." Further, he noted that, "Standards activity within the EMC Society is quite high on a per member basis for such a small Society compared with the 'big hitters' such as the Computer Society and the Power Engineering Society." Mr. Heirman acknowledged that this progress could not have been possible without the effort and support of the entire Standards Committee and his wife, Lois, whom he praised for her patience while he worked on Standards activity.

It was a memorable evening at a most memorable Symposium.

— by Janet O'Neil



BILL GJERTSON
PRESIDENT,
EMC SOCIETY

Several thoughts come to mind as I respond to the deadline for input into this Newsletter. One thought is that we have had a great EMC year with the 1997 EMC Symposium in Austin, Texas especially being a terrific event. The Society extends a big thank you to John Osburn and the entire Austin Symposium Organizing Committee.

Another thought is we will have a new President of the EMC Society in 1998.

Elections for new officers of the EMC Society Board of Directors will take place at the November Board meeting in Atlanta.

The last thought I had concerned how the Society might make more intelligent use of the internet. Our Society is made up of many very experienced and well educated engineers whom I'm confident can offer better and more beneficial ideas on the use of the internet. We are bombarded with articles containing many "good ideas". My sense is that good ideas are easy to come up with.

Ideas which will utilize the internet to the benefit of all IEEE EMC Society members is much more difficult. Do you think everything has already been thought of?

No! I don't believe that either. We really need to focus on how the internet can help us, the EMC Society, and be of great benefit to the EMC Society members.

OK, let's do it. Let's give ourselves one day or one week and then toss out the idea and send it to the Directors of the EMC Society. The Society has within the Communication Services Directorate, an electronic media committee at work and they will consider and evaluate every idea. The Board of Directors (i.e. the 18 Directors elected by you, the membership) during elections at our November Board meeting will elect some new Vice Presidents for the areas of Standards, Communication Services, Member Services and Technical Services.

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Janet O'Neil, Editor, with John Osburn, Chairman of the Austin Symposium Committee.

Hats Off to the Austin Symposium Committee!

This year I attended the EMC Society Symposium in Austin wearing many hats, not literally of course, but this year I represented many different entities. I attended as a representative of my employer, Lindgren RF Enclosures, as a member of the EMC Society Board of Direc-

tors and as the new editor of the EMC Society Newsletter. It was in this last role that I found my greatest challenge in Austin: I was the investigative reporter gathering news and information for the next newsletter! Wearing my "Dick Tracy" hat, I combed the aisles of the exhibit halls, attended various meetings and presentations, and participated in social functions. With my clipboard and pen, I jotted down notes on interesting activities and newsworthy events. I'd like to share a bit of the news with you.....

Did you notice a few babies in Austin at the symposium? Potential members of the EMC Society abounded with the likes of **Isabel Prchlik**, daughter of **Mark and Joan**. Isabel was born just one week prior to the symposium! Mark is with EMC Test Systems and he was a member of the symposium organizing committee. **Todd and Bonnie Robinson** were proud to show off **five month old baby Kendall** whose namesake is..... you guessed it, the Kendall family as in **Chris and Chuck Kendall** of CKC Laboratories. Bonnie is the daughter of Chris and Todd works in marketing for CKC Labs. **Andy and Barbara Drozd** gamely brought **11 week old Evan** to the symposium. They were also spotted dining with Evan at a wonderful restaurant nearby.

There were also changes in the air at Austin. **Steve Kulha** is new to Seimens Automotive from United Technologies. **Jacob Alkalay** recently moved from Chrysler to Yazaki North America. **Ray Kujawski**, formerly of Bay Networks, is new to Cisco Systems. **Ed Bronaugh** joked that he joined Seimens Communications in Austin just to get an e-mail ad-

dress! **Randy Smith** is new to IBM at Research Triangle Park. He was formerly with Alcatel. **Don Heirman** is a new Associate Director for the University of Oklahoma's Center for the Study of Wireless EMC.

Other noteworthy tidbits include.....**Ken Javor** of EMC Compliance drove from Huntsville, Alabama to Austin in a convertible. He received honors for having the best tan in Austin. **Ross Hansen** of Retlif traced the origins of the company name to the simple fact that Retlif is filter spelled backwards. **Howard Plummer** of Caterpillar is a volunteer member of Rescue 702 in Tremont, Illinois. He's training to be a paramedic. **Ralph Trefney** of Cisco Systems showed photos of a plane he's building in his spare time. It's a Team Mini Max 103 which he described as "legal ultra light" (its empty weight is less than 254 pounds). Ralph's put 280 hours into building the plane and has 40 hours left to go! Texan **John Hirvela** of Compaq Computers was overheard commenting that the Austin Capitol is 6' higher than the US Capitol in Washington DC. "Everything's bigger in Texas," says John. **Scott Lytle** of Eaton confirmed this fact by noting that the San Juacinto Monument is taller than the Washington Monument. Scott could only observe that "Texans need to outdo everyone!" Over 200 shipworthy souls attended the boat cruise on Town Lake hosted by Parker Chomerics, Fair-Rite and International Compliance Corporation. Ever wonder what Fischer Custom Communication (FCC) model numbers JM1 and JM2 stand for? Well, if you guessed **Jim Muccioli** as the "JM", you guessed correctly. Jim worked with FCC to develop a small, innovative TEM Cell whose part numbers now bear his initials. At the EMC Society membership booth, sales of CD ROMs discs were going strong. That's forty years of EMC Society symposium records on CD-ROM for 40 bucks (IEEE member price). What a deal! Also moving like hotcakes were the free copies of the 1996 Wroclaw, Poland EMC symposium record. **Gabe Sanchez** reported that Or-

Continued on page 10



TODD HUBING
ASSOCIATE EDITOR

Unified by a common goal and inspired by the success of the Austin Symposium, the Committee to bring the International IEEE EMC Symposium to Rolla, Missouri is hard at work. Sure, Rolla is a small town, but Austin demonstrated that you don't have to be a vast metropolis to put on a great symposium. The Austin symposium committee was able to get more than a thousand EMC engineers to come to one of the hottest places in the U.S. during the hottest month of the year. And symposium attendees had a great time! How did they do it? What was the big attraction? Was it the Mexican food? Was it the bats under the Congress Avenue Bridge? Was it the Southern charm and hospitality of the Austin Symposium Committee?

The Committee to Bring the International IEEE EMC Symposium to Rolla is of the opinion that it was none of these things (except Roy, who thinks it was the bats). The consensus of the committee is that people come to the symposium to find out about the latest developments in the EMC field, to see the new products displayed by the exhibitors, to network with other EMC professionals, to become better informed and therefore more valuable to their employers, and to have a good time.

The committee feels that if people will go to Texas in August, then they will go just about anywhere to attend an IEEE EMC Society Symposium. Cities have already been lined up to host the symposium in the years 1998-2005, so Rolla is setting its sights on 2006.

True, Rolla doesn't have a large hotel or convention center, but Rolla itself is like one big open-air convention center. We have 750 hotel rooms in the town ranging in price from \$22-\$50 per night. Those interested in saving money can stay in one of the university dormitories. Or, if you're really on a tight budget, several members of the committee have volunteered to provide a room in their home for the week to anyone who will help with the dishes and do odd, EMC-related jobs around the house.

Rolla is located along historic Route 66 in a very beautiful and unspoiled part of the U.S. It's out of the way (the closest airport is 115 miles away), but it's worth the trip; particularly if you enjoy hiking, fishing, exploring caves, or swimming in creeks fed by ice-

cold natural springs. Sure, people may initially be reluctant to attend a symposium in a city that doesn't have a shopping mall, but to paraphrase a line from an old movie about baseball, "If you have a great slogan, they will come!" That's why the Committee to Bring the IEEE EMC Symposium to Rolla has been working day and night to come up with a slogan that is sure to draw a big crowd. Here are the slogans the committee has come up with so far:

1. "Show Me" your EMC solution
[Missouri is the "Show Me" state]
2. Enjoy the "ambients" in Rolla, Missouri
3. Give me a hollah when you get to Rolla
4. From 1st street to 14th street, there's lot's to do in Rolla
5. Is this a great place to have a symposium or what?
6. The haircut is 6 dollars, the EMC design advice is free!
7. I made it all the way to Rolla ... AND BACK!
8. We have millions of bats too, but they live in caves [Roy's idea]
9. Get your EMC fix on Route 66

Ok, perhaps we've still got some work to do on the slogan, but the residents of Rolla are excited at the prospect of hosting the International IEEE EMC symposium. The mayor reflected the sentiments of the entire town last week when he said "The 2006 symposium will provide Rolla with the unique opportunity to discover just how many EMC engineers this town will hold." With inspired leadership like that and an attention-getting slogan, Rolla is destined to be the "EMC place-to-be" in 2006.

Central New England

The Chapter Officers elected for 1997/1998 are: Mirko Matejic, Chair; John Luchini, Vice Chair; and John Clarke, Secretary/Treasurer.

Baltimore

During the May 20, 1997 regular meeting, the EMC Baltimore Chapter members re-elected the following officers for another 1-year term: Ted Harwood, Chairman; Vil

Arafiles, Vice Chairman; Chuck Gaston, Secretary; Fred Kirby, Treasurer; and Joe Flynn, Programs Director.

The chapter plans to resume bi-monthly meetings beginning September 16, 1997, and the third Tuesdays of November 1997, January, March, and May 1998. The meetings will feature a dinner, a business meeting, and technical presentations on EMC standards, measurements, and history from prominent members. Please contact Vil Arafiles (vparafiles@aol.com 301-688-6276) or Chuck Gaston(cwg3@juno.com) for details.

Chicago

Ray Klouda reports that the Fall Program got off to a safe start with a presentation on Product Safety Testing from Dwayne Davis of Associated Research. His presentation included answers to some frequently asked questions such as "Why are electrical safety tests performed?" and "Which tests are commonly specified?" Once again Lucent Technologies graciously offered their facilities for the meeting.

Germany

Uwe Keller reports that 35 students from Belgium, France, Greece, Italy, and Germany gathered in Hannover, Germany, to join the ERASMUS Intensive Program on EMC from Sept. ~8 to Sept. ~10. This summer course is a fairly well established annual event, where students from all over Europe come together in order to attend a set of lectures on the basics of electromagnetic compatibility.

The EMC tutorial, initiated by Prof.J.Catrysse from Oostende, Belgium, and Prof.A.Marvin from York, UK, covers the more formal issues like the legal regulations as well as the technical background of EMC. In order to establish a common base, fundamental electromagnetic theory is reviewed and computational methods available for the numerical treatment of structures not amenable to pure analytical procedures are discussed. Some overview of the efficient representation of components via macro models is provided and relevant issues of printed circuit board design are taught. Since measurement is inherently attached to EMC, traditional procedures and novel techniques are presented as well. The course is augmented by measurement and software demonstrations, where the students can get involved and try out things themselves.

The teaching staff supporting the two Professors comprised also of Prof.H. Garbe, the chairman of the German EMC chapter of the IEEE, who was hosting the event in Hannover this year, and Dr.J.Dawson, also from York, M.Kebel and M.Koch from Hannover, and U.Keller, Paderborn, Germany.

According to the students the course was very instructive as well as entertaining, though it was sometimes a bit

difficult to follow the eight hours of intensive lecturing for non-native English speakers. And it was a lot of fun to meet with fellow students from various countries and to make contacts on an international level. The ERASMUS EMC Intensive Program is supported by the European Commission under ICP—1054/B/06.

Israel

Elya Joffe reports that the Israeli chapter holds about four chapter meetings a year, where participation averages about 50. Since they are a relatively small country, and have only one Chapter, members have to drive great distances (100-150 km) to attend the meetings.

They have therefore concluded that it is better to hold four or five full-day meetings than 10 two-hour meetings, since many members have to travel many hours or more to attend the meetings. The Israeli IEEE EMC Chapter held the second chapter meeting on September 14, 1997. This meeting, a full day workshop on EMC, was sponsored by the Israeli Institute of Standards and took place in the excellent facilities they provided. The workshop was held as a part of "National Quality Week", which took place September 14-19, 1997. EMC was the opening issue that week. Participation in the meeting was great! Over 70 attendees, including 30 IEEE members. Participants arrived from places as far as 150 km from Tel-Aviv. For many, this was their first meeting, but, as they said - not the last! For a small country like Israel - this is wonderful! After a short welcome by Chapter Chairman, Elya B. Joffe, a welcome address on behalf of the Israeli Institute of Standards was given by Mrs. Michaela Oren, Head of the Standardization Department. She is responsible for the activities of all standardization committees, including EMC. Mrs. Oren emphasized the importance of EMC, and the great contribution of the chapter members to the EMC standardization process in Israel, as members of the Chapter are the majority of the Committee members. Also, she announced that the chapter chairman, Mr. Elya Joffe, was elected as the new National EMC Standardization Committee Chairman. Following the welcome address, the following technical presentations were given: "Where are the Government Industries Heading in a World of Commercialization of EMC?", by Mr. Elya B. Joffe, of K.T.M. Project Engineering; "Unification of Military and Commercial EMC Standards - Realization of a Dream or Catastrophe?", by Mr. Yoni Schiff of the Israel Defense Forces; "The Effect of a 'Via Fence' on the Coupling between Stripline Transmission Lines on Printed Circuit Boards", by Dr. Moshe Merzer of Rafael/ADA; "Interference in Communication Systems on Aircraft Undergoing an Avionic Upgrade", by Mr. Amnon Bussel and Mr. Amnon Caspi, of Elbit; "Errors in the Manufacturing Process - the Hidden Enemy of Electromagnetic Compati-

bility", by Mr. Avi Marshali of Elbit; "The Relationship between EMC Analysis and Relevant Measurements," by Mr. Moshe Henig of Telrad and "A Demonstration of EFT/B (Electrical Fast Transients) Effects and Solutions," by Dr. Alex Axelrod of EMI Test.

The Israel chapter delegated three members to attend and participate in the EMC'97 Beijing International Symposium on EMC. This is the beginning of a co-operation process between the chapters, where members from each chapter will assist and participate in the Organizing Committees of the International and National EMC Symposia. The members who participated included: Mr. Elya B. Joffe (Chapter Chairman), Mr. Moshe Netzer (Chapter Vice Chairman) and Dr. Jacob Gavan (Chapter Member, and Fellow of IEEE/EMCS, also a member of the Organizing Committee of the Beijing Symposium). This was a great opportunity to get together with many EMC colleagues, enjoy the Chinese hospitality, and assist with the Symposium. Additional meetings are scheduled for 1998. Information on them may be found on the Web Site of the Israel IEEE Section at <http://www.eng.tau.ac.il/~ajw.ieee.html>. The Israel EMC chapter encourages IEEE members from the Middle East, in particular from Egypt, Jordan and the Palestinian Authority (PA) who wish to join us in our activities, to contact the Israel IEEE EMC Chapter Chairman, who will welcome them wholeheartedly.

Los Angeles

Ray Adams reports that the Los Angeles Chapter had the summer off for good behavior. One exception being the Student Activities Chair, Dave Simons, who spoke to the student IEEE Chapter at DeVry Institute in Long Beach. Dave has taken an active role in educating/enlightening the local electrical engineering undergraduates as to their career possibilities and letting them know just what EMC is and how they can benefit from this knowledge.

The first chapter meeting after the summer break featured Doug Smith from Auspex Systems. Doug's talk was titled "A Heuristic Approach to Shielded Cables" and subtitled "Without Triple Integrals". He described just how a shield works and why it sometimes does not work.

Doug also gave a repeat performance of the paper he presented at the Austin Symposium, since most in attendance did not attend the symposium. This paper was about troubleshooting noise in digital chips and was an actual case study. The chip, when a certain bit pattern was produced, would create a crosstalk problem and trigger a logic gate. He told us that the logic designer had used a logic analyzer to attempt to find the problem and Doug was able to troubleshoot the problem with a paperclip in the form of a square loop attached to an oscilloscope. In these days of maximizing profits, this is really using one's head. Chapter

member, Joe Fischer, inquired about Doug's new book and he indicated that it would be done in about a year. A brief question and answer period ensued with just enough time to get the speaker to LAX for his 9:30 P.M. flight. NOTE TO POTENTIAL SPEAKERS: Our meeting place is just 2 miles from the airport, so signup now!!!

Southern Maryland

Since December 1996, the revived IEEE Communications, Computers and EMC Southern Maryland Superchapter has held 10 consecutive monthly meetings in the Lexington Park, Maryland area. These technical meetings have averaged an attendance of at least 15 people. The meetings held to date include:

1. "NAWCAD's Large Anechoic Chamber", Presented by Mr. John Dawson - NAWCAD on Dec. 28, 1996 at lunchtime in Veda Incorporated's main conference room.
2. "Medical Equipment and EMI Requirements", Presented by Mr. Bill Duff - Lockheed-Martin on Jan 28, 1997 at dinner time in the Roost Restaurant's back room.
3. "Air Interoperability Center (AIC) Project", Presented by Mr. Pete Butt - NAWCAD on Feb 24, 1997 at lunchtime in Veda Incorporated's main conference room.
4. "High Performance Computing Center", Presented by Dr. Danny Weddle - NAWCAD on March 31, 1997, at lunchtime in Veda Incorporated's main conference room.
5. "NAWCAD's Science and Engineering Organization Changes", Presented by Mr. Dennis Distler - NAWCAD on April 28, 1997, at dinner time in the Roost Restaurant's back room.
6. "Multi-Computer System Architecture Used in Advanced DOT Human Factors Research Automobile", Presented by Mr. Wayne Devereux - Veda Incorporated on May 19, 1997, at lunchtime in Veda Incorporated's main conference room.
7. "Mobile Differential GPS Enhances Range Testing Capabilities", Presented by Mr. Keith Wallace - Veda Incorporated on June 30, 1997, at lunchtime in Veda Incorporated's main conference room.
8. "Human Body Current Monitor for HF Radiation Hazards", Presented by Mr. John Pasour - Mission Research Corporation on July 28, 1997, at dinner time in the Roost Restaurant's back room.
9. "Aircraft Communications Simulation", Presented by Mr. V. Panei - NAWCAD on Aug 25, 1997, at lunchtime in Veda Incorporated's main conference room.



Photo by: Henry Benitez

Line-Up of Speakers: (L-R) Don Bradley, Dan Garigan, Fu Li, Scott Repp, Tom Canning, Pradeep Karunakaram, Jay Mearns, Henry Benitez, John Prohodsky.



Photo by: Henry Benitez

Ramp to Portland Spirit cruise.



Photo by: Henry Benitez

The Portland Spirit cruise ship, site of the Summer Get Together in Oregon.

10. "Hawkeye 2000: E-2C Mission Computer System Airborne Data Recorder Development" Presented by Mr. Glennn Minucci - Veda Incorporated on Sept 29, 1997, at lunchtime in Veda Incorporated's main conference room.

Oregon

Oregon Chapter Chair, Henry Benitez, reports that the first EMC chapter meeting of the year took place in June of 1996. They had seven regular chapter meetings and two special events for a total attendance of approximately 450! They have been fortunate to have an excellent meeting facility at Tektronix, Inc. in Beaverton, Oregon. Henry served as interim chairman until they elected a full set of officers for the 1997 calendar year. The set of new officers brought a great amount of enthusiasm and eagerness to contribute to the success of this chapter. The new officers made Henry's job a lot easier. The Oregon chapter has officer meetings every month. This allowed them to organize chapter meetings with quality guest speakers, and two special EMC events. The special events included an EMC Colloquium attended by ~170 people and a Summer Get Together attended by over 100 people! The Oregon chapter has formed an alliance with the Seattle, Washington EMC chapter to share EMC Distinguished Lecturers by scheduling their meetings on consecutive nights.

Bruce Brunstad reports that the IEEE Section Summer Get Together occurred on Wednesday, July 30th and was considered by all attending to be a resounding success. It was an exciting early evening Willamette River cruise aboard the Portland Spirit cruise ship. All arrangements for the event were handled by the fledgling IEEE EMC Chapter. Attendance for the event was considered outstanding, with over 100 people partaking in the three-hour cruise. The purpose of the get together was to bring all of the Chapters within the IEEE Section together under one roof, where representatives from each area could relate a tiny bit of what their respective chapter was about to the others in attendance. This information sharing experience appeared to be well received by all. It has been a Section goal to increase inter-chapter communications. The EMC Chapter officers certainly support the Section in this endeavor. There are benefits to be attained, such as coordinating joint meetings or sharing speakers where our various disciplines may cross. We can also learn from one another's successes and failures. The program included one hour for reports from all chapters and IEEE sponsored activities. In addition there was plenty of food, drinks, sunshine and social time. The cruise in-



Photo by: Henry Benitez

Liz Wylie and Bruce Brunstad at registration desk. Mr. and Mrs. Bill Gjertson signing in.

cluded access to the upper deck where the view up and down the Willamette River was spectacular! The response to the First Annual Section Get Together was tremendously positive. The EMC Chapter strongly suggests that the Section continue this activity for years to come. With more time to plan, we could expect to double or triple the attendance. The presenters were as follows: Thomas Canning (IEEE Oregon Section), Henry Benitez (IEEE Oregon EMC Chapter), Pradeep Karunakaram (IEEE Communication Chapter), Fu Li (Signal Processing Society and PSU Student Branch), Jay Mearns (Power Engineering), Daniel Garigan (Computer Society and Engineering Medicine and Biology), John Prohowsky (PACE/Northcon), Ed Perkins (Northcon), and Don Bradley (Portland International Conference on Management of Engineering and Technology).

Rocky Mountain

The September 23rd meeting of the Rocky Mountain Chapter of the EMC Society featured Franz Gisin, Distinguished Lecturer. His talk was on site and antenna calibrations with a touch of test distance extrapolation thrown in for good measure. It was well received by the approximately 20 people in attendance.

Seattle

The Seattle chapter enjoyed a great summer social at Acme Testing in Acme, Washington on Saturday, September 6. Acme Testing is located in a rural valley some 70 miles north of Seattle. Chapter members

knew they had long passed the urban environment as the country drive passed signs stating "Goat Club Meeting Tonight" and "Mushrooms - Marinated Compost" (now what does that mean?). Those members and guests who braved the long drive were in for a treat as host (and Acme Testing President) Steve Fitzgerald and his crew went all out to show the chapter a good time. Salmon and chicken sizzled on the large outdoor barbecue pit and many tempting salads graced the buffet table. The barbecue picnic was held near the banks of the Nooksack River. The scenery of a gentle river and rolling green hills could not have been more relaxing or idyllic. After a sumptuous lunch, the guests were treated to a tour of Acme Testing. This included their three meter indoor anechoic chamber and their ten meter open area test site. Some notable quotes were picked up during the tour. This included Steve's comment,

"Speaking of immunity and emissions, if the cows were closer, you'd get a whiff of some real emissions." Also notable was Ghery Pettit's remark, "The EMC Directive was the EMC professional's act of 1989." By the end of the lazy afternoon, of course, it was a clubby group so the banter was active. It was a wonderful summer social and the chapter members were appreciative of Acme Testing's hospitality.

On September 30, the Seattle chapter hosted Franz Gisin of Silicon Graphics in Santa Clara. Franz is a Distinguished Lecturer of the EMC Society and his presentation entitled "Fun with the Fourier Series" did not disappoint the audience. Some 30 chapter members attended the meeting held at CKC Laboratories in Redmond. Concerned that the topic might not be a draw, it is an oxymoron after all, CKC Labs and Lindgren RF Enclosures volunteered to provide free pizza for the dinner before the meeting. Every-



Photo by: Janet O'Neil

Steve Fitzgerald of Acme Testing (C) pauses during his duties as "Host with the Most" at the Seattle Chapter Summer Social to chat with Seattle Chapter Chairman Ghery Pettit (L) and Chapter member Grany Gillet (R).



Photo by: Janet O'Neil

Everyone joined in on the fun at the Seattle Chapter Summer Social! That's Paul and Kim Slavens of Acme Testing with their children Jason and Abby.

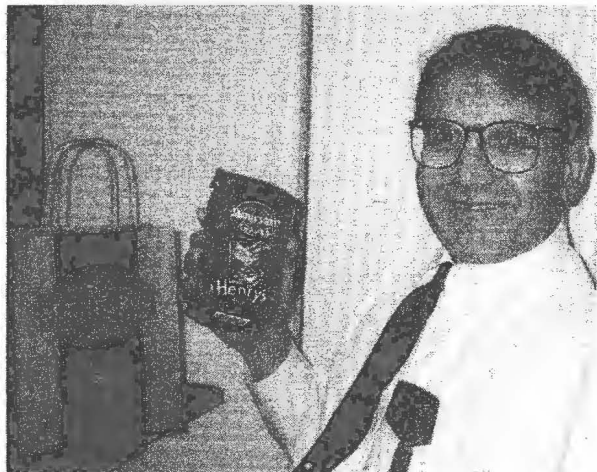


Photo by: Janet O'Neil

EMC Society Distinguished Lecturer, Franz Gisin of Silicon Graphics, is treated to a pound of fresh coffee after his presentation to the Seattle Chapter. Franz was thrilled to receive the special "Henry's Blend" (could this be an EMC blend named after Henry Ott?)

one seemed to enjoy the pizza and the presentation. Franz had the unique ability to discuss the topic in an entertaining and informative way. His viewgraphs especially were great. Basically, he provided a simple but effective method of obtaining the Fourier Series of complex waveforms, and then analyzed several common problems normally encountered in the EMC field.

Everyone is welcome at the Seattle Chapter meetings! Contact Ghery Pettit of Intel for more information at phone 253.371.5515 or e-mail g.pettit@ieee.org

Letter from the Editor . . .

Continued from page 4

bit F/R, a leader in the antenna measurement field, recently acquired Advanced Electromagnetics, Inc. (AEMI) through a stock purchase agreement. The purchase of AEMI was contemporaneous with the initial public offering of Orbit F/R. Gabe Sanchez continues as President of AEMI. Also on the company front, the employees and managers of Electro-Metrics, led by **Ken Bach**, President, have completed a buyout of the company from its former parent corporation Penril Datacomm Networks, Inc. The buyout included all products, technology, patents, facilities and equipment. Operation will continue under the name Electro-Metrics, Inc. from the company's facilities in Johnstown, (Upstate) NY.

While I couldn't be everywhere at once, as much as I would have liked, I tried to stay on the investigative trail. If I missed something particularly newsworthy in Austin, let me know. I can't promise to publish everything, but we do have an EMC Society web page (http://www.emclab.umn.edu/ieee_emc/) and you might just find your information there. In fact, visit the web page to see photos from Austin. Thank you to **Todd Hubing** for scanning these photos and creating our first virtual collage of symposium highlights.

I have been to every EMC Society Symposium consecutively since 1982 and I must say that the energy level at the Austin symposium was at an all time high. The exhibit area, the papers, and the committee meetings were all very well attended. At some of the committee meetings especially, such as those held by the SAE EMI and the EMC Society Standards Committees, respectively, there was standing room only. EMC is hot right now and it's getting hotter! The 90 degree temperatures in Austin in August were a fitting backdrop to this hot industry. My "Dick Tracy" hat is off to **John Osburn** and the entire Austin symposium organizing committee for doing a super job!

President's Message . . .

Continued from page 3

Early in 1998, each Vice President will verify, re-designate or nominate the committee chairs of the respective committees within their specific areas of responsibility. In the meantime, all ideas on how the IEEE EMC Society can better use the internet should be sent to Franz Gisin (gisinf@engr.sgi.com), Chairman of the Internet Committee, or to the EMC Society Board of Directors (an e-mail alias for all 18 Directors is emc-bod@ieee.org).

And while we are thinking of good ideas for the internet and for our Society, let us all help the new Vice Presidents and their committees identify volunteers to work in 1998 on EMC Society business. As Bruce Eisenstein told the TAB Nominations and Appointments Committee recently, we are all talent scouts and should be on the look out for potential IEEE volunteers. We, the EMC Society, are also Talent Scouts searching for volunteers to do EMC Society work and IEEE work. Volunteers are the IEEE and the EMC Society.

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



BOB ROTHENBERG
ASSOCIATE EDITOR

This is the third in a series of articles that presents *fundamental* EMC concepts as they exist within a printed circuit board (PCB). Material is extracted from *Printed Circuit Board Design Techniques for EMC Compliance*, by Mark I. Montrose, IEEE Press, 1996.

EMC Suppression Concepts for Printed Circuit Boards Bypassing and Decoupling

Mark I. Montrose

Use of decoupling capacitors prevents generation of differential-mode voltage drop between two circuits as well as reduces common-mode currents from being injected into I/O interconnects. Capacitors also prevent radio frequency (RF) emissions from being created in addition to minimizing externally induced RF fields from entering the product (immunity protection). Before we examine how capacitors work, a definition of three different uses for capacitors is provided.

Capacitors are used in one of three configurations; decoupling, bypassing and bulk.

Decoupling -

Removes RF energy generated on the power planes from high frequency switching components. Decoupling capacitors provide a localized source of dc power for devices or components, and are particularly useful in reducing peak current surges being propagated across the circuit board.

Bypassing -

Removes unwanted RF noise that couples component or cable common-mode EMI into susceptible areas and provides other functions of filtering (bandwidth limited).

Bulk -

Maintains constant dc voltage and current to components when all signal pins switch simultaneously under maximum capacitive load. Also prevents power dropout due to dI/dt current surges generated by components consuming voltage and current in the power distribution system.

Restating, bypassing and decoupling refers to preventing propagation of RF energy from one area to another. These areas

are power and ground planes, components, and internal power connections to I/O connectors. Bulk capacitors provide sufficient dc power to components to prevent a momentary voltage drop from occurring when a power supply is not located in the vicinity of the switching device.

Decoupling is used to provide a localized source of dc voltage and current for proper operation of components during clock or data transitions, especially when all component signal pins switch simultaneously under maximum capacitive load. Decoupling is accomplished by ensuring there is a low-impedance power source present in the power planes. Because decoupling capacitors have decreasing impedance (ability to remove RF switching currents) as the frequency increases up to the point of self-resonance, high frequency noise is effectively removed from the signal trace, while low frequency RF energy remains relatively unaffected. All capacitor values must be calculated and used for a specific function. In addition, the dielectric material of the capacitor must be properly selected; it cannot be left to random choice from past usage or experience.

Capacitors, in reality, consist of an LCR circuit with L (inductance in the lead length), R (resistance in the leads) and C (capacitance). A schematic representation of a capacitor is shown in Figure 1. At a known frequency, the series combination of L and C becomes resonant, providing very low impedance and effective RF shunting. At frequencies above self-resonance, the impedance of the capacitor becomes increasingly inductive and bypassing or decoupling becomes ineffective. Hence, lead lengths of capacitors (surface mount, radial, or axial), including trace length between a component and the capacitor, vias in the circuit, and the like, affect bypassing and decoupling performance. Lead length inductance is an important parameter to consider when selecting capacitors for bypassing and decoupling. Other important parameters are its dielectric material and the tolerance rating of the capacitor's value.

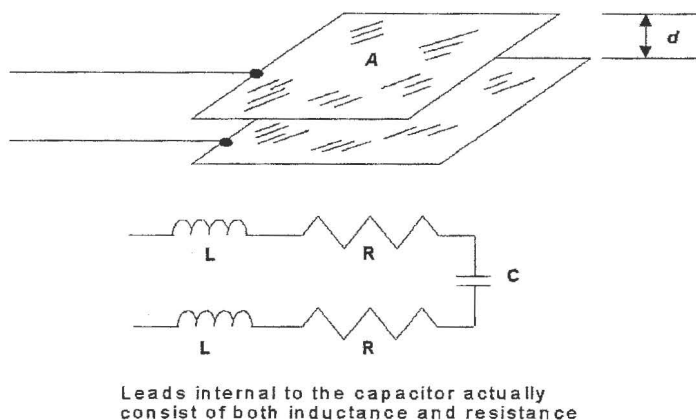


Figure 1.

One of the more important design parameters when selecting a capacitor for prevention of RF energy is its “self-resonant frequency”.

Decoupling capacitors

Clock circuit components must be RF decoupled. This is due to the switching energy generated by logic components being injected into the power and ground plane structure. This switching energy will be transferred to other logic circuits or subsections as common-mode and/or differential-mode RF noise. Typically, one selects a capacitor with a self-resonant frequency in the range of 2-100 MHz for circuits with edge rates of 2 ns or less. Typical multi-layer PCBs are self-resonant in the 200-400 MHz range. Proper selection of decoupling capacitors, along with knowing the self-resonant frequency of the PCB (acting as one large bulk capacitor) will provide enhanced EMI suppression of switching noise. Surface mount devices have a much higher self-resonant frequency typically two orders of magnitude (or 100 times) due to less lead length inductance. Aluminum electrolytic capacitors are ineffective for high-frequency decoupling and are best suited for power supply subsystems or power line filtering.

Always provide high-frequency RF decoupling capacitors in addition to bypass capacitors in clock circuit areas. Calculate the decoupling capacitance to suppress RF switching noise for all significant clock harmonics. Choose a capacitor with a self-resonant frequency higher than the clock harmonics requiring suppression, generally considered to be the fifth harmonic of the original clock frequency.

Decoupling capacitors ideally should be able to supply all the dc current necessary during a state transition of the switching device. Calculating the local point-source charge of the decoupling capacitor is detailed in Equation 1. This equation does not calculate the self-resonant frequency, only the localized source charge required to remove RF switching noise from the power system. As observed, use of

0.1 μf capacitors in today's products is usually insufficient for optimal decoupling when the edge rate of the device is faster than 5 ns. Use of decoupling capacitors on two layer boards is also required to reduce power supply ripple. Decoupling capacitors for low frequency applications are usually not needed when multilayer boards are used, given that the capacitance between the power plane and ground plane provides overall decoupling for low frequency or slow edge rate components.

$$C = \frac{\Delta I}{\Delta V / \Delta t}$$

$$\text{i.e. } \frac{20 \text{ ma}}{100 \text{ mv} / 5 \text{ ns}} = 0.001 \mu\text{f} \text{ or } 1000 \text{ pf} \quad (\text{Eq. 1})$$

where ΔI = current transient
 ΔV = allowable power supply voltage change (ripple)
 Δt = switching time

When selecting bypass and decoupling capacitors, in addition to providing a localized source charge, calculate the self-resonant frequency of the capacitor based on the actual edge rate of the logic family used. Equation 2 provides for calculating self-resonant frequency. Be aware that inductance is a part of this equation. Lead length inductance is not intuitively known, and is generally an unknown constant.

$$\omega = \sqrt{\frac{1}{LC}} \quad (\text{Eq. 2})$$

A capacitor is capacitive up to its self-resonant frequency. Above self-resonance, the capacitor becomes inductive and ceases to function for RF decoupling. This is seen in Figure 2. Placement of the capacitor should also be as close to the component as physically possible to minimize lead length inductance if a multi-layer board is not provided. It is common practice to use a 0.1 μf capacitor for decoupling high technology PCBs. This value was determined in 1965 by the U.S. military to decouple 20 kHz components. Components used in today's products require decoupling in the range of 0.01 μf to 100 pf. Again, capacitance value and lead length inductance determines the self-resonant frequency and the amount of decoupling provided.

Another concern for selection of a decoupling capacitor is the dielectric material used in the manufacture of the device. Figure 2 shows the self-resonant plots of three different materials. The cost of using NPO material, although greater than X7R or Z5U is negligible, especially when EMI compliance is required if decoupling will assist in solving the emissions problem.

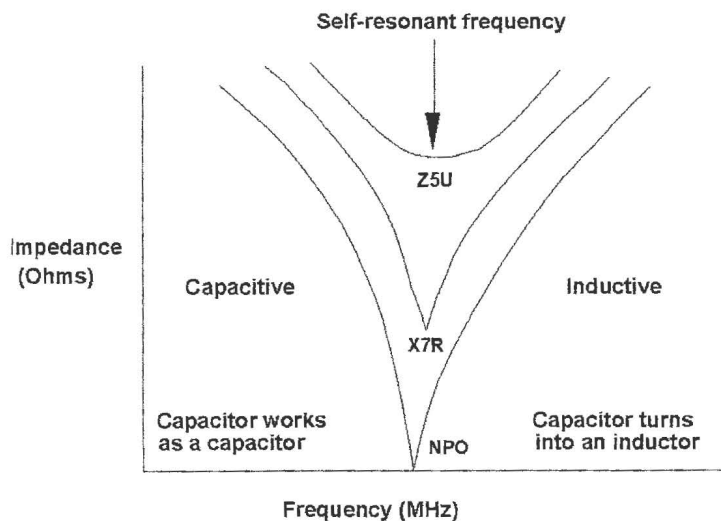


Figure 2.

A benefit of using multilayer PCBs is the placement of the power and ground planes adjacent to each other. The physical relationship of these two planes creates one large decoupling capacitor, generally in the range of 200-400 MHz. This capacitor (zero cost in material) usually provides adequate decoupling for slow speed (slow edge rate) designs. If components have signal edges (t_r) slower than 10 nsec. (e.g., standard TTL logic), use of low, self-resonant frequency decoupling capacitors is generally not required. Bulk capacitors, however, are still needed to maintain proper voltage levels for performance reasons.

Bypass capacitors

Bypass capacitors are commonly used to divert common-mode RF currents that exist on cable shields by creating an AC short to chassis ground. Bypassing is usually placed where I/O interconnects attach to the PCB. If the braid of the cable is floating, not bonded to chassis ground, a bypass capacitor is required to remove common-mode currents present on the cable shield. Bypass capacitors should not be provided on individual I/O lines. This is because the capacitor may alter the signal profile of the I/O trace to that of non-functionality. In addition to corrupting the data signal, concerns for ESD exist. Again, short lead lengths are a primary design consideration. When selecting bypass capacitors, keep in mind:

1. proper bandwidth filtering, and
2. peak surge voltage protection capabilities for electrostatic discharge

Another item to remember for ESD protection is to use bypass capacitors with a high self-resonant frequency between power and ground. These bypass capacitors must have as low an equivalent series inductance (ESL) and equivalent series resistance (ESR) as possible. Frequent use of bypass capacitors reduces loop areas of the power and ground planes for low-frequency, high-level ESD pulses.

For higher-frequency ESD events, standard value capacitors (i.e., 0.1 μ f) become less effective due to both the capacitors' internal stray and interconnect trace inductance to the component or ground stitch location. Use of MOVs, transient suppression devices, spark gaps, diodes, etc., may also be required.

Bulk capacitors

Bulk capacitors provide dc voltage and current to components when these components switch all data, address and control signals simultaneously under maximum capacitive load. Large power consuming devices have a tendency to cause voltage fluctuations on the power distribution system. These fluctuations can cause improper circuit performance due to voltage sags. Bulk capacitors provide large amounts of energy storage to maintain voltage and current requirements. Bulk capacitors play no significant role in EMI control.

Bulk capacitors (usually tantalum dielectric), in addition to high self-resonant frequency decoupling, should be used to provide dc power for components and to prevent power plane RF modulation. Place one bulk capacitor for every two LSI and VLSI components in addition to the following locations:

- adjacent to clock generation circuits
- power entry connector on the printed circuit board
- all power terminals on I/O connectors for daughter cards, peripheral devices and secondary circuits
- near power-consuming circuits and components
- the furthest location from the input power connector
- high density component placement remote from the dc input power connector

When using bulk capacitors, calculate the capacitor voltage rating such that the nominal circuit working voltage equals 50% of the capacitor's voltage rating to prevent the capacitor from self destruction if a voltage surge occurs.

Summary

One must differentiate between decoupling and bypassing when implementing suppression techniques on a PCB. Decoupling is provided at the component level to prevent ground-noise voltage and high frequency voltage spikes injected into the power and ground planes from propagating throughout the board. Differential-mode voltage creates common-mode current. It is common-mode currents that are measured as EMI emanating from a product. Bypass capacitors remove common-mode currents off I/O cables, thus allowing only the desired data stream to be present. Bulk capacitors keep the unit functioning by ensuring that sufficient voltage is present to all circuits under maximum power consumption usage.



KIMBALL WILLIAMS
ASSOCIATE EDITOR

IEEE EMC-Society Education and Student Activities Committee:

Austin Symposium 1997:

The Austin symposium for 1997 is now history, and what a historical event it was. The Austin Symposium committee deserves thanks for putting on a great show. At the symposium the Education Committee achieved successes in areas we have been working on for several years. In the article that follows I have pointed out some of the highlights and occurrences of interest for those who may have not been able to attend the symposium, or those who were too busy with all the activities to notice some of the other things that went on.

Tutorials:

Maqsood Mohd again organized an introduction for new engineers entering the field of EMC engineering. Noted lecturers and engineers (including Dr. Mohd) from several different organizations gathered together to provide grounding in the fundamentals of EMC from the equipment design point of view.

According to the attendance levels, the fundamentals tutorials were again one of the most popular and well received events at the symposium.

University Grant:

For several years the University grant sub-committee, under the direction of John Howard, has been seeking worthy universities for the award of a grant to assist in the establishment of an EMC course at that institution. This year the committee was able to make its first award to Dr. Vincent P. McGinn of the Department of Electrical Engineering at Northern Illinois University in DeKalb, IL. This grant of \$5,000 is to help establish the first EMC introductory course at his university.

Don Sweeney, director of DLS Laboratories and a member of the EMC-S Board of Directors, has agreed to represent the EMC Society at a University function where he will present Dr. McGinn with the award check.

Note that this is the FIRST award of this kind sponsored by the Education Com-

mittee. If you know of a school that needs help in getting such a course started, please contact our sub-committee chair, John Howard at jhoward@svpal.org.

TC-7 & Student Activities:

Officers from Technical Committee 7, Non-sinusoidal Fields, contacted the Education Committee with the suggestion for a possible joint activity in the form of a student contest to achieve a cost effective solution to a significant EMC problem, to be contributed from industry. The Vice Chair of TC-7, William Croisant, attended the Education Committee and presented the proposal which was warmly received.

As a result, our new chair of Student Activities, Mike Boguzs, and several members of the Education Committee will join with members of TC-7 to design and implement the contest which is scheduled to culminate at the Seattle symposium in 1999 with an 'event' where all the student entries which reach that level will be tested. Hopefully, the 'testing' will take place in the exhibit hall, with test equipment and personnel provided by some of the exhibitors. The final awards will be presented at the awards lunch.

We are all excited about this effort, and of the potential that it presents for further activities of this nature with cooperation between the TC's, the exhibitors and the Education Committee. As we evolve this process, it will be in all our best interest to carefully document it.

Experiments Manual On-Line:

The first publication of the Education Committee, the Experiments Manual, and its more complete follow on, the Education Manual, are being expanded with Volume II of the Experiments Manual under the guidance of Jim Drewniak. As part of the process of moving the whole committee 'on line', one of Jim's associates, Robert Irons, has put Volume I of the Experiments Manual on the web at: <http://emclab2.ee.umn.edu/files/EMCman.pdf>.

If you have an Adobe Acrobat Reader,

you can download the entire manual from the FTP site today. If you need an Adobe Acrobat Reader, it is easily downloaded from: "<http://www.adobe.com>".

Jim is still seeking new experiments that use more sophisticated instruments than were permitted in Volume I. If you have an interest in this area, or if you have a favorite experiment you would like to contribute to this new volume, contact Jim at drewniak@ee.umn.edu.

NARTE Activities:

Once again, Dr. Jim Whalen of the University of Buffalo presented his workshop for engineers and technicians preparing to take the National Association of Radio and Telecommunications Engineers (NARTE) examination to certify as EMC engineers and technicians. Once again, the workshop was planned to grow in size and once again it burst its seams and had to turn away several potential students when seating space ran out. A special afternoon session was arranged for the 'over flow' students.

At the NARTE examination on Friday, 29 engineers and 11 technicians sat for the exam. The word from NARTE is that 25 of the engineers and 7 of the technicians passed the examination. Our congratulations to all the successful applicants, and welcome to the ranks of certified NARTE professionals. Also, our thanks to Dr. Whalen for his tireless efforts on behalf of NARTE, and also to the staff of NARTE who provided information at their booth, and brightened up our symposium with two gracious young ladies.

Demonstrations:

The series of physical demonstrations of EMC phenomenon continued in Austin providing both new and experienced EMC engineers with the 'Ah Ha' of seeing the physical reality of what, in many cases, was until now only a theoretical or mathematical awareness. It has always amazed me to experience that sudden shift from theory to practical demonstration. It seems to also affect a lot of others in the same way to judge from all the experienced engineers I noticed smiling as they left a demonstration and commenting, "Now I know what that is all about!"

Our thanks to Andy Drozd and Larry Cohen for putting together the Demonstrations at Austin. If you have a demonstration that you would like to provide at the Denver Symposium, contact Andy at andro1@aol.com and offer your help.

Education Committee Officers:

Several new appointments to the Education Committee occurred either at or just before the Symposium, including:

Vice Chair: Maqsood Mohd

Chair - Student Activities: Mike Boguzs

Chair - Demonstrations: Andy Drozd

Vice Chair - Demonstrations: Larry Cohen

Chair - Video Productions: Dick Ford

I want to personally thank all the officers of the Education Committee for their tireless efforts to bring the very best in EMC education materials, demonstrations, workshops and tutorials to each symposium, and to the membership of the EMC Society throughout the year.

Kimball Williams
Chairman EMC Society Education Committee

Congratulations!

Congratulations to the newly elected members of the EMC Society Board of Directors. Those serving a three year term beginning January 1, 1998 include:

Henry W. Benitez
Todd H. Hubing
Mark I. Montrose
Henry W. Ott
Donald L. Sweeney
Kimball Williams

Additionally, in accordance with recent changes to the Society By-laws, a member from Region 8 and Region 10 has been elected to satisfy the requirement for adequate international representation on the Board. Those serving a three year term beginning January 1, 1998 include:

Ferdy Pierre Mayer
Takeo Yoshino

Congratulations to those newly elected and thank you to all candidates for your willingness to serve and for permitting your name to be included on the ballot.

Scenes from the IEEE EMC Society Symposium in Austin, Texas



EMC Society President Bill Gertson (L) congratulates Mirko Malejic (R), Boston Symposium 2003 Chairman, at the Awards Luncheon. Mirko received a Certificate of Achievement.



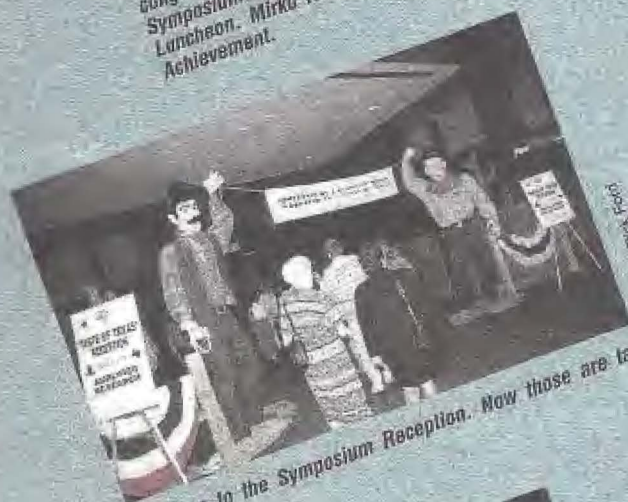
EMC Society President Bill Gertson (L) congratulates You-gang Gao, Beijing Chapter Chairman (R), at the Awards Luncheon. You-gang accepted the Chapter of the Year Award on behalf of the Nanjing chapter.



Dr. EMI on the loose in the exhibit hall!



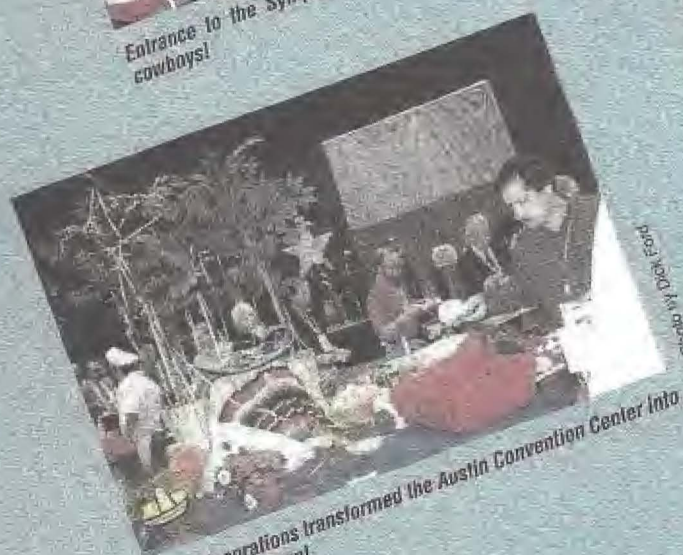
(Left to Right) Chris Holloway, Steve Kawalko and Bob Johnk represent the National Institute of Standards and Technology (NIST) in force at the Symposium.



Entrance to the Symposium Reception. Now those are tall cowboys!



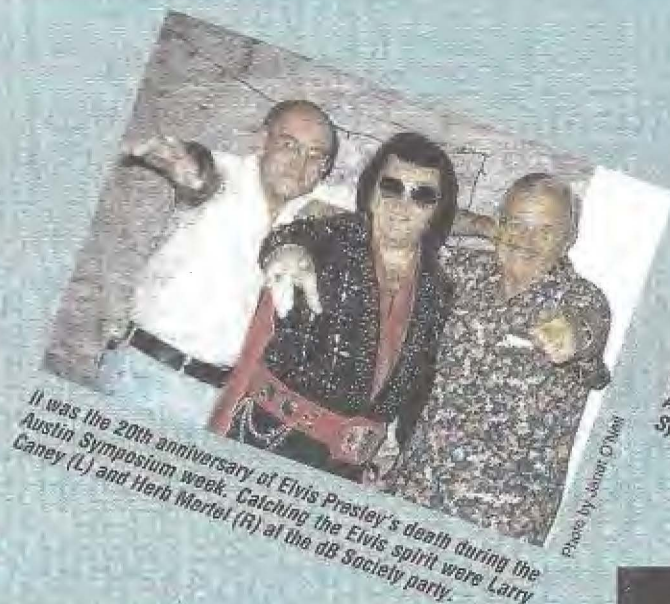
(Center left to right) Don Bush, Diane Kempf and "Buzz" Brezinski "pony up" to the bar at the Symposium Reception.



Great decorations transformed the Austin Convention Center into a Texan Ho Down!



(Left to Right) Flo Haislmaier, Todd Hubing and Al Mills enjoy a break from the brisk activity in the EMC Society membership booth.



It was the 20th anniversary of Elvis Presley's death during the Austin Symposium week. Catching the Elvis spirit were Larry Caney (L) and Herb Mortel (R) at the dB Society party.

Photo by Janet O'Neil



Martin Alexander (R) congratulates Wally Pilat (L) upon Wally's successful completion of the ANSI C63.4 short course held just prior to the Symposium.

Photo by Janet O'Neil



Photo by Janet O'Neil

Todd Robinson of CKC Laboratories shows off his little EMC'er, baby Kendall, who doesn't seem to quite appreciate the many interesting products on display in the exhibit hall.



Photo by Janet O'Neil

That's over 30 years of EMC Society Transactions experience between current Editor Dick Kanda (L) and immediate past Editor Dick Schulz (R). Kanda is pointing to his candidate to receive the award for the longest tenure as Editor of Transactions on EMC.



Photo by Dick Ford

Bob Goldblum receives the Richard R. Stoddard Award at the Awards Luncheon.



Photo by Dick Ford

Cowboys line up at the luncheon in the exhibit hall which featured live entertainment.



Photo by Dick Ford

Lively entertainment at the Wednesday evening gala.



Photo by Dick Ford

Who's that behind the shades? Could it be Daryl Garke? And could that possibly be Ron Brewer hiding under the wig? Were these fellows stand-ins for the entertainment at the Wednesday evening gala?

For more photos . . .

Check out the Austin Symposium virtual photo collage on the EMC Society Web Page!

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



JOE BUTLER
ASSOCIATE EDITOR

COMMITTEE ON MAN AND RADIATION (COMAR)

Dan Hoolihan

Representative Advisory Committee (RAC)

This technical committee, now organized under the IEEE Engineering in Medicine and Biology Society (EMBS), had its most recent meeting in June in San Antonio with the next meeting scheduled for October in Chicago. Information is available on activities on the COMAR website; <http://homepage.seas.upenn.edu/~kfoster/comar.htm>. One of the most recent Technical Information Statements on video display terminals was published in a recent issue of the *IEEE Engineering in Medicine and Biology* magazine.

SAE AUTOMOTIVE EMI AND EMR COMMITTEES

Ed Bronaugh

RAC Representative

These committees continue to meet on a regular, frequent basis, primarily in the Novi, Michigan area although one of the recent meetings was at the symposium in Austin. The work of the committees continues to be the refinement of SAE standards J1113 and J551 and their harmonization with the activities of ISO/TC 22/SC3/WG3 and CISPR/D as well as CISPR 12.

SAE AEROSPACE AE-4 EMC COMMITTEE

GARY FENICAL

RAC Representative

SAE AE-4 has recently sent out a draft revision of SAE ARP 1972 for review within the committee with comments due back by the beginning of October.

ASTM COMMITTEE D09.12.14

Drew Peregrin

RAC Representative

This committee continues its development of a several new EMI gasket measurement standards, e.g., transfer impedance, transfer impedance with environmental conditioning, and a radiated field slot aperture measurement. Revisions to ASTM D 4935 for shielding effectiveness of planar materials are also proceeding. The most recent meeting of the committee was in mid-October in San Diego.

RTCA SUBCOMMITTEE 135

Erik Borgstrom

RAC Representative

The RTCA has recently released RTCA/DO-160D which toughens EMC radiated immunity requirements and adds ESD for commercial avionics systems. The radiated immunity requirements now extend up to 600 volts per meter and allow the use of mode stirred chambers.

APPLIED COMPUTATIONAL ELECTROMAGNETICS SOCIETY (ACES)

Todd Hubing

RAC Representative

ACES has sent out a call for papers for the 14th Annual Review of Progress in Applied Computational Electromagnetics to be held March 16-20, 1998 in Monterey, CA. Visit their website at <http://www.emclab.umn.edu/aces>.

CISPR/G

Don Heirman

RAC Representative

The long awaited immunity standard for Information Technology Equipment, CISPR 24, has been approved and should be published in early 1998.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) COMMITTEE C63.8 ON MEDICAL DEVICE EMC

Dan Hoolihan

ANSI C63.8 Chair

The ANSI C63.8 committee has several activities underway: an investigation into the human body effects of radiated immunity testing of patient connected devices; a standards development activity involved with radiated immunity of hearing aids due to digital cellular telephones; liaison activities with IEC 62A/WG 13 with regard to proposed revisions to IEC 601-1-2 standard for medical device EMC; and liaison with the Association for the Advancement of Medical Instrumentation (AAMI) EMC committee which is developing two Technical Information reports, one containing EMC guidelines for hospital clinical engineers

and the other EMC design guidelines for manufacturers.

UNITED STATES COUNCIL OF EMC LABORATORIES (USCEL), a subcommittee of the American Council of Independent Laboratories (ACIL)

Dave Case

RAC Representative

USCEL has recently released its first 13 technical guidance notes with regard to European Union EMC requirement interpretations. This committee has also spawned a new subcommittee, the EMC Competent Body Group, involved with developing criteria for U.S. lab Competent Body status.

IEEE SOCIETY STANDARDS COMMITTEE

Don Heirman

EMC-S Standards Committee Chair

The IEEE Standards Committee has sent out one new standard for ballot - P1302 "Guide for the Electromagnetic Characterization of Conductive Gas-kets in the Frequency Range DC to 18 GHz" and a proposed revision to an existing standard - IEEE-STD-299 "Guide Method of Measuring the Effectiveness of Electromagnetic Shielding Enclosures".

1997 Professional Activities Conference (PACE) Tools For Tomorrow's Technology Leaders

A. H. Mills

PACE Coordinator

EMC Society

The 1997 Professional Activities Conference was held in St. Petersburg, Florida during the past Labor Day weekend. Over 300 members of the IEEE Board of Directors, members of the United States Activities Board, and PACE representatives from sections, councils, regions, divisions and societies and guests attended.

The theme for the conference was "Tools For Tomorrow's Technology Leaders." Five plenary sessions were held on professional vitality, government and industry relations, career strategies, US engineering labor market, and surviving in the corporate environment. There were also sessions in which topics of interest to young professionals were discussed. Workshops tended to reinforce the plenary sessions. Encouragement was given in the Division/Society meetings to plan and execute PACE projects within the Society activities. Consideration is being given to having a session on professional activities at the EMC Symposium in Denver next year.

Starting in 1998, IEEE United States Activities will change its name to IEEE United States of America (IEEE-USA). Its president, president-elect, and the members-at-large of its board of directors will be elected by the US membership. Currently, the United States Activities Board (USAB) is headed by the chairman, (IEEE vice president, professional activities), and is appointed by the IEEE board of directors. The IEEE-USA president will be a member of the IEEE board of directors. This reorganization will provide an opportunity for IEEE-USA to be more independent and autonomous in providing service for the professional needs of IEEE members in the United States.

The new organization of IEEE-USA will consist of the president, the president-elect, the past president, which for the first year in 1998 will be the IEEE vice president, professional activities, two members-at-large, six US Regional Directors, five vice presidents and a secretary/treasurer. The five vice presidents will be responsible for Member Activities, Career Activities, Technology Policy, Professional Activities and Operations. They will be supported by various committees.

The candidates for 1997 IEEE president-elect, Donald Bolle, Kenneth Laker and Joel Snyder, responded to questions submitted by the attendees during a forum following the Saturday lunch. At the Sunday lunch, the candidates for IEEE-USA president, George McClure and John Reinert, and for IEEE-USA president-elect, Paul Kostek and Charles Lessard, responded to questions from the attendees.



HERMAN GARLAN
1908-1997

HERMAN GARLAN died on August 18, 1997 at age 89. He is survived by his wife, Judy, two daughters and three grandchildren.

Herman was a long-time respected member of the EMC community. He was elected to Fellow grade of the IEEE for leadership in and development of EMC standards. He was also co-founder of the Institute of Radio Engineers (IRE) Professional Group on Radio Frequency Interference, forerunner of the IEEE EMC Society.

Herman received Bachelors and Masters degrees in engineering and mathematics from Columbia University and the City College of New York, respectively. He joined the Federal Communications Commission in 1939 as a radio inspector in the Chicago Field Office and transferred to Washington in 1944, where he worked on the development and implementation of the new mobile radio services. In 1954, Herman was appointed Chief of the newly formed Radio Frequency Devices Branch with the responsibility for developing and implementing a regulatory policy for controlling interference from a plethora of intentional and unintentional radiators that operated without an individual license. Herman's door was always open for discussions of the Commission's Rules. To this end he authored many technical papers on the subject which were presented at various EMC conferences.

Herman was the guiding force in the development of Parts 15 and 18 of the FCC Rules. The regulatory principles that he pioneered more than forty years ago still serve today as the foundation for controlling interference between the countless electronics products and communications services. His remarkable career spanned from the early efforts to control interference from industrial, scientific and medical equipment, from radio receivers, from TV interface devices, and from the first personal computers.

The growth of an entire industry of manufacturers of low power transmitters

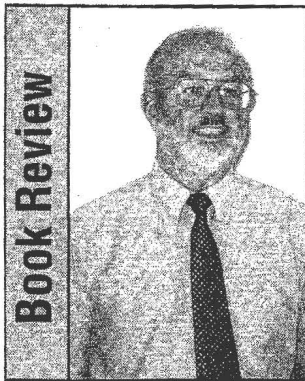
can be traced to Herman Garlan's efforts. He developed the first provisions for such devices and through his career established the provisions for garage door openers, field disturbance sensors, remote control and security devices, biomedical telemetry equipment, and many others. His work eventually led to provisions for unlicensed spread spectrum systems and unlicensed personal communications services.

Herman also had a major hand in the development of analog television. He implemented the all-channel requirements for TV receivers and many other technical requirements to ensure adequate UHF performance of TV receivers.

Herman was a leader and long-time active supporter of the development and use of voluntary industry standards by actively participating in the IEEE EMC Society, ANSI Committee, C-63 on Radio-Electrical Coordination and numerous other voluntary standards committees. For many years he was a regular United States Delegate to annual meetings of the International Special Committee on Radio Interference (CISPR), which develops international standards for controlling interference from unintentional radiators.

Mr. Garlan "officially" retired from the FCC in 1977, yet he continued on the staff as a consultant for another seven years, working just as tirelessly as ever. In the professional sense, Herman's most significant legacy was his true leadership in developing EMC policies and standards. But his friends and colleagues will remember Herman for much more than that. He had a sharp mind with a rare ability to simplify complicated issues. And he had a magnificent talent for writing clearly and concisely. Most importantly, he was mentor to EMC engineers at the FCC, in industry and throughout the world. His contributions to the EMC community and friendship to so many will never be forgotten.

— Art Wall, Julie Knapp, Ralph Showers



SCOTT BENNETT

Mr. Bennett is the author of Control and Measurement of Unintentional Electromagnetic Radiation which was reviewed in the previous Newsletter. In this article, he reveals a startling discovery.

This Participant Found Renewed Purpose In Austin

Scott Bennett

For many years I have tried to view the physics of EMC with simple pictures and basic mathematics. That has yielded a better understanding of many aspects of EMC for me and, I hope, for a few others as well. However, the road traveled in making this effort has not always been bump-free. For example, midway between the time my paper went in for the Austin Symposium and the time it was to be presented, it came to me that some of it was based on an over-simplified picture. What is even worse, the paper that won third prize for me at Santa Clara last year was based largely on that same picture! Quickly turning to the third chapter of my newly published book I was very relieved to verify that the same over-simplification had not corrupted that discussion. And, there was a further sigh of relief when I saw that neither symposium paper leads to invalid practical conclusions. The fact did remain, however, that there are errors in both papers. They are both based in part on insufficient detail, and that would have to be made known in Austin.

The over-simplified picture I had used is valid for small circuits with matching load impedances, but it is incomplete for small loop antennas and circuits with nonmatching loads. Omitted from the picture were the H-field changes that occur along with the current changes. Because those H-fields were not pictured, I led myself astray as follows. At the point on a loop or circuit that is equidistant from both source terminals, current changes that are equal in amplitude and direction arrive from opposite directions. In other words, at that halfway point an increase in charge arriving from one direction will always equal the decrease in charge arriving there from the opposite direction. Thus it appeared that arriving changes would complement each other at the halfway point, equilibrium would be established there, and the changes would not propagate beyond that point.

However, shortly after coming to that conclusion, it dawned on me that the H-field changes that accompany the current changes to the halfway point do not complement one another. Therefore, equilibrium will not be established for the H-field changes and they

will continue to propagate beyond the halfway point in both directions. Also, reciprocity will cause the current changes to accompany them. And, that continued propagation of the current changes is the exact opposite of what I had previously concluded.

Next it occurred to me that a matching load placed at the halfway point of a circuit, or loop, would cause the arriving H-fields to be dissipated. And, in that case they would cease to propagate, reciprocity would again enter the picture, and, because the H-field changes will not propagate beyond that point, neither will the current changes. Thus, the picture I had been using is valid only for small circuits with matching loads. It is only partially valid for small loop antennas and for small circuits with nonmatching loads.

I hope to have the opportunity to further clarify this, and expand upon it at the Denver Symposium next year. In the meantime, however, it should still be clear that propagation time should not be neglected in determining the radiation patterns of currents in circuits or loops, no matter how small they may be. And, it should still be very clear that the most effective way to minimize the radiation of any circuit is to minimize the distance separating the paths of the oppositely-directed currents that propagate from its source to its load. All of this was shared with my audience in Austin, although I must admit that I was still in a partial state of shock at that point. Now the shock is gone, however, and as bumpy roads often do, this experience has caused a complete revitalization of my investigative efforts. As they have always been, my primary objectives are still (1) to picture the physics of EMC as simply as possible, (2) to analyze those pictures with the simplest mathematics possible, and (3) to do both of those things thoroughly and accurately. However, in my own mind, at least, I have now added to the latter "with absolutely no oversimplification and absolutely no under simplification."

To bring about a renewal of purpose such as this, in a soon-to-be-elderly semiretired traveler of bumpy roads, the timing of the Austin Symposium could not have been better.



DR. WILLIAM G. DUFF
ASSOCIATE EDITOR

Introducing Maria Sabrina Sarto

Maria Sabrina Sarto was born in Rome, Italy, on May 20, 1968.

In 1987 she started her studies in Electrical Engineering, which consisted of 5 year courses involving 28 exams, at University of Rome "La Sapienza". Since September 1991, Sabrina Sarto has pursued research activity at the Department of Electrical Engineering under the supervision of Prof. Marcello D'Amore on the topic "Analysis of Field-Excited Networks with Nonlinear Loads." This topic was included in the Research Project SCIENCE "Electromagnetic Compatibility: Fast Transients in Telecommunication and Power Apparatus and Systems" supported by the European Community. Within this research activity, M.Sabrina Sarto developed her degree thesis. On July 14, 1992, she achieved the degree in Electrical Engineering summa cum laude, and received a special acknowledgment for the scientific value of her thesis and her outstanding scholastic career.

On September 1992, she joined as external scientist the research group coordinated by Prof. D'Amore at the Department of Electrical Engineering of the University of Rome.

During November 1992, she was with the Department of Measurement Engineering/EMC of the Technical University of Hamburg-Harburg, Germany, where she carried out some studies concerning the experimental characterization of the transient response of gas arresters and two-stage protection circuits, under the supervision of Prof. J.L.ter Hasborg.

In March 1993, she presented her first technical paper entitled "EMP-Coupling to Multiconductor Dissipative Lines With Nonlinear Loads Above a Lossy Ground" co-authored with Prof. D'Amore at the 10th International Zurich Symposium and Technical Exhibition on Electromagnetic Compatibility, Zurich, Switzerland.

During August 1993, she spent a short period at the University of Houston, Texas,



where she carried out research activity under the supervision of Prof. Donald R. Wilton and held the seminar "Analysis of Field-Excited Multiconductor Lossy Lines with Nonlinear Loads: An Integral Equation Approach."

In August 1993, Ms. Sarto received the Best Paper Award of the 1993 IEEE International Symposium on

EMC, Dallas, Texas, for the paper "Time Response of a Network Containing Field-Excited Multiconductor Lossy Lines with Nonlinear Loads" co-authored with Prof. D'Amore.

During September and October 1993 she received a scholarship grant from CNR, the Research Council of Italy.

After classifying first in a national competition, in November 1993 she started the Ph.D. in Electrical Engineering at the University of Rome "La Sapienza".

In March 1994, she obtained the position of Researcher at the University of Rome "La Sapienza" within the group of Prof. D'Amore.

During August 1994, Ms. Sarto was a visiting researcher at the University of Illinois at Chicago. Here she pursued some studies concerning the electromagnetic wave propagation in bianisotropic media, under the supervision of Prof. P. L.E Uslenghi and in collaboration with Prof. R.D. Graglia of the Polytechnic of Torino, Italy.

During August 1996, she spent a short period at the Electromagnetic Field Division of the National Institute of Standards and Technology, in Boulder, Colorado, where she carried out some studies concerning the multipole expansion technique, under the supervision of Dr. Motohisa Kanda.

In 1996 and 1997 she received from the EMC Society of the IEEE the President's Memorial Award "In Recognition and Encouragement of her Technical Excellence and Commitment to EMC."

In August 1997, during the 1997 IEEE International Symposium on EMC in Aus-

tin, Texas, she received the Best Transactions Paper Award as co-author with Prof. D'Amore of the paper "Theory of Field Excited Networks", IEEE Transactions on EMC, August 1996, vol 38, n.2.

After dissertation of her Ph.D. thesis entitled "Susceptibility and Radiated Emission of Complex Electrical Networks" (in Italian) in front of a National Committee, in autumn 1997 she received the Ph.D. in Electrical Engineering.

Her research interests are mainly in the field of electromagnetic compatibility. In particular, they are focused on the analysis of field-excited multiconductor networks with nonlinear protection devices, and on the modeling of electromagnetic interaction to advanced composite materials for aircraft applications. Further research interests are related to the field of both EMC and power engineering; they concern the analysis of the electromagnetic radiated emission from a power line carrier channel considering the spread-spectrum transmission technique, and the development of line simulation models for implementation in the Electromagnetic Transient Program (EMTP).

Sabrina Sarto is author or co-author of nearly forty technical papers covering these topics, published in international journals or in the proceedings of EMC related International Symposia.

She is member of the Local Organizing Committee of the International Symposia EMC'94ROMA, EMC'96ROMA, and EMC'98 ROMA, chaired by Prof. D'Amore. She has been a member of the IEEE EMC Society since 1992 and has served as reviewer of technical papers for the IEEE Transactions on EMC.

During her free-time, she enjoys playing tennis; moreover she loves downhill skiing and wind-surfing.

Notice to the Members of the EMC Society

At the August meeting of the Board of Directors, the Board approved the following change to the Bylaws to implement the Constitutional change reported in the Summer 1997 issue of this Newsletter. This change becomes effective 1 January 1998.

Bylaws Change Approved at the August 21, 1997 Meeting of the EMC Society Board of Directors

Revised Bylaws To Implement Constitutional Changes

3.2 Executive Directors: The President, President-Elect, Treasurer, immediate Past President, and the Vice-Presidents shall be Executive Directors. These are elective offices by the process contained in Section 5.O.

5.0 Election of Officers of Board of Directors: During the first year of the sitting President's term of office and at the first meeting following the election of the incoming Directors-at-Large, the Board of Directors comprised of the newly elected members and current Directors-at-Large and Executive Directors shall nominate and elect from among the Directors-at-Large and the Executive Directors, a President-Elect who shall serve one year in that office coinciding with the second year of the President's term of office. The President-Elect then becomes President. From the Society membership, a Secretary, Treasurer and Vice Presidents shall be nominated and elected who will occupy those respective offices for the succeeding two years. Election shall be by secret ballot and when a quorum is not present, by mail balloting. The first meeting shall be prior to 1 January if at all possible.

5.1 Term of Office: The term of office for the President shall be two calendar years immediately following a one year term as President-Elect. The President shall not be eligible for election to President-Elect until a lapse of three years. There is no restriction on the successive two year terms of office of the Vice Presidents, the Secretary, and the Treasurer. It is of benefit to the Society that both the Secretary and the Treasurer be encouraged to serve at the request of the Board of Directors for a minimum of two terms in order that the expertise developed by these officers not be lost to the Society by early replacement. All officers shall continue to serve until their successors take office.

5.4 President-Elect Duties: The President-Elect shall fulfill the duties of the President if the President is absent, incapacitated or requests a temporary replacement. The President-Elect shall also fulfill such other functions as the President of the Board of Directors

may from time to time direct. (Note: The immediate Past President shall fulfill these duties during the first year of the President's term of office.)

5.7 Vice Presidents' Duties: The Vice Presidents shall supervise and coordinate the activities of the Standing Committees and Technical Committees assigned to them.

7.1 Editor's Term of Office: An Editor may serve indefinitely, subject to mutual agreement with the President and the appropriate Vice President.

7.3 Editor's Compensation: Compensation for an Editor may be considered by the President in consultation with the appropriate Vice President with the advice and consent of the Board of Directors.

10.0 Technical Committees: A Technical Committee, which may organize a subsociety if desired, functions in a specific technical area as directed by the appropriate Vice President with a scope to be approved by the Board of Directors. In carrying out the Committee responsibilities, the Vice President shall be assisted by the Technical Advisory Committee.

10.1 Appointment: Officers of the Technical Committees shall be appointed by the appropriate Vice President with approval of the Board of Directors. Members shall be appointed by the officers of the Technical Committee.

10.2 Terms of Appointment: Technical Committee officers and membership shall be appointed with the following terms:

- a. Committee membership - three years
- b. Committee officer - two years

The appropriate Vice President, with the consent of the Board of Directors, may extend the terms for a longer period of time.

11.0 Executive Committee: The Executive Committee consists of the President, immediate Past President, President-Elect, Vice Presidents, Secretary and Treasurer. These officers, who are also identified as Executive Directors, are elected officials in accordance with paragraph 5.0. The functions of the Executive Committee will be to:

- a. Act for the Board of Directors in emergency situations wherein time is not available to call a special meeting of the Board of Directors.
- b. Assist the incumbent President as necessary.

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

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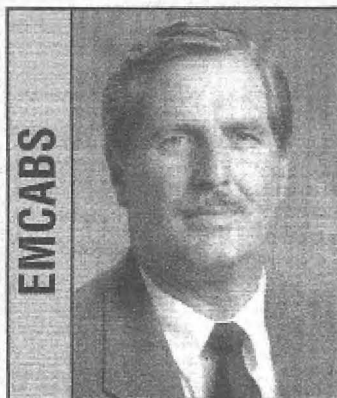
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IEEE EMC Society Awards

The IEEE EMC Society sponsors a number of awards to recognize people who have made significant contributions to the society and/or the EMC profession. These awards are normally presented at the awards banquet during the annual symposium. To nominate someone for an award, first review the awards described on the IEEE EMC Society Awards web page at http://www.emclab.umn.edu/ieee_emc/awards. Then determine which award is most appropriate to recognize the achievements of the person you want to nominate. You can send your nomination to Bill McGinnis (wmcginnis@ieee.org) or any member of the EMC Society Board of Directors. Nominations are reviewed by the board and award recipients are selected approximately three months prior to the annual symposium. Details of the nomination and selection procedures vary for different awards, so be sure to review the information provided on the web site before making a nomination.



WILLIAM H. MCGINNIS
ASSOCIATE EDITOR

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

EMCAB COMMITTEE

Mike Crawford, Consultant

Bob Hunter, Consultant

Prof. Fujiwara, Nagoya Inst. of Technology

Sha Fei, EMC Research Section,
N. Jiatong Univ., Beijing, China

Ferdy Mayer, L.E.A.D., Maisons, Alfort France

Perry Wilson, EMC Baden, Ltd., Switzerland

Heinrich Garn, Austrian Research Center

"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 staffs of the Japan Technical Group and the EMC Japan Tokyo Chapter have offered to act as a central point for requests of papers abstracted here. Most of the papers will be available in Japanese only. Abstracts of papers from EMC Japan will be clearly identified. The steering staff will assist in routing your request to the author(s) but will not translate the papers. The contact person is Professor Osamu Fujiwara, Department of Electrical and Computer Engineering, Nagoya Institute of Technology, Gokiso-Cho, Showa-ku, Nagoya 466, Japan. E-mail: sfujiwara@odin.elcom.nitech.ac.jp

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 members 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 my attention at my address shown on page 3 of this Newsletter. 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. Thank you for any assistance you can give to expand the EMCS knowledge base.

BASIC STUDY OF APPLICATION OF A NEAR FIELD ANTENNA MEASUREMENT TO A EMI MEASUREMENT

Takeshi Uchida, Yoshihiko Konishi, Naoto Oka, and Shuji Urasaki
EMC-Japan meeting at Kikai-Shinko-Kaikan, Tokyo
January 24, 1997, EMCJ96-64

EMCABS: 01-11-97

Abstract: We know two Antenna radiation pattern measurement, "Near Field Far Field Antenna Measurement" and "A Far-Field Radiation Pattern Measurement for Eliminating Residual Reflection by Distance Changing".

We'll examine a Radiated EMI Measurement by combing these two methods, which calculate a radiated EMI value at semi-anechoic chamber from measurement pattern at arbitrary place. In this paper, we test this method with L-band standard gain horn antenna, compare a measurement value and calculated value. And we confirmed that measurement value and calculate value with white noise in the semi-anechoic chamber are corresponding.

Index terms: EMI measurement, near field far antenna measurement

ESTIMATION OF PROPAGATION-PATH VISIBILITY FOR INDOOR WIRELESS LAN SYSTEMS UNDER SHADOWING CONDITION BY HUMAN BODIES

Katsuyoshi Sato, and Takeshi Manabe
EMC-Japan meeting at Kikai-Shinko-Kaikan, Tokyo
February 20, 1997, EMCJ96-96

EMCABS: 04-11-97

Abstract: Millimeter-wave application systems such as indoor communication system need the direct connection between base stations and terminals.

Because human bodies may block the propagation paths in 60 GHz band in indoor environment, we have estimated the propagation-path visibility in office room environments under shadowing conditions by human bodies.

Although a lot of base stations or very tall terminals are needed to avoid the shadowing by human bodies perfectly without base station diversity, the diversity switching between only two base stations provides 98 % propagation path visibility.

Index terms: Millimeter wave, indoor wireless LAN, indoor propagation, propagation path visibility

A PROPOSAL OF CDMA SYSTEM PRODUCING ANALOG PN SIGNAL WITH CODE-ORTHOGONALIZING FILTER

Seiji Hamada, and Shinichi Tachikawa
EMC-Japan meeting at Kikai-Shinko-Kaikan, Tokyo
February 19, 1997, EMCJ96-74

EMCABS: 02-11-97

Abstract: In an asynchronous direct-sequence/ code-division multiple access (DS/CDMA), multiple access interference (MAI) can be reduced using code-orthogonalizing filter (COF). However, a few own signal power is also lost using it, and it's performance deteriorates for a case of using orthogonal code in a synchronous system. In this paper, we propose a novel method of producing analog PN signals that have an orthogonal relation for all users, using COF, and we show an asynchronous DS/CDMA system using the method. As results of computer simulations, we show several properties of the system in additive white Gaussian noise (AWGN) environment.

Index terms: DS/CDMA, asynchronous, COF, analog PN signal

TRANSIENT RESPONSES OF ELECTROMAGNETIC PULSE TRAIN IN BIOLOGICAL TISSUES

Yoshihiro Ando, Shuzo Kuwano, and Kinchi Kokubun
EMC-Japan meeting at Kikai-Shinko-Kaikan, Tokyo
February 20, 1997, EMCJ96-98

EMCABS: 05-11-97

Abstract: The transient responses in multilayered cylindrical biological tissues exposed to electromagnetic plane-wave pulse train with microwave carrier frequency are computed using the fast Fourier transform. The responses are compared with that of multilayered planar biological tissues. It is shown that a hot spot occurs by diffraction effect in the cylindrical biological tissues only.

Index terms: Biological tissues, multilayered cylinder, pulse train, transient responses, fast Fourier transform

EVALUATION OF INTERFERENCE TO ELECTRONIC EQUIPMENT USING EACH OF MULTIPLE ACCESS IN MOBILE COMMUNICATION

Hideaki Tanaka, and Akihiko Sugiura
EMC-Japan meeting at Kikai-Shinko-Kaikan, Tokyo
February 20, 1997, EMCJ96-84

EMCABS: 03-11-97

Abstract: It is a problem that the mobile communication gives the interference to an electronic device such as medical equipment. In this paper, we evaluate the effect of interference to electronic equipment by using experimental system of each multiple access method such as FDMA, TDMA and CDMA.

In this experiment, we measure clock error rate with a digital simple electronic equipment composed of the clock oscillator and counter. First, we evaluate the effect when the antenna line is contacted in the broadband frequency.

Second, we evaluate the effect of the radio wave which uses the same power as a portable telephone in the VHF/UHF band.

Index terms: Mobile communication, electronic equipment, multiple access, malfunction, error rate

ROLE OF HUMAN MODEL ON R&D OF HAND-HELD WIRELESS EQUIPMENT

Koichi Ito, and Masao Taki
EMC-Japan meeting at Kikai-Shinko-Kaikan, Tokyo
February 20, 1997, EMCJ96-99

EMCABS: 06-11-97

Abstract: With the development of hand-held wireless equipments, it becomes quite important to assess objectively and quantitatively the EM interaction between human body and such equipment. It is essential to establish proper numerical and experimental human models and to obtain simulated results through the models. Firstly, a typical numerical human head model as well as an experimental phantom will be introduced. Secondly, some roles of a human model will be described. Finally, a few comments on using such human models will be made.

Index terms: Hand-held wireless equipments, human model, phantom, simulation, safety assessment

TECHNIQUE FOR ESTIMATING SITE ATTENUATION IN ANECHOIC CHAMBER USING WIRE-GRID METHOD

Tetsuya Tanaka, Junichi Nishiaki, Masamitsu Tokuda, and Yuji Maeda
EMC-Japan meeting at Okayama University, Okayama
May 14, 1997, EMCJ97-8

Abstract: We calculate site attenuation of half-wave tuned dipole antenna by using wire-grid method at an open field test site as well as in anechoic chamber. Our calculated values were compared with theoretical values appeared in most credible paper by Sugiura. As a result, our values are almost in agreement with those values for the frequency range from 30MHz to 1000MHz, the maximum difference is within less than 0.03dB. Therefore, our analysis program turned out to be reliable. For the technique to estimate anechoic chamber characteristics using wire-grid method, we studied that a space in which anechoic chamber's wall and antenna represented by a wire can be divided into a free space and loss space. As a consequence, it turned out to represent anechoic chamber's absorption characteristics.

Index terms: Anechoic chamber, wire-grid method, site attenuation, absorption, complex dielectric constant

EMCABS: 07-11-97

RADIATED IMPULSIVE ELECTROMAGNETIC FIELDS CAUSED BY COLLISION ESD (PART1)

Masamitsu Honda, and Jing Huang
EMC-Japan meeting at Kikai-Shinko-Kaikan, Tokyo
March 17, 1997, EMCJ96-121

Abstract: We analyzed the collision ESD phenomena by use of both the charging process of the metal objects and the impulse radiation mechanism. We concluded that one of the charging processes of a metal object is the dynamic charge induction mechanism under a fluctuating (moving) field. A strong impulsive electromagnetic field is observed on the moving axis of the collision objects.

Index terms: Collision ESD, moving charge, fluctuation field, dynamic charge induction, charge polarity/distribution, kinetic energy, relative velocity, moving axis, electromagnetic radiation, impulsive electromagnetic fields

EMCABS: 10-11-97

DEPENDENCE OF THE SPATIAL PEAK SAR ON THE SHAPE OF A HUMAN HEAD MODEL EXPOSED TO MICROWAVE BY A CELLULAR PHONE

Tetsuya Namada, So-ichi Watanabe, Toshiyuki Tanaka, and Masao Taki
EMC-Japan meeting at Okayama University, Okayama
May 14, 1997, EMCJ97-10

Abstract: It is needed for estimating the radiation hazard of users of a cellular phone to investigate electromagnetic energy absorption in the human head exposed to microwave (MW) in the near-field region of the phone. This paper presents the effects of the shape of head models (i.e., sphere or cube) on localized specific absorption rate (SAR). Furthermore, this paper presents the comparison between the spatial peak SARs of the simple head models and those of realistic head models, showing that the simple head models appear to be good approximate models for estimating the spatial peak SAR of the realistic head model without auricles.

Index terms: Biological effect, SAR, human head model, cellular phone, FDTD method

EMCABS: 08-11-97

FDTD COMPUTATION OF TEMPERATURE-RISE INSIDE REALISTIC HEAD MODEL FOR 1.5GHz MICROWAVE EXPOSURE

Masaaki Yano, Jianqing Wang, and Osamu Fujiwara
EMC-Japan meeting at Kikai-Shinko-Kaikan, Tokyo
April 24, 1997, EMCJ97-1

Abstract: Bio-effects of a localized SAR (specific absorption rate) due to radio-frequency electromagnetic field exposure can be caused by the temperature rise inside the brain which includes the central part governing the body-temperature regulation function. From this perspective, this paper numerically analyzes the temperature-rise distribution inside our developed realistic human head model for 1.5GHz microwave far-field exposure, using the FDTD (finite-difference time-domain) method. As a result, we found that the peak temperature-rise occurs in eyes and muscle tissue, which is at most 0.35 degrees centigrade for the microwave exposure with the safety level, and also that the temperature rise in the hypothalamus regulating the body-temperature is 0.0026 degrees centigrade, which is below a hundredth of the threshold (0.3 degrees centigrade) inducing the regulation behavior.

Index terms: Microwave, localized SAR, biological effects, realistic head model, temperature-rise

EMCABS: 11-11-97

LOW-FREQUENCY SHIELDING EFFECTIVENESS OF THE CONDUCTOR WITH BUTT AND GROOVE

Akio Tanaka, Takashi Fujino, Yoshinori Tanaka and Nobuo Takehira
EMC-Japan meeting at Okayama University, Okayama
May 14, 1997, EMCJ97-11

Abstract: The problem of electromagnetic shielding effectiveness of a sheet conductor of infinite extent is solved. In this paper, we study low-frequency shielding effectiveness of the conductor with butt and groove which have various shapes of cross section. The result is that butt in conductor reduces shielding effectiveness.

Index terms: Shielding effect, butt, groove sheet conductor

EMCABS: 09-11-97

PROPOSAL OF RF IMMUNITY TESTING METHOD IN THE BAND OF RADIO TELEPHONES OVER 1GHz

METHOD TO USE EXISTING UNECHOESTIC CHAMBER FOR IMMUNITY TESTING IN THE RANGE OF RADIO TELEPHONE
Ryo Ohishi, Toshihide Watanabe, Masayasu Okazaki, Yutaka Nakajima, Yositsugu Takahashi, and Hisashi Yosinaga
EMC-Japan meeting at Kikai-Shinko-Kaikan, Tokyo
April 24, 1997, EMCJ97-3

Abstract: Recently there has been significant increase in the use of radio telephones. The needs of compatibility with these equipment are now highly consumed. But, not all existing facilities are able to manage the compatibility test over 1GHz because of their absorber characteristics and/or cable loss-power of amplifier, especially in small 6 surface ferrite tile finished chambers. This proposal intends to introduce the method of compatibility testing on radio telephone frequencies respecting IEC 1000-4-3 and employing the concepts of partial illumination using narrow beam antenna with minimum re-work on unechoestic chamber.

Index terms: Immunity, Compatibility, radio telephone, unechoestic chamber, absorber, over 1GHz

EMCABS: 12-11-97

EMCS Board of Directors Activities

By Janet O'Neil, Secretary of the Board



Photo by: Dan F. Martin Photography & Graphics

The EMC Society Board of Directors with IEEE Immediate Past President Wallace Read. Seated left to right: Janet O'Neil, Don Heirman, Bill Gjertson, Wallace Read, Warren Kesselman, Bill Ritenour. Standing left to right: Joe Butler, Dick Ford, Todd Hubing, Bob Hofmann, Bill Duff, Herb Zajac, Andrew Podgorski, Bill McGinnis. (Not pictured: Dan Hoolihan, Don Sweeney, Kimball Williams, Franz Gisin, Jim Muccioli, Norm Violette, and Andy Drozd.)

The third meeting in 1997 for the EMC Society Board of Directors was held on August 17 in Austin, Texas at the Hyatt Regency Hotel. On August 21, a dinner meeting was held. The meetings were held in conjunction with the 1997 IEEE EMC Society International Symposium.

Attending the Board meeting were officers President Bill Gjertson, Vice-President Dan Hoolihan, Treasurer Warren Kesselman, Secretary Janet O'Neil, and Board members Don Sweeney, Joe Butler, Len Carlson, Franz Gisin, Bill Duff, Jim Muccioli, Todd Hubing, Bill Ritenour, Dick Ford, Andy Drozd, Andrew Podgorski, Kimball Williams, Bob Hofmann, Don Heirman, Bill McGinnis, and Herb Zajac. The absent Board member was Norm Violette. Guests in attendance included Ferdy Mayer, Elya Joffe, Dave Traver, Takeo Yoshino, Lee Hill, Don Clark, Henry Benitez, Bob Brook, Leo Makowski, Ghery Pettit, Scott Roleson, Dale Svetanoff, Chet Smith, Hugh Denny, Mirko Matejic, Henry Ott, John Osburn, Glen Watkins, and Maqsood Mohd.

President Gjertson called the meeting to order at 9:00 am and thanked everyone for coming. A round of introductions was made.

Secretary Janet O'Neil then presented the minutes from the May 5, 1997 Board meeting for approval. Some changes were required and the amended minutes were approved.

Treasurer Warren Kesselman next presented his report. The IEEE 1996 "Post Close-Post Audit" Financial Statement dated June 8, 1997 indicates that the Society's year-end deficit was \$27,872.25. Total income was \$638K and total expenses were \$666K. The Society net worth on December 31, 1996 was \$582K. Net worth on June 30, 1997 was \$598K. As of July 31, 1997, the present surplus is \$6K. CD-ROM sales at the Austin symposium will provide an increase in income for 1997. Also, increased membership levels will result in an increase in dues income and the IEEE investment income distribution in December (conservatively estimated at \$40K) will raise the 1997 surplus.

The Treasurer's report was approved as presented.

Todd Hubing, Director for Member Services, then presented his report and distributed copies of the EMC Society Membership Directory for review (copies are available by calling 573-341-6069 or via e-mail to t.hubing@ieee.org).

Todd Hubing reported that Chapters Coordinator, Ray Adams, has advised that there is potential new chapter activity in Italy. The recipient of this year's Most Improved Chapter award is the Central New England chapter. The Chapter of the Year for 1997 is the Nanjing chapter.

Steve Mullenix will organize the membership booth at the Austin symposium. The CD-ROMs of EMC/S symposia records will be sold from the booth. The IEEE Press will

have its own booth at the Austin symposium this year so that the EMC/S membership booth may be solely devoted to membership activities and sales of the CD-ROMs.

Awards Committee Chairman Bill McGinnis distributed the list of awards to be presented at the Austin symposium. The Board discussed ways in which the membership can be solicited and encouraged to nominate their peers for awards. A call for nominations will be published in the Newsletter (see page 25 of this Newsletter) and advertised on the EMC Society web page.

Scott Roleson, Chairman of the Distinguished Lecturer (DL) Program, submitted a report on program activities to date. The report notes that the DL program continues to be very popular. To date in 1997, over 434 chapter members worldwide have attended a presentation by one of our Distinguished Lecturers. Two new speakers were approved for the DL program starting in January 1998. They are Donald R. Bush and Robert W. Dockey. The terms of DLs Todd Hubing and Franz Gisin expire December 31, 1997. Contact Scott Roleson at phone 619.655.4809 or via e-mail at scott@SDD.HP.COM for more information about the DL program.

Concerning the Constitution and Bylaws, Warren Kesselman distributed a proposed Bylaws change to implement the Board approved Constitution change. The proposed Bylaws change was approved. It will be presented to the membership in the next Newsletter (see page 23 of this Newsletter).

As Nominations Chairman, Mr. Kesselman reported that the 1997 Nominating Committee selected twelve candidates for the ballot for six Directors-at-Large to begin a three year term effective January 1, 1998. (Subsequent to the meeting, the results of the ballot vote were announced by the IEEE. See page 15 of this Newsletter.)

Bill Duff, Fellows Search Committee Chairman, noted that the IEEE is seeking a nomination from our Society for a member of the IEEE Fellows committee.

Joe Butler presented the report as Director of Technical Services. All of his committee chairs were present to personally present their respective reports. Don Heirman, Chairman of the Standards Committee, reported on the activities of his last committee meeting in Zurich, Switzerland held in conjunction with the EMC conference. There were nine committee members present at this meeting and 18 guests other than EMC/S Board members. This meeting concentrated on introducing the IEEE EMC/S Standards Committee activities to interested members of the European Community. Mr. Heirman reported on the status of various standards. He noted that Standards 139, 140, 1140 and 1309 are current. Standards 213 and 376 have reached four years since reconfirmation. A reconfirmation ballot will be completed through the IEEE Standards Office. Standards 377 and 473 have reached five years since reconfirmation and extensions will be requested from the

IEEE Standards Office. Standard 299 is current, having been reconfirmed in 1991. Work in earnest is being done on this standard in order to meet the October 31, 1997 deadline to avoid withdrawal. Standard 475 has completed the balloting process. Activity concerning PARs 428-1992, 1128, 1302, and 1385 was reviewed and discussed.

Kimball Williams, Chairman of the Education and Student Activities Committee, advised that there will be significant committee activity in Austin. (Please refer to Mr. Williams' article on page 14 of this Newsletter.) As Co-Chairman of the Education Activities Board (EAB) Life Long Learning committee, Mr. Williams is becoming very involved in their activities. The EAB initiated a new effort that will work with President Clinton's education initiative to bring technical literacy into the public school system and foster Life Long Learning in young students.

Regarding the Technical Activities Committee (TAC), the acting Chair is Mr. Williams. Andrew Podgorski is the incoming TAC Chair. Gary Bush is the new Technical Committee (TC) 7 Chairman (Nonsinusoidal Fields). His committee presented a proposal for a student IEEE EMC design competition. The majority of TCs will meet in Austin.

Leo Makowski, chairman of the Representative Advisory Committee (RAC) presented his report. RAC will host a committee luncheon meeting during the Austin symposium to determine ways in which RAC can better service the Society. The RAC report included subcommittee reports by representatives Ed Bronaugh on SAE Automotive EMI & EMR, Dan Hoolihan on COMAR, Don Heirman on ANSI C63 and CISPR A & G & E, Bill Ritenour on the ESD Association, Gary Fenical on the SAE AE4 EMC committee, Erik Borgstrom on the Radio Technical Commission (RTCA), Dave Chase on NARTE and USCEL, and John Osburn on EIA G46 and Commercial. The RAC report also includes Len Carlson's report on the Aerospace Policy Committee, Drew Peregrin's report on the American Society Testing Material (ASTM) D09.12.14 Electromagnetic Shielding, Todd Hubing's report on ACES, Dick Ford's report on the USAB R&D Policy Committee, and Dave Imeson's report on the Association of Competent Bodies (ACB).

Andy Drozd reported on the IEEE Technical Activities Board (TAB) Intelligent Transportation Systems (ITS) ad hoc committee meeting held on June 28, 1997 in Cleveland, Ohio. Presently, this is an ad hoc committee, but its goal is to be a permanent, official Technical Council of the IEEE. The committee's purpose is to coordinate technical activities in the inter-disciplinary area of ITS and provide focus for cooperative efforts among IEEE TAB entities and Technical Societies. The committee is chaired by Rye Case.

Secretary Janet O'Neil distributed the report for the Director for Professional Services, Norm Violette, since Mr. Violette was unable to attend the meeting.

Ferdy Mayer, International Activities Chairman, presented a proposal concerning opening an EMC/S operational office in Paris to serve the growing EMC/S membership in Europe. The office would be organized with the French SEE Society. The office would require financial support on behalf of the EMC/S. Mr. Mayer will continue to oversee the exchange of national and international EMC conference proceedings. 50 copies of the 1996 Wrocław EMC conference record were shipped directly to Austin to be distributed free of charge from the EMC membership booth.

Mr. Al Mills, PACE Chairman, will attend the Austin symposium as the PACE representative and will be present in the EMC/S membership booth to promote PACE activities. (See Mr. Mills's article on PACE on page 19 of this Newsletter.)

Regarding the Employment Analysis Survey/Member Feedback Form, Committee Chairman Dick Ford advised that the survey is ready for distribution during the Austin symposium.

The report of Bob Brook, the EMC/S liaison to the Society for the Social Implications of Technology (SSIT) was reviewed. His report highlighted the activities of the International Symposium on Technology and Society held in Glasgow, UK on June 20, 21, 1997. This event was jointly sponsored by the IEEE SSIT, the Institution of Electrical Engineers (IEE) UK and the British Computer Society. The chairman was Simon Burne of the European Patent Office in the Hague, the Netherlands. There were participants from 11 countries. The subject of the symposium was "Managing Technological Change."

Regarding the Public Relations Committee, Chairman Herb Zajac reported that the basic project for the EMC/S video produced by Empire Video has been completed. Copies will be ordered for national and international distribution. Because of the significant cost for translations, it was decided not to proceed with foreign language editions of the video.

Len Carlson, Director for Communication Services, next presented his report. Chet Smith was present to give the History Committee report. The CD-ROMs will be offered for sale in the EMC/S membership booth at the Austin symposium. After the Austin symposium, they can be purchased by calling AMC Applied Microfilm directly at 781-893-7863. AMC can accept credit card (Master Card or Visa) orders over the phone. If the sales of CD-ROM discs of symposia records goes well, then Mr. Smith recommends proceeding with putting 40 years of EMC/S Transactions on CD-ROM as well. Preliminary financial proposals for this effort have been solicited.

Henry Ott, Chairman of the Symposia and Conferences Committee, reported that the financial books will soon be closed for the Santa Clara symposium. The 1998

Denver symposium is on track and space issues have been resolved so that there will be space for 230 booths. The Seattle symposium budget was presented and approved. Limited booth space at the Seattle symposium is also an issue and is being addressed. Exhibitor booth fees in general were reviewed and discussed. Exhibitor fees at other technical conferences held nationally were compared with EMC/S exhibitor fees. The Austin symposium is running smoothly. John Osburn, Symposium Chairman, and Glen Watkins of the symposium organizing committee gave a detailed presentation of the symposium, including what went right and wrong.

Hugh Denny reported for the IEEE Press committee. He attended the annual IEEE Press Board meeting at IEEE headquarters in Piscataway, NJ on April 12-14, 1997. The new Director of the Press is Ken Moore. Sales from the IEEE Press booth at the Santa Clara symposium were strong and are expected to be the same in Austin. The IEEE is sending two people to staff the booth in Austin. The gross sales of the EMC books published by the IEEE Press are approximately \$400K.

Franz Gisin reported about the World Wide Web and suggested guidelines for the use of the EMC/S web page. This specifically addressed the commercial versus non commercial use of a web page and information that is interesting to membership that should be included on a web page.

Lastly, Moto Kanda presented his report as Editor of Transactions. The paper "Theory of Field-Excited Networks" by D'Amore and Sarto was selected as the 1996 Best Transaction Paper. A special issue on lightning is planned for August 1998.

Next followed the Planning Committee report. Vice-President and Chairman Dan Hoolihan noted that he has received input from the four Service Directors regarding their respective objectives in meeting the goals of the EMC/S Long Range Plan. This will be discussed in more detail at the November Board meeting.

The following items were discussed under New Business:

A. BOARD STRUCTURE: In light of the recently approved changes to the EMC/S Constitution concerning the organizational structure of the Board, an ad hoc committee was formed to implement the new Board structure. This committee will be chaired by Joe Butler and will include Dan Hoolihan, Kimball Williams, Warren Kesselman, Don Heirman, Todd Hubing and Leo Makowski as members.

B. RAC SPEAKER FOR DENVER SYMPOSIUM: The RAC budget was increased to fund the travel of Elena Santiago to be a speaker at the Denver symposium.

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

EMC Related Conferences & Symposia

1998

April 1998

(exact date to be announced)

Sponsored by the Santa Clara Valley EMC Chapter
SCV EMC '98: ONE DAY EMC COLLOQUIUM AND EXHIBITION on "Product Compliance: Understanding the Fundamentals"
 Santa Clara, CA
 Franz Gisin
 415.933.8789

April 6 - 8

Sponsored by the US EMC Standards Corporation in cooperation with the American National Standards Institute, Accredited Standards Committee C63 - Electromagnetic Compatibility (ANSI ASC C63)
EMC MEASUREMENT UNCERTAINTY WORKSHOP AND ISO/IEC GUIDE 25 WORKSHOP
 Santa Clara, CA
 Janet O'Neil
 425.868.2558

April 6 - 10

DoD E³ PROGRAM REVIEW AND CONFERENCE
 Omni Rosen Hotel
 Orlando, FL
 Registration: George Johnson
 Tel: 703.486.7023
 Fax: 703.486.2659
 E-mail: gjohnson@RBitem.com

April 28

Sponsored by the Seattle Chapter of the IEEE EMC Society
ONE DAY TUTORIAL WITH HENRY OTT
 Seattle, WA
 Janet O'Neil
 425.868.2558

April 30

Sponsored by the Los Angeles Chapter of the IEEE EMC Society
ONE DAY TUTORIAL WITH HENRY OTT
 The Marriott Hotel
 Manhattan Beach, CA
 Ray Adams
 310.662.7878

June 14-19

11TH INTERNATIONAL CONFERENCE ON HIGH-POWER ELECTROMAGNETICS: EUROEM '98
 Tel Aviv, Israel
 The Secretariat Euroem '98
 Tel: 972.3.5140000
 Fax: 972.3.5140077
 e-mail: euroem98@kenes.com

June 29 - July 1

Sponsored by the US EMC Standards Corporation in cooperation with the American National Standards Institute, Accredited Standards Committee C63 - Electromagnetic Compatibility (ANSI ASC C63)
EMC MEASUREMENT UNCERTAINTY WORKSHOP AND ISO/IEC GUIDE 25 WORKSHOP
 Portland, OR
 Henry Benitez, 503.627.1217

IEEE Administrative Meetings 1998

April 27

EMC Society Board of Directors
 Westin Hotel
 Seattle, WA
 Janet O'Neil, 425.868.2558

EMCS Cooperating Symposia

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

IEEE EMCS Symposia Schedule

- 1998** Denver, CO
 August 24-28
 Adam's Mark Hotel
 Barry Wallen
 303.682.6600
- 1999** Tokyo, Japan
 (International IEEE)
 May 17-21
 S. Nitta
 e-mail: nitta@cc.tuat.ac.jp
- 1999** Seattle, WA
 (National IEEE)
 August 2-6
 Westin Hotel
 Bill Gjertson
 206.773.3482
- 2000** Washington, DC
 August 21-25
 Washington Hilton
 Bill Duff
 703.914.8450
- 2001** Montreal, Canada
 Montreal Convention Center
 Christian Dube
 514.653.6674
- 2002** Minneapolis/St. Paul
 Hyatt Regency,
 Minneapolis
 Dan Hoolihan
 612.638.0250
- 2003** Tel-Aviv, Israel
 (International IEEE)
 Elya Joffe
 Fax: 972.9.765,7065
- 2003** Boston, MA
 (National IEEE)
 Sheraton Boston
 Mirko Matejic
 508.549.3185
- 2004** Santa Clara, CA
 Franz Gisin
 415.933.8789
- 2005** Chicago, IL
 Bob Hofmann
 630.979.3627

The IEEE EMCS Newsletter welcomes contributions to this calendar page. Please send information to:

Editor, IEEE EMCS Newsletter

fax 425.868.0547

e-mail: j.n.oneil@ieee.org

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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An Institutional Listing recognizes contributions to support the publication of the IEEE EMC SOCIETY NEWSLETTER and the IEEE TRANSACTIONS ON ELECTROMAGNETIC COMPATIBILITY. Minimum rates are \$500.00 for four consecutive issues of each publication during one calendar year (each publication is distributed quarterly). Larger contributions will be most welcome. Payment for Institutional Listings for Calendar Year 1998 is due now. Note there is limited space available. Space is confirmed in the order of payment received until the space is full. Please send your check payable to the "IEEE EMC Society" to Warren Kesselman, EMC Society Treasurer, 31 Hope Road, Tinton Falls, NJ 07724. Include instructions on how you wish your Institutional Listing to appear. No agency fee is granted for soliciting such contributions.