

# Electromagnetic Compatibility Society

Newsletter



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EDITOR: ROBERT D. GOLDBLUM

## THE YEAR IN REVIEW AND THE FUTURE



Donald N. Heirman, President

Your Board of Directors and I hope all of you had a happy holiday season. It's the time of the year to make those resolutions to do better this year. As far as our Society is concerned, the resolutions might be to continue the work started and revitalized in the past year in important areas such as standards activities, encouraging your participation in the technical and administrative operation of your Society, and renewed activity at the Chapter level, especially in support of BoD projects--to name a few.

In 1980, we have made significant strides in our standards activities. We have withdrawn four standards which were outdated; reaffirmed two; updated and sent out for ballot for approval two more; have actively under review four; and four need your contributions to change where necessary to keep up with current technology. The ones needing your participation involve measurement of field intensity above 300 MHz from RF industrial, scientific, and medical

equipment, open field method of measurement of spurious radiation from FM and TV broadcast receivers, susceptibility of non-implanted cardiac pacemakers, and signal grounding practices. If you are interested, please call Bud Taggart, Standards Chairman, at 303-497-3462. In addition, East and West Coast standards working committees were formed with Leonard Thomas heading the former and Hank Knoller, the latter. We are very pleased with this activity and urge you, our members, to contribute your inputs. We further envision that the standards contribution could be an important Chapter activity. Some of the chairmen attending the EMC Symposium in Baltimore indicated interest in standards support. We hope to follow through on this incentive in 1981.

Of course, the highlight of our past year was our annual symposium which attracted over 400 attendees. We want to thank the Symposium committee for its outstanding effort, the session organizers and authors for their contributions, and the attendees who filled sessions which at times overflowed into the corridors. There has never been so much widespread interest in EMC and it has been long awaited. Close to 50 attendees visited our EMC Society booth in the exhibit area. We handed out all of our draft handbooks on the Society's activities. The handbook was given to those who were especially interested in standards and technical/standing committee work and desired key Society contacts. I had over a half dozen who said they were joining one of the committees while at least another dozen said they were going to join the IEEE

(Cont'd., pg. 16)

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## EDUCATION COMMITTEE NEWS

Many seminars and short courses on EMC related subjects are scheduled for the spring of 1981.

R & B Enterprises will offer two one-day seminars. Requirements & Testing per FCC Docket 20780 and Designing to Meet FCC Docket 20780 will be offered on consecutive days. They will be offered on January 26 & 27 in Boston, MA, February 2 & 3 in San Francisco, CA, February 4 & 5 in Los Angeles, CA and February 19 and 20 in Valley Forge, PA. The instructors for these two course will be Milton C. Mobley and Richard J. Mohr, respectively. For more information, contact R & B Enterprises at 215-828-6236.

Don White International Training Center is offering a large number of courses in the USA, as well as abroad. Grounding and Shielding will be offered February 17-19 in Phoenix, AZ, on April 21-23 in Atlanta, GA and on May 19-21 in Boulder, CO. EMI Control in Electronic Data Processing Equipment will be given May 11-15 in San Francisco, CA. Design and Measurement for Control of EMI will be presented March 9-13 in Los Angeles and on June 1-5 in Ottawa, Canada. FCC and CISPR/VDE Design and Measurements will be offered July 14-16 in Los Angeles, CA and on February 10-12 in Orlando, FL. Introduction to EMI/RFI/EMC will be presented March 24-26 in Washington, DC and May 26-28 in Seattle, WA. For more information on these, as well as additional courses being offered, contact Don White International Training Center at 703-347-0030.

The Continuing Education Program at George Washington University is offering several courses in Washington, DC. Electromagnetic Interference and Control will be offered on March 23-27. Hazardous Electromagnetic Radiation will be offered May 11-12. Grounding, Bonding and Shielding will be presented May 4-5. The instructor for these courses will be Dr. Bernhard E. Keiser. On February 2-3 and June 1-2, a course on Lightning Protection will be given by A. K. Guthrie and Bernhard Keiser. For more information on any of these courses, contact George Washington Univ. at 202-676-6106 or 800-424-9773.

The Center for Professional Advancement is sponsoring a 4-day course on Electromagnetic Compatibility Engineering to be presented March 30 - April 2 in central New Jersey. The instructors will be Henry W. Ott and Donald N. Heirman. For more information, contact The Center at 201-249-1400.

Henry Ott

Chairman  
EMCS Education Committee  
Bell Laboratories  
Room 2C-248A  
Whippany, NJ 07981  
201-386-6660

DEADLINE FOR APRIL 1981 ISSUE OF  
THE NEWSLETTER IS MARCH 15, 1981

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## REFLECTIONS ON THE 1980 SYMPOSIUM

by

Andrew Farrar

The 1980 International EMC Symposium, related workshops, and exhibitions were held during the week of October 6-10, 1980. Like the EMC symposiums held in the last few years, the large attendance at the EMC '80 Symposium substantiated the fact that interest in the EMC technology is definitely growing. Approximately 600 people attended the Symposium and its related activities. Committees held during the Symposium contributed to the participation.

The workshops at the EMC '80 Symposium were well attended and the exhibitors were pleased with the traffic pattern which provided them with good visibility.

One of the highlights of the Symposium was the opening session in which the Symposium attendees were addressed by the Honorable Henry Geller, Assistant Secretary of the Department of Commerce for Communications and Information. In his address, Mr. Geller outlined the actions taken by the WARC-79 and provided guidelines for the progress of the EMC technology for the next decade. He indicated the need for less government regulations and he emphasized the importance of research and development in the EMC discipline. This opening session was followed by well attended technical sessions. The credit for the large number of attendees at this Symposium is due, in part, to the active participation of the Sequency Union and URSI Commission E. These two activities contributed much to broadening the technical base of the Symposium.

The highlights of the week's activities by all standards were the banquet and award ceremony held at the Baltimore and Ohio Railroad Museum and the thought provoking remarks by Dr. Leo Young. At the reception dinner, Dr. Harold E. Putoff, SRI International, gave a fascinating talk on "remote viewing" related to his research activities on Extra-Sensory Perception (ESP).

The IEEE booth placed in a suitable strategic location was manned by Don Heirman and his volunteers, who surprised us with over 20 new applicants for membership in the IEEE Society.

The hospitality program for the guests who accompanied some of the attendees was directed by Mrs. Irene Newhouse who not only added an extra touch to the Symposium program; but, provided a welcoming opportunity especially to those guests who came from abroad.

The EMC '80 Symposium was fortunate to have a relatively large number of attendees from Europe and the Far East, hence, a truly international symposium.

In summary, I feel that we had a memorable symposium in Baltimore. I deeply appreciate the great deal of work which the members of the Steering Committee and the members of the various related committees have put forth. Furthermore, on behalf of the 1980 Steering Committee, I want to wish the best of luck to Bud Taggart and his Steering Committee as they prepare for the 1981 Symposium in Boulder, Colorado.

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## 1980 EMC SOCIETY FELLOWS

Two EMC Society senior members, James C. Toler, former President of the EMC Society, and William G. Duff, Associate Editor of the EMCS Newsletter, have been elected to the grade of IEEE Fellow. Congratulations, Fellows!

Nominations for 1981 Fellows should now be in process for transmittal to the IEEE Fellow Committee early in 1981. Time is getting short!

Any IEEE member, regardless of IEEE member grade, can act as nominator. In particular, chapter chairmen and present fellows, because of their knowledge of technical accomplishments of other IEEE people, have a special responsibility to make sure that "outstanding performance" is recognized. Information concerning the fellow nominating process was presented on Page 19 of the Fall Issue of the EMCS Newsletter. IEEE nominating kits containing guidance material and all necessary forms can be obtained from Jim Hill, 6706 Deland Dr., Springfield, VA 22152, tel.: 703-451-4619; A. H. Sullivan, Jr., 7121 WolfTree La., Rockville, MD 20852, Tel.: 301-881-4036; or, directly from the Staff Secretary, IEEE Fellow Committee, 345 E. 47th St., New York, NY 10017, Tel.: 212-644-2750. Call Sully or Jim if you have any questions or need help in preparing the forms.

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## RTCA AVIONICS TEST STANDARD

A new standard for environmental test conditions for airborne equipment has been released by the Radio Technical Commission for Aeronautics (RTCA). The document describes procedures for checking temperature, altitude, humidity, vibration, shock, waterproof, salt spray and sand and dust, fungus and RF interference.

The new standard supercedes a 1975 document and takes effect immediately. Further information or copies of the standard at \$25 each can be obtained from the RTCA Secretariat, Suite 655, 1717 H St., N.W., Washington, DC 20006.



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## EMC SOCIETY AWARDS PRESENTED AT THE 1980 INTERNATIONAL SYMPOSIUM IN BALTIMORE

The presentation of the annual awards was made at the B&O Railroad Museum in Baltimore. Recipients of the awards were as follows:

The Richard B. Stoddart Award was presented to Edward N. Skomal in recognition of his outstanding contributions to and organization of the data bank on the radio noise environment. An honorarium of \$100 is made with this award.

Richard B. Schulz received the Laurence G. Cumming Award in recognition of his contributions to the administration and overall success of the Society and for his service as Transactions Editor for the past twelve years.

The Certificate of Appreciation for outstanding contributions to the welfare, administration, and overall success of the Society was presented to Jacqueline R. Janoski, Herbert K. Mertel, and Leslie A. Wall.

Certificates of Achievement were presented to James C. Toler for his "outstanding contributions in the understanding of electromagnetic effects on biological systems and the performance of medical devices," and to William S. Lambdin for "his outstanding contributions in the design of instrumentation and measurement systems for the evaluation of electromagnetic effects."

The Certificate of Recognition was presented to Leo Young, IEEE President, for his "contribution to and support of the Society over the years." The certificate also was presented to Andrew Farrar for "services rendered as Chairman of the 1980 International Symposium on EMC." Harold E. Putthoff also received the certificate for "his outstanding contribution as after-dinner speaker on 'Paranormal'."

The 1979 Transactions Prize Paper Award went to David Middleton for a pair of papers on canonical models appearing in the August 1979 issue. An honorarium of \$100 went with this award.

The New Jersey Coast Chapter was again the winner of the Chapter-of-the-Year Award. Margaretta V. Stone was chairman during this year, 1979. The other officers for 1979 were William H. Chriss, Gary S. Kath, and Luke G. Schimpf.

A special Certificate of Recognition was presented to the Honorable Henry Geller, Assistant Secretary of Commerce for Communications and Information, who was the keynote speaker at the symposium plenary session.

The symposium papers were judged in three categories: EMC papers, Sequence Union papers, and student papers. The following authors received prizes and certificates:

EMC Papers - First Prize, D. M. LeVine  
Second Prize, A. Farrar and  
A. T. Adams  
-Hon. Mention, A. A. Toppeto

Sequence Union Papers -  
First Prize, H. F. Harmuth  
Second Prize, P. Ramakrishna  
Rao

Student Papers -  
First Prize, C. Ryba  
Second Prize, M. J. Hackert

## SAE EMC MEETINGS

The AE-4 Committee on EMC of the Society of Automotive Engineers (SAE) has announced its meeting schedule for its next two meetings. These will be held in San Diego on March 31st to April 3, 1981 at the Town and Country Hotel, and in Boulder on August 17, 1981 at the Harvest Hilton. The Boulder meeting will be in conjunction with the IEEE EMCS Symposium. For additional information, contact Jack L. Moe, Chairman, c/o General Dynamics Corp., P. O. Box 748, Ft. Worth, TX 76101; Tel.: 817-732-4811, Ext. 2572.

## WROCLAW POLAND EMC SYMPOSIUM RECORD NOW AVAILABLE

The printed Record of the Fifth International Wroclaw Symposium on Electromagnetic Compatibility, September 17-19, 1980 now can be ordered from a limited supply now available in the United States. The Symposium Record contains the full text of all papers delivered at the symposium. Of the 96 papers making up the technical program, 57 are in English language and 39 are in Russian. The Record is in two volumes in a 17 X 24 centimeter format.

Send orders to James S. Hill, The EMXX Corporation, 6706 Deland Drive, Springfield, VA 22152. The price is \$20 for IEEE members and \$25 for non-members. Make checks payable to "EMC Society-IEEE." Shipment will be postpaid to any address in the USA.



## PLANS FOR GROUP TOUR TO THE EMC SYMPOSIUM AT ZURICH, SWITZERLAND

The Fourth Symposium and Technical Exhibition on Electromagnetic Compatibility will be held at the Federal Institute of Technology in Zurich from March 10 to 12, 1981. A description of this symposium appears in the last issue (No. 107) of this Newsletter. Preliminary programs are available from the symposium secretary, Dr. T. Dvorak, ETH Zentrum-KT, 8092 Zurich, Switzerland; Phone: (411) 326-2790. Of the 112 papers on the program, 36 are by USA authors. In addition, there are 3 workshops directed by USA personnel.

We have arranged with Swissair for a basic one-week tour leaving New York on March 7th and returning on March 15th. We will be put up at the Continental Hotel in Zurich, with breakfast included. There will be a  $\frac{1}{2}$  day orientation tour of Zurich on Monday and an optional one-day tour to Berne on Friday. Within limits, the basic tour can be modified to accommodate those who would like to leave from Boston and who would like to extend the tour to two weeks, with provision for a rental car or rail pass or other modifications. Reduced air rates apply when making connections to the trans-Atlantic flight from any part of the USA.

For more detailed information on the group tour, return the coupon below.

Send to: James S. Hill  
EMC International Affairs Committee  
6706 Deland Drive  
Springfield, VA 22152

I am interested in participating in the group tour to the EMC Symposium and Technical Exhibition in Zurich. Please send more information.

I would stay two weeks \_\_\_\_\_ with rental car \_\_\_\_\_ with rail pass \_\_\_\_\_

Other Interests \_\_\_\_\_

Name \_\_\_\_\_ Number in Party \_\_\_\_\_

Street \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Telephone, including area code ( ) \_\_\_\_\_



FCC GRANTS STAY ORDERS AND WAIVERS  
OF ITS COMPUTING RULES

The FCC has granted four stays and waivers of its recently adopted computer rules, which are designed to control radio and television interference from computing devices.

The actions included:

- Health Industry Manufacturers Association (HIMA) was granted a waiver of the interim label requirements of Section 15.805 for medical devices. The interim label states the device has not been tested for compliance and may cause interference to radios or televisions, and it must be placed on all computing equipment manufactured after January 1, 1981, until the device is tested and complies with technical specifications.

HIMA claimed the label's wording may conflict with a Food and Drug Administration full-disclosure requirement. It also claimed labelling costs would be high and would not be justifiable since most medical computing equipment is used in hospitals and is not likely to cause interference.

The waiver for medical devices only will continue, pending the Commission's study of an industry petition to exempt all medical computing equipment from the computer rules.

- In response to petitions filed by Stern Electronics, Inc., Sega Enterprises Inc. and Atari Inc., the Commission stayed from January 1, 1981, to October 1, 1981, the requirement that coin-operated electronic games be certified.

The stay was granted to avoid unnecessary expense to the industry while the Commission responds to petitions for rulemaking by Williams Electronics Inc. (RM-3738) and Atari (RM-3789) to reclassify coin-operated electronic games as Class A computers. (The computer rules established Class A for commercial or industrial uses, and Class B, mainly for home use.) Favorable action on these petitions would eliminate certification.

In granting the stay, the Commission accepted the petitioners contention of a very low risk of interference, noting the report of a joint study by Atari and the Oregon State Police that the present generation of coin-operated games do not interfere with police communications.

The Commission cautioned that coin-operated electronic games must carry the interim label warning they have not been tested and may cause interference.

- The Commission granted Tandy Corporation a waiver of technical standards and the certification requirement for Radio Shack interface device Models 26.1140, 26.1141, and 26.1142, which connect various peripherals to the TRS-80 Model I computer to expand its capability. The waiver permits Radio Shack to keep its promises to computer purchasers to stock these interfaces.

The waiver was granted on the conditions that: manufacture of the non-complying interface devices must stop December 31, 1981; the interference potential of the TRS-80 must not be increased by more than 6 decibels when the non-complying interface device is attached; not more than 30,000 units may be manufactured; the interface device made under the waiver cannot be attachable to any personal computer made after January 1, 1981; and Radio Shack agrees to correct interference caused by its equipment or refund the price of the equipment.

The Commission delegated authority to its chief scientist to grant similar waivers for peripherals to other manufacturers subject to the same conditions.

- Apple Computer Inc. and Heath Co. received extensions from January 1 to April 1, 1981 to get certification for their personal computers. Both said that despite strenuous efforts and substantial expenditures, their personal computers do not comply with FCC technical standards and that without an extension, they would have to close their plants, resulting in heavy economic losses to the companies and severe hardship for employees.

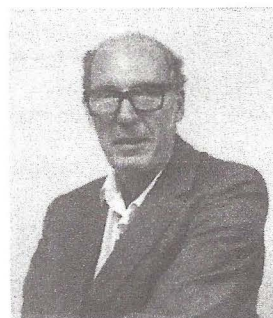
Each unit made under the waiver must carry a label with the following wording: "This equipment is marketed pursuant to a waiver of FCC Rules Part 15 Subpart J. Operation of this computer in a residential area may cause objectionable interference to radio and TV reception, because it emits more radio frequency energy than the FCC Rules allow. If interference occurs, the user will be required to take all steps necessary to correct the interference."

The Commission delegated authority to its chief scientist to grant similar conditional waivers to manufacturers who can show: steps taken to meet the January 1 date and why it was not met; an exact timetable for each product to comply; and assurance that equipment will include as many radio frequency (RF) suppression techniques and components as are possible during the waiver.

Apple's extension request was granted in full. Heath's was granted in part; but, the Commission said it would consider a petition for more time if it contained the required showing.



# CHAPTER CHATTER



by Charles F. W. Anderson

## Albuquerque

The joint AP-S/MTT-S/EMC-S Chapter held a meeting on October 2nd at which Dr. David Giri of LuTech - Berkley, CA was the speaker. His topic was "The Insulated Antenna." His presentation outlined the development of the insulated antenna since its inception in 1928, covering the considerable amount of information that has been published in this area, particularly in the last ten years. A dinner at the Montana Mining Company preceded the talk. (Thanks to Jim Prewitt, Chapter Secretary, for the above.)

## Central New England

The Chapter held a meeting on October 2nd which featured John Dobmeier of the IITRI EMC/IAP Support Group at RADC speaking on "Computer-Aided Intrasytem EMC Modeling and Analysis." He described the mathematical modeling techniques, which are structured to give design and EMC engineers the flexibility to achieve compatible systems. The IEMCAP also provides system managers with greater visibility and more accurate information on which to base program decisions. Plans include a mid-January meeting at which Chet Smith (Chapter Vice Chairman) will speak on low-power source coupling onto power lines in the 100-200 kHz band. For March, a meeting dealing with standards and test methods for radiated EMI originating in SCR-controlled propulsion systems. The Chapter also is planning an evening lecture series in the spring on applications of non-sinusoidal waves for radar and radio communications and advanced signal design and processing. Further details will appear in the spring issue. (Again, our thanks to John Clarke for providing news of CNE Chapter's activities.)

## Denver/Boulder

Charlotte Tyson (IBM-Boulder) wrote to advise that she recently was elected Chairwoman of the Denver EMC/Instrumentation and Measurements Joint Chapter. Serving with her will be Richard Fitzgerald (who is a project leader in EMC/radiation hazards metrology at NBS) and Ron Johnson (Hewlett-Packard field sales engineering) as Vice Chairman and Secretary/Treasurer, respectively. Although the existing group is based in Boulder, it is known as the Denver EMC/I&M Chapter. However, Abul Rashid is actively engaged in formation

of a Chapter in the Denver area, which probably will be composed mainly of Martin Marietta employees. (Abul called a few weeks ago to advise me of this activity -- we wish him well in his efforts to bring another Chapter into being!). Charlotte also reported that the Boulder group is progressing in their preparation for the '81 Symposium.

## Dayton

On October 15th, the Chapter had a luncheon get-together, followed by a presentation on the "Stormscope" at Air Force Institute of Technology. Paul Ryan, President of Ryan Stormscope, Columbus, OH, described the "Stormscope" weather mapping system, which can be installed in small aircraft to provide a storm-avoidance function with cost and space savings. A short business meeting preceded the talk; committee reports were presented and a nominating committee to select officers for 1981 was appointed. Eldon Wick keeps us up-to-date on the Dayton Chapter's activities with his newsletter.

## Los Angeles

Fred Nichols was the speaker at the Chapter's September 18th meeting. His talk covered some of the common misconceptions with respect to shielded enclosure design, materials and construction types.

Gene Knowles and your Column Editor would like to acknowledge the contributions of the Chapter Chairmen who participated in the lively discussions during the breakfast meeting at the Baltimore Symposium. The comments and suggestions will be most helpful to us in our mutual Chapter coordinating activities.

A December 4, 1980 letter to your Chapter Chatter Column Editor from Tei Iki, Sony Corp. of America, San Diego Plant, 16450 W. Bernardo Dr., San Diego, CA 92127, reads as follows:

Dear Charlie:

News From Tokyo Chapter

On June 16, 1980, IEEE EMC's Tokyo Chapter was established. This was the formation of our first foreign Chapter, giving the EMC Society a truly international stature. It is now composed of about 40 members.

The officers of the new Chapter are:



Chairman: Risaburo Sato (Professor of  
Tohoku Univ.)  
Aramaki Aza Aoba, Sendai City,  
Japan 980

Vice-Chairman:  
Toshihiko Namekawa (Professor  
of Osaka Univ.)  
Yamada Ue, Suita City, Japan  
565

Secretary: Tasuku Takagi (Professor of  
Tohoku Univ.)  
Aramaki Aza Aoba, Sendai  
City, Japan 980

Treasurer: Mahoki Onodo (Professor of  
Tokyo Institute of Technology)  
2-12-1, Ookayama, Meguroku,  
Tokyo, Japan 152

The formation of the Tokyo Chapter was the culmination of a six-year effort by a group of people under the leadership of Prof. Risaburo Sato of Tohoku Univ. Six years ago, it became evident to the founders that a formation of the Japanese EMC Group was needed. However, as in most cases, considerable preparation work was required. Finally, in 1977, the Japanese EMC Society was formed from IEE and IECE groups in Japan. To cover the deluge of technical information, a monthly meeting was established at this time. The format of the meeting was - and still is - basically a mini-symposium in which five to twenty papers were presented. (Abstracts of translated Japanese technical papers will appear in future issues of the Newsletter.)

It should be noted that there are IEEE members in Japan; about 40 of whom have EMC interest. Therefore, Prof. Sato decided to form the EMC-IEEE Chapter in Japan. In October 1979, Dr. Sato approached ADCOM on this matter. At that time, he proposed to hold an international symposium on EMC in Tokyo in 1984. This, by the way, will coincide with the 100th Anniversary of IEEE.

We are pleased to note that both proposals have been successfully implemented. We now have, under Mr. E. D. Knowles, West Coast Chapter Coordinator, a new Tokyo Chapter. Our congratulations to Dr. Sato and to the new officers of Tokyo Chapter.

We wish to extend to all EMC members, through Dr. Sato, an invitation to contact Tokyo Chapter to participate in their activities.

#### EMCS CHAPTER CHAIRMEN

The following is the list of Chapter Chairmen as our records presently indicate. Chapter officers are requested to send all changes or corrections to:

Charles F. W. Anderson  
1716 Reppard Road  
Orlando, FL 32803

Albuquerque  
Juinn Yu  
1511 Columbia Dr., N.E.  
Albuquerque, NM 87106

Atlanta  
Donald E. Clark  
4086 Shady Circle  
Atlanta, GA 30247

Baltimore  
William E. Tate  
12901 Broadmore Rd.  
Silver Spring, MD 20904

Boston  
C. L. Smith  
2 Jonathan La.  
Bedford, MA 01730

Boulder  
Ezra Larsen  
3450 Emerson Ave.  
Boulder, CO 80303

Central New England  
Arthur W. Murphy

Dayton  
J. C. Corbin, Jr.  
48 Esquire Ave.  
Dayton, OH 45459

Denver  
Herb F. Ostenberg  
230 N. Cedar Brook Rd.  
Boulder, CO 80302

Long Island  
S. S. Bernstein  
2797 School St.  
Bellmore, NY 11710

Los Angeles  
Michael Malinick  
18822 Via San Marco  
Irvine, CA 92715

Mohawk Valley  
Carmen A. Paludi, Jr.  
5626 Main St.  
Verona, NY 13478

New Jersey Coast  
Margaretta V. H. Stone  
130 Summit Ave.  
Neptune City, NJ 07753

San Diego  
Open at this moment, owing to  
Abul Rashid's move to Denver

San Francisco  
Evangelos Tonas  
726 - 26th Ave.  
San Mateo, CA 94403

Santa Clara Valley  
Sam B. Shankle  
1502 Wright Ave.  
Sunnyvale, CA 94087

Seattle  
G. M. Gillet  
2507 W. Viewmont Way, W.  
Seattle, WA 98199

Tucson  
Thomas F. Hassett  
Bell Aerospace Co.  
1050 E. Valencia Rd.  
Tucson, AZ 85706

Washington, DC  
Bernhard E. Keiser  
2046 Carrhill Rd.  
Vienna, VA 22180



NAVAL AIR SYSTEMS COMMAND  
ELECTROMAGNETIC COMPATIBILITY  
AEROSPACE RESEARCH AND DEVELOPMENT  
(EMCARD) PROGRAM

The Naval Air Systems Command has established the Electromagnetic Compatibility Aerospace Research and Development (EMCARD) Program for the development of engineering techniques (e.g., shielding, bonding, grounding, measurement and analysis) and devices (e.g., filters and transient protection) to assure electromagnetic compatibility of Naval aircraft and weapons systems in all anticipated operational electromagnetic environments. The program involves fifteen projects, of which one, the Electromagnetic Technical Advisory Group (EMTAG), directly supports through technical integration the systems acquisition programs and the Air Systems Corrective Action Program (ASEMICAP).

Additional projects included within the EMCARD program are the investigation of lightning effects and P-static effects on aircraft systems. NAVAIRSYSCOM is jointly sponsoring with other agencies (FAA, NASA, Air Force, et al) programs designed to acquire statistical lightning and P-static data to characterize information so that worse case threat environments can be defined and lightning protection and test techniques can be improved.

Another program conceptually aligned with EMCARD is the Electromagnetic Environmental Effects (E<sup>3</sup>) Composite Materials Program. The program includes the analysis and use of computer programs to define better approaches and methods to investigate E problems which arise by the use of composite material structure in aircraft systems.

The EMCARD program is coordinated with NAVSEA and NAVELEX programs to ensure joint exchange of information. The output provides improved engineering techniques and devices for utilization in the design and development of new aircraft and weapons systems; in solving Fleet electromagnetic interference problems; and the engineering data for updating or preparing specifications and standards.

*The above NAVAIR material was provided  
by Ron Lane, NADC, Warminster, PA.*

PLEASE NOTE . . . .

Concerning information on the Fourth Electromagnetic Compatibility Symposium and Technical Exhibition, Zurich, March 10-12, 1981 -- as given in the Fall 1980 issue of this Newsletter -- the new telephone number at which you can contact Dr. T. Dvorak for copies of the Preliminary Program with registration forms, plus any further information, is: (+411) 256-2790.

In the Fall 1980 issue of the Newsletter, the contact for the article, "Nominations for IEEE Fellows" is A. H. Sullivan, Jr., 7121 WolfTree La., Rockville, MD 20852; Tel.: 301-881-4036.

WILLIAM R. JOHNSON

The EMC community is saddened by the death of William R. Johnson, Staff Engineer at TRW Defense and Space Systems Group in Redondo Beach. Bill had not been active in the EMC community for the past several years because he had been on medical leave. He will be remembered professionally for his significant contributions in the area of large scale computer analysis of EMC in electronic systems. He was largely responsible for the development of the fundamental concepts which produced the SEMCAP System EMC Analysis program and in communicating the technology to the community at large. He shared heavily in the development of cable coupling algorithms in the late 60s. Bill was well grounded in EMC fundamentals and had a unique ability to see complex system problems clearly. He loved to share his knowledge with others and did so at every opportunity. His enthusiasm for engineering and for people was a rarity which added much to those around him.

Bill also will be remembered, by those fortunate enough to have known him personally, for his warmth and humor, and for the feelings of camaraderie that enveloped everyone who shared "after hours" engagements with him. He will be missed.

Bill was born in Shawnee, OK on December 17, 1931. He passed away on May 24, 1980. Following a memorial service, his ashes were scattered over the San Bernardino Mountain country where he spent his last years.



## NTIS OFFERS

### "INFORMATION FOR INNOVATORS" NEWSLETTER

The National Technical Information Service (NTIS) is offering a bi-weekly, 8-page review of federally-sponsored research and development reports. The newsletter, Information for Innovators, also covers reports on foreign technological developments. Order for \$85 annually from NTIS, Springfield, VA 22161.

## CONGRESS EYES CONSULTANTS

Both the House and Senate are cranking up a new public inquiry after the General Accounting Office reaffirmed the existence of widespread mismanagement and waste of millions of dollars a year for private consultant contracts.

For the past year, a Senate Governmental Affairs Subcommittee on Civil Services and General Services and a House Civil Service Subcommittee on Human Resources have been digging into the government's increasing reliance on private consultants and contractors.

Federal contracting of all kinds is put at an estimated \$150 billion a year - or one-fourth of the federal budget. Such spending has led to what Sen. David Pryor (D-AR) called creation of a "shadow government: of four million to eight million people not on the federal payroll; but, who actually are paid by federal funds through the contractors and consultants.

Rep. Herb Harris (D-VA), who heads the House Subcommittee, and Senator Pryor, the Senate Subcommittee head, said the abuses confirmed by the GAO "warrant immediate attention."

### "FLY-BY-LIGHT SUBSYSTEM MAKES ITS MILITARY DEBUT"

The Air Force is flying a futuristic aircraft control system that uses fiber optics in its digital flight controls aboard an A-7D research aircraft. This is the first time that such a fiber optics subsystem - popularly called fly-by-light - has been flown on U.S. military aircraft. These A-7 flights continue an Air Force research and development program called DIGITAC, for Digital Tactical Aircraft Control, that started in the mid-1970's.

## EMC CONSTITUTION AND BYLAW UPDATE

Although the EMC Constitution and ByLaws were recently revised, a few sections need minor re-wording for clarity. Also, some portions were not changed. Before making any further changes, comments and suggestions from the membership are solicited. Call or write Doug Robertson, Georgia Institute of Technology, Atlanta, GA 30332; Tel: 404-894-3542.

## POST OFFICE ECOM PLAN

The U.S. Postal Service Board of Governors has approved a proposal for electronic computer-originated mail (Ecom), that would allow common carriers to compete for the electronic transmission portion of the planned service. According to the Postal Rate Commission's estimate, Ecom service should begin operations within the next 12 to 18 months. Meanwhile, the Ecom jurisdictional battle between the Federal Communications Commission and the Postal Service is still pending in court.

## BOOK ON COMMUNICATION INTERFERENCE

The publication of Interference Analysis Communication Systems, a book of selected reprints, has been announced by the IEEE Press. This collection, edited by Peter Stavroulakis of Oakland University, is sponsored by the IEEE Electromagnetic Compatibility Society. The 41 papers reprinted in this volume are arranged by subject into the following four parts: Analog-Signal Interference; Digital-Signal Interference; Interference Reduction/Cancelling; Computer Simulations. The papers in each part are preceded by introductory comments by the editor. A special effort was made to include as many key original contributions, tutorial treatments, and papers with bibliographies as possible.

Interference Analysis of Communication Systems is priced at \$17.45 for the paperback member edition. A clothbound edition is available for \$34.95 (discounted to \$26.20 for IEEE members). This 432 page book can be ordered postpaid from the IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. Payment should accompany orders.



## IEEE TESTIFIES ON TELECOMMUNICATIONS R&D BEFORE HOUSE PANELS

The House Science Committee, which has oversight responsibility for the full sweep of the government's R&D effort, conducted a series of hearings in mid-May on telecommunications research. It did so through the instrumentality of two subcommittees, one chaired by Rep. Tom Harkin (D, Iowa) and the other by Rep. George Brown (D, CA). Invited by the Harkin panel for its views, IEEE responded through its Committee on Telecommunications Policy.

IEEE was represented by Dr. Richard Marsten, Chairman of the Telecommunications Committee, along with John Puente (of Maryland) and James Palmer (of Pennsylvania), both Committee members. After the testimony (on May 22), they were complimented by the subcommittee staff and by telecommunications experts in the audience both on substance and clarity of presentation. Staff people indicate that they will look to the IEEE in the future for information and support on this complex area.

Witnesses from the government's civil agencies, Department of Defense, private firms prominent in communications, and professional organizations also testified. They addressed several questions posed by the Science Committee: What is the role of the Federal government in communications R&D? How can the government encourage innovation in telecommunications technology? How can communications technology be used in energy-saving ways (by promoting substitutes for transportation, for instance)?

Marsten told the panels that most telecommunications research in this country is initiated and funded by industry, which supports such research vigorously. The U.S. telecommunications industry is largely self-sufficient in technology R&D, with some standout exceptions such as small ground stations for satellite communications and high-power, high-frequency solid-state microwave devices for use in satellite transmission.

Since industry tends to bypass R&D in high-risk technologies with payoffs in the distant future, government support is needed in certain areas, Marsten pointed out. He listed the following three classes of candidates for that support:

1. High-risk, long-delayed payoff technologies whose applications would have social benefit, or a far-off commercial market, or both. As an example, many aspects of satellite communications fall in this class.
2. Future services for which no present market exists, but for which a future one can be foreseen because of social benefits.
3. National security telecommunications.

In answer to a question from Rep. Harkin about possible effects of the recent FCC "deregulation" decision, Jim Palmer took the microphone and explained a breakthrough achieved by his own engineering-oriented manufacturing company. He said his company has just introduced a new hardware item important to the cable television industry. What we need, Palmer said, is less intervention in our business by the government. He said the cable industry has been overregulated by the FCC for the past thirty years. His company's current growth "is the result of recent deregulation and the unshackling by the FCC. What we need now are tax incentives for development in the tooling for production."

## IEEE HISTORY CENTER NOW IN OPERATION

The Center for the History of Electrical Engineering began operations at headquarters on August 11th. Under the guidance of the History Committee, the Center has been established to promote and assist all activities related to the history of electrical science and technology, serving engineers, historians and the public.

For IEEE entities, the Center will be both a source of information and support for local history projects and a resource center providing materials for meetings, publications, and exhibits. Information regarding history activities (articles, exhibits, entity histories, programs and the like) should be sent to the Center, which will make it available for the benefit of all members.

The Center's archival program is concerned with locating and preserving (primarily in local repositories) collections of documents that may be of value in recording the history of electrical engineering. Assistance will be sought from all IEEE entities in identifying sources of documents (correspondence, lab notes, drawings, proposals, etc.), artifacts, and photographs and bringing them to the Center's attention. The alertness of members will be especially important in the effort to save materials that are in danger of destruction or disposal.

Other activities of the Center include an oral history program, exhibits and the publication of an occasional newsletter. Ideas are sought from all members on other ways to preserve and to understand the engineering heritage.

For additional information, call Robert Friedel at 212-644-7501.



## MURPHY'S LAW OF RESEARCH ENGINEERING

First Law: In any field of endeavor, anything that can go wrong will go wrong.  
Rule 1: Everything goes wrong at one time.  
Rule 2: If there is a possibility of several things going wrong, the one that will go wrong is the one that will do the most damage.  
Rule 3: Left to themselves, things will always go from bad to worse.  
Rule 4: Plans must be reproducible; they should fail in the same way.  
Rule 5: Nature always sides with the hidden flaw.  
Rule 6: If everything seems to be going well, you have overlooked something.

Second Law: It is usually impractical to worry beforehand about interference during system implementation; if you have none, someone will supply it for you.  
Rule 1: Information necessitating a change in plans will be conveyed to you after, and only after, the plans are complete.  
Rule 2: In listing alternatives, presenting one obvious right way vs. one obvious wrong way, it is often wiser to choose the wrong way to expedite subsequent revisions.  
Rule 3: The more innocuous a modification appears to be, the further its influence will extend and the more plans will have to be redrawn.

Third Law: In any collection of performance and data, the figures that are obviously correct and beyond all need of checking contain the errors.  
Rule 1: Those you ask for help will not see the error.  
Rule 2: Any nagging intruder who stops by with unsought advice will spot it immediately.

Fourth Law: In any problem situation you find yourself doing an immense amount of work, the answer can be obtained by simple inspection.  
Rule 1: Prepare no plans or proposals simply if a way can be found to make them complex and wonderful.  
Rule 2: A detailed compilation of data is useful; it indicates that you have been busy.  
Rule 3: Before studying a subject, first understand it thoroughly.  
Rule 4: Do not believe in luck; rely on it.  
Rule 5: Always leave room, when writing a report, to add another explanation if the first one does not work (rule of the way out).

*(From IEEE APS Newsletter, April 1980)*

## REPRESENTATIVE BROWN RECEIVES DISTINGUISHED PUBLIC SERVICE AWARD

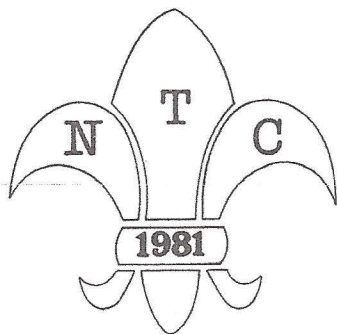
The United States Activities Board of the IEEE presented its Distinguished Public Service Award to Representative George F. Brown (D-CA). Dr. John Guarrera, Past President of the IEEE, presented the award to Mr. Brown for his singularly distinguished achievements in advocating before the Congress of the United States the IEEE goals of professionalism in engineering.

In presenting the award, Dr. Guarrera said, "In his assignment as Chairman of the Subcommittee on Science, Research and Technology of the Science and Technology Committee, Mr. Brown has supported the goals of the IEEE in science and technology policies and programs. He has been the author of much legislation to enhance and utilize technology and is a strong supporter of technology in many areas."

The Distinguished Public Service Award, presented at a symposium sponsored jointly by the IEEE and the School of Engineering and Computer Science of the California State University at Northridge, is given annually to an individual outside the engineering profession for contributions which further the professional purposes of the Institute. One of these purposes is the enhancement of the quality of life through the constructive application of technology and promoting understanding of the influence of such technology on the public welfare. These purposes have been accomplished to an outstanding degree by Representative Brown.

Elected to Congress in 1972, Mr. Brown is recognized as a leading spokesman on technology issues, and he has consistently supported the engineering community in the areas of research and development and innovation. He is the author of the National Technology Foundation Act, a bill presently before the Congress, and a strong supporter of the Technology Innovation Act of 1980. Mr. Brown is Chairman of the Subcommittee on Science Research and Technology which has jurisdiction over all scientific research and development applications and programs, national science policy, technology transfer, technology assessment, technological innovation and international cooperation in science and technology.





# National Telecommunications Conference

New Orleans, Louisiana

November 29 — December 3, 1981

INNOVATIVE TELECOMMUNICATIONS — KEY TO THE FUTURE

## CALL FOR PAPERS

If you have an idea for an original paper in the field of telecommunications, why not submit it for consideration by the NTC'81 Technical Program Committee? We are now accepting for review papers covering topics in the following disciplines:

Aerospace and Electronic Systems  
Communication Electronics  
Communication Software  
Communications Terminals  
Communication Switching  
Communication Systems Disciplines  
Communication Theory  
Computer Communication

Data Communication  
Electromagnetic Compatibility  
Geoscience and Remote Sensing  
Information Theory  
Microwave Theory and Techniques  
Mobile Radio and Maritime  
Communications  
Optical Communications

Radio Communication  
Radio Frequency Interference  
Social Implications of Technology  
Space Communication  
Spectrum Management  
Spread Spectrum Communication  
Standards Coordination and Liaison  
Transmission Systems

## SPECIAL TOPICS

Using Communications Technology to Develop Energy Resources,  
Expand Energy Production, and Promote Energy Conservation  
Innovative Uses of Telecommunications Products and Services

We will also consider other related topics and are especially eager to include innovative ideas. Please note these dates:

		<b>International Papers</b>
Notice of intent due (see below) .....	March 1, 1981 .....	February 20, 1981
Complete manuscript and abstract due .....	May 1, 1981 .....	April 15, 1981
Notifications of Acceptance mailed .....	July 1, 1981 .....	July 1, 1981
Camera-ready copies due (to USA address) .....	September 1, 1981 .....	August 15, 1981

Send 5 double-spaced copies, in English, of the manuscript (3000 word limit) and a 1-page abstract to:

**ASIA**  
Dr. Noriyoshi Kuroyanagi  
Electrical Communication  
3-9-11 Midori-Cho  
Musashino-shi, Tokyo 180, Japan  
Tel. (0422) 59-2882

**EUROPE**  
Michel Urien  
C.N.E.T.  
22301 Lannion Cedex  
France  
Tel. (96) 38 29 15

**NORTH AMERICA & OTHER REGIONS**  
G. Allan Ledbetter  
South Central Bell  
365 Canal St. - Room 1360  
New Orleans, Louisiana 70140  
Tel. (504) 528-7350

Include the author's name, return address, and telephone number on the abstract. All other pages (text and illustrations) should bear the title of the paper and the author's name. Page charges will be assessed for camera-ready copies exceeding 5 pages.

We expect to have an outstanding conference and earnestly solicit your participation in it.

G. Allan Ledbetter  
Technical Program Chairman

### Notice of Intent

I plan to submit a paper on:

\_\_\_\_\_

\_\_\_\_\_

It falls into the technical disciplines:

\_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_

\_\_\_\_\_

Telephone \_\_\_\_\_



and the EMC Society. I urge that each of you who volunteered to carry out your promise to provide us help. Your response made the booth effort worth the effort and we plan to do the same in Boulder in August.

Other accomplishments in 1980 include:

1. The formation of a new technical committee on Sequency Union chaired by Dr. Henning Harmuth.
2. A new chapter being formulated in South-east Denver area giving us two Denver Section Chapters (the Boulder Chapter is the other).
3. The Tokyo Chapter under the chairmanship of Dr. Sato has established mini-symposia almost on a monthly basis with several technical papers presented at these Chapter meetings each time.
4. Preparation of a video cassette on the "Introduction to EMC" is well under way, thanks to the revitalized EMC-S education committee and its chairman, Hank Ott.
5. Contribution of an EMC-oriented response for targeted research for Congressional consideration.
6. Preparation of an initial draft of an EMC-S handbook which contains committee descriptions and reports key contacts so that you can find out more information in your area of interest. Art Wall is heading up this effort.
7. EMC-oriented technical sessions were held at COMSOC International Conference on Communications and National Telecommunications Conference, as well as MIDCON. Bill Parker and Fred Matos are active in these intersociety relations efforts.

There were many other accomplishments in 1980 such as our special Transactions that are keeping our Society well. I apologize for not being able to fit in all the remaining accomplishments and those who contributed to their success. Let me still extend my special thanks to these unsung contributors.

WHAT ABOUT 1981? We need more volunteers to keep our projects alive and going forward. Our goal is to continue our extensive efforts as we did in 1980. Hence, all technical and standing committees need your help now! Key contacts for the various committees can be found by contacting our EMC-S Secretary, Leonard Thomas, on 202-526-2545. Technical committee contacts

can be found by a call to Herb Mertel, Committee Advisor, on 714-453-2480. My telephone number is 201-949-5535, and I will be happy to answer your inquiries if you leave a message after 5:00 P.M., New York City time. Remember, your contribution need not be extensive. For example, even if you have seen a paper from a journal that might be of general interest to the Society, why not pass it along to Ed Bronaugh, 516-684-5111, Ext. 2792, who can use the titles and abstracts for the EMC Abstracts which appear elsewhere in this Newsletter. Bob Goldblum would be happy to receive inputs to the Newsletter to make it even more useful to you.

Finally, we invite those who can attend to one or all of our three Board of Directors meetings in 1981:

1. Tuesday, February 24, 1981, at the FCC Building at 2025 M St., Washington, DC. Art Wall is the contact: 202-653-8128.
2. Monday, August 17, 1981, at the EMC Symposium in Boulder, CO
3. Either Thursday, November 12, 1981, at MIDCON in Chicago or Wednesday, December 2, 1981, at NTC '81 in New Orleans

These meetings are open to all of our members. We like you to see how the Board functions and hope that you may then want to participate more formally. The opportunity to run for the Board is coming up in April when petitions are needed for the September elections. This gives you an opportunity to present your views in running the Society. We encourage you to consider serving your Society in this important role.

There were about 180 new Society members in 1980. If even 10 percent became more active in the many technical and administrative opportunities the EMC Society offers, we will continue to make an important contribution to the Institute and to the public, based on our past as well as our new members' needs. Please take time this year to meet the challenge to serve your Society. I hope to see many of you in Boulder and, hopefully, at our Society's information booth. Good luck in 1981!!

*Don Heisma*



## EMCABS

EDWIN (ED) BRONAUGH

In this issue, we are publishing 48 abstracts. These are abstracts on various EMC topics. We plan to continue publishing abstracts of papers from previous EMC Symposia and from other conferences. The present EMCABS committee is composed of the members listed below. Several members of our present committee have indicated they cannot continue to support EMCABS work, so I am now looking for volunteers to help abstract EMC articles. Please write to me at the address listed in the listing of associate editors.

L. F. Babcock  
D. R. Kerns  
R. B. Schulz

E. L. Bronaugh  
R. N. Hokkanen  
R. M. Showers



# Book Reviews



by Jim Hill, EMXX Corporation

The review in this issue was volunteered by Bill Duff. We would like to have more volunteers. If any of our readers have a book that has not been reviewed in this column and that you feel would be of interest to other readers, please don't hesitate to send in your review. If you are too busy to write a review, then drop us a line and give the title and publisher of the book. We will do a review for you. The book should be one that currently is available from the publisher.

*"The Sinusoidal Analysis and Modeling of Weakly Nonlinear Circuits: With Application to Nonlinear Interference Effects"*

BY

Donald D. Weiner and John F. Spina

Published by Van Nostrand Reinhold  
135 West 50th St., New York, NY 10020  
May, 1980. Price, clothbound, \$27.50.

Reviewed by William G. Duff  
Atlantic Research Corp., Alexandria, VA

A number of sources of EMI problems such as desensitization, intermodulation, cross-modulation, harmonics, and spurious responses result from nonlinear operation of circuits. The difficulties associated with analyzing nonlinear problems have long been recognized. However, considerable progress has been made in recent years. Although no single analytical approach is generally applicable, solution procedures do exist for specific classes of nonlinear problems. This book deals with the class of "quasi-linear" circuits which are referred to as "weakly nonlinear." The nonlinearities in such circuits depart from linear behavior in a gradual, as opposed to abrupt, manner.

The class of weakly nonlinear circuits is exceptionally large. Such circuits arise in most communications equipments. Small-signal mixers, frequency multipliers, and square-law detectors represent three examples of intentional class members while "linear" amplifier circuits, all of which inadvertently contain weak nonlinearities, are examples of unintentional members. It is important to be able to analyze the effects of weak non-linearities in all cases. Even in "linear" circuits, where the non-linearities are negligible as far as the intended mode of operation is concerned, non-linear effects can be generated which severely limit system performance.

For many years, weakly nonlinear circuits have been analyzed with limited success by employing the classical power series approach. Even though excellent results were obtained in some applications, severe discrepancies occurred in others. A newly developed analytical tool, referred to as the nonlinear transfer function approach, provides the basis for this book. It corrects many of the shortcomings associated with the classical technique. The new approach is based upon the Volterra functional series and is capable of determining the response of weakly nonlinear systems to arbitrary inputs.



Unfortunately, when presented in its full generality, the nonlinear transfer function approach is obscured by relatively complicated mathematics. This has greatly impeded its acceptance by practicing engineers. This book provides a simplified, highly readable presentation which preserves the important concepts and their utility. The presentation is simplified by limiting the discussion to the sinusoidal steady-state response of weakly nonlinear circuits. Because the significant features of a weakly nonlinear circuit can be extracted from its sinusoidal response and because sinusoidal excitations and sums of sinusoids are frequently used as input signals, the presentation is not overly restrictive.

To the reviewer's knowledge, this is the first book to deal in-depth with application of the Volterra series method to nonlinear distortion and interference effects in communication circuits. Much of the material in the book is new - and cannot be found in other books. The book incorporates a relatively low level of mathematics and most equations are derived in considerable detail. The results are deliberately not presented in handbook form. All too frequently, tabulated results are used incorrectly because of lack in understanding of the assumptions employed in their development. The book provides a simple and coherent presentation which enables the interested engineer to both correctly use the results and understand how they came about. All that is required by the reader is an introductory course in linear circuit theory.

In order to provide a review of the sinusoidal steady-state analysis of linear circuits, power considerations are discussed in Chapter 2. This material has application in later chapters where nonlinear effects are characterized in terms of input and output powers. Various power gains are defined and their equivalence, under special conditions, is pointed out.

The classical power series approach to the analysis of weakly nonlinear systems is presented in Chapter 3. Although this technique has been widely used in the past, it is not generally applicable. Nevertheless, it is a convenient analytical tool, where appropriate. Using this model,

analytical expressions are developed for the response of weakly nonlinear systems to a sum of sinusoidal inputs.

The more general nonlinear transfer function approach is developed in Chapter 4. It is shown that the amplitudes and phases of the various sinusoidal outputs are determined directly by the nonlinear transfer functions. Examples of some experimentally determined nonlinear transfer functions are presented and discussed.

In Chapter 5, the harmonic input method is presented for determining the nonlinear transfer functions from circuit diagrams. Terminal relationships are discussed for nonlinear resistors, capacitors, inductors, and controlled sources. The harmonic input method is shown to reduce a weakly nonlinear problem to an equivalent linear problem where the non-linearities manifest themselves as known excitations.

Criteria for characterizing nonlinear distortion and interference effects are discussed in Chapter 6. Analytical expressions utilizing the nonlinear transfer functions are developed for the various criteria.

Before the harmonic input method for determining the nonlinear transfer functions can be applied, it is necessary to model each electronic device appearing in a weakly nonlinear system by a nonlinear incremental equivalent circuit. In Chapter 7, models are presented for the semiconductor diode, bipolar junction transistor, junction field-effect transistor, and metal-oxide semiconductor field-effect transistor. Emphasis is on device behavior as opposed to device physics. Attention is also given to the problem of obtaining model parameters from laboratory measurements.

This book provides the first clearly-written, authoritative presentation of the nonlinear transfer function approach, a newly developed analytical tool based on the Volterra functional series. The book is a valuable contribution to the field of EMC and should prove to be an invaluable reference for practicing engineers as well as professors and students of engineering.



# EMC STANDARDS ACTIVITIES

by Richard B. Schulz



The spotlight for EMC Standards Activities this issue is on the Society of Automotive Engineers, specifically SAE Committee AE-4 on Electromagnetic Compatibility and the EMI Standards and Test Methods Subcommittee of the Electronic Systems Committee.

## Society of Automotive Engineers

The Society of Automotive Engineers is a not-for-profit educational and scientific organization dedicated to the advancement of automotive technology to better serve mankind - to preserve and improve the quality of life through every facet of the technology of self-propelled vehicles. Included in its organization are over 600 technical committees of seven councils; the two committees of EMC interest are in the Aerospace Council and the Motor Vehicle Council, respectively.

The Society develops and publishes technical literature and formulates engineering standards, specifications, and test procedures that are used in the design and manufacture of ground and aerospace vehicles.

SAE is headquartered in Warrendale, PA, 19 miles north of Pittsburgh.

## AEROSPACE COUNCIL

### SAE AE-4 Electromagnetic Compatibility

Chairman: Mr. Jack L. Moe  
M/S 2463  
General Dynamics/FW  
P. O. Box 748  
Ft. Worth, TX 76101  
817-732-4811, X 2572

**EMC Interest:** Committee AE-4 provides a technical, coordinating, and advisory function in the field of aerospace electromagnetic interference and studies electrical and electronic accessories in spacecraft, aircraft and propulsion systems for compatibility with various communications media.

**Program:** This exceptionally active committee is concerned with developing concepts that might be considered as a basis for improving a number of military EMC standards and is investigating various new approaches. Subject areas of concern include the following:

1. MIL-STD-461/462
  - 1.1 Conducted Emissions - A draft proposed test method is expected by the next meeting.
  - 1.2 Radiated Emissions - Revisions under consideration are: a) TEM Cell, b) parallel-plate line, c) "noise-ball" calibration method, d) open-field method (like FCC), e) no change, f) mode-stirred chamber.
2. Business Systems - Recently combined with Medical Devices area.

3. Cabling Techniques - Being considered are: a) revisions to AIR 1F00, "Upper Frequency Measurement Boundary for Evaluation of Shielding Effectiveness in Cylindrical Systems," b) mode-stirring measurement techniques for use above 1 GHz
4. MIL-E-6051, Systems EMC - Jointly with EIA G-46, a) updated a tailoring table, b) identified two areas to be addressed: analysis and error budget
5. Engines - Some interest expressed in correlating AIR-1423 with DO-160 (RTCA)
6. International Liaison - EMC workshop will be held at EMC Symposium in Zurich, 3/10-12/81.
7. Gaskets - Proposed ARP 1705 "Coaxial Test Procedure to Measure the RF Shielding Characteristics of EMI Gaskets" has been sent out for review and, subsequently, revised.
8. Lightning - Work is progressing on a document for transient testing of aircraft avionics and work has started on a User's Manual associated with the new MIL-STD-1757 on lightning test techniques for aerospace vehicles and hardware.
9. Medical Devices - A questionnaire has been prepared for distribution to AE-4 membership. Replies will be analyzed and correlations among answers will be provided.
10. Shipboard EMC - Work is progressing on a ship cabling specification.

**Documents:** SAE documents published as the result of the work of this committee are in the nature of an Aerospace Recommended Practice (ARP) or an Aerospace Information Report (AIR). Current publications are:

ANTENNAS and Antenna Factors, EMC:	
How to Use Them	AIR 1509
CABLING Guidelines for Electromagnetic Compatibility	AIR 1394
CAPACITOR, 10 MFO for EMI Measurements	ARP 936
CORROSION Control and Electrical Conductivity in Enclosure Design	ARP 1481
DC Resistivity vs RF Impedance of EMI Gaskets	AIR 1404
ELECTROMAGNETIC Compatibility (EMC) System Design Checklist	AIR 1221



ELECTROMAGNETIC Compatibility AIR 1423  
on Gas Engines for Air-  
craft Propulsion

ELECTROMAGNETIC Interference ARP 1267  
(EMI) Measurement Impulse  
Generators: Standard  
Calibration Requirements  
and Techniques

EMI Control Plan Outline. ARP 935  
Suggested

ENCLOSURE Design. Corrosion ARP 1481  
Control and Electrical  
Conductivity in

FILTERS, Conventional, EMI ARP 1172  
Reduction, General Spec-  
ifications for

INTERFERENCE, Electro- AIR 1147  
magnetic, on Aircraft from  
Jet Engine Charging

METHODS of Achieving Electro- AIR 1425  
magnetic Compatibility of  
Gas Turbine Engine Access-  
ories for Self-Propelled  
Vehicles

SHIELDING Characteristics, ARP 1173  
RF, Test Procedure to  
Measure the, of EMI Gaskets

SPECTRUM Analyzers for EMI AIR 1255  
Measurements

STATIC Electrification, Light-AIR 1406  
ning Protection and

STATIC, Lightning and Pre- AIR 1208  
cipitation-Bibliography

SUSCEPTIBILITY Testing, for AIR 1209  
EMI, Construction and Cali-  
bration of Parallel Plate  
Transmission Line

#### MOTOR VEHICLE COUNCIL

#### SAE EMI Standards and Test Methods Sub- committee of the Electronic Systems Committee

Chairman: Mr. Myron L. Crawford  
Sec. 276.03  
Natl. Bureau of Standards  
Boulder, CO 80302  
303-497-5497

EMC Interest: This subcommittee was char-  
tered with the responsibility of evaluat-  
ing test methods and standards for the  
measurement of EMI to, and generated by,  
electronic and electrical devices and sub-  
systems on or within vehicles from sources  
in or outside the vehicles. The sub-  
committee objectives are:

1. To collect data on characteristics  
of sources of EMI
2. To publish standards for test  
levels of EMI
3. To investigate and recommend pro-  
cedures for EMI susceptibility  
testing of vehicle components, and
4. To investigate and recommend pro-  
cedures for EMI susceptibility  
testing of whole vehicles.

Program: Information reports are in final  
preparation to describe:

1. Open-field licensing and testing  
procedures using high-power RF  
sources and directional antennas  
for susceptibility measurements
2. Use of large Helmholtz coils for  
magnetic-field susceptibility  
testing at frequencies below  
15 kHz

3. Use of large absorber-loaded TEM  
cell for susceptibility testing,  
60 Hz to 30 MHz
4. Use of mode-stirred/tuned enclo-  
sures for susceptibility testing  
with complex E fields, 100 MHz -  
18 GHz

Document: SAE J1113a, "Electromagnetic  
Susceptibility Test Procedures for  
Vehicle Components (Except Aircraft),"  
June 1978

#### SCHEDULED COMMITTEE MEETINGS OF MAJOR EMC INTEREST

COMMITTEE	NAME	NEXT MTG.
ANSI C63	Radio Elec. Coord. Techn. & Develop.	SCI-2/25/81 DC (FCC?)
ANSI C68	High-Voltage Test- ing Techniques	May 81 Ft. Lauderdale
ANSI C95	Radio Frequency Radiation Hazards	2/26/81 NY (ANSI)
ANSI MD105	Medical Electronics	5/12/81 DC (HIMA)
CBEMA ESC5	Environment & Safety Comm. - Subcommittee 5	1/20-22/81 Phoenix (Pointe Re- sort)
EIA G-46	Electromagnetic Compatibility	Early May Dayton (WPAFB) 8/17/81 Boulder (EMC '81)
EIA R-2	Consumer Electro- magnetic Compati- bility	Unscheduled
EIA TR8.10	Vehicular Electri- cal Interference & Electromagnetic Compatibility	Unscheduled
IEEE S27	EMC Standards Committee	8/17/81 Boulder (EMC '81)
SAE AE-4	Electromagnetic Compatibility	3/31-4/3/81 San Diego (Town & Coun.) 8/12-21/81 Boulder (EMC '81) 10/5-/8/81 Anaheim (SAE Congress)
SAE ESC/SC	Electronic Sys- tems Comm./EMI Standards & Test Methods Subcommittee	Unavailable
SAMA PMC 33	Process Measure- ment & Control	2/4-5/81 DC (SAMA)

#### NEW STANDARD

A revised ANSI standard, the work of Comm-  
ittee C63, has been approved for publi-  
cation on November 20, 1980. Since it  
has to await its turn for printing, it is  
not yet available for purchase. The  
standard is:

ANSI C63.4-1980 Radio-Noise Emissions  
from Low-Voltage Electrical and Elec-  
tronic Equipment in Range of 10 kHz to  
1 GHz, Methods of Measurement of  
(revision of ANSI C63.4-1963)



FCC's Computing-Equipment EMI Standards Pose Threat to Other Products' Shipments

Andy Santoni

Editor

EDN

March 5, 1980, pp. 47-54

ACCESSION NO.

EMCABS 12-80-1

**ABSTRACT:**

An FCC order limiting radiation from digital equipment - including computers, switching power supplies, video games and even test equipment - has raised the specter of a halt in shipments of such products after July 1. Few companies outside the computer industry appear to have realized the importance of this new rule, and many firms with broad product lines are concerned by the short time available to comply with it.

**INDEX TERMS:** FCC, Digital Equipment, Radiation, Suppression, Technical Standard, Docket 20780

Choosing RFI Shielding for Thermoplastic Resins

Nina S. Lewis, et al

General Electric Co., Pittsfield, MA

Design News

March 1980, pp 211-216

ACCESSION NO.

EMCABS 12-80-2

**ABSTRACT:**

Fabricating versatility, light weight and high strength have made engineering thermoplastics the materials of choice for electronic equipment components and housings. Unfortunately, these plastics have no natural electromagnetic-radiation shielding.

**INDEX TERMS:** RF shielding, plastics, silver reduction, conductive paint, vacuum metallization, cathode sputtering, flame spray, foil, electroplating

Shielding PWM Servo Drives from RF Radiation

W. P. Birkemeier

University of Wisconsin

Design News

January 1980, pp 101-104

ACCESSION NO.

EMCABS 12-80-3

**ABSTRACT:**

Stray radio-frequency (RF) emissions from pulse width modulation (PWM) servo drives operating machine tools can cause radio-controlled overhead cranes to malfunction. Protecting cranes and other susceptible equipment - including the computers controlling the tools - has become a very important design consideration.

**INDEX TERMS:** Pulse Width Modulation, Shielding, Servo Drives, Radio

Test Fixture Noise, Symptoms, Causes and Cures

Norman D. Megill

Production Services Corp.

Electronics Test

May 1980, pp. 46-60 (Vol. 3, No. 5)

ACCESSION NO.

EMCABS 12-80-4

**ABSTRACT:**

Crosstalk and ground noise form the most common causes of fixture noise. The symptoms are short-duration spikes, around 50 nsec or less, appearing on the fixture wires entering the UUT. When high enough, they can cause edge-sensitive devices such as flip-flops to switch into the wrong state. If they appear on signal wires driven by unbuffered UUT flip-flops, they can feed back into the internal flip-flop circuitry causing state changes.

**INDEX TERMS:** Digital test fixture, crosstalk, ground noise, flat cable, twisted pair, noise, ringing

Test Fixture Noise, Part 2 - Pinpointing and Curing Common Errors

Norman D. Megill

Production Services Corp.

Electronics Test

June 1980, pp. 30-39 (Vol. 3, No. 6)

ACCESSION NO.

EMCABS 12-80-5

**ABSTRACT:**

If an interface fixture exhibits ground noise, crosstalk or ringing, the test program can suffer from intermittent failures and distorted results. This article tells how to reduce noise-related failures with ferrite beads, capacitors and other techniques, emphasizing methods for use with Schottky TTL logic.

**INDEX TERMS:** Digital Test Fixture, crosstalk, ground noise, ferrite beads, capacitor, twisted wire

Conductive-Elastomer Applications Abound

Harry Stern

Conductive Rubber Technology

Electronic Design

Vol. 28, No. 13, June 21, 1980, pp. 105-109

ACCESSION NO.

EMCABS 12-80-6

**ABSTRACT:**

Conductive elastomers are replacing conventional products as rf shields, press-fit connectors and switches in all sectors of the electronics world. Designers looking to get involved with conductive elastomers and their many possible applications could be in for a rough time if they don't understand the chemical, electrical and mechanical properties they'll be dealing with - and the potential pitfalls.

**INDEX TERMS:** Conductive elastomer, gaskets, shields, connections, pitfalls



Jim Fetterolf  
AMP, Inc.  
Electronic Design  
Vol. 28, No. 13, June 21, 1980, pp. 95-99

**ABSTRACT:**

When switching rise times get faster than 1 ns, switch from conventional open wiring to impedance control by transmission-line technology and to crosstalk control by shielding and guiding the signal paths.

**INDEX TERMS:** Data transmission, flat cable, twisted pairs coaxial cable, crosstalk impedance match, microstrip

## Electromagnetic Interference Testing Standards and Specs

R. K. Bossart  
Sanders Associates  
Electronics Test  
Vol. 3, No. 5, May 1980, pp. 76-83

**ABSTRACT:**

An increasing number of test professionals must deal with electromagnetic interference (EMI) in the laboratory or on the production line. Intended as an introduction, this article examines some military and consumer standards that address electromagnetic interference control, as well as some common test methods and EMI-related terminology.

**INDEX TERMS:** EMI, testing, harmonics history, facilities military standards, commercial standards, measurements, far field.

Cathodic Protection Volume 2, 1974-1976 (Citations from the Engineering Index Data Base)

Mona F. Smith

Nat'l. Technical Info. Service, Springfield, VA.  
Rept. for 1974-76, NTS/PS-78/0467/7GA PC N01/MF N01

May 78, 226 p See also NTS/PS-78/0466 & Vol. 1 '70-'74, NTIS/PS-76/0341  
**ABSTRACT:** Citations of worldwide research on cathodic protection of ships, underground pipelines and cables, oil wells, off shore structures, underwater equipment, and steel reinforcement in concrete are presented. Design, installation procedures, anodes and cathodes, power supplies, interference, and performance studies are included. (This updated bibliography contains 219 abstracts, none of which are new entries to the previous edition.)

**INDEX TERMS:** Bibliographies, Cathodic protection, Corrosion, prevention, Ships, Pipelines, Cables, Underground corrosion, Underwater environments, Sea Water

ACCESSION NO.  
EMCAES 12-80-7

ACCESSION NO.  
EMCAES 12-80-8

ACCESSION NO.  
EMCAES 12-80-9

Isidor Straus  
Dash-Straus Associates  
EDN  
Vol. 25, No. 11, June 5, 1980, pp. 141-144

**ABSTRACT:**

If you plan to design, a restricted-radiation device that "generates timing signals or pulses at rates in excess of 10,000 pulses per second and uses digital techniques," a recent FCC ruling could affect your efforts. This very broad definition covers small computers, computer peripherals, electronic games, switching power supplies, motor controllers, test equipment, calculators and even digital watches.

**INDEX TERMS:** FCC, Digital Standard, EMI emission, checklist, shielding

ACCESSION NO.  
EMCAES 12-80-10

## Guide for the Construction of Driven-Rod Ground Beds

R. L. King, H. W. Hill, Jr., R. R. Bafana, and W. L. Cooley  
Bureau of Mines, Pittsburgh, Pa. Pittsburgh Mining and Safety Research Center.  
Information circular, 1978, 32p BuMines-IC8767, PB-278 501/2GA PC A03/MF A01

**ABSTRACT:**

A method for designing and constructing ground beds has been developed. The procedures for designing and constructing a driven-rod ground bed with a resistance of 5 ohms or less is given. Some of the theory of soil resistivity and fall-of-potential resistance measurements is included. Results of a bed constructed at the U.S. Bureau of Mines mine car roadway are also included.

**INDEX TERMS:** Electric grounds, Mine safety, Electrical grounding, construction, Mining equipment, Electric equipment, Electrical resistivity, Mining engineering, Mine Haulage, Design.

## Transient Response of Filters

J. B. Y. Tsui, J. E. Adair, J. E. Hawkins, and S. J. LeFleur  
Air Force Avionics Lab Wright-Patterson AFB Ohio  
Interim rept. Oct 75-Nov 77, Dec 77, 50p Rept. no. AFAL-TR-77-240, AD-A055 324/8GA PC A03/MF A01

**ABSTRACT:**

One of the most important factors in designing receivers is to determine the transient response of the signal after it passes filters. It is time consuming and costly to measure the transient response experimentally. This report presents the theoretical analysis and a computer program to calculate filter transient response. Experimental data from both conventional and surface acoustic wave filters have also been presented to verify the validity of the program. The program can handle both Butterworth and Chebyshev filters and their combinations in cascade. The input signals can be a square, a composite, and a sine square wave. The computer program that calculates the transient response is also listed. (Author)

**INDEX TERMS:** Chebyshev filters, Butterworth filters, transient response, SAW filters, GPC-6600 computers, SAW devices.

ACCESSION NO.  
EMCAES 12-80-11

ACCESSION NO.  
EMCAES 12-80-12



# Bolted Lapped-Joint EMP Shields

A. L. Whitson, and E. F. Vance  
SRI International Menlo Park Calif  
Jun 77, 79p DNA-4472F, AD-E300 255 AD-A056 251/2GA PC A05/MF  
A01 Contract DNA001-76-C-0386

ACCESSION NO.  
EMCABS 12-80-13

## ABSTRACT:

Bolted, nonwelded joints in shields leak electromagnetic energy of frequencies above a few MHz. Overlapping joints have been measured to define joint characteristics that can be used for EMP shields. Also some nonideal joints were measured to determine joint quality requirements. (Author)

**INDEX TERMS:** Aircraft shelters, Electromagnetic shielding, bolted joints, joints, reveted joints, structural analysis.

## A Summary of Required Input Parameters for Emitter Models in IEMCAP

Clayton R. Paul, and Donald D. Weiner  
Georgia Inst of Tech Atlanta  
Final technical rept., Jun 78, 50p RADC-TR-78-140 Contract  
F30603-75-C-0118 Prepared in cooperation with Kentucky Univ., Lexington,  
AD-2056 805/5GA PC A03/MF A01

ACCESSION NO.  
EMCABS 12-80-14

ABSTRACT: The Intrasystem Electromagnetic Compatibility Analysis Program (IEMCAP) requires the inputting of various parameters to describe the emitter ports' emission spectra. This information is contained in the IEMCAP User's Manual (RADC-TR-74-32) but is not presented in a very concise manner. This report has summarized the required parameters and their measurements units. Along with this information the form of the power spectral density and suggested frequency table input values, to adequately represent the spectrum, are presented. This information will simplify the effort needed to model an emitter port. (Author)

**INDEX TERMS:** IEMCAP, Electromagnetic compatibility, interference, computerized simulation, single sideband communications, systems engineering, emission spectra, pulse modulation, chirp radar, carrier waves.

Coal Mine Electrical System Evaluation, Volume III, Shielded Cables  
Lloyd A. Morley, Robert H. King, and Peter A. Sopko  
Pennsylvania State Univ., University Park, Dept. of Mineral Engineering

ACCESSION NO.  
EMCABS 12-80-15

Annual rept., 15 Jan 77, 173p BUMINES-OFR-61(3)-78 Grant G055003 PB-283 492/7GA PC A08/MF A01 See also Volume 2, PB-283 491, and Volume 4, PB-283-493. Also Available in set of 8 reports PC E13, PB-283 489-SET

ABSTRACT: Proposed advantages and disadvantages of low-voltage shielded trailing cables are formulated utilizing the literature and industry sources. A partial analysis of these proposed advantages and disadvantages is completed through a review of the literature. Cable costs are assembled from mine operators, cable and splice manufacturers, and actual cable purchases. To confirm each advantage and disadvantage, an underground test site is established and testing is performed here and in the laboratory. All testing procedures are completely described. The results of this investigation are reported and used to formulate recommendations attendant to low-voltage shielded cables. Suggestions for installation, handling, and maintenance are presented.

**INDEX TERMS:** Mine safety, Electric cables, coal mines, power systems, trans-

## Development of Conduit Design Analytical Procedure

William Croisant, Paul Nielsen, David Sieber, and Raymond G. McCormack

ACCESSION NO.  
EMCABS 12-80-16

Construction Engineering Research Lab(Army) Champaign Ill  
Interim rept., AD-A056 218/1GA PC A07/MF A01 Jun 78, 149p Rept no. CERL-IR-M-234

ABSTRACT: This report presents proposed for analysis of the electromagnetic pulse (EMP) signals in conduit shielded circuits. The models are intended for use in an analytical procedure for evaluating conduit system designs currently being developed. The development of preliminary models for calculating (1) EMP penetration in solid conduit, (2) EMP leakage through defects, and (3) the effect of circuit impedances on EMP induced signals is presented. EMP properties and conduit physical properties important to the conduits shielding characteristics are examined. Both time domain and frequency domain analysis are presented. (Author)

**INDEX TERMS:** Circuits, electromagnetic shielding, conduits, mathematical models, electromagnetic pulses, electromagnetic fields, leakage (electrical), hardened structures, time domain, frequency.

## Time Domain Solutions for Electromagnetic Coupling

Allen Taflove

IIT Research Inst Chicago Ill  
Final technical rept. 26 Aug 77-26 Mar 78 AD-A056 728/9GA  
RC A05/MF A01 June 78, 98, RADC-TR-78-142 Contract F30602-77-C-0163

ACCESSION NO.  
EMCABS 12-80-17

## ABSTRACT:

This research program investigated a new tool for the analysis of electromagnetic coupling and shielding problems: the finite-difference, time-domain (FT-TD) solution of Maxwell's equations. The objective of the program was to evaluate the suitability of the FD-TD solution to determine the amount of electromagnetic coupling through an aperture into an enclosed conducting container. Two specific geometries were used for the evaluation. The first, a conducting cylinder with one open end. The other, the guidance section of a missile. Each of the two geometries was modeled to calculate the electromagnetic field coupled into the structure and the results were compared to data previously obtained by other techniques. (Author)

**INDEX TERMS:** Electromagnetic coupling, Aperture coupling, Guidance sections, Corners, Electromagnetic shielding, Maxwells equations, Finite difference theory, Electromagnetic fields, Apertures, Plane waves, Time domain, Mathematical models

Applications of Multiconductor Transmission Line Theory to the Prediction of Cable Coupling. Volume 5. Prediction of Crosstalk Involving Twisted Wire Pairs.

ACCESSION NO.  
EMCABS 12-80-18

Jack W. McKnight and Clayton R. Paul  
Kentucky Univ Lexington Dept of Electrical Engineering  
Final technical rept. AD-A053 559/1GA PC A11/MF A01 Feb 78, 247p RADC-TR-76-101-VOL-5 Contract F30602-75-C-0118 See also Volume 6, AD-A053560

ABSTRACT: A transmission line model of the twisted wire pair is presented which may be used to compute electromagnetic coupling between the twisted wire pair and other circuits. The model is derived by representing the transmission line for the twisted wire pair as a cascade of uniform loops and 'abruptly' nonuniform twists. The overall transmission line matrix is found by cascading the chain parameter matrices, which represent the loops, with the permutation matrices, that represent the twists. Comparisons are presented between the twisted wire pair, the straight wire pair, and the single wire circuit configurations. A second, simpler model for low frequencies is presented. Both models are experimentally verified.

**INDEX TERMS:** Twisted pairs, Wire to wire coupling, Transmission lines, Multiconductor cables, Electromagnetic compatibility, Crosstalk, Models,



Applications of Multiconductor Transmission Line Theory to the Prediction of Cable Coupling. Volume VI.

Clayton R. Paul

Kentucky University Lexington Dept. of Electrical Engineering. Phase rept., Feb 78, 197 p RADC-TR-76-101-6-VOL 6 Contract F3062-75-C-0118 See also Volume 7, AD-A046 662 AD-A053 560/9GAPC A09/MF A01

**ABSTRACT:** The report describes a digital computer program which is designed to compute the terminal currents induced in a multiconductor transmission line by an incident electromagnetic field. Sinusoidal steady state behavior of the line is assumed. The transmission line is uniform and consists of n wires and reference conductor immersed in a homogeneous, loss less, linear, isotropic medium. The n wires and the reference conductor are assumed to be loss less. The reference conductor may be a wire, an infinite ground plane or an overall, cylindrical shield. The incident electromagnetic field may be a uniform plane wave or a general nonuniform field. The primary restriction on the program validity is that the cross sectional dimensions of the line, e.g., wire separation, must be much less than a wavelength.

**INDEX TERMS:** Transmission lines, Multiconductor cables, Electromagnetic compatibility, Crosstalk, Electromagnetic fields, Wire to wire coupling

Applications of Multiconductor Transmission Line Theory to the Prediction of Cable Coupling Vol. IV, Prediction of Crosstalk in Ribbon Cables Clayton R. Paul Kentucky Univ. Lexington Dept. of Electrical Engineering RADC-TR-76-101 Final Technical Report, Vol. 4, Feb. 78, 63P AD-A053 548/4GA, PC A04/MF A01

**ABSTRACT:** The prediction of crosstalk in ribbon cables is investigated. Experimental results are obtained for a 20 wire ribbon cable and compared to the predictions of the multiconductor transmission line (MTL) model. Accurate predictions of crosstalk can be achieved in controlled characteristic cables such as these. Predictions are typically within  $\pm 1$  dB for frequencies such that the line is electrically short ( $L < 0.1\lambda$ ) and  $\pm 6$  dB for frequencies such that the line is electrically long ( $L > 0.1\lambda$ ). Parasitic wires in the cable can have a significant effect (as much as 40 dB) on the coupling between the generator and receptor circuits in the cable. Therefore one must consider the interactions between all wires in the cable. The wire insulation can be ignored when the line is electrically short. Conversely, the impedance of the reference wire cannot be ignored for low frequencies.

**INDEX TERMS:** Transmission lines, Multiconductor cables, Electromagnetic fields, Electrical impedance, Wire to wire coupling, Ribbon cables, Flat pack cables.

Railroad Electromagnetic Compatibility

J. Young and D. O'Neill Electromagnetic Compatibility Analysis Ctr., Annapolis, MD ECAC-CH-78-009, FRA/ORD-77/77.1 Final Report. 1959-77 Mar 78, 136p, Volume I, Electrification Bibliography

**ABSTRACT:** In an effort to provide a single source of referable material concerning electromagnetic interference/electromagnetic compatibility (EMI/EMC) associated with railroad electrification, a special document was prepared for the Federal Railroad Administration. This bibliography is the result of that effort and contains numerous abstracts of mixed foreign and domestic material. The abstracts are compiled from previous published bibliographies on related subjects, with special attention given to the Railroad Research Information Service File. The material in this document is categorized into the following subject topics: Catenary System, Electrification, Power Transmission Line, Signalling and Telecommunication, Substation, Track Circuit, Traction Control System and Miscellaneous.

**INDEX TERMS:** Electric railroads, electromagnetic compatibility, bibliographies, electromagnetic interference, electric locomotives, telecommunication, control equipment, circuits, catenaries.

Vulnerability, Electromagnetic Test Operations Procedure

Army Test and Evaluation Command Aberdeen Proving Ground Md Sept. 12, 77, 38 p Rept. no. TOP-6-2-508 Supersedes Rept. no. MTP-6-2-508, AD-718 643 AD-A054 097/1 GA PC A03/MF A01

**ABSTRACT:** Provides methods for determining the electromagnetic vulnerability of communications-electronics (C-E) equipment. Describes procedures to determine (a) whether C-E systems or equipments possess inherent deficiencies which can be intentionally exploited by enemy electromagnetic means and (b) whether the contribution of the systems or equipments to the electromagnetic environment can be used to detect their presence and location.

**INDEX TERMS:** Electromagnetic compatibility, Communication equipment, electronic equipment, vulnerability, Receivers, Transmitters, Simulation, Electronic counter countermeasures, Radio interception, Radio interference, Radio jamming,

The University of Oklahoma Severe Storms Intercept Project 1979

Howard B. Bluestein

Oklahoma Univ., Norman, School of Meteorology

Final rept. 13 Mar-31 Dec. 79, Dec 79, 46p NOAA-800222203, PB80-166010 PC A03/MF A01

**ABSTRACT:** The purposes of the project were to provide National Severe Storms Laboratory (NSSL) with ground-based visual observation in the field of thunderstorms observed simultaneously by Doppler radar, to document and photograph severe-storm phenomena and related damage, and to obtain high-quality movies of tornadic debris clouds. A ground-based intercept crew consisting of four members operated from 1 April 1979 - 15 June 1979.

**INDEX TERMS:** visual observation, thunderstorms

Rate Statistics for Radio Noise from Lightning

D.M. Levine, R. Meneghini, and S.A. Tretter

National Aeronautics and Space Admin., Goddard Space Flight Center, Greenbelt, MD

May 80, 34p NASA-TP-1665, G80F5117 N80-23933/8 PC A03/MF A01

**ABSTRACT:** Radio frequency noise from lightning was measured at several frequencies in the HF - VHF range at the Kennedy Space Center, Florida. The data were examined to determine flashing rate statistics during periods of strong activity from nearby storms. It was found that the time between flashes is modeled reasonably well by a random variable with a lognormal distribution.

**INDEX TERMS:** Radio frequency noise, lightning, flashing, statistics.



A Field Investigation of Electric Currents Associated  
with Severe Local Storms  
Christopher R. Church  
Purdue Univ., Lafayette, IN. Dept. of Geosciences

ACCESSION NO.  
EMCABS 12-80-25

**ABSTRACT:** Recent efforts to evaluate the nature and magnitude of point discharge currents during severe storms are described. During the early part of 1979 several corona current amplifiers were developed, and with the help of NSSL personnel, were installed at surface mesonet stations in central Oklahoma, where they provided corona data during a major portion of SESAME 79. This report deals primarily with the results of this endeavor and includes scant details concerning instrumentation and operations.

**INDEX TERMS:** Lightning, point discharge currents, severe storms, amplifiers, corona data

Protection of Terrestrial Photovoltaic Systems from  
Lightning Effects  
C. B. Rogers

ACCESSION NO.  
EMCABS 12-80-26

Sandia Labs., Albuquerque, NM  
1980 6p CONF-800106-6 Contract EY-76-C-04-0789 14, photovoltaics specialists conference, San Diego, CA, USA, 7 Jan 1980. SAND-80-0076C PC A02/MF A01

**ABSTRACT:** Transients caused by nearby strokes constitute the major threat from lightning to photovoltaic power systems. Failure thresholds of silicon solar cells are dominated by the melting of the metal grid on the illuminated face of the cell. The optical flash from lightning is not a significant threat to cells. The use of guard wires over underground cables appears to be a cost-effective shielding technique. Terminal protection devices are available although their use may require some special design features. (ERA citation 05:011608)

**INDEX TERMS:** Lightning; transients, photovoltaic, failure thresholds, silicon solar cells

Communications-Electronic Intrasystem Electromagnetic  
Interference Measurement Techniques and Instrumentation.  
Lester E. Polisky & John Savage

ACCESSION NO.  
EMCABS 12-80-27

Atlantic Research Corp. Alexandria VA  
Quarterly rept. no. 3, 21 Dec 79-20 Mar 80, May 80, 73p  
CORADCOM-79-0786-3 Contract DAAK80-79-C0786 AD-A085 161/8 RC A04/MF A01

**ABSTRACT:** This report presents the results obtained during the third quarter of the Communications-Electronics Intrasystem Electromagnetic Interference Measurement Techniques and Instrumentation Project. The period covered was 21 December 1979 to 20 March 1980. The major effort in the third quarter consisted of completing the broadband measurement technique description and initiating the evaluation of MIL-STD-461A techniques. (Author)

**INDEX TERMS:** Communications-Electronics Intrasystem Electromagnetic Interference Measurement Techniques and Instrumentation, broadband measurements, IEMCAP

Communications-Electronic Intrasystem Electromagnetic Inter-  
ference Measurement Technique and Instrumentation

Lester E. Polisky, Thomas E. Baldwin, Jr., and John Savage  
Atlantic Research Corp. Alexandria VA

ACCESSION NO.  
EMCABS 12-80-28

Quarterly rept. no. 2, 21 Sep-21 Dec 79, Feb 80, 72p CORADCOM-79-0786-2  
Contract DAAK80-79-C-0786 AD-A081 830/2 PC A04/MF A01

**ABSTRACT:** This report presents the results obtained during the second quarter of the Communications-Electronics Intra-System Electromagnetic Interference Measurement Techniques and Instrumentation Project. The period covered was 21 September 1979 to December 1979. The major efforts in the second quarter consisted of completing the IEMCAP feasibility study and developing a broadband measurement system for conducting EMC measurements. (Author)

**INDEX TERMS:** Communications-Electronics Intra-System Electromagnetic Interference Measurement Techniques, IEMCAP

Federal Evaluation of Lightning Tracking Systems (FELTS)

R. L. Johnson

Southwest Research Inst. San Antonio, Tx.

Final rept. 1 May 79-31 May 80, May 80, 44p, Contract N00014-79-C-0223, Availability: Microfiche copies only. AD-A084 791/3 MF A01

ACCESSION NO.  
EMCABS 12-80-29

**ABSTRACT:** A side-by-side performance evaluation of two lightning tracking systems was done at Kennedy Space Center, Florida during the period 1 June-13 July 1979. The competing systems were manufactured by Lightning Location and Protection Inc. (LLP) and by Atlantic Scientific Corp. (ASC). Although the ASC system satisfied a preliminary performance test, it was observed that the device required continuing modification by the manufacturer. The LLP system experienced two hardware failures during this period, but otherwise operated 24 hours daily in an automatic unattended data acquisition mode. Because of the continuing developmental effort required on the ASC device, it was determined that the operational evaluation of this system was premature. (Author)

**INDEX TERMS:** performance, evaluation, lightning tracking systems, Lightning

Communications-Electronic Intrasystem Electromagnetic Inter-  
ference Measurement Technique and Instrumentation

Lester E. Polisky

Atlantic Research Corp. Alexandria VA

Quarterly rept. 20 Jun-20, Sept. 79, Jan 80, 37p CORADCOM-79-078601  
Contract DAAK80-79-C-0786 AD-A081 715/5 PC A03/MF A01

ACCESSION NO.  
EMCABS 12-80-30

**ABSTRACT:** This report presents the results obtained during the first quarters of the Communications-Electronic Intrasystem Electromagnetic Interference Measurement Techniques and Instrumentation project. The period covered was 20 June 1979 to 20 September 1979. The major effort in the first quarter consisted of a literature search, report reviews, site visit to Fort Knox to examine armored vehicles for MIL-STD-461A and -462 evaluation and an initiation of the feasibility of IEMCAP as an EMI/EMC analysis tool for system measurements. (Author)

**INDEX TERMS:** Communications-Electronic Intrasystem Electromagnetic Interference Measurement Techniques, IEMCAP



EMC Considerations In Classification Yard Design

Daniel J. O'Neill,

Electromagnetic Compatibility Analysis Ctr., Annapolis, MD

Jan 80, 137p ECAC-PR-79-035, FRA/ORD-80/12 Prepared in

cooperation with IIT Research Inst., Annapolis, MD PB80-176621 PC A07/MF A01

ACCESSION NO.

EMCABS 12-80-31

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**ABSTRACT:** The automated freight classification yard is composed of many electrical and electronic devices working in a complex inter-relationship, with the goal of safe and efficient transportation of goods. Since many of these devices potentially emit and/or are susceptible to electromagnetic energy, thus degrading equipment reliability and overall safety, electromagnetic compatibility considerations are of great concern in the design of new yards or the upgrade of presently existing yards. Important railroad electromagnetic compatibility considerations are discussed in a tutorial manner. In addition, measurement techniques used to obtain source and susceptibility data, and techniques to successfully mitigate electromagnetic interference are presented.

**INDEX TERMS:** automated freight classification, transportation, electromagnetic compatibility, railroad, susceptibility, electromagnetic interference

Ground/Bonding for Large Space System Technology (LSST)

W. G. Dunbar

Boeing Aerospace Co., Seattle, Wash. Apr 80, 93; NASA-CR

161486 Contract NAS8-33432

N80-26604/2 PC A05/MF A01

ACCESSION NO.

EMCABS 12-80-32

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**ABSTRACT:** The influence of the environment and extravehicular activity remote assembly operations on the grounding and bonding of metallic and nonmetallic structures is discussed. Grounding and bonding philosophy is outlined for the electrical systems and electronic compartments which contain high voltage, high power electrical and electronic equipment. The influence of plasma and particulate on the system was analyzed and the effects of static buildup on the spacecraft electrical system discussed. Conceptual grounding bonding designs are assessed for capability to withstand high current arcs to ground from a high voltage conductor and electromagnetic interference. Also shown were the extravehicular activities required of the space station and or supply spacecraft crew members to join and inspect the ground system using manual or remote assembly construction.

**INDEX TERMS:** extravehicular activity, grounding, bonding, static buildup, spacecraft, electromagnetic interference

Electromagnetic Compatibility Standard for Medical Devices

Food and Drug Administration, Silver Spring, MD

Technical rept. 1 Oct 79, 62p FDA/BMD-80/71, MDS-201-0004 See also PB-271 635

PB80-180284 PC A04/MF A01

ACCESSION NO.

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**ABSTRACT:** This standard establishes maximum levels of electromagnetic emissions which medical devices are allowed to produce and it establishes minimum levels of electromagnetic interference to which medical devices must not be susceptible. A section containing test methods is included to provide a consistent means of verifying compliance with the requirements. Appendix A contains a rationale which provides technical support for the requirements and test methods incorporated into this standard.

**INDEX TERMS:** standard, electromagnetic emissions, electromagnetic interference, test methods

Electromagnetic Radiation Analysis Test Operations Procedure

Army Test and Evaluation Command Aberdeen Proving Ground Md

10 Apr 78, 18p Rept no. TOP-6-2-559 AD-A058 647/1GA PC

A02/MF A01 Supersedes Rept. no. MTP-6-1-006-3 dated Jul 15, 75.

ACCESSION NO.

EMCABS 12-80-34

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**ABSTRACT:** A methodology is given for determining whether electromagnetic radiation of sufficient strength to cause performance degradation to the test item exists at the test item location. The results of an electromagnetic radiation effects test are used to identify the radio frequencies and electromagnetic radiation levels to which the test item is susceptible. Further using a test bed, comparisons are made with the representative signal levels to determine if the levels at which the test item suffers performance degradation would occur in the field. Signal transmission characteristics are developed for each radiation source to provide recommended minimum separation criteria.

**INDEX TERMS:** Radiofrequency interference, electronic equipment, electromagnetic fields, hazards, radiation damage, threshold effects, strength (general), test beds, test methods.

Fundamental Considerations of Lightning Protection, Grounding, Bonding, and Shielding.

Federal Aviation Administration, Washington, DC

28 Jul 78, 331 p N79-76935/2 PC A15/MF A01

ACCESSION NO.

EMCABS 12-80-35

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Zinc Oxide Varistors for Lightning Arrester Service

Robert I. Seace

National Bureau of Standards, Washington, D.C.

Final rept. Oct 78-Sept. 79, Dec. 79, 25 p NBSIR-79-1939

Sponsored in part by Dept. of Energy, Washington, D.C.

Division of Electric Energy Systems. PB80-1444645 PC A02/MF A01

**ABSTRACT:** The application of zinc oxide (ZnO) varistors to high-power surge arresters for electrical transmission lines is considered, with particular attention to the special measurement problems posed by the application and by the unique properties of these varistors. The development of ZnO varistors and the present theory of ZnO varistor action are discussed. Consideration is given to the need for further elaboration of the theory.

ACCESSION NO.

EMCAES 12-80-37

**INDEX TERMS:** Varistors, Zinc-Oxide Varistors, Lightning, Lightning arresters, High Power Surge Arresters, Electrical Transmission Lines, Zinc Oxide Varistors, Lightning, Varistors, High-power Surge Arresters, Electrical Transmission lines

System Data File (SDF) for the Intrasystem Analysis Program (IAP) Surface Geometry.

Richard Robertson

Atlantic Research Corp., Alexandria VA

Final technical rept. June 77-Dec 78, Dec. 79, 75 p RADC-TR

79-213-Vol-2 Contract F30602-77-C-0126 See also Vol. 1, AD-A080 584

AD-A080 585/3 PC A04/MF A01

ACCESSION NO.

EMCAES 12-80-38

**ABSTRACT:** This report describes a general methodology for digitally storing the three-dimensional shape of geometric surfaces. This methodology has been developed for application with the Electromagnetic Compatibility/Intrasystem Analysis Program. Provisions are made for storage of the surface definition data on the System Data File. The file builder must be thoroughly familiar with the contents of this report before attempting to collect the geometric data.

**INDEX TERMS:** Intrasystem Electromagnetic Compatibility Analysis Program, (IEMCAP), System Data File (SDF), Intrasystem Analysis Program, (IAP), Surface Geometry, Geometric Data, Digital Storage.

EMP Hardening of Airborne Systems through Electro-Optical Techniques: Design Guidelines

R. A. Greenwell, 15 Dec 79, 55 p Rept no. NOSC/TR-469

Naval Ocean Systems Center San Diego CA

AD-A080 650/5 PC A04/MF A01

ACCESSION NO.

EMCAES 12-80-39

**ABSTRACT:** This report examines the utilization of fiber optics technology as an alternative to system EMP hardening and provides design guidelines for airborne system applications. It also examines potential EMP vulnerabilities of the overall fiber optic data subsystems, defines and quantifies methods of protection against the EMP threat, and compares vulnerabilities with those of hard-wired data systems.

**INDEX TERMS:** EMP Hardening, Electro-Optical, Fiber Optics, Vulnerabilities

A Monitor Unit for Automatically Logging Power Line Disturbances

W. M. Kemp. Sep 79, 37 p ERL-0104-TR, AR-001-905

Electronics Research Lab., Adelaide (Australia)

PB80-125669 PC A03/MF A01

ACCESSION NO.

EMCAES 12-80-40

**ABSTRACT:** A portable monitor system has been developed for automatically gathering data on the quality of electrical mains supplies. The equipment will store the number of times overvoltages or undervoltages occur in a chosen period, and will give a breakdown of the data into five disturbance-duration categories, plus an indication of the accumulated disturbance time. The equipment is self-contained and requires no attention during the monitoring period, making it particularly useful for remote or unmanned sites. Up to 100,000 excursions outside the preset thresholds can be tallied in any one period. The unit will continue to acquire and store data through extended mains failures for virtually the shelf life of its internal battery.

**INDEX TERMS:** Power line disturbances, Portable monitor, Mains failures, Automatic Logging

Final Report of the Advisory Committee on Cable Signal Leakage

Federal Communications Commission, Washington, D.C.

1 Nov 79, 247 p

PB80-119605 PC A11/MF A01

**ABSTRACT:** The Advisory Committee was asked by the F.C.C. to help determine the relationship between cable television system signal leakage, as measured at ground level, and the probability of harmful interference to aeronautical and other radio services. The Committee advised staff of the Commission and other federal agencies in their research directed toward this question. The report is a detailed review of that research and analysis. The report concludes that it is possible, on the basis of ground-based measurements, to determine whether leakage fields in the airspace will be sufficient to cause interference. A regulatory scheme to prevent such interference is suggested.

ACCESSION NO.

EMCAES 12-80-41

**INDEX TERMS:** Radio Frequency Interference, EMI, Cable Signal Leakage, Cable television, Harmful interference, Aeronautical, Regulations.

Measurements of an FM Receiver in FM Interference

John R. Juroshek

National Telecommunications and Information Administration,

Boulder, CO. Inst. for Telecommunication Sciences,

Oct 79, 40 p NTIA-REPORT 79/27 PB80-119316 PC A03/MF A01

**ABSTRACT:** This report investigates the performance of an FM, landmobile, receiver in FM interference. Measurements are described showing the effects of multiple interfering FM signals as a function of modulation index, signal-to-interference ratio, signal-to-noise ratio, and frequency offset between the victim and interferer. The performance of the receiver is measured with various combinations of one to three interfering FM signals. The report also describes the spectra of the audio output during various interference conditions.

ACCESSION NO.

EMCAES 12-80-42

**INDEX TERMS:** EMI, RFI, FM Receiver, FM Interference, Landmobile, Signal-to-interference ratio, Signal-to-noise ratio.



Conf. on Cert. of Aircraft for Lightning and Atmospheric Electricity Hazards - Held ONERA Chatillon, France  
Joseph Taillet Sept. 14-21, 1978  
Office National D'Etudes Et de Recherches Aerospatiales  
Chatillon-Sous-Bagneux (France) 30 Jul 79, 230 p EOARD-TR-79-6 Grant AFOSR-78-3653 Final rept. 1 Jul 78- 30 June 79  
PC A11/MF A01

ACCESSION NO.  
EMCABS 12-80-43

**ABSTRACT:** This conference was organized to disseminate in a tutorial fashion to the NATO Air Electrical Working Party and their technical advisors the information related to the recent progress of atmospheric electricity hazards and lightning protection studies. The conference program covers the following topics: Theory of Lightning; Basis of Specification; Lightning Attachment and Swept Stroke Testing; Fuel Vapor Ignition and Direct Effects Testing; Indirect Effects Testing and Lightning Protection Methodology; Static Electricity.

**INDEX TERMS:** Lightning, Atmospheric Electricity Hazards, Lightning protection, Lightning Attachment, Swept Stroke, Fuel Vapor Ignition, Direct Effects, Indirect Effects, Static Electricity, Aircraft.

Lightning Protection Guidelines for the U.S. Army Coastal Engineering Research Center (CERC) Facilities.

Morris Campi, and James D. Penar

Harry Diamond Labs Adelphi MD

Technical memo, Aug 79, 51 p Rept. no. HDL-TM-79-9

AD-A076 491/0 PC A04/MF A01

ACCESSION NO.  
EMCABS 12-80-44

**ABSTRACT:** General lightning protection guidelines are presented for the field research facility of the U.S. Army Coastal Engineering Research Center (CERC) at Duck, NC. This report draws heavily on existing lightning protection codes, specifications, and publications, all of which are referenced for completeness.

**INDEX TERMS:** Lightning, Lightning protection, Guidelines

FAA Lightning Protection Study: Report of Investigations Relative to Providing Lightning Protection for Control Lines for the Remote Ctr. Air-to-Ground (RCAG)

Richard M. Cosel/ Rome Air Development Ctr. Griffiss AFB NY

May 79, 14 p FAA-RD-79-102 Contract DOT-FA72WAL-356

AD-A076 943/0 PC A02/MF A01

ACCESSION NO.  
EMCABS 12-80-45

**ABSTRACT:** The purpose of the Lightning Protection Study is to determine the degree of susceptibility of FAA electronic systems to induced electromagnetic pulse effects due to lightning and to propose protective devices adequate for low voltage solid state systems. This report covers the RCAG. While the RCAG does contain solid state circuitry with potentially susceptible components they are sufficiently isolated from transients so that effects are apparently negligible. Two separate reviews of four RCAG's in Florida failed to surface any outages directly attributable to lightning induced transients on control lines.

**INDEX TERMS:** Lightning, Lightning Protection, Susceptibility, Induced Electromagnetic pulse, Low voltage, Solid state, Transients.

The EMP Response of a System of Uncoupled, Interconnected Cables

Robert F. Gray

Harry Diamond Labs Adelphi MD

Technical Rept., Oct 79, 20 p Rept. No. HDL-TR-1903

AD-A077 659/1 PC A02/MF A01

**ABSTRACT:** An approximate analytical technique is developed for the electromagnetic pulse (EMP) response of a complex system of cables deployed over a real earth. The technique involves an existing transmission-line solution for the EMP response of a cable which is extended to a system of interconnected but uncoupled cables by the principle of superposition. The complete response of one particular cable is found by replacing all the other cables connected to it with equivalent Thevenin sources. The response of the cable due to the EMP and the equivalent sources are then summed. The equivalent Thevenin sources are developed from the existing transmission-line solution for the EMP response of a single cable. Experimental verification of the applicability of the superposition principle to transmission lines is also given.

ACCESSION NO.  
EMCABS 12-80-46

**INDEX TERMS:** EMP, Interconnected Cables, Analytical technique, Transmission-line.

Electromagnetic Radiation System (EMRS) for Susceptibility Testing

Margaretta V. Stone

American Electronic Labs Inc. Farmingdale N.J.

Apr 79, 15 p CORADCOM-76-0332-9 Quarterly rept. 1 Oct-1 Dec 78,

Contract DAAB07-76-C-0332 AD-A080 226/4 PC A02/MF A01

ACCESSION NO.  
EMCABS 12-80-47

**ABSTRACT:** The function of the Electromagnetic Radiation System (EMRS) is to generate electromagnetic energy to produce a constant field strength that can be automatically scanned as a function of frequency. The design objective is to cover the frequency range of 30 hertz to 40 gigahertz with field strength intensities up to 200 volts per meter. This report describes system equipment status and results of performance tests in all demonstration frequency ranges (30-60 MHz, 1.0-2.1 GHz, 2.1-4.0 GHz and 12.4-18.0 GHz).

**INDEX TERMS:** Susceptibility, Testing, Instruments, Electromagnetic Radiation, Field Strength, Generators, High-Strength Fields.

System Data File (SDF) for the Intrasytem Analysis Program (IAP). Vol. 1 Description

Richard Robertson

Atlantic Research Corp. Alexandria, VA

Dec 79, 71 p RADC-TR-79-213-VOL-1 Contract F30602-77-C00126

See also Vol. 2 AD-A080 585 AD-A080 584/6 PC A04/MF A01

**ABSTRACT:** The objective of this effort was to develop the schema for a system data file (SDF) which would contain the data that describe the physical and electrical characteristics of a weapon system from an electromagnetic compatibility (EMC) point of view. This file would contain data such as the description of the surface geometry of the structure and the signal characteristics of all electrical ports within the system. This data file and its schema can be used as the nucleus on which a standardized system data file can be built. The SDF can be used by the Intrasytem Analysis Program (IEMCAP) computer codes as a source of system data. An SDF provides an engineer all the system characteristics needed to perform an EMC analysis. Moreover, since the parameters are in a central digitized data file, they can be retrieved by a computer.

ACCESSION NO.  
EMCABS 12-80-48

**INDEX TERMS:** IEMCAP, Intrasytem Analysis Program (IAP), System Data File (SDF), electromagnetic compatibility, (EMC), digitized data, computer, retrieval.



## INSTITUTIONAL LISTINGS

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EMI meters and automated systems incl., calculator/computer-based; 20 Hz-40 GHz \*MIL-STD/CISPR/VDE/SAE/FCC.

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TECKNIT, INC., 320 N. Nopal St., Santa Barbara, CA 93103  
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HONEYWELL, ANNAPOLIS OPERATION, P. O. BOX 391, Annapolis, MD 21404  
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CHOMERICS, INC., 77 Dragon Ct., Woburn, MA 01801  
Telephone (617) 935-4850  
EMI/RFI shielding materials: gaskets, adhesives, coatings, shrinkable cable shields, honeycomb vest panels, laminated shields.

SPECTRUM CONTROL, INC., 8061 Avonia Rd., Fairview, PA 16415  
Telephone (814) 474-1571 Telex 510/699-6848  
EMC test and consulting VDE, CISPR, MIL-461, FCC, Mfr. RF filters, RFI capacitors, chips, variable caps—in stock at HALLMARK.

LECTROMAGNETICS, INC., 6056 W. Jefferson Blvd., Los Angeles, CA 90016  
Telephone (213) 870-9383  
RF shielded enclosures, modular, prefabricated & all welded. RFI/EMI power line filters; signal line filters.

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