

#### EDUCATION COMMITTEE NEWS

I have just recently assumed the responsibility of Chairman of the Education Committee and have been reviewing what was done in the past, and looking into what can be done in the future. I have some ideas for a couple of new projects, and will cover them in future columns.

The committee is in need of some new members. These should be both from industry and from the academic world in order to provide a variety of opinions. Anyone interested in serving on the committee should contact me.

This column will continue to publish information on EMC related seminars and short courses. Information on such courses should be sent to me at the address below.

I would like to express my appreciation to my predecessor, Ken Exworthy, for the fine job he has done with the Education Committee in the past.

Henry Ott

Chairman EMCS Education Committee

Room 2C-322 Bell Laboratories Whippany, NJ 07981 201-386-6660

#### NBS ISSUES NEW PUBLICATION

A new publication, "Electromagnetic Interference Radiative Measurements for Automotive Applications" by Adams, Taggart, Kanda and Shafer, dated June 79, is now available from NTIS (Number NES-TN-1014). It also may be ordered from the Superintendent of Documents, US Government Printing Office, Washington, DC 20402 at \$3.00 per copy.

This report describes the measured results of the electromagnetic (EM) environment encountered by three different-sized vehicles exposed to a selection of CB and mobile radio transmitters and broadcast stations. The vehicle in these situations is immersed in the near field of the radiating signals and the measured data is near-field data. This report gives measured data of electric and magnetic fields measured independently. The purpose of the report is to identify the EM environmental conditions under different circumstances in order to estimate EMC testing criteria for vehicles and their electronic systems.

#### RESULTS OF THE AD COM ELECTION BALLOT

A ballot for the election of six Electromagnetic Compatibility Society AdCom members was issued on August 23, 1979. The ballots returned have been counted, and the following candidates have been elected for a three-year term beginning January 1, 1980:

> William E. Cory William G. Duff Eugene D. Knowles Richard B. Schulz Margaretta V. Stone Leonard W. Thomas, Sr.

We wish to thank all nominees for their willingness to serve and for permitting their names to be included on the ballot.

#### NEWSLETTER STAFF

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#### FDA EMC SPEC ISSUED

It has finally happened. The long awaited HEW/FDS EMC Standard for Medical Devices, MDS-201-0004, dated October 1, 1979, has been issued. Limited copies are available by calling or writing the FDA, Bureau of Medical Devices, Attn.: HFK-310, 8757 Georgia Ave., Silver Spring, MD 20910; Tel.: 301-427-7222.

The publication is a medical device performance standard, developed by the Bureau of Medical Devices, Division of General Medical Device Standards. At this time, the standard is not being promulgated under the provisions of Section 514 of the Federal Food, Drug and Cosmetic Act. Therefore, compliance is not required by Federal Law and conformance to the requirements are voluntary.

However, readers and potential users of this standard should recognize that compliance may become mandatory under certain circumstances, for example:

- when referenced in Federal regulations, particularly those promulgated under the provisions of Section 514 of the Federal Food, Drug, and Cosmetic Act;
- when referenced in regulations promulgated by State and local regulatory agencies; and,
- when referenced in procurement specifications.

#### 1979 SALARY SURVEY AVAILABLE

The all-new IEEE 1979 U.S. Membership Salary and Fringe Benefit Survey provides up-to-the-minute information for individual EEs, corporate and engineering management, personnel and salary administrators. The survey compares EE salaries relative to job function, supervisory responsibility, type of employer, company size, years of experience, and many other variables. In addition, the survey features extensive tables showing income based on pairs of variables simultaneously, such as income vs. engineering experience by highest degree earned, income vs. geographic region by industry or service of employer, income vs. engineering experience by geographic region, and many others.

The survey also contains an analysis of such fringe benefits as pension coverage (including value and requirements), insurance plans, vacations and professional society activities.

The IEEE Service Center in Piscataway, NJ, is handling orders. Ask for IEEE Catalog #UH0134-7. The IEEE member price is \$36 (non-members, \$54).

#### EMC COMPUTER MODELS

As a result of the comments received on the announcement of the special issue of the EMC Transactions on modeling ("IEEE Transactions on Electromagnetic Compatibility, Vol. EMC-21, No. 2, p. 157, May 1979), it has become necessary to make the following changes in the composition of this issue. The special issue will be composed of two parts. Part one will contain the contributions received from organizations extensively involved in developing a number of models for EMC analysis in the past decade. Each contributing organization is invited to prepare an overview of the models which it has developed and their availability to Transaction readers. The overview may include a brief description of the major areas of expertise and a commentary on how the reader may make use of the facilities. The second part of the issue will be for articles describing single models. Contributors to this issue are invited to submit their articles to the following address (note change):

> Dr. Andrew Farrar U.S. Dept. of Commerce National Telecommunication and Information Annapolis Office 179 Admiral Cochrane Dr. Annapolis, MD 21401 301-224-4307

The contributors to Part 2 of the issue are requested to use the information given in the earlier announcement (Vol. EMC-21 mentioned above) as a guide for the preparation of their articles.

#### COMMUNICATIONS ACT

Senate and House rewrites of the 1934 Communications Act have drawn cautious but nevertheless enthusiastic responses overall from several industry circles, although major concern continues to center around what impact the proposed legislation would have on AT&T.

#### IMPORTS OF ENGINEERS OPPOSED BY TWO ENGINEERING GROUPS

The Council of Engineers and Scientists organization and the American Engineers Association representing a membership of over 71,000 will work with the Labor Department to determine how many U. S. engineers may be available to fill jobs that might have been offered to engineers from outside the U. S.

## **EMC STANDARD ACTIVITIES**

by Richard B. Schulz

This new column will focus on EMC activities of voluntary (non-government) committees engaged in establishing either recommended practices or standards, or in coordinating standards. The plan, subject to revision, is to keep readers informed on EMC standards-related activities of the following organizations:

- American National Standards Institute (ANSI)
- Computer and Business Equipment Manufacturers Association (CBEMA)
- Electronic Industries Association (EIA)
- Institute of Electrical and Electronics Engineers (IEEE)
- Radio Technical Commission for Aeronautics (RTCA)
- Scientific Apparatus Makers Association (SAMA)
- Society of Automotive Engineers (SAE)

It is further planned to spotlight a different specific organization each time and to present a schedule of planned future meetings of all committees.

The focus this time is on Committee C63 of the American National Standards Institute (ANSI). ANSI is a federation of industrial, trade, technical, labor and professional organizations, government agencies, and consumer groups. The principal functions of ANSI are to coordinate the development of voluntary standards in the private sector and to provide national representation to international standardization organizations. Many ANSI standards in the areas of computers, data transmission, and information processing have been adopted by the Federal Government. ANSI standards are available from IEEE, which serves as the secretariat to ANSI committees included here

Various ANSI committees are concerned to some extent with EMC-related subjects. Among these are:

<u>Cl6:</u> <u>Communication and Electronic</u> <u>Equipment</u>

Chairman: Irving Kolodny

EMC Interest: Portions of standards concerning EMC subjects, such as intermodulation, local-oscillator radiation, impulse measurements.



C63: Radio-Electrical Coordination

Chairman: Ralph M. Showers

EMC Interest: Entire scope, as follows: "Development of definitions and methods of measurement of noise and signal strengths, determination of levels of signal strength, levels of interfering sources, limiting ratio of noise to signal and development of methods of control of influence, coupling and susceptiveness."

#### C68: High-Voltage Testing Techniques

Chairman: A. F. Rohlfs

EMC Interest: Portions of standards concerning EMC subjects, such as switching impulses and corona.

C95: Radio-Frequency Radiation Hazards

Chairman: Prof. S. Rosenthal

EMC Interest: Entire scope, as follows: "Hazards to mankind, volatile materials and explosive devices which are caused by man-made sources of electromagnetic radiation. The frequency range of interest extends presently from 10 kHz to 100 GHz. It is not intended to include infrared, X-rays, and other ionizing radiations."

MD105: Medical Electronics

Chairman: Robert Flink

EMC Interest: Entire scope, as follows: "To review and recommend adoption of standards for safety, performance, data collection aspects, definitions and terminology, methods of tests for medical electronic devices and systems interconnecting these devices in the following general categories: prosthetic devices and orthotic, therapeutic devices, monitorial devices, diagnostic devices and analytical devices. X-ray, hearing aids and nuclear medical devices are excluded."

More information on C63 and its subcommittees is provided below:

AN	SI COMMITTEE	COMMITTEE NAME	CHAIRMAN	SECRETARY
	C63	Radio-Electrical Coordination	R. M. Showers Moore School of Elec. Engrg., Univ. of PA, 200 S. 33rd St., Phila., PA 19174 215-243-8123	L. W. Thomas, Sr. Thomas Engrg. Co. 1604 Buchanan St., N.E., Washington, DC 20017 202-526-2545
	C63.1	Techniques and Developments	R. M. Showers (Acting Chairman)	L. W. Thomas, Sr.
	C63.2	Terms and Definitions	R. B. Schulz IIT Research Institute ECAC, N. Severn Annapolis, MD 21402 301-267-2258	
	C63.3	International Standardization	L. W. Thomas, Sr.	
	C63.4	High Voltage Apparatus	H. A. Gauper, Jr. (Chairman Pro Ter R&D Center General Elec. Cc. Schenectady, NY 12301 518-385-3422	• n) •

New ANSI C63 EMC standards in various stages of approval follows:

Standard Number	Title	Comments
C63.2	Specifications for Electromagnetic Noise and Field Strength Instrumentation, 10 kHz to 1 GHz	Draft approved (Combines former C63.2 and C63.3)
C63.4	Methods of Measurement of Electromag- netic Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 10 kHz to 1 GHz	Draft in ballot
C63.12 7/20/79	Recommended Practice on Procedures for Control of System Electromagnetic Compatibility	Draft approved by IEEE and issued for l year trial u se

Availability: C63.12 is available from IEEE, 345 E. 47th St., New York, NY 10017

During the past year, Committee C63 responded to two FCC Notices; Dockets 20718 on overall revision of Part 18 on ISM equipment, and 78-369 in RF interference to electronic equipment. (These replies have been endorsed by the IEEE EMC Society.)

#### SCHEDULED COMMITTEE MEETINGS OF MAJOR EMC INTEREST

Committee	Name	Next Meeting
ANSI C63	Radio Electrical Coordination	l/29-30/80 FCC, Washington, DC (Members Only)
ANSI C95	Radio Frequency Radiation HAZARD	Unscheduled
CBEMA ESC5	Environment and Safety Committee, Subcommittee 5	Tentative mid-February Phoenix, AZ
EIA G-46		*
IEEE S27	EMC Standards Committee	Unscheduled
RTCA SC135	Environmental Conditions and Test Procedures for Airborne Electronic/Electrical Equip- ment and Instruments Process Measurement and Control Section	Unscheduled
SAE AE-4	Electromagnetic Compatibility	4/23-25/80, Warminster, PA (Host to NATO Group) 10/6/80, Baltimore Hilton
SAE ESC/SC	Electronic Systems Committee/ EMI Standards and Test Methods Subcommittee	2/26 or 2/28/80 Cobo Hall, Detroit
SAMA PMC33	Process Measurement and Control	3/5-6/80 Probably SAMA Washington, DC

\*Unavailable by publication deadline.

PLANS FOR GROUP TOUR TO EMC SYMPOSIUM AT WROCLAW, POLAND

The EMC Society is cooperating with the Polish Society of Electrical Engineers and the Technical University of Wroclaw for a Symposium on EMC to be held in Wroclaw on the 16th through the 18th of September, 1980. The Symposium will be located at the University or at a nearby old castle which has been converted into a conference center. Papers will be presented either in English or Russian with simultaneous translations facilities at each session. A group tour is being planned to leave the United States on September 14th and travel through Warsaw to Wroclaw, arriving there on the 15th. The return will tour the Polish countryside on the 19th and 20th, leaving Warsaw on Saturday the 20th and arriving in the USA on the same day. For more detailed information on the tour, return the coupon below.

Send to:			
James S. Hill International Affairs Committee 6706 Deland Drive Springfield, VA 22152			
I am interested in participating i Symposium at Wroclaw, Poland. Ple	in the group the send more	cour to the Inter detailed inform	cnational EMC mation.
Name	an and a subscription of the state	Number in party	/
Street			
City	State _	Zip_	

## **EMC PERSONALITY PROFILES**

by William G. Duff



BERNHARD E. KEISER

Dr. Keiser received the BS, MS and DSCEE degrees from Washington University, St. Louis, MO. His introduction to EMI problems, however, started with his hobby, ham radio, in which he has been licensed since 1946.

Dr. Keiser, while at RCA Laboratories, was one of the designers of the first ELF experimental transmitting stations, which included a 109 mile long antenna from southern Virginia to central North Carolina, and which demonstrated communications to a deeply submerged submarine in 1962.

In 1969, Dr. Keiser moved to the Washington, DC area as Vice President and Technical Director of Page Communications Engineers, Inc., and later joined Fairchild Space and Electronics Company where he was responsible for all EMC work on the ATS-6 spacecraft.

In 1974, Dr. Keiser established his own consulting practice and serves a number of industrial and government clients in tele-communications and EMC.

Dr. Keiser has authored numerous papers in EMC and related fields. He has written two books, "Principles of Electromagnetic Compatibility" published in 1979 by Artech House, Dedham, MA, and "EMI Control in Aerospace Systems" published in 1979 by Don White Consultants, Inc., Gainesville, VA. Of interest to members of the EMC Society is the fact that Dr. Keiser also teaches continuing engineering education courses in Electromagnetic Compatibility, Grounding, Bonding and Shielding, Lightning Protection and Hazardous Electromagnetic Radiation. While at Cape Canaveral from 1964 to 1967, he became Chairman of the Canaveral Chapter of the IEEE Communications Technology Group and also served nationally on the IEEE Communications Technology Awards Commtee. In July 1969, he was appointed representative to the USA Standards Committee C-16, Radio and Electronic Equipment, by the IEEE Standards Committee. Since January 1979, he has been Chairman of the IEEE Region 2 Membership Development Committee. Currently, he is Vice Chairman of the IEEE Northern Virginia Section, and Chairman of the Washington Chapter of the EMC Society.

Dr. Keiser is the Chairman of the Technical Program Committee for the International EMC Symposium to be held in Baltimore October 7-9, 1980. He and his committee are looking for top quality papers for presentation at this symposium. The call for papers has been issued. Abstracts and summaries are being received and the final selection of papers for the symposium will be made this spring.

Dr. Keiser is a member of Pi Mu Epsilon (Mathematics), Tau Beta Pi (Engineering) and Sigma Xi (Science). He is a member of the Armed Forces Communications Electronics Association (AFCEA) and a member of Commission E (Interference Environment) of the International Union of Radio Science (URSI). He is a Fellow of the IEEE.

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# CHAPTER CHATTER



#### by Charles F. W. Anderson

Quite gratified to be able to report that there's more news this time!

#### Japan

Professor Risaburo Sato of Tohoku University (whom I had the pleasure of meeting at the Symposium) has sent me lists of papers presented at EMC Technical Meetings of the IECE/IEE of Japan in October and November. I would be glad to send copies to those of you who are interested. The diversity of the topics and the apparent technical depth speaks very well for the state of EMC across the Pacific.

#### Atlanta

The Chapter's 25 September meeting featured an "EMI/RFI Instrumentation Seminar," presented by Jerry Rothhammer of AILTECH, with emphasis placed on programmable data collection systems. The Chapter also has worked out a "Plan-of-the-Year" which was published in their Newsletter. On November 20th, Barry Cown, of the Georgia Tech Engineering Experiment Station, spoke on the topic, "Statistical Prediction Models for EMC Analysis of Out-of-band Antennas."

With Jim Toler's presentation of a check for \$4592.54 at the AdCom meeting in San Diego, the total cash surplus realized from the 1978 Symposium in Atlanta amounts to \$5335.83! Congratulations to the Chapter for a fine job!

In the Chapter's November Newsletter, Bob Hammack of AT&T requests information on "very strong (lightning) bolts in the southeastern U.S." Please call or write him with any data which you may have concerning such occurances. (Bob Hammack, c/o AT&T, Room 1405, 100 Edgewood Ave., N.E., Atlanta, GA 30303; 404-529-2371.

If you're in the area, phone Don Clark (404-894-3535), or Bob Hammack (phone above) for meeting dates.

The Chapter is planning a membership drive during January and will be contacting prospective members in the Atlanta area.

#### Central New England

The Chapter held its first meeting of the season on 23 October. The presentation was an elementary tutorial on the art of identifying sources of intermods, isolation of same to receiver or transmitter non-linearities, and implementation of fixes or design corrections. Speakers were Richard H. Brown III'and Frank H. Stites of GTE-Sylvania. There were 22 attendees. Planning for future meetings includes such topics as VDE Standards, Rail Transit EMC Problems, and a tour of the Emerson & Cuming facility in May.

Approval of Boston as the site for the 1985 Symposium by AdCom and the Boston Section Committee has initiated planning activities. Selection of a steering committee and suitable facilities are to be the first items.

When in the Boston area, check with John Clarke at 494-2020 for meeting details.

#### Dayton

Welcome to our newest Chapter!

Their first function was a luncheon meeting held at the WPAFB Officers' Club on 4 December. Nominees for the 1980 Officers are: Chairman, Dr. John C. Corbin, of ASD's Avionics Engineering EMIC Branch; Vice Chairman, Lawrence C. Walko, Flight Dynamics Lab, WPAFB; Secretary, Elden E. Wick, also of the EMIC Branch.

Chapter By-Laws also were considered at that meeting.

If your business takes you to Wright-Pat, contact John Corbin at 255-2907 for information on their future meetings.

#### Denver

Pleased to report that there is a joint EMC/Instrumentation & Measurement Chapter in Denver. Herb Ostenberg of HP's Regional Sales Office is the Chairman. Here's hoping we have some news from them for the next issue.

#### New Jersey Coast

Roger Peterson, who has taken over as Editor of the Newsletter as previously reported, has changed the format slightly. The first meeting of the season was held on 15 October. Cliff Schaible of Bell Labs spoke on "Active Signal Processing in the Coastal Harbor Radiotelephone System." The November 13th meeting featured a talk by Roy E. Anderson of GE-Schenectady on "Land Mobile Communications Using Geostationary Satellites." The December meeting had as the speaker W. B. Bryson of Phelps Dodge Communications. His topic was "Transmitter Combiners."

One of the Chapter's long-time members, Joe Chislow, has been elected Chairman of the New Jersey Coast Section. Congratulations, Joe!

The Chapter shared the "Chapter-of-the-Year" award with the Washington Chapter.

Call Roger Peterson at 229-6850 for info on meetings when in the area.

#### Washington

The first meeting of the 1979-80 season was held on 19 September. Dr. Samuel W. Fordyce, of the NASA Office of Space & Terrestrial Applications, talked on "Microwave Power Transmission." There were 18 attendees.

The second meeting, on November 15th, was addressed by David Janes, Chief, Electromagnetic Radiation Hazards Branch of EPA, whose topic was "Radio Frequency Environments in the USA." Attendance at the meeting was 19.

Contact Art Wall (FCC) at 632-7095 for meeting information if you're in the DC area.

#### COLUMN EDITOR'S PLEAS FOR NEWS!

I would like to be able to report on what's what with the other Chapters which I know are active - but, if I don't get inputs, I can't give outputs.

Chapter Chairmen of Secretaries: Please send me your information. Deadline for items to me for the next issue will be the first week in March. In addition, we'd like to hear from those of you who are not close enough to one of the Chapters to participate in its activities, but who are doing things in EMC, such as giving talks, presenting papers, acting as Section or Chapter officers, getting advanced degrees - you name it!

Let's hear from you . . . .

Charlie Anderson 1716 Reppard Rd. Orlando, FL 32803 305-352-2000, Office 305-896-6649, Home

#### KEEPING UP-TO-DATE PAYS OFF

One of the reasons IBM has maintained its preeminence in its industry is its policy of keeping technical people up-to-date. While other firms with large numbers of engineers fail to take steps to overcome the problem of  $7\frac{1}{2}$  year half-life of an engineering education, IBM has a number of programs, both in-house and university based, through which engineers keep pace with the advances in the field. IBM managers of engineers are rated on their ability to develop the careers of those working under them through such devices as job rotation and job redesign as well as additional learning experiences.

The National Center for Productivity and Quality of Working Life has recorded this phase of the IBM experience, as well as that of Xerox and the Pennsylvania State Government. "Productivity and Job Security: Case Studies of Continuing Education for Engineers, Technicians and Managers" is available from the U. S. Government Printing Office, Washington, DC 20402 for \$1.90. Stock No. is 052-003-00529-8.

(From Sept. /Oct. 79 issue of the EMS Newsletter)

#### WORK CLIMATE STUDIED

The first joint IEEE-industry conference on "Building a Professional Work Climate" was held at the Hyatt Regency in Atlanta on November 28-29, 1979. The concept was first proposed by IEEE President Jerome J. Suran.

The program, under the chairmanship of Lindon E. Saline, USAB task force leader for professional conferences and manager of human resources systems development at General Electric, provided an opportunity for idea and information exchange, shared experiences, and gaining new insights.

Topics included the meaning and importance of a professional work climate from the viewpoints of the large and small employer and professional employee; surveys, interviews, and guidelines as ways of assessing work climate; work organization and design, performance appraisal and feedback, retraining professionals, successes and difficulties in maintaining credibility with dual ladders, and managerial psychology and style as ways of improving work climate; and enhancing productivity, innovation and growth, and planning for a work climate improvement effort.

#### EMC '80 ADVANCE CALL FOR PAPERS

As our society becomes increasingly technological, the EMC field reaches a growing variety of disciplines. With this thought in mind, the EMC '80 technical program will offer a "Constellation of Ideas" in line with the far reaching scope of the EMC field.

Accordingly, original, unpublished papers are being sought in the following and related areas:

#### ELECTROMAGNETIC COMPATIBILITY

#### TECHNOLOGICAL AREAS

Electromagnetic Environment RF Hazards Interference Control Design Techniques Grounding and Bonding Materials and Shielding Lightning and EMP Antennas and Propagation Measurements Fiber Optics Instrumentation Techniques Spectrum Management Computer Analysis Techniques Assignment Techniques Susceptibility and Immunity EMIC Analysis Techniques Non-Design Characteristics Standards and Specifications

#### SYSTEM APPLICATIONS

Biomedical Applications Communication Systems Computers Consumer Electronics Defense Aerospace Power Systems Transportation Railroad - Automotive -Aviation - Maritime Process Controls

#### NON-SINUSOIDAL SIGNALS

TECHNOLOGICAL AREAS

Sequency Theory Walsh Functions Orthogonal Functions Transforms Switching Theory Pattern Classification and Recognition Filters Logic/Coding Radiated Interference

#### SYSTEM APPLICATIONS

Digital Signal Processing Speech and Image Processing Communications Radio Multiplexing Spread Spectrum Radar Spectroscopy Nonlinear Systems Generators/Transmitters Analyzers/Receivers One or more joint sessions with URSI Commission E are being planned. Prospective authors should submit a 50 to 70 word abstract and a 600 to 800 word summary (up to four illustrations) that clearly explain their contribution, its originality, and its relationship to EMC technology.

Upon paper acceptance, authors will receive forms and instructions for the preparation of materials to be printed in the Symposium Record. Papers written by students will be eligible for a student prize.

Submit abstracts and summaries to:

Bernhard E. Keiser Technical Papers Chairman P. O. Box 1711 Annapolis, MD 21404 Tel.: 703-281-9582

For more information, contact:

Andrew Farrar General Chairman P. O. Box 1711 Annapolis, MD 21404 Tel.: 301-224-4306

#### CALL FOR PAPERS

The 1980 Canadian Conference on Communications and Power will be held in Montreal, Canada, on October 15-17, 1980, at the Queen Elizabeth Hotel. Technical papers are solicited on subjects dealing with principles, techniques, developments and applications of power and telecommunications systems and networks. Preferential subjects are listed below as an indication of the emphasis of this Conference.

Common Power and Communication Themes:

- Impact of technology on the environment such as visual impact, noise and electromagnetic interference, biological effects, etc.
- Fiber optics representing both the telecommunications and power perspectives,
- Simulation and optimization techniques applied to flow control or architectural aspects of either power or telecommunication networks.

#### Communications:

- Image and speech processing techniques and applications
- Impact of microprocessors and distributed intelligence in telecommunication networks with the aim of providing new services

Authors wishing to present papers are requested to submit three copies of both a 500 word summary and a brief biographical note by March 1, 1980. Authors of accepted papers will be notified by April 15, 1980. At the conference, a 15 minute discussion period will be allocated to each presentation, and this will be followed by a 15 minute discussion period. Papers may be presented in English or French. They may be a maximum of four standard pages and will be published in the Conference Proceedings.

Send summaries to Yvon Gervais, Technical Program Committee, Ecole Polytechnique, CP/PO Box 6079, Succ. "A," Montreal, Quebec, Canada H3C 3A7.

#### EIGHTEENTH INTERMAG CONFERENCE

The 18th International Magnetics Conference, sponsored by the Magnetics Society of the IEEE, will be held at the Sheraton-Boston Hotel in Boston, MA from Monday, April 21st to Thursday, April 24, 1980. The purpose of the 18th International Magnetics Conference is to provide a forum for presentation of new developments in applied magnetics, related magnetic phenomena, and information storage techniques. In addition to the contributed papers, there will be invited papers, sessions wherein competing technologies can be assessed, tutorial sessions, and workshops for less formal discussion of timely and/ or controversial topics. Special emphasis will be placed on applications oriented topics in the above as well as in the contributed papers. Contributed papers are solicited in all areas of applied magnetics, related magnetic phenomena, and information storage technologies. Topics of wide interest in recent years have included all aspects of magnetic recording, various magnetic and other memory technologies, microwave magnetics, electronics, transformers, permanent magnet materials and technologies, control and power conversion and conditioning, magnetometry and transducers, magnetic gradient separation, magnetic levitation and drives, magnet field calculations, and magnetic materialsproperties and processing. This list is intended to be suggestive rather than restrictive.

Individuals who are not on the Conference mailing list may obtain details concerning the preparation and submission of abstracts, as well as other Conference information, by contacting either the Conference Chairman, D. I. Gordon, Naval Surface Weapons Center, White Oak, Silver Spring, MD 20910 or the Publicity Chairman, R. M. Josephs, Sperry Univac, P. O. Box 500, Blue Bell, PA 19424. Abstracts (prepared in exact conformity to instructions) should be submitted to L. J. Varnerin, Jr., Bell Laboratories, Murray Hill, NJ 07974.

An exhibit of equipment, components, materials, and technical information is being arranged. Firms wishing to participate are urged to contact the exhibit managers, C&M Associates, P. O. Box 68, Maple Glen, PA 19002.

#### 1980 NUCLEAR EMP MEETING

#### FIRST CALL FOR PAPERS

The 1978 Nuclear EMP Meeting (NEM 1978) held in Albuquerque at the University of New Mexico generated considerable interest in holding such conferences on a regular basis. The Permanent NEM Committee was formed consisting of principal officers of the previous NEMs and sponsoring organizations in order to sponsor and schedule periodic NEMs. It was decided to sponsor such conferences every second year with about half of these conferences at locations other than Albuquerque.

A committee has been formed in the Los Angeles area to host the 1980 Nuclear EMP Meeting (NEM 1980) at the Disneyland Hotel in Anaheim, California on August 5-7, 1980. Subject areas of interest for this meeting include:

ENVIRONMENT Source Region (EMP and SGEMP Generation) Source-Free Region (Propagation

Effects) SIMULATION TECHNOLOGY

Simulator Proper (antennas, parallel plates, etc.) Simulator/Object Interaction;

Pulsers

MEASUREMENT TECHNIQUES

INTERACTIONS Aircraft, Missiles, Satellites, etc.; Antennas; Apertures; Shields; Cavities

LABORATORY TESTING

SYSTEM LEVEL TESTING System Configuration; Test Point Selection; Test Data Analysis; Extrapolation Techniques; Assessment Techniques

SYSTEM HARDENING TECHNOLOGY

LIGHTNING Lightning Phenomenology, Interaction, Testing, etc., particularly as related to EMP phenomena and technology

Unclassified papers are solicited describing original work, which can be analytical, numerical, experimental and/or applications oriented. Although any papers dealing with nuclear electromagnetic-pulse related matters will be considered, the above subject areas are regarded as particularly appropriate for this meeting. Authors are requested to submit a one-page abstract, original plus five copies, by May 1, 1980 to:

> Kelvin S. H. Lee Dikewood Industries, Inc. 2716 Ocean Park Blvd. Suite 3000 Santa Monica, CA 90405



#### IEEE EXPANDS DISCOUNT PLAN

Little more than a year old, the IEEE Individual Benefits and Services Committee is acting to upgrade and expand discount and insurance plans for IEEE members. The Avis car rental program was recently expanded to offer IEEE members a discount of 25% on domestic rates and 10% on foreign rates. All a member needs to qualify is to show his or her IEEE membership card with the discount number A/A606000 written next to the signature. Avis/IEEE discount cards also are available from IEEE headguarters, 345 E. 47th St., NY, NY 10017.

Additional discount programs now under study by the committee are in such areas as travel, auto insurance, consumer goods buying service, education and training programs, and legal services.

The committee also is studying the expansion of insurance programs for members. IEEE members now are eligible to request coverage under the following 7 insurance plans: life insurance, group annuity, high-limit accidental death and dismemberment, in-hospital plan, disability income, excess major medical, and major medical expense insurance/senior plan. Further information on these plans and applications should be obtained from the Administrator, IEEE Group Insurance Program 1797 L St., N.W., Suite 700, Washington, DC 20036; Tel.: 202-296-8030.

The IEEE Individual Benefits and Services Committee Chairman is Arthur M. Killen, and its other members are Robert Barden, Robert Briskman, Donald Brereton, William, Farrell, Robert House, Donald King, Burkhard Schneider, and Leo Young.

The programs are approved by IEEE solely as a service to members and their families. IEEE incurs no expense, nor does it gain financially, nor does it take any responsibility for coverage.

PLANS FOR GROUP TOUR TO EMC SYMPOSIUM AT SOUTHAMPTON UNIVERSITY

The EMC Society is cooperating with the IERE of England for the International Conference on Electromagnetic Compatibility to be held at the University of Southampton, Tuesday 16th to Thursday 18th of September 1980. A 14-day United Kingdom tour has been organized by Cosmopolitan Travel of Washington, DC. The tour will take participants to the conference at Southampton University and follow on tour by motor coach to some of the outstanding points of interest in England. At Stonehenge, they will see the immense stone monoliths rising from the broad expanse of Salisbury Plain. These prehistoric stones may have served as an ancient solar observatory. Going on to Bath, the sightseeing in this beautiful city will include the remarkable Roman baths for which the town in named. Ancient hot springs supplied the hot mineral waters in which the Romans would plunge. Next, we come to Stratford-on-Avon, a prosperous market town in ancient times; today, Stratford is known as the home of William Shakespeare. His birthplace, the school he attended and Anne Hathaway's cottage will be visited. The Elizabethan atmosphere has been maintained by its age worn buildings in careful preservation. On to Bristol, a town noted for its old port and green countryside. The tour will wind up in London with a visit to a stunning succession of landmarks, interrupted by visits to Westminster Abbey and the Tower of London. When Big Ben chimes at 4 o'clock, a traditional tea at Fortnum and Mason or the Ritz will be in order. There will be time to visit the British Museum with its Egyptian mummies and the famous Elgin Marbles or stop at the elegant department stores. Piccadilly Circus, Trafalgar Square, the English Pubs and the world's best theatre are incomparable London attractions. For more detailed information on the tour, return the coupon below.

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#### PETITION CANDIDATE LEO YOUNG ELECTED PRESIDENT OF IEEE

Dr. Leo Young, Staff Consultant of the Electronics Technology Division of the Naval Research Laboratory in Washington, DC, has been elected 1980 President of the IEEE. Dr. Young was elected by a 22,947 to 18,544 margin over the IEEE Board candidate, Burkhard H. Schneider. This is the first time in IEEE history that a petition candidate has defeated the Board nominee for the office of President. On January 1, Dr. Young will succeed Dr. Jerome J. Suran, Staff Executive of the Technical Systems and Materials Sector of General Electric Company in Fairfield, CT.

Dr. Young's campaign platform stressed the need to make IEEE more responsive to members' career needs and to enhance engineering as a profession. He emphasized the importance of so-called "bread-and-butter" issues such as incomes, jobs and pension rights. He also supported the position that IEEE, while maintaining its technical excellence and its first-rate publications, should encourage the dissemination of more practical information. Dr. Young further promised that, if elected, he would endeavor to integrate technical and professional activities to be mutually supportive.

Dr. Young has had extensive experience as a volunteer member of IEEE, including five years of service on the IEEE Board of Directors, first as Division Director (1971-74) and then as Executive Vice President (1979). His technical service includes the Chairmanship of the IEEE Microwave Theory and Techniques Society and the IEEE Committee on Man and Radiation (COMAR), IEEE National Lecturer, and membership in the IEEE Standards Coordinating Committee on Quantities and Units, the Technical Activities Board, the Microwave Theory and Techniques Transactions Editorial Board and various conference program committees. Dr. Young was instrumental in the establishment of IEEE Professional Activities and has been actively working for pension reform, particularly for portable pensions.

Since 1973, Dr. Young has been affiliated with the Naval Research Laboratory in Washington, DC. He previously served as Staff Scientist and Program Manager at Stanford Research Institute (1960-73) and Advisory Engineer at Westinghouse (1953-61). Dr. Young is Navy liaison representative on the U.S. National Committee of URSI (the International Union of Radio Science). His microwave filter designs are widely used in industry. In 1963, Dr. Young received the IEEE Microwave Prize. He was elected Fellow of IEEE in 1968, being cited for "his contributions in the field of microwaves." Dr. Young earned his Doctorate in Electrical Engineering in 1959 from the Johns Hopkins University in Baltimore, where he held the Lamme Scholarship. He also received honors degrees in physics He and in mathematics from Cambridge University, England.

#### PANEL DISCUSSION ON RADIO SIGNALS WITH LARGE RELATIVE BANDWIDTH

A discussion panel on sequency theory in general and radar with large relative bandwidth in particular is being organized for the 1980 IEEE International Symposium on Electromagnetic Compatibility to be held in Baltimore, MD from 7 to 9 October 1980. The discussion is primarily planned to be on radar, since about 40 carrier-free radars have been built, and they have been used in many applications, including an airborne radar. It is expected to have an exhibition booth at the Symposium to answer guestions about practical implementation conveniently and convincingly.

At this time, the discussion panel has members from the US and the Peoples Republic of China, while additional members are hoped to come from Canada. West Germany, and the Soviet Union. All these members are proponents of nonsinusoidal radio signals in general and radar with large relative bandwidth in particular.

A strong effort was made to find opponents willing and able to serve on the Discussion Panel. Numerous invitations were mailed, particularly to persons who had published opposing opinions in journals of the IEEE. These efforts have so far been without success.

Anyone who not only opposes the use of radio signals with large relative bandwidth commonly referred to as nonsinusoidal signals - but is willing and able to do so as a member of a Discussion Panel at a major IEEE Symposium conveniently located in the Washington area, is invited to submit his or her name to the organizer of the Panel: H. F. Harmuth, Dept. of Electrical Engineering, Catholic University, Washington, DC 20064; Tel.: 202-635-5193, or to the Committee Chairman for the Sequency Union: G. R. Redinbo, Dept. of Electrical and Systems Engineering, Rennselaer Polytechnic Institute, Troy, NY 12181; Tel.: 513-270-6324.

NSPE INVOLVEMENT IN GOVERNMENT AFFAIRS

The National Society of Professional Engineers has pledged strong involvement in legislative and governmental affairs at all levels, according to its new master plan. The Society says it will strive to ensure application of engineering knowledge and skills in the public interest, as well as to foster public understanding of the role of engineering in society.

# EMCABS



EDWIN (ED) BRONAUGH

In this issue we are publishing 36 abstracts. These are abstracts of some of the papers presented at the last International EMC Symposium that was held in San Diego, California, in October. We plan to continue publishing abstracts of papers from this symposium until all have been published, and then we will start on previous symposia. The EMCABS committee is composed of the following members:

L.	F.	Babcock	E.	L.	Bronaugh
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R.	B.	Schulz	R.	M.	Showers

1	
EMP Response Prediction for Closely Spaced Monopole-Type Structures Chester L. Smith, SM IEEE Communication Systems Div., GTE Sylvania, Needham, MA 02194 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC October, 1979 pp. 1-5 <b>ABSTRACT:</b> In considering the problem of the response of a set of whips or monopole-type structures to an EMP event, it is not always possible to neglect the interaction of nearby elements. Situations where mutual interaction must be considered occur where a large number of antennas are installed in close proximity as on board a ship and in circular arrays. Other possibilities are the "Antenna Farm" and a parking lot where there are light poles relatively near one another. This paper develops the theory for determining the open circuit voltages and short circuit currents for such a collection of "antennas" with special attention to the Circularly Disposed Array Antenna (CDAA) or Wullenweber. In some cases, the field itself is quite well defined and the elements of the victim field are sufficiently close that strong interactions may be expected. It is this situation to which the methods outlined in this paper are directed. The solution is given in the frequency domain. <b>INDEX TENNS:</b> EMP, Monopole Antennas, Interaction between Antenna Elements, Antenna Farm, CDAA, Wullenweber, Frequency Domain.	Transient Response of Braided-Wire Shields B. Demoulin, P. Degauque and R. Gabillard, Lille University Electronics Dept., 59 655 Villeneuve d'Ascq Cedex, France 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC October, 1979, pp. 19-26 Struct: We present time-domain measurements to determine the shielding properties of braided coaxial cables. We show the influence of the transfer inductance and capacitance for various geometrical structures of the braid and, furthermore, that the waveform of the response signal depends on the optical coverage ratio of the shield. INDEX TENS: Time Domain, Transient Response, Coaxial Cable, Transfer Impedance, Shield Braid Coverage
Empirical Electromagnetic Pulse Response Predictions Using Stepped Continuous Wave Measurement System Dr. T. W. Buckman, IRT Corp., San Diego, Ca.Dr. C.B. Williams Byron Gage, LCDR W. E. RABKE 1979 IEE International Symposium on EMC, 79CH1383-9 EMC October, 1979 pp. 6-12 Binary Determining the susceptibility of an electronic system to an electro- magnetic pulse is often much more expensive than the actual protection of the equipment. This paper described utilization of a specialized measurement system developed for the Defense Nuclear Agency to empirically predict response of a complex electronic communications installation to an electromagnetic pulse after illuminating the installation with non disruptive low level contin- uous wave radiation. Effect of varying antenna design on pulse response is discussed, and comparisons of predicted and actual pulse response waveforms of several points within the installation are provided. A method of trans- forming the continuous wave data to pulse response is presented. The method shows promise for lightning analysis as well as its obvious cost effectivity as an EMP assessment tool. The paper discussed utilization of the measurement system in assurance testing of electromagnetic pulse protected installations. INDEX TENDS: EMP, Lightning, Empirical Predictions, Cost Effective Analysis	Shielding Effectiveness Measurements on Conductive Plastics D. G. Bodnar, H. W. Denny, B. M. Jenkins Engineering Experiment Station Georgia Institute of Technolog yEMCABS 12-79-05 Atlanta, Georgia 30332 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC ABSTRACT: October, 1979 pp. 27-33 A specialized test fixture for measuring the shielding effective- ness of conductively loaded plastic panels was designed and constructed. This fixture is described in detail. With this fixture, the shielding effectiveness of several test panels was measured over the frequency range of 10 MHz to 1000 MHz. Typical results are presented.
Shielding Effectiveness of Long Cables Albert R. Martin & Steven E. Emert Raychem Corp. Menlo Park, CA. EMCARS 12-79-03 1979 IEEE International Sumposium on EMC, 79CH1383-9 EMC. October, 1979 pp. 13-18 <b>ISTRACT:</b> In this paper, we discuss a revised triaxial method for testing the shielding effectiveness of long cables. Using this method, measurements show that the commonly accepted rule that doubling cable length decreases the shielding effectiveness by half (6 db) holds only for a very special case. In general this rule is not even approximately true, and data are given to illustrate the point. Finally, reasons for the failure of the doubling law are briefly discussed.	A Model for Time Waveform Simulation of FDM/FM Receivers Arecio A. Hernandez, IIT Research Institute/ECAC, Annapolis, Maryland 21402 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC October, 1979, pp. 34-38 <b>INTACT:</b> A computer simulation model developed for determining the manner in which various types of undersired signals affect the performance of FDM/FM receivers is outlined. Continuous wave, frequency modulation, frequency division multiplex-frequency modulation, pulse (chirped and non chirped), binary phase shift keying and quadrature phase shift keying interference signals were modeled. In addition to these interference signals, white Gaussian noise was modeled. The desired (test tone)-to-undesired signal power ratio at the output of a user selected demultiplexer channel was one of the performance measures computed. The Model was validated by comparing model predictions with measured data for a 600-channel RDM/FM system.
Triaxial Cable Test Method	BPSK, QPSK, Interference Noise

	Methodology for Developing Expected Values of Radiated Emissions from Cables John D. Osburn & Donald R. J. White, Don White Consultants, Inc., Gainesbille, Virginia 22065 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC ABSTRACT: October, 1979, pp. 39-45	Multiple-Component Lightning High-Current Testing Edward H. Schulte, McDonnell Aircraft Company, St. Louis, Missouri 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC October, 1979, pp. 56-61 ABSTRACT: NASA-JSC and SAE Committee AE-4L have provided useful documents
	narrowband electric and magnetic fields emanating from small linear and loop radiating elements excited by continuous wave signals is presented. This model is then extended to the broadband excitation case and to varying configurations of radiating elements, and an applications example is presented.	which define severe high current test waveforms for lightning damage effects testing. The defined waveforms pose a challenge to laboratory simulation facilities when attempts are made to simulate the complex waveforms in their entirety. This paper discussed the need and impact of combined waveform testing. It also presents the results of successful efforts to combine a high-peak current, an intermediate current, a con- tinuing current, and a high-current restrike.
	INDEX TERNS: Cable Radiation, Mathematical Model, Electric and Magnetic Fields, Broadband Radiation	INDEX TERNS: Lightning, High Current, Testing, Laboratory Simulation
31	Numerical Electromagnetic Code (NEC) G. J. Burke, A. J. Poggio, Lawrence Livermore Laboratory, Livermore, California 94550 J. C. Logan, J. W. Rockway, Naval Ocean Systems Center, San Diego, California 92152 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC October, 1979, pp. 46-48 <b>AESTRACT:</b> The development and the application of the Numerical Electromagnetic Code (NEC) - Method of Moments are described, NEC is based on a previous method of moments code for this wires, the Antenna Modeling Program (AMP) and yields improved estimates of the performance of antennas mounted on shore stations, ships, aircraft, and spacecraft. The NEC can model antennas in free space, over a perfectly conducting ground plane, and over finite conduction (lossy) earth.	Lightning Protection Design External Tank (Space Shuttle) A. Anderson, Electrical Engineering Section Chief, E. Mumme, Martin Marietta 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC October, 1979 pp. 62-67 Ansulator, During liftoff, the Space Shuttle may be struck by lightning. This paper described Martin Marietta's innovative lightning protection design for the External Tank portion of the Shuttle System. The theory logic and testing which substantiated the design are also discussed.
	INDEX TERNS: Numerical Codes, Method of Moments, Antenna Modeling, NEC, AMP	INDEX TERNS: Lightning, Protection, Space Shuttle
	A Lightning Protection Program For The F-16 Fly-By-Wire System Dr. Carl S. Droste, Grp. Engr., Flight Control Design, Gen. Dynamics, Ft. Worth, Tx., Robert T. Zeitler, James L. Dabold 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC Crober, 1979, pp. 49-55 The General Dynamics F-16 aircraft represents the beginning of a new era in Flight Control System design. The F-16 is the first operational aircraft with a fly-by-wire system where flight control is completely depen- dent on electrical/electronic circuitry. Because of this fly-by-wire system, a program was conducted to design the aircraft against the effects of lightning. Particular concern was paid to lightning-induced voltages and currents which could be coupled into the flight critical systems and subsequently cause damage to sensitive electronic components. This paper is an account of the lightning susceptibility test program performed on the F-16 fly-by-wire system and how that system was hardened against the effects of lightning.	Lightning Near Fields Generated By Return Stroke Current R. A. Pearlman, McDonnell Aircraft Co., McDonnell Douglas Corp., P. O. Box 516, St. Louis, Missouri 63166 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC October, 1979, pp. 68-71 MSTRAUT The electromagnetic transients associated with a lightning strike pose a threat to the electrical systems of nearby aircraft. It is difficult to calculate the coupling to aircraft internal wiring, but it is clear that both electric and magnetic fields are important in the coupling mechanism. The electromagnetic field needs to be treated as a whole in the overall coupling phenomenon. To predict the threat, the lightning phenomena must be understood. Models have been proposed for the effects of lightning in the far field zone, but little has been published about the very near fields of interest in a nearby strike. This paper describes a return stroke model that was constructed to predict the nearby electromagnetic fields (between 20 and 200 Meters from the channel) as a function of lightning parameters such as return stroke velocity, pulse rise time and path tortuosity.
	INDEX TERNS: Lightning, Flight Controls, Electronic Flight Controls, Coupling, Susceptibility, Hardening	INDEX TERNS: Lightning, Coupling, Near Fields, Return Stroke Model, Electromagnetic Fields

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	VHF-UHF Precipitation-Static Interference Effects on Air- craft J. D. Robb,* D. J. Brady, L. Donatich * Lightning & Transients Research Institute, St. Paul, MN. October, 1979, pp. 72-76 <b>ABSTRACT:</b> Precipitation static at VHF frequencies causes interference on communications channels. This can present a serious hazard during ground controlled instrument approaches as well as jeopardizing possible mission success. Experimental investigations of aircraft have disclosed that the severe interference is caused by electrically isolated metallic sections on the aircraft exterior which become charged by frictional contact with atmospheric particles and then sparkover to the airframe. This results	RF Compatibility-Environment to Component Part P. McBrayer, McDonnell Aircraft Co., St. Louis, MO B. Showalter, G.E. Company, Binghamton, NY 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC October, 1979 pp. 91-95 ABSTRACT: The Navy F-18 Fighter Aircraft's Radio Frequency environment on a carrier deck is known from MIL-HB-235. These levels have been analyzed by "method of moments" and trade offs were made for the aircraft weight and the equipment costs which initiated the development of high RF current filter pin connectors. Special tests and procedures were developed for these connectors. Several manufacturers are approved as suppliers of these high		
	corresponding to the diemnsions of the section which is sparking. Also, corona discharges from grounded VHF-UHF antennas cause receiver desensitization without a corresponding break in receiver squelch. The magnitude of the desensitization may reach 30 db. This phenomena suggest a serious potential problem which needs to be identified and corrected. INDEX TERNS: Precipitation Static, Interference, Desensitization, Safety of Flight, Corona, Noise Spectrum.	<ul> <li>a This paper discussed the analysis and trade study results and the general design and application techniques for filter pin connectors. The special test procedures for high RF current tests and lightning tests are discussed and general results of the tests are presented.</li> <li>INDEX TERNS: R.F. Compatibility, EMC, RF Environment, Method of Moments, Filter Pin Connectors, Test Procedures</li> </ul>		
	A Design Guide for Lightning Protection of Aircroft	Using NCAP to Predict RFI Effects in Operational Amplifiers		
	J. Anderson Plumer, Lightning Technologies, Inc., 560 Hubbard Avenue, Pittsfield, Massachusetts 01201 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC	Ta Fang Fang, James J. Whalen, and Gordon K. C. Chen, Dept. of Electrical Engineering. State University of NY at Buffalo 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC October, 1979, pp. 96-103		
17	<b>ABSTRACT:</b> October, 1979, pp. 77-84 It is possible to design an aircraft to be safe from hazardous lightning effects. Lightning protection is most effective and least expensive when designed into an aircraft while it is still on the drawing board. Retrofitted lightning protection is usually more costly and much less effective. Adequate lightning protection influences the design of each aircraft major system and structure. The designers must be made aware of lightning problems and their solutions. This technology is documented in numerous technical reports and references whose existence is unknown to many designers. Sets of checklists are provided for typical aircraft systems together with references to sources of further information. Examples of some of the more common problems are also given.	Applications of the Nonlinear Circuit Analysis Program (NCAP) to calculate RFI effects in electronic circuits containing discrete semiconductor devices and small scale linear bipolar integrated circuits have been reported previously. This paper demonstrates that the computer program NCAP can also be used to calculate RFI effects in linear bipolar integrated circuits (ICs) of greater complexity. The IC reported upon is the µA741 operational amplifier (op amp) which is one of the most widely used ICs. The NCAP was used to predict how amplitude modulated RF signals are demodulated in the op amp to cause undesired low frequency responses. The predicted and measured results for RF frequencies in the .050 to 100 MHz range are in good agreement. The paper contains a complete set of NCAP parameter values for all the transistors in the uA741 op amp. These values may be used as typical data for similar transistors in other ICs.		
	There is besign Guides, Lightning, Protection, Check-list, Hazards	Non, computer Analysis, operational Amplifies EMI		
	Response Coefficients of a Double-Balanced Diode Mixer M. A. Mauizzo, S. H. Cameron 1979 IEEE International Symposium of EMC, 79CH1383-9 EMC October, 1979, pp. 85-90	EMC Concerns in Magnetic Bubble Memory Modules John A. Malack, IBM Corporation, System Products Division, Endicott, New York 13760 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC October, 1979 pp. 104-111		
	<b>ABSTRACT:</b> When receivers are to be deployed in a closely-spaced environment with one or more transmitters, the receiver response to spurious signals is important and largely a function of the first mixer. The use of balanced mixers is widespread, and the balance of the components of these circuits can have a great effect on many of the undesired responses. The results of a computer-assisted analysis of a commonly used double-balanced diode mixer circuit is presented. It is shown that the spurious performance is sharply dependent on how well the mixer diodes are balanced. A computer program based on a Fourier series expansion of the time-dependent coefficients of a Taylor series representation of the four diode currents was employed to compute the response coefficients of the mixer. The method treats the switching action characteristic of the large local oscillator power levels.	<b>ABSTRACT:</b> Magnetic bubble memory devices offer nonvolatile data storage and increased storage densities over contemporary storage devices; they are available world wide. The devices are small and use low signal levels. For operation, they require a unique set of static and dynamic orthogonal magnetic fields. Unlike semiconductors, bubble memory devices do not employ p-n junctions. This paper describes basic bubble memory operation, identifies conditions necessary for memory operation, and presents EMC (electromagnetic compatibility) concerns of a magnetic bubble memory module. Emc concerns of the module are discussed from two aspects: internal compatibility, which considers inherent factors that compromise bubble detection in the unique operation environment; and external compatibility, which considers electro- magnetic factors of the outside environment in which the module must satisfactorily operate. INDEX TERDES Bubble Memories. EMC, Bubble Memory EMC, Magnetic Fields		
	Computer Analysis, Fourier Series, Nonlinearity			

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	The NCAP Nonlinear T Model For Bipolar Junction Transistors at UHF Frequencies Carmen A. Paludi, Jr., Rome Air Development Ctr., Griffiss AFB, NY, and Dr. James J. Whalen 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC INTRACT: October, 1979, pp. 112-117 The Nonlinear Circuit Analysis Program (NCAP) has been used to calculate nonlinear transfer functions which subsequently predict Electro- magnetic Interference (EMI) effects in electronic circuits containing dis- crete semiconductor devices for RF frequencies up to 100 MHz. However, NCAP has not previously been tested nor documented in the UHF frequency range (300 to 3000 MHz). The purpose of this paper is to present the first predic- ted results of EMI effects in discrete bipolar junction transistors, using NCAP's nonlinear transfer functions, in the UHF range. The predicted results will be compared to experimental results.	Determination if Fiber-Optic Immunity is Adequate for Deployment in the V/STOL Airframe John A. Birken, Naval Air Systems Command, Washington, D.C. 1979 IEEE International Symposium on EMC, 79CH1383 EMC <sup>20361</sup> Cotober, 1979, pp. 131-132 <b>INTRACT:</b> Non-metallic materials will replace aluminum in the V/STOL airframe. Fiber-optics are being considered to compensate the material's low frequency transparency. Quantitative predictions and measurements are being conducted to assure that fiber-optic immunity is adequate and essential.
	INDEX TERNS: NCAP, Non-Linear Model, BJT, UHF, EMI Prediction in Semiconductors	INDEX TERNS: Immunity, Fiber-Optics, Low Frequency, Susceptibility
18	The RAE Research and Development Programme on EMC For Air- craft and Flight Weapons Systems J. M. Thomson, Royal Aircraft Establishment, Farnborough, Hants, UK 1979 IEEE International Symposium on EMC, 79-CH1383-9 EMC October, 1979, pp. 118-123 The major emphasis in EMC for aircraft and flight weapons systems must be in areas where its neglect can hazard flight safety or mission success. RAE's research programme is outlined and reviewed to show how the EMC problem is being tackled from source, through coupling mechanism, to susceptible systems.	Electromagnetic Relationships Between Shielding Effectiveness and Transfer Impedance Mr. G. Dike, Dr. R. Wallenberg, Syracuse Research Corp., Syracuse, NY 13210, Dr. J. Birkin, Naval Air Systems Command 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC ABSTRACT: October, 1979, pp. 133-138 There has recently been a proliferation of measurements of the magnetic and electric shielding effectiveness of composite materials. In order to relate these measurements, the transfer impedance to shielding effectiveness are derived for basic shield geometries. The independence of surface transfer impedance from geometry and incident field type is then exploited so that shielding effectiveness data for basic shield geometries may be extended to calculate the electromagnetic shielding for more general geometries.
	INDEX TERMS: EMC for Aircraft, Coupling, Susceptibility	INDEX TERNS: Shielding Effectiveness, Transfer Impedance, Composite Materials, Modeling
	Electrical Bonding in Aircraft J. Brettle and M. W. Baskerville, Plessey Research (Caswell) Limited Allen Clark Research Centre, Caswell, Towcester, Northants 1979 IEEE International Symposium on EMC, 79CH1383-9 EMC ARSTRACT: October, 1979, pp. 124-130 The requirements for reliable low impedance electrical bonds in aircraft are discussed. The problems of making bonds and the often competing requirements of corrosion protection and low interface resistance are described. Some preliminary results on the electrical properties of carbon fibre composite (CFC) materials and bonding of CFC are presented.	EMP Measurements of Composite Panels Mounted on An Aluminum Cylinder Dr. George W. Bechtold, Naval Surface Weapons Center, Silver Spring, Maryland 1979 IEEE International Symposium on EMC 79CH1383-9 EMC ABSTRACT: October, 1979, pp. 139-142 This paper discussed measurements made to determine the shielding of composite panels. The approach was: Tests were conducted in a 20 KV/m EMP field produced by one of the NAVSWC simulators. The test object consisted of an aluminum cylinder with a composite panel, an aluminum panel, or no panel mounted on the surface. The internal H field, E field, and the voltage and current on an internally mounted wire were measured. Comparisons were made for the composite panel, aluminum panel, and no panel installed.
	INDEX TERNS: Electrical Bonding, Corrosion Protection, Aircraft, Composites	INDEX TERNS: Composite Materials, Shielding, EMP, Coupling

A Case for Submicrosecond Rise-Time Lightning Current				
Pulses for Use in Aircraft Induced-coupling Studies				
Don W. Clifford, E. Philip Krider and Martin A. Uman				
1979 IEEE International Symposium on EMC 79CH1383-9 EMC				
October, 1979, pp. 143-149				

ACCESSION NO. EMCABS 12-79-25

ACCESSION NO.

EMCABS 12-79-26

ABSTRACT: Recent measurements of lightning return stroke currents made using both direct and indirect techniques are reviewed and summarized. The data indicate that return stroke current pulses exhibiting submicrosecond rise times are common. Slower rise times reported previously may have been due to instrumentation limitations and, in some cases, to the investigator's definition of rise time. The earlier measurements led to the 2 x 50-microsecond current waveform which is the basis for lightning simulation specifications used in the aerospace industry. Laboratory induced-coupling studies and theoretical considerations are reported which indicate that, for aircraft work, use of the traditional 2 x 50-microsecond waveform represents inadequate testing, since the more realistic, faster pulses contain frequency components in the range of aircraft system resonances.

INDEX TERNS: Lightning, Rise Time, Coupling, Testing Aircraft

Long ARC Simulated Lightning Attachment Testing Using a 150 KW Tesla Coil

Robert K. Golka, Project Tesla, Wendover AFB, Utah 84083 In Conjunction with AF Flight Dynamics Lab. Wright-Patterson 1979 IEEE International Symposium on EMC 79CH1383-9 EMC

October, 1979, pp. 150-155 ABSTRACT: The purpose of the program was to evaluate the Tesla Coil as a laboratory tool for lightning effects research on aircraft. The ability of a Tesla Coil to generate high voltage pulses at high rep rates results in the capability to create artificial lightning-like streamering and long electrical discharge arcs and makes it a desirable alternative to the high voltage impulse generators currently in use. Another characteristic of a Tesla Coil is that many long arcs can be generated over a very short time period. These Tesla Coil Characteristics are highly desirable in lightning effects research using full scale (e.g. an actual aircraft) test specimens. Secondary objectives of the program were to investigate methods for measuring the output attachment characteristics of the Tesla Coil, and the attachment characteristics of an Advanced Design Composite Aircraft (ADCA) model.

INDEX TERNS: Simulated Lightning, Tesla Coil, Composites, Lightning Tests.

Ground Impedance, Ground Coupling, EMI. New Techniques for the Measurement of Natural and Simulated Unscrambling the Mysteries About Twisted Wire Lightning Phenomena Robert B. Cowdell, Consultant - EMC/TEMPEST, 19151 La Loma ACCESSION NO. Lawrence C. Walko, AF Flight Dynamics Laboratory, Wright-Drive, Santa Ana, Calif., 92705 EMCABS 12-79-27 Patterson Air Force Base, Ohio 45435, Timothy J. Seymour 1979 IEEE International Symposium on EMC 79CH1383-9 EMC 1979 IEEE International Symposium on EMC 79CH1383-9 EMC October, 1979, pp. 180-187 October, 1979, pp. 156-159 ABSTRACT: Twisted wire has long been known to increase immunity to ambient Within the last few years new techniques have been developed for magnetic fields as well as to decrease levels of H-field radiation from the measurement of natural and simulated lightning phenomena. These techniques potential sources. This paper answers the following questions: (1) How much have evolved from the need for increasingly accurate measurements of the are radiating magnetic fields reduced when wires are twisted? (2) How much electromagnetic effects of lightning as in regards to aircraft lightning can ambient H-field induced pick-up be reduced by the twisting of wires? protection. This need stems from the use of new technologies such as low (3) How many turns per foot are most effective? (4) Is it possible to power level solid state electronics in critical aircarft circuits and predict pick-up levels in twisted wires? (5) Is it possible to compute advanced composite materials in aircraft structures. This paper describes twisted wire H-field emanations? H-Field pick-up and radiation can be renew techniques used to increase the accuracy of natural and simulated duced up to 54 dB when compared to paralleled transmission lines. H-Field lightning measurements and described techniques that are in development. pick-up and emanation levels can be accurately computed using the transfer functions shown in Figures 4, 5 and 6.

Evaluation of Lightning-Induced Transients in Aircraft Using High-Voltage Shock Excitation Techniques ACCESSION NO. D. W. Clifford & K. S. Zeisel, McDonnell Aircraft Co.,

EMCABS 12-79-28

1979 IEEE International Symposium on EMC 79CH1383-9 EMC October, 1979, pp. 160-166

St. Louis, Missouri

ABSTRACT: The time history of a long-spark discharge to a simulated in-flight aircraft and the corresponding transient signals induced on an internal wire pair were measured in this study. Three separate induced coupling conditions related to the aircraft/lightning interaction process have been identified, and each condition has been studied. The three laboratory conditions are believed to be analogous, respectively, to (a) nearby lightning, (b) steppedleader attachment and (c) return stroke discharge. A unique arrangement of high-voltage (long-spark) generators, electrically floating E-field sensors, fiber optic data links and transient digital recorders was used in this study. Using this equipment, high-voltage shock excitation tests have been developed for each condition and have been labeled E-dot, V-dot and I-dot, respectively, since in each case the induced coupling depends upon the time rate of change of the excitation source.

INDEX TERNS: Lightning, Testing, Sensors, Fiber-optics.

Ground - A Path for Current Flow

Henry W. Ott, Bell Laboratories, Whippany, New Jersey 07981

ACCESSION NO. EMCABS 12-79-29

1979 IEEE International Symposium on EMC 79CH1383-9 EMC October, 1979, pp. 167-170

ABSTRACT: A signal ground is normally defined as an equipotential point or plane that serves as a reference potential for a circuit or system. This definition, does not emphasize the importance of the actual path taken by the current in returning to the source. Only by knowing this can the designer accurately estimate the radiated emission from a circuit, or the susceptibility of a circuit to electromagnetic energy. An alternative definition for a signal ground is: A low impedance path for current to return to the source. This emphasized the importance of the current flow in the ground system. It implies that there will be difference in potential between the two ends. This "current" concept of a ground is also useful in determining where decoupling capacitors should be connected, and explains why, in some cases, eliminating a ground may make a circuit less susceptible to electromagnetic interference.

INDEX TERMS: Grounding, EM Emissions, EM Susceptibility, Ground Current,



INDEX TERMS: Lightning, Measurement Technique, Lightning Protection

INDEX TERMS: Twisted Pairs, H-Field Coupling, H-Field Emissions, Nomagraphs.

	Corrosion Effects on EMI Gasketed Joints George Kunkel, Spira Manufacturing Corporation, Burbank, California 91504 1979 IEEE International Symposium on EMC 79CH1383-9 EMC October, 1979, pp. 198-203 AFSTRACT: The effects which corrosion can have on a gasketed joint is documented This documentation is in the form of illustrating previous published work and the results of moisture and salt spray tests which were performed on gasketed joints. The results include conclusions and recommendations based upon the referenced previously published information and the testing reported in the paper. The recommendations list a series of gasket materials and surface plating which can be successfully used without experiencing excessive corrosion as a function of the required environment and level of shielding.	Applications of Design Communication Alorithm (DECAL) and Performance Evaluation Communication Algorithm (PECAL) S. T. Li, J. W. Rockway, and J. H. Schukantz, Jr. Naval Ocean Systems Ctr., San Diego, Calif. 92152 1979 IEEE International Symposium on EMC 79CH1383-9 EMC October, 1979, pp. 211-214 ABSTRACT: This paper presents the applications of the Design Communication Algorithm (DECAL) and Performance Evaluation Communication Algorithm (PECAL) which are currently being used for the design and integration of shipboard exterior communication systems and non-shipboard cosited communication systems.
	INDEX TERNS: Corrosion, EMI Gaskets, Salt Spray Tests, Testing, Shielding	INDEX TERNS: DECAL, PECAL, Computer Analysis, CAD, Shipboard Communications
20	Electromagnetic Compatibility Analysis Program (EMCAP) An Automated Frequency Management Tool for EMC Between Surface Missile Systems John W. Kozicki, Naval Surface Weapons Ctr., Dahlgren, VA 1979 IEEE International Symposium on EMC 79CH1383-9 EMC AMSTRACT: October, 1979, pp. 204-207 In the modern naval task force, Electromagnetic Interference (EMI) between missile systems poses a serious threat to successful mission completion. An interactive computer program has been developed for use as a fleet tool to rapidly analyze the EMI problem. The program provides frequency management and tactical options to insure Electromagnetic Compatibility (EMC) within a missile equipped task force.	Weapon System Survivability in Electromagnetic Environments W. R. Free and D. E. Clark, Engineering Experiment Station Georgia Institute of Technology, Atlanta, Georgia 30332 1979 IEEE International Symposium on EMC 79CH1383-9 EMC October, 1979, pp. 221-223 AESTRACT: Electromagnetic compatibility considerations are being recognized as an important factor under the weapon system survivability umbrella. The combination of today's weapon system sophistication and the requirement for them to operate in an increasingly dense electromagnetic environment has caused the weapon system survivability scope to be broadened. In the 1980's, efforts must be directed to ensuring that all weapon systems are properly designed and developed so as to enhance their survivability. Also in the 1980's, it will be necessary to shorten the weapon system acquisition cycle to cut costs and to maintain technological leads. These future EMC require- ments can best be met with an integrated EMC system concept or methodology which is based on a long-term approach and provides guidance as to management and engineering goals and actions. The methodology must be cast in terms of the total acquisition process and not be restricted to a single acquisition INDEX TENDS: cycle phase.
	Management The U. S. Navy Combat Readiness Electromagnetic Analysis and Measurement (CREAM) Program John M. Meyers, Naval Surface Weapons Ctr., Dahlgren, VA 1979 IEEE International Symposium on EMC 79CH1383-9 EMC October, 1979, pp. 208-210 ABSTRACT: Electromagnetic Compatibility on combatant ships presents unique problems that require innovative means of solution. The CREAM Program has been initiated to provide the fleet with capable, standardized measurement and analysis equipment and techniques and trained personnel so that an effective Navy-wide electromagnetic compatibility effort can be implemented and sustained. INDEX TERMS: Shipboard EMI, CREAM Program, Navy EMC	Survivability, EM Environment, EMC, Integrated EMC System Concept, Management. Statistical Measurements and Modelling of HVDC Powerline Noise Wilfred R. Lauber & Jean M. Bertrand, Communications Research Centre, Dept. of Communications, P.O. Box 11490, Station H Ottawa, Canada K2H 852 1979 IEEE International Symposium on EMC 79CH1383-9 EMC Oct., 1979 pp. 224-231 ABSTRACT: Both basic and statistical measurements of HF radio noise near a HVDC transmission line and converter station were made in Winnipeg in July 1977. Values of V <sub>rms</sub> and V <sub>d</sub> were calculated from the amplitude probability dis- tributions (APD) of the radio noise and were found to compare favourably with the directly measured values. Four models, the Rayleigh and three others, which were designed for atomospheric noise, were fitted to the measured APD data. The measured noise was inherently non-Gaussian, thus, the Rayleigh model was a poor fit, but Atomspheric, Log-Normal and Hall models also compared favourably with the measured ACR data. INDEX TERMS: HF Radio Noise, APD, Log-Normal Model, Hall Model, Atmospheric
	2	5 Noise Models, HVDC Power Lines.

**Book Reviews** 



by Jim Hill, EMXX Corporation

We have three reviews in this issue. As promised, Jim Toler has submitted a review of "Electromagnetic Interference Control in Medical Electronics." Dr. Henning Harmuth has offered a review of a Russian book on sequential transmission. In addition, we have a review of Dr. Schlicke's book by Aaron Sullivan. I trust that this varied fare will have something of interest to our readers.

#### "Electromagnetic Interference Control in Medical Electronics"

ВУ

Michael F. Gard Published by Don White Consultants, Inc. State Route 625, P. O. Box D Gainesville, VA 22065, 1979 186 pages, \$29.50

> Review by Jim Toler Georgia Tech, Atlanta, Georgia

The Foreword and Preface state the aim of this book as being to communicate the "how" and "why" of EMC to medical electronic device designers who need maximum information in minimum time to meet deadlines and guidelines. It is then acknowledged that EMC is an unfamiliar and/or uncomfortable topic with many designers, and that designers of medical electronic equipment tend to have little experience with EMC. In view of this acknowledgement, the aim of the book seems overly ambitious, especially when the text length and general nature are considered. In fact, the book does not achieve its stated aim, but is effective in creating an awareness of most of the medical electronic areas that require EMC design attention.

Early chapters in the book provide an overview of designer-oriented EMC considerations in medical facilities and electronic devices. A definition of basic EMC terms would be helpful, especially in view of the lack of EMC familiarity of most medical electronic designers. The need for EMC design consideration in clinics and hospitals is well presented in spite of the fact that reference numbers do not always seem to fit the cited reference. Major electromagnetic contributors to present and predicted hospital environments are thoroughly and correctly identified; however, units on some graphs presenting unit conversions need to define the system used to express exponential terms. As written, these terms are, at best, confusing and, at worst, incorrect. Material concerned with types of equipment causing EMC problems and types of equipment responsive to hostile EM environments are well written and deserve special notice from medical electronic device and facility designers. Comments on how the FDA EMC guidelines evolved and how they should be used describe clearly the public review process that was used and the referee technique. To be complete, it would have been helpful to the designer to point out

some of the numerous pitfalls that a medical device designer should avoid in design/test efforts (for example, the - 40 dB error that can result when radiated emission tests are conducted in shielded enclosures). Also, it would have been helpful to know how the susceptibility limits for one device are related to the emission limits of other devices expected to be located in close proximity.

Electrical safety requirements have historically been one of the purposes for which EMC controls are imposed, in spite of the fact that EMC control for electrical safety is often not recognized. In a clinic or hospital environment, however, electrical safety requirements take on a much more urgent meaning. These hospital safety requirements are effectively presented in EMC terms, and what they translate to in medical electronic device design is clear yet concise. Improvements might be provided by referencing the work of Kouwenhoven, Walter, Aronow, etc., in material concerned with the derivation of leakage current limits. Also, a good figure showing the human body and its various electrical interconnections with power systems, equipment leads, patient circuits, etc., would add to the electrical safety information (see Figure 1.2 in "Detection and Elimination of Hospital Electrical Hazards" by Sprawls and Peterson). The influence of power distribution systems on electrical safety is well-presented and related to patient lead-leakage currents and chassis leakage currents. As always, more information on typical hospital and clinic grounding systems would enhance the designer's understanding of the hostile conducted environment within which medical electronic devices must reliably function.

Later chapters in the book deal with specific EMC design techniques at the device and system levels. Individual designs, however, tend to exhibit their own characteristics and it is, therefore, difficult to provide thoroughly applicable universal design techniques. This situation is marginally accommodated by (1) presenting only design generalizations and (2) classifying all medical electronic devices as either analog or digital. Such generalizations and classifications often result in the designer being unable to relate specific design problems to the presented material. This leads to the adequacy of the presented material being argued. For example, consider the design generalizations for operational amplifiers and note that Figures 1.3 and 1.5 (Chapter 1) show large conducted emissions at frequencies below 3 kHz in hospitals. Consequently, the generalization that analog circuits are relatively immune to conducted interference because of their low passband (slew rate) is not entirely adequate.

Perhaps, the designer might argue, the generalization should note that many analog circuits are differential with high common-mode rejection, or that the input to analog patient monitoring circuits only interconnect the patient and the equipment (not the "rest of the world"). Even with low frequency passbands, operational ampli-fiers with single-ended inputs may be susceptible to conducted 60 Hz stray currents unless the circuits and interfaces are properly designed. Further, the designer might argue, why are analog circuits presented as being susceptible to radiated but not conducted interference, while digital circuits are presented as being susceptible to conducted but not radiated interference?

If a published reference were cited or an explanation (rather than a generalization) given, the matter of analog and digital device susceptibility to emissions could be appreciably clarified. In view of the generalized nature of the design information, it would have been most helpful if one or more specific references had been cited for each EMC design technique. The designer could then obtain the references of interest and find design information and guidance in much greater detail.

Overall, the book can be viewed as a needed and useful first step toward providing the "how" and "why" of EMC to medical electronic device designers. It successfully creates an awareness of EMC in that essentially all major EMC areas that a designer must consider are mentioned. However, detailed design guidelines are not provided for most of these areas. Consequently, the book should be considered as an introduction to EMC in medical device design, and specific (rather than general) EMC guidelines useful to the designer of both medical devices and facilities should be assembled and published.

"Sequential Transmission of Digital Information in the Presence of Intersymbol Interference"

D. D. Klovsky and B. Nikolaev (Translated from the Russian by B. Kuznetsov) MIR Publishers, Moscow, USSR, 215 pages

> Review by Dr. Henning Harmuth Catholic University, Washington, DC

Klovsky has written - sometimes with coauthors - at least four books on communications in Russian, but the language barrier has restricted their distribution. This paperback enables the English reading scientist to learn about the state of the art of radio receiver design in the Soviet

26 22

Union. The first three chapters develop the theory of digital signal transmission via radio links, the fourth discusses technical problems, and the fifth treats in some detail the design of modems for the transmission and reception of short pulses. A list of the chapter headings gives a good summary of the book: 1, Linear Dispersive Channels with Memory and Additive Noise; 2, Optimal and Suboptimal Detection of Sequentially Transmitted Digital Messages in the Presence of Intersymbol Interference; 3, Performance Comparison of Sequential and Parallel HF Communication Systems; 4, Some Engineering Problems in the Syn-thesis of Optimal and Suboptimal Recievers for Sequential Digital Communication Systems using Channels with Frequency-Time Selectivity; 5, Basic Embodiments of a Modem for the Sequential TPP Data Communication System.

It is very unusual that a book ranges from basic theory to equipment design. The field of information transmission in the presence of noise and distortions has been particularly plagued by an outpouring of theory with little or no connection to the real world. This book is an excellent example that good theory and good engineering can be combined.

Let us add a few comments on the commercial side of this book. Such a specialized book would be very hard to publish in the western world. At best, one could print the usual 2,500 copies, while MIR was able to print 10,700 copies. The price is stated as 97 kopeks, which equals about \$1.60 at the official rate of exchange. Since specialized scientific and technical books are almost always ordered individually from the publisher in the western world, one needs about \$5.00 to cover selling expenses. This, in turn, calls for a price of about \$15.00 or more for the book, in order to keep the selling expense from being too large a fraction of the total cost. To produce a paperback with a stated price of \$1.60 is very commendable; but, it is not clear how MIR will solve the selling problem of the western world that differs so much from the one in the Soviet Union.

The translator did an excellent job, considering that he probably has never been in an English speaking country. There are definitely unfamiliar, although understandable, terms like "bandwidth-duration product" for "time-bandwidth product," and the title of the book would sound less translated in the form "Serial Transmission of Digital Signals in the Presence of Intersymbol Interference." "Electromagnetic Compossibility"

BY Dr. Heinz M. Schlicke Published by Interference Control Co. Milwaukee, Wisconsin, 1979, 110 Pages, \$13.00

Review by A. H. Sullivan, Jr. Sullivan Associates, Rockville, Maryland

Many books have been written on electromagnetic compatibility, radio frequency interference and so-called "electrical noise." To warrant critical attention, a new book in this technical area should contain a new approach - and, this one does.

The author states concisely that he is "aiming at the cutting edge of the art" in electromagnetic compatibility (EMC) through application of basic physical, mathematical and electromagnetic principles. He assumes that his audience is familiar with EMC standards and codes, as well as the basic aspects of impedances, grounds, shields and filters. He warns that he will not go over that well-trodden field again but will proceed into theory and practice in the relatively unexplored area of multifaceted industrial, commercial and nonmilitary EMC. To this reviewer's knowledge, this is the first book to be devoted exclusively to the engineering science of analysis and control of EMC in modern electrical circuits, components, and systems used in the industrial world.

H. Schlicke is an outstanding engineering scientist who previously had written "The Essentials of Dielectromagnetic Engineering" (John Wiley, 1961) and had contributed to many other texts on materials, circuitry and electromagnetic compatibility. He is an IEEE Fellow and was twice president of the IEEE Electromagnetic Compatibility Society.

He states that the word "compossibility" is, according to Webster, "the possibility to live together." The book's emphasis, therefore, is on basic electrical engineering principles, as applied to complex systems whose components and circuits must "live together" and, therefore, must be compatible electrically.

It is pointed out that the problems of attaining compatibility in industrial systems are greatly magnified by the multiplicity of sources and sensors (not always recognized by designers); by general nonlinearity of circuits due to the presence of magnetic and dielectric materials and also as semiconductors; by a wide spread of frequencies and wave forms; and by changing circuit conditions due to corrosion of connectors, fasteners, and ground systems.

This is not a book of recipes for the nonmathematically minded technician or craftsman. It is a book that uses principles of physics and electromagnetic theory to solve problems caused by unwanted electrical currents and voltages that can be harmful to equipment and dangerous to humans. The author has coined an acronym, FATTMESS, for the critical EMC parameters: F (frequency), A (amplitude), T (time), T (temperature), M (mode), E (energy), S (structure, size), S (statistics). The acronym is not frivolous; it refers to actual EMC problem areas occurring in any structure or circuit having electrical properties. The acronym serves as a warning to the practicing engin-eer that designing for EMC is complex and a reminder that each of the eight important aspects of EMC must be considered.

The book is well organized. In fact, the author has taken pains to point out in Chapter O his exact objectives and how they are carried out in the succeeding 11 chapters. There are no wasted words, and one must proceed carefully to profit fully from the well programmed presentation.

This is not a text of theory alone, although it delves deeply into the technical aspects of modern circuitry, solid-state devices, optical components, and the use of dimensionless representations. It also contains many examples of difficult EMC problems and their solutions, a considerable number of mathematical models of EMC situations, and a variety of practical approaches to breaking down what may appear to be insoluble EMC complexities into pieces that can be handled.

Theory is applied to electrical circuitry where incidental inductances and capacitances can cause major changes in so-called circuit constants; where external voltage and current disturbances can cause malfunctions of switches, controls, and data processors, with subsequent catastrophic disruption of equipment and systems; and where changes in connector and contact impedance due to aging can create major system unbalances.

The subjects covered include identification of electrical interference sources, transfer media, and a description of receptors and their EMC hazards. There is a thorough discussion of the limitations (and dangers) of using standards, codes, and specifications without full consideration of understanding of complete circuit parameters. For example, an electrical ground, designed according to accepted standards, is not always a ground, particularly at higher frequencies, or under conditions of very high impulsive current (as in a lightning stroke), or when the ground resistance is high (shale, sand, rock), or when the ground elements are corroded and cause dangerously high circuit impedances. Chapter 9 gives key pointers to architects and contractors on designing and installing ground systems.

A theme of cost-effectiveness runs through the entire book. Electrical equipment and systems should be designed for compatibility, the author stresses, to avoid costly system breakdowns (due to electrical interference with control circuitry) and to prevent hazardous (frequently unknown and unforeseen) working conditions for humans.

The book is recommended for all engineers and contractors who must design, install, and maintain industrial and commercial electrical systems. Although not specifically directed at aerospace technical people, they, too, can profit from studying the principles and examples.

My one reservation: although the figures and diagrams are excellent technically, they are hard to grasp and would have benefitted greatly from further explanation and considerable enlargement and decluttering.

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#### EMC SOCIETY AWARDS PRESENTED AT THE 1979 INTERNATIONAL SYMPOSIUM IN SAN DIEGO

The presentation of the annual awards was made at the Symposium in San Diego. Recipients of the awards were as follows:

The Richard R. Stoddart Award, a new award this year, was presented to Dr. Ralph M. Showers in recognition of his outstanding performance in the development of national and international standards in the control of electromagnetic interference. A monetary sum of \$100 goes with this award.

Leonard W. Thomas, Sr., received the Laurence G. Cumming Award, also new this year, in recognition of his outstanding service in contributing to the administration and overall success of the Society. This award consists of a bronze plaque.

The Certificate of Appreciation was given to Edwin L. Bronuagh for outstanding contributions to the welfare, administration, and overall success of the Society.

The Certificate of Achievement was presented to Donald A. Weber for outstanding contributions in the architect/engineer planning cooperation for large electromagnetic test facilities.

Myron L. Crawford also received a Certificate of Achievement for his outstanding contributions in the development of the TEM Cell as an electromagnetic compatibility test device.

Certificates of Acknowledgement were presented to Donald N. Heirman for services rendered in the promotion of intersociety relations and to Fred J. Nichols for services rendered as Chairman of the 1979 International Symposium on Electromagnetic Compatibility.

The Transactions Prize Paper Award was given to T. K. Sarkar, D. D. Weiner, and R. F. Harrington for their paper titled "Analysis of Nonlinearly Loaded Multiport Antenna Structures Over an Imperfect Ground Plane Using the Volterra-Series Method." This was published in the Transactions Vol. 20, No. 2, May 1978. An award of \$50 was made to each author.

The Chapter-of-the-Year Award was made to the New Jersey Coast Chapter and to the Washington, DC Chapter. The scoring was so close that a tie was declared.

#### FIVE EMC SOCIETY MEMBERS ARE NEWLY ELECTED FELLOWS

The 1980 class of Fellows of the IEEE includes five EMC Society members. They are Fred Bauer of Dearborn, MI; Rexford Daniels of Concord, MA; Bernhard Edward Keiser of Vienna, VA; John J. Kelleher of Falls Church, VA; and Edward Nelson Skomal of Redlands, CA. The citations for each of the new Fellows read as follows:

- Fred Bauer "For accomplishments in the unification of worldwide vehicular radio frequency interference standards and innovations in the technology of electromagnetic compatibility."
- Rexford Daniels "For innovative concepts and leadership in the study and publicizing of the beneficial use of non-ionizing electromagnetic energy and its potential dangers due to biological side-effects."
- Bernhard Edward Keiser "For original contributions to a more precise understanding of radiation system phenomena, in particular, spacecraft electromagnetic compatibility and extremely low frequency communication systems."
- John J. Kelleher "For continued and sustained technological contributions in the field of telecommunications, especially domestic and international satellites for space to earth and earth to space with associated electromagnetic compatibility."
- Edward Nelson Skomal "For contributions to the experimental and theoretical determinations of surface and airborne man-made incidental radio noise environment of metropolitan areas."

## NOTES FROM SEQUENCY UNION



#### IMPULSE RADARS

I have recently discovered that a significant amount of applications work with impulse radar has been performed. This work is very fascinating and involves a number of scientific areas as diverse as archaeology and oceanography. Impulse radars have been used on land and water as well as in the air! The advanced state of art of impulse radar is impressive. The purpose of this brief article is to outline some of the applications and to provide some references for interested researchers to pursue.

Currently the major manufacturer of impulse radars is Geophysical Survey Systems, Inc., 15 Flagstone Drive, Hudson, NH 03051. They offer a number of complete systems employing a variety of pulse widths ranging from 6 nanoseconds to as short as 1 nanosecond. However the linear system characteristics of the transducers limit the bandwidth of the transmitted and received pulses so that the devices exhibit a bandpass type of frequency response.

An interesting group of three papers in a 1974 conference discuss some of the previous work on ground-probing radar. The conference, sponsored by the American Society of Civil Engineers (same address as IEEE headquarters), was entitled "Subsurface Exploration for Underground Excavation and Heavy Construction". The three papers appear in succession on pages 175 through 232 and were authored respectively by John Cook, David Moffatt and Rexford Morey. Two of these papers deal with impulse and video pulse radars. In one instance a video pulse with a 0.25 nanosecond 3 db width was used, although the antenna and its matching network broadened the width to 2 ns. Also at that time CALSPAN of Buffalo, NY was active in ground-probing radar.

BY G. ROBERT REDINBO



The Centre for Cold Ocean Resources Engi-neering of Memorial University of Newfoundland, St. Johns, Newfoundland, has made extensive use of impulse radar in its studies of sea ice. James Rossiter is the leader of the Ice Detection Group there. They have provided the incentive for the airborne use of this type of radar. Such radar has been mounted on both fixed-wing and rotary-wing aircraft. Several of their recent reports, e.g., numbers 79-9, and 79-10, give the test results for an impulse radar mounted on a de Havilland Twin Otter. Also comparisons were performed with more conventional pulsed-CW radars. Data was collected at altitudes from 100 to 300 feet with aircraft speeds of 100-140 knots. Earlier results on the use of impulse radar in determining the underwater shape of icebergs were reported in Nature (vol. 271, No. 5640, 1978) and

Desalination (vol. 29, pp. 99-107, 1979). The Tatter paper includes comparisons with the British Antarctic Survey System, a very successful lowfrequency radar sounding system.

Other novel applications of impulse radar have surfaced. The assessment of peat reserves is accomplished by mapping wide areas with the impulse radar. The resulting two-dimensional display provides a cost effective tool for mining resource management. Historical archaeology has employed this type of radar. The University Museum, University of Pennsylvania, has used impulse radar to map underground discountinuities to indicate where items of archaeological interest might be located. For example buried pipe or the remnents of brick walls are easily detected. An unusual application involves the measurements of changes in soil moisture. This is a consequence of the fact that the propagation velocity, which can be measured easily with impulse radar, varies according to the moisture content of the soil.

#### CALL FOR OPPONENTS

### PANEL DISCUSSION ON SUBSTITUTE RADIO SIGNALS WITH LARGE RELATIVE BANDWIDTH

A discussion panel on sequency theory in general and radar with large relative bandwidth in particular is being organized for the 1980 IEEE International Symposium on Electromagnetic Compatibility to be held in Baltimore MD, from 7 to 9 October 1980. The discussion is primarily planned to be on radar, since about 40 carrierfree radars have been built, and they have been used in many applications, including an airborne radar. It is expected to have an exhibition booth at the Symposium to answer questions about practical implementation conveniently and convincingly.

At this time, the discussion panel has members from the US and the Peoples Republic of China, while additional members are hoped to come from Canada, West Germany and the Soviet Union. All these members are proponents of nonsinusoidal radio signals in general and radar with large relative bandwidth in particular.

A strong effort was made to find opponents willing and able to serve on the Discussion Panel. Numerous invitations were mailed, particularly to persons who had published opposing opinions in journals of the IEEE. These efforts have so far been without success.

Anyone who not only opposes the use of radio signals with large relative bandwidth commonly referred to as nonsinusoidal signals but is willing and able to do so as member of a Discussion panel at a major IEEE Symposium conveniently located in the Washington area, is invited to submit his or her name to the organizer of the Panel (H.F. Harmuth, Department of Electrical Engineering, Catholic University, Washington, DC 20064) or to the Committee Chairman for the Sequency Union (G.R. Redinbo, address inside cover)

#### USAB CAREERS GOAL

The USAB Program Goal IV, Improve Career Conditions and Opportunities, has been budgeted for \$110,000 and has five projects as follows:

Employer Cooperation in Professional Career Maintenance and Development

Project 4041 is designed to encourage employers to provide full financial and other necessary support for professional career maintenance and development of their electrical engineers.

Age Discrimination

Project 4042 will provide a national program aimed at creating awareness and taking appropriate action when engineers are discriminated against because of their age.

Committee on Professional Opportunities for Women (COMPOW)

Project 4043 will promote affirmative action principles for women in Electrical Engineering; to identify and address special problems that women encounter in entering and advancing in Electrical Engineering; to encourage the participation of women members in IEEE activities; to act as a resource for inquiries to IEEE concerning women in Electrical Engineering.

Manpower Activities

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Project 4044 will assess newly emerging forces as well as changes in force that influence the engineering manpower market, and attempt to develop improved manpower projection models.

#### NATIONAL ENGINEERING FOUNDATION URGED

A "National Engineering Foundation," paralleling the National Science Foundation, would help the United States improve productivity and increase innovation, said IEEE Vice President Dr. Bruno Weinschel, lead-off speaker at the IEEE Conference on U. S. Technological Policy.

"Only a small fraction of the fruits of basic research is useful and...only a fraction affects productivity and innovation and usually after a time delay of one or two decades," Weinschel said.

"In order to reestablish our competitiveness in modern sophisticated manufacturing engineering, we must teach in our universities additional 'application oriented' sources," he stated.

#### USAB POSITION PAPERS

The following summaries represent a few of the position papers available from the Washington USAB Office. Positions dealing with Patents, Pensions, Solar Energy, Solar Power Satellite, and Breeder Reactors are also available, upon request. For further information or copies of the following, write. IEEE/USAB Office, 2029 K St., N.W., Washington, DC 20006.

Summary of IEEE Position on Electricity in the United States Economy

The position statement addresses the perceived need for a national energy policy to be developed by the government, in cooperation with industry and technical and professional organizations. The availability of energy is noted to be fundamental to the welfare and economic health of society.

The position recommends prompt action to promote utilization of coal and uranium for electric power generation, as well as major emphasis on conservation, efficiency, and reliability. Adequate public safeguards and environmental protection is urged, as well as the development of most favorable new and advanced energy technologies.

### Summary of IEEE Statement on Fusion Power

The IEEE endorses fusion power as a source of abundant fuel with reduced radioactive hazards and environmental impact, as well as the potential for improved operating safety. The IEEE urges the continuance of broad areas of international cooperation in promoting fusion power, and fears that the present funding levels, although significant, correspond to research level programs, without adequate provision for the engineering development of demonstration devices leading to construction of full-scale on-line power plants.

The Institute, therefore, urges substantial increases in funding levels for fusion power.

The Institute also urges the adoption of measures to promote voluntary compliance with energy conservation techniques, as well as cost incentives. The Institute also supports the review of appropriate product performance requirements and building codes in improving conservation.

#### Summary of IEEE Position on Role of the U.S. Government in Civilian Communications Satellite Research and Development

The IEEE is concerned with the dramatic decrease in funding for domestic communication satellite research and development since the U.S. Government withdrawal from that role in 1973. While the U.S. enjoyed an early lead in the development of communication satellite technologies, that lead is rapidly evaporating. In the countries committed to communications satellite R&D programs, government funding for them outweighs that of the U.S. by a substantial margin.

The IEEE recommends that the U.S. Government resume active participation in communications satellite research and development, as industry cannot fill the void left by the U.S. Government in this role in 1973. The position of the Institute stresses that additional R&D support be extended to include:

- Communications technology, including improved modulation and multiple access systems.
- b. Communications satellite technology, including higher frequencies, greater radiated power, multiple beam antenna, on-board processing, and inter-satellite links at microwave and optical frequencies.

#### Summary of IEEE Position on R&D

The Institute voices its concern that domestic investment in research and development has been declining since 1965 when measured as a percentage of the GNP. The position focuses on the downward trend in government support for research and development in three areas: research and development conducted by the Department of Defense, the National Science Foundation, and the National Aeronautics and Space Administration.

The position recommends that in order to reverse this trend, it should be national policy to devote 3 percent of the GNP to research and development; also, that the Federal Government take the necessary steps to fill the gap between privatesector support for R&D and this 3 percent figure. Further, the Government is urged to make appropriate allowances and inducements to promote private-sector investments in research and development and that these investments exceed 1 percent of the GNP. Finally, the position urges modification of Government regulations and procedures which discourage long-term research projects.

#### Summary of IEEE Position on Energy Conservation

It is the IEEE position that energy conservation programs should be given the highest national priority in energy planning. In promoting such programs, the Institute urges consideration of the following concepts and objectives:

- a. Immediate reduction of energy use by measures such as modifying thermostat settings, car pooling, and lowering lighting levels.
- b. Improvement of efficiency of the transportation sector.
- c. Application of modern technologies for improved control and utilization of energy.
- Reduction of energy loss during generation, transmission, and coversion of energy.
- Recapture of waste energy released during generation and use.
- Maximum utilization of work capability of energy prior to use for space or water heating.
- g. Utilization of energy potential of discarded solids and liquids, including agricultural, industrial and municipal waste, and sewage sludge.
- h. Maximum recovery and reuse of materials and products which require relatively large amounts of energy in their production and distribution.
- Reduction in use of energy intensive materials having short service life and poor recoverability relative to competing materials.

#### METRIC BOARD TO BECOME MORE AGGRESSIVE

The United States Metric Board is advancing from the coordination stage of voluntary conversion to the metric system to a more aggressive open advocacy and leadership effect on behalf of metrication. Metric Board Chairman, Louis F. Polk, has stated that the Board will take the initiative to encourage and support an environment which will facilitate conversion as required by the Metric Conversion Act.

#### PROPOSED IEEE CONSTITUTIONAL AMENDMENTS DEFEATED

Constitutional amendments calling for the direct election of the Vice President of Professional Activities and for the direct election of the Nominations and Appointments Committee failed to receive the necessary two-thirds majority of ballots cast in this year's voting by the members of The Institute of Electrical and Electronics Engineers (IEEE). Neither amendment received even a simple majority, the first failing 18,541 to 21,387 and the latter failing by a margin of 19,859 to 20,227.

Under the present system, the Vice President of Professional Activities is elected by the annual Assembly, which consists entirely and solely of member-elected IEEE Board officials. The proposal for direct election by US voting members was opposed by the IEEE Board of Directors on the grounds that the present procedure provides for election by a democratically elected annual Assembly and, thus, provides for effective membership expression in professional activities. The Board further maintained that the proposed amendment did not allow for direct input by the technical societies in the election of an officer who directly affects their well-being. It also was stated that the proposal would deprive membership outside of the US of a vote in the election of the Vice President of Professional Activities, an activity which affects the entire profession worldwide.

Robert C. Bruce, Senior Member of IEEE and the principal petitioner for the proposed amendment claimed that the proposal, which would have made the Vice President of Professional Activities, who also serves as the Chairman of the United States Activities Board (USAB), a member-elected officer, would restore responsiveness to the position and make the position petitionable by US members.

The Nominations and Appointments (N & A) Committee is responsible for the recommendation of candidates for office to the annual Assembly and the Board of Directors. Under the present system, the N & A Committee is chaired by the Junior Past President and has as members the President, the Senior Past President, and nine additional members elected by the Board of Directors. The proposed amendment, which called for the election of the N & A Committee by voting members of IEEE, would have made the incumbent President ineligible to serve on the Committee during the term of office and for six months thereafter. Moreover, no past President would have been eligible to serve as chairman of the Committee.

The proposed amendment was opposed by the IEEE Board of Directors on the grounds that it would weaken the demonstrated effectiveness of a knowledgeable committee, experienced in the diverse activities of The Institute, which is now able to match IEEE requirements to the proven capabilities of selected candidates.

38 29

#### INSTITUTIONAL LISTINGS

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

> SERVICE DIVISION, AMERICAN ELECTRONICS LABS., INC., Richardson Rd., Montgomeryville, PA 18936 EMI/EMC, shield, enc. consult. test. & anal.; Scrn. rm. (incl. for large veh.); Comp. instr. for Mil. EMI test.

AILTECH, Los Angeles Operation, 5340 Alla Road, Los Angeles, CA 90066 Computer operated/automatic/manual EMI test-system, EMI meters, antennas, and components.

ELECTRO-METRICS, Division of Penril Corp., 100 Church St., Amsterdam, NY 12010 EMI meters and automated systems incl., calculator/computer-based;20 Hz-40 GHz\*MIL-STD/CISPR/VDE/SAE/FCC.

EMERSON & CUMING, INC., Canton, MA—Gardena, CA—Northbrook, IL. Eccoshield RF shielded chambers—Eccoshield EMI/RFI gaskets and materials—Eccosorb anechoic chambers.

METEX ELECTRONIC SHIELDING GROUP, A Unit of Metex Corporation, 970 New Durham Road, Edison, NJ 08817 EMI/RFI, EMP & EMC Shielding Materials, Custom-Engineered Conductive Components, and Coatings.

> CENTRALAB/USCC, 4561 Colorado Blvd., Los Angeles, CA 90039 EMI/RFI Filters, Monolithic Ceramic Capacitor (Chips).

TECKNIT, INC., 320 N. Nopal St., Santa Barbara, CA 93103

EMI/RFI Shielding Products, Conductive Components, Textiles, Coatings, Adhesives, and EMC Windows.

HONEYWELL, ANNAPOLIS OPERATION, P. O. BOX 391, Annapolis, MD 21404 Telephone (301) 224-4500

EMI/EMC/TEMPEST, R & D, Test and Analysis, Communication and Digital Design.

CHOMERICS, INC., 77 Dragon Ct., Woburn, MA 01801 Telephone (617) 935-4850

EMI/RFI shielding materials: gaskets, adhesives, coatings, shrinkable cable 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.

An Institutional Listing recognizes contributions to support the publication of the IEEE Newsletter and TRANSACTIONS ON ELECTRO-MAGNETIC COMPATIBILITY. Minimum rates are \$75.00 for listing in one issue; \$200.00 for four consecutive issues. Larger contributions will be most welcome. No agency fee is granted for soliciting such contributions. Inquiries, or contributions made payable to the IEEE, plus instructions on how you wish your Institutional Listing to appear, should be sent to M. Bonaviso, The Institute of Electrical and Electronics Engineers, Inc., 345 East 47 Street, New York, NY 10017.

30