#### Electromagnetic E E Compatibility Society Newsletter (ISSN 0164-7644) ISSUE NO. 111 EDITOR: ROBERT D. GOLDBLUM FALL 1981 FCC RECEIVES DB AWARD NATIONAL RADIO SCIENCE AND EMP MEETING The dB Society has voted unanimously to The 1982 International Symposium sponsored award its Traveling Trophy for the year 1982 to the Federal Communications Commissby the IEEE Antennas and Propagation Society (AP-S), the National Radio Science Meeting ion for its "Outstanding International sponsored by USNC/URSI Commissions, and the Contribution to the Field of Electromagnetic Nuclear EMP Meeting (NEM) sponsored by the Compatibility." The Traveling Trophy is Permanent NEM Committee, and in cooperation awarded yearly to an outstanding individuwith the Harry Diamond Laboratories (ARMY), al, company or professional organization Naval Surface Weapons Center, Air Force for technical contributions to EMC endeav-Weapons Laboratory and Defense Nuclear Agency, will be held jointly on the campus of the University of New Mexico, Albuquerque, ors. The IEEE was the 1977 recipient of the award. For the year 1978, the Air May 24-28, 1982. The technical sessions for Force Systems Command was the recipient. IEEE/AP-S, USNC/URSI and NEM will be coor-In 1979, the Naval Air Systems Command was the recipient. The North Atlantic dinated to provide a comprehensive and well Treaty Organization (NATO) was awarded the balanced program. Authors are invited to trophy for 1980 and it was on display at submit papers on all topics of interest to NATO Headquarters in Brussels for that the AP-S and URSI membership. Inquiries regarding the technical program may be di-rected to: Dr. Kendall F. Casey, The year. The award presently resides with the SAE in Warrendale, PA for 1981. Dikewood Corporation, 1613 University The dB Society is a fraternity of eminently Blvd., N.E., Albuquerque, NM 87102. All qualified engineers devoted to excellence summaries and abstracts must be received in the field of Electromagnetic Compatibefore January 4, 1982. bility (EMC). Its charter fosters the conservation of the electromagnetic spectrum, promotes the introduction of young engineers into the EMC field, and provides financial assistance to engineering students in pursuit of studies related to our field. IEEE ELECTROMAGNETIC COMPATIBILITY SOCIETY NEWSLETTER is published quarterly by the EMC Group of the Institute of Electrical and Electronics Engineers, 6014849 SM EDWIN L BRCNAUGH 27N \*\*\* Inc., 345 East 47th Street, New York, SEP10 NY 10017. Sent automatically and 6024 CAMMIE WAY without additional cost to each member SAN ANTONIO TX 78238 of the EMC Group. Second-class postage paid at New York, NY and additional mailing offices. 1

#### EDUCATION COMMITTEE NEWS

A session on EMC Education (sponsored by the Education Committee) was held at this year's symposium in Boulder, Colorado. The session was very successful, with much interest and enthusiasm shown by the 65 attendees.

A preliminary version of the video tape, "An Introduction to EMC," produced by the Education Committee, was shown at the session, as well as in the IEEE EMC Society booth in the exhibit area and received a favorable response. Questionnaires were distributed to those watching the tape. Over 90 responses were received and they are being analyzed. As a result of these comments, changes will be made to the tape and a final version will be produced some time next year. Anyone interested in receiving information on the availability of the tape should send me their name and address for inclusion on the mailing list.

The following is a listing of some of the seminars and short courses being offered in the near future on EMC related subjects:

Don White Consultants will be offering Introduction to EMI/RFI/EMC in San Francisco on December 8-10. Grounding and Shielding is scheduled for Philadelphia on November 17-19. EMC Design and Measurement for Control of EMI will be presented in San Francisco on November 16-20. For additional information on these courses, contact Don White at 703-347-0030.

The Continuing Education Program at George Washington University is sponsoring a 2-day short course on Grounding, Bonding, and Shielding in Washington, DC on December 7-8. The instructor will be Dr. Bernhard Keiser. For more information, contact the University at 202-676-6106 or 800-424-9773.

The Center for Professional Advancement is sponsoring two 4-day courses on Electromagnetic Compatibility Engineering. These courses will be offered on December 14-17 in San Francisco and on January 25-28, 1981 in Chicago. The instructors will be Henry Ott and Don Heirman. For more information, contact the Center at 201-249-1400.

Drexel University will sponsor two courses in Philadelphia: Hazardous Electromagnetic Radiation on November 23-24 and Lightning Protection on November 30-December 1. Dr. Bernhard Keiser will be the instructor for both courses. A. K. Guthrie also will instruct in the Lightning Protection course. For more information, contact the Continuing Professional Education Center at Drexel University, Philadelphia, PA. R & B Enterprises is presenting a seminar on the VDE and other international standards on electromagnetic interference. The seminar will be presented on October 19th in Philadelphia; October 20th in Boston; and, October 23rd in Chicago. The instructor for this seminar will be Karl-Otto Muller of Rohde and Schwarz in Munich, West Germany. For more information, contact R & B Enterprises at 215-828-6236.

#### Henry Ott

Chairman, EMCS Education Committee

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#### SYMPOSIUM BOARD ACTIVITIES



DONALD N. HEIRMAN PRESIDENT

Your Board of Directors wants to extend its thanks to all those who organized and ran our 1981 symposium in Boulder. They, along with the over 600 attendees, made this one of our most successful events.

As you know, the Board of Directors meets the day before our symposium. This year, we had a full house with only-four-members absent. With ex-officio members, committee chairpersons, chapter chairmen, and interested Society members, over 30 were present. As a consequence, there was a lot accomplished. Some of these are as follows:

1. Our Society is financed within IEEE guidelines without the need to increase Society membership dues for yet another year. The uncommitted funds are presently at \$110,700.

2. Our Newsletter may take on a new look. Editor Bob Goldblum was given the go-ahead to investigate adding color, typesetting, and better quality paper.

3. Several appointments were made to increase Society contributions in many areas:

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EMC Society Repre-

sentation on	Ap	<u>601</u>	ncee
Society of Social Im- plications of Tech- nology	R.	H.	Brooks
Committee on Man and Radiation	J.	H.	Chislow
Committee on Large Scale Systems	H.	R.	Hofmann
EMC Abstracts	s.	Kui	niyoshi
CISPR Subcommittee A	₩.	S.	Lambdin
Public Relations	Ρ.	Gra	ant

With regret, we also have accepted the resignation of our fine Vice President, Carl Allen, who has served the Board well in the past years. Carl will be retiring from Honeywell in November and no longer will be involved with EMC. He also leaves an unexpired term on the Board through 1983. We wish Carl well. 4. Future symposium reports were given. Next year, our symposium will be during the Labor Day week at the Marriott Hotel in Santa Clara. The sessions will be on Wednesday, Thursday and Friday, September 8-10, 1982, with the Board meeting on Tuesday, September 7. The usual day after the symposium meetings are being held on Saturday, September 11. For more information, call Andy Nalbandian, Chairman, on 408-742-5536.

5. Our international symposium policy regarding other EMC-type symposia moved one step further to reality with the Board recommending use of a draft pend-ing the outcome of a review by IEEE Headquarters. The policy introduces a new category of interest called "cooperating." This is a limited involvement in which there is a mutual exchange of mailing lists and use of nonprofit mailing label rates. There is no EMC Society financial or technical organizing involvement. This mutual interest will help in spreading out symposium dates to avoid conflicts as well as provide publicity for each other's event. This policy, if approved by Headquarters, will be used in our dealings with the Zurich and Wroclaw Symposia. Any questions, call Bill Duff on 703-250-9100.

6. Our standards effort urgently needs help in updating and rewriting the many standards for which our Society is responsible. Much more will be reported in the next Newsletter on this activity. For now, it is encouraging that our Japan Chapter, under the highly motivated leadership of Dr. Risaburo Sato, has volunteered to help in standards associated with measurement of field intensity/spurious radiation from FM and TV broadcast receivers. We appreciate this offer from our newest and most active Chapter. There are still a dozen more standards needing work. Contact Bud Taggart on 303-497-3462 or the Society President on 201-949-5535.

7. The Board approved publishing a Society Committee Directory that lists the names and phone numbers of the following:

Society Officers Board of Directors Services and Standing Committees Representatives to IEEE Technical Activities Board Committees Representatives to Outside Society Organizations Chapter Chairmen BoD and Standing Committee Chairmen

along with the

Locations and Dates of Future EMC Symposia.

This directory will be distributed to Society members by the end of the year and affords an excellent source of contacts for all Society business. For more information, call Art Wall on 202-653-8247.

8. A 20-minute video tape on "Introduction to EMC, " prepared by the Education Committee, was shown every 30 minutes at the symposium. About 100 viewer comment sheets were filled out during the symposium. These strongly supported the making of the tape and offered many suggested improvements. A large number wanted copies of the tape. However, this was a first cut and details on the availability still are to be worked out. The cost probably will reflect cost plus handling and overhead to continue to improve the tape or add other tapes on EMC subjects of interest. The cost to EMC Society members will be substantially less than that to the nonmember rate. For further information, contact Hank Ott on 201-386-6660.

The second annual Chapter Chairman 9. Breakfast was held the Wednesday morning of the symposium. Thirteen of the 18 chairmen were in attendance. Newly elected officers were identified and each had an opportunity to review their technical programs and point out areas where they need help from the Society. Of special interest were those Chapters experiencing difficulties in maintaining ongoing activity and finding suitable speakers. The technical committees of the Society were identified as sources for speakers, as well as Board members who travel to Chapter cities. We want to apologize for the skimpy breakfast. The arrangements were crossed. This will not happen in the future. It was suggested that to allow more time for discussion, the meeting might be held at dinner with the cost offset by the Society. In any case, we will not repeat the meal problem. For more information, contact Gene Knowles on 206-576-5796 or Charlie Anderson on 305-352-2259.

10. The Central Texas Chapter (San Antonio) is one step closer to reality. Paperwork has been submitted to the local Section for approval. Ed Bronaugh will be the Chairman. For more information, call Ed on 512-684-5111, Ext. 2792. Dr. George Costache, Bell Northern Research, also is canvassing members for an Ottawa, Canada Chapter. We hope to report Chapter status in the next Newsletter.

11. Membership development continues to show positive signs of paying off. We gained 90 new members in the past year. In fact, at our EMC Society booth at the symposium, we offered to pay for EMC membership if individuals joined our Society. Over a dozen signed up and still counting. It was suggested that the registration fee include IEEE and EMC Society membership dues for those nonmembers. This is done by some Societies and allows registrants to voucher their membership dues, too. What do you think of that idea? Let Jim Toler know on 404-894-3964. Jim is also actively seeking senior member applications for our regular membership. Ninety-three qualified members have been identified as of September 1. Jim will be happy to hear from you and give you a package to upgrade your membership. Both Jim and Warren Kesselman did abovethe-call-to-duty work at our Society booth in discussing membership and upgrading matters.

12. As you know, election of new Board of Directors was held. The results are found in an accompanying news story. We thank Gene Knowles for his hard work in putting together the slate and handling the paperwork.

13. Amendments to our Constitution and Bylaws were proposed by Doug Robertson. By the way, Doug retired in July. We want to thank him for his efforts in this important committee work. Hugh Denny has agreed to take over Doug's job. The changes proposed include proxy voting, change in the field of interest, and the limited voting right for Chapter Chairmen. These and other changes will be discussed at the next Board meeting. Any comments or further changes should be directed to Hugh Denny, 2528 Lavista Rd., Decatur, GA 30033.

14. An important proposed IEEE position paper on biological hazards from nonionizing radiation was discussed. Any members wanting copies of the paper should call our COMAR representative, Joe Chislow, on 201-949-6600. Comments are due by November 9 to be processed at the next TAB meeting on December 3-4, 1981.

15. An action item on developing ways to measure broadband interference was addressed, especially in light of recent FCC activity in this area. Paul Newhouse (ECAC) and George Hgan (SRI) are heading our proposed standard in this area. Call George on 703-941-7663 for further information. For information on FCC activity in this area, call Art Wall on 202-653-8247.

16. The Board again was asked to set policy on various aspects of symposium activity. Noted were problems with conflicting meetings by nonsymposium sponsored organizations, technical review of papers, technical committee sponsoring of sessions, workshop guidelines, profit guidelines, no papers dealing with sales pitches, limiting the number of papers, and other quality improvement areas. More will be reported in the Winter Newsletter. Any comments in this area should be forwarded to Don Heirman, 143 Jumping Brook Rd., Lincroft, NY 07733.

17. Election of new officers and installation of newly elected BoD members will be conducted at the next BoD meeting on November 10, 1981, at MIDCON in Chicago. Nominees for Treasurer, Secretary and the four Technical Directors can be any Society member, while President and Vice President must be from the Board membership. All nominations must be sent to me prior to November 1 at the address in Item 16 above. All nominees should be willing to serve, attend all Board meetings (presently, three a year) and actively assist in specific tasks assigned by the President. For further details, call me on 201-949-5535. Details about the MIDCON meeting arrangements will be handled by Leonard Thomas (202-526-2545) and ARt Wall (202-653-8247).

That brings you up to date on the activities of the Board at its August 17th meeting and throughout the third quarter of the calendar year. Please offer your assistance to our Society's many needs listed above. We need volunteers to keep up our momentum into the mid-80's. Let's hear from you!

# EMC SOCIETY AWARDS PRESENTED AT THE 1981 SYMPOSIUM IN BOULDER

The presentation of awards was made at the Awards Luncheon on Wednesday, August 19th at the Hilton Harvest House, Boulder, CO. Recipients of the awards were as follows: The Richard (B) Stoddart Award was presented to Ralph E. Taylor in recognition of his outstanding contributions in the con-

trol of electromagnetic interference and measurement of electromagnetic environment. Taylor received an honorarium of \$100 with the award. He is with the NASA Goddard Space Flight Center at Greenbelt, MD.

Warren A. Kesselman received the Laurence G. Cumming Award in recognition of his ten years of service on the Board of Directors and as Treasurer of the Society. The Cumming Award is in the form of a bronze plaque.

The Certificate of Appreciation for outstanding contributions to the welfare, administration, and overall success of the Society was presented to Risaburo Sato, Professor of Information Science at Tohoku University, Sendai, Japan.

A Certifiate of Achievement was awarded to Edward F. Vance for his outstanding contribution to the electromagnetic pulse technology and in dealing with the electrostatic charging of aircraft. The Certificate of Acknowledgement was awarded to Harold E. Taggart for his services rendered as Chairman of the 1981 International Symposium on EMC. It also was awarded to Andrew Farrar as guest editor of the IEEE Transactions on EMC, Special Issue on EMC Computer Models, November, 1980.

Honorary Life Membership was bestowed on Douglas W. Robertson of the Georgia Tech Engineering Experiment Station, and Don B. Clark of the Naval Civil Engineering Laboratory, Port Hueneme. Both of these members are retiring and were honored for their distinguished services to the EMC community.

The 1980 Transactions Prize Paper Award went to Prof. Frank A. Benson and Farrokh Arazm for their paper, "Nonlinearities in Metal Contacts at Microwave Frequencies," published in Volume EMC-22, Number 3, August 1980. Prof. Benson is Head of the Department of Electronic and Electrical Engineering at the University of Sheffield, England. Dr. Arazm is a Lecturer in the Department of Electronics and Electrical Engineering at the University of Tehran, Iran. An honorarium of \$100 went with this award.

A special Certificate of Recognition was presented to Stephen J. Lukasik for his service as keynote speaker at the 1981 EMC Symposium. Dr. Lukasik is Chief Scientist of the Federal Communications Commission.

William Duff and James Toler, two EMC Society members who have been very active in the administration of the EMC Society were elected to Fellow grade membership in the IEEE. Dr. Duff elected to receive his Fellow certificate at his Washington Section ceremony, while Jim Toler received his Fellow certificate at the EMC Symposium in Boulder.

#### BOARD OF DIRECTORS ELECTION

Six members of the Society have been elected to the Board of Directors:

Charles F. W. Anderson B. Leonard Carlson Don B. Clark — NAYY Fred J. Nichols Dr. Risaburo Sato Dr. Chester L. Smith

From 1900 members, 500 ballots were received. This indicates that every vote really counts and that one-third of the membership has elected the new BoD members.





# EMC PERSONALITY PROFILES

by William G. Duff





EDWIN L. (ED) BRONAUGH

Edwin L. (Ed) Bronaugh (M '69, SM '78) was born in Salina, Kansas in 1932. He received the BA Degree in Physics and Mathematics (with arts minor in music and language) from East Texas State University in 1955, and did graduate work in physics until entering the US Air Force. In the Air Force, Ed worked in flight operations as a transport pilot and as a rescue coordinator, and in communications and electronics as a base communications officer and as a command, control communications director.

Ed is presently at Southwest Research Institute in San Antonio, Texas where he man-ages and directs applied research, development and engineering in electromagnetic compatibility. He has done testing and equipment design to meet military and commercial EMC standards, including British, Canadian, and German standards, and has developed multi-national EMC standards encompassing CISPR recommendations and the radio interference regulations of Australia, Canada, Japan, South Africa, United Kingdom, West Germany, other European countries, and the United States. He has studies the characterization of automotive ignition interference to satellite communications, and the hazards of highstrength electromangetic fields to automotive electronics. Ed has developed specialized EMC instrumentation applying isolated electromagnetic field probes to produce accurate field measurements inside shielded enclosures. He has done TEMPEST

testing and is involved in the development of modern design techniques to meet TEMPEST requirements. He has designed equipment applying back-scattering and reradiation techniques at UHF and microwave frequencies. He has developed optical communications systems using fiber-optic links in specialized EMC instrumentation and applied fiber-optic links to the solution of EMC problems. He developed one of the early automated EMC data acquisition systems with associated computerized data reduction system. He has designed radio and telemetry receivers and transmitters and developed solid-state miniaturized multiplex radio relay and repeater systems for remote, unattended operation. He has participated in research in the bio-effects of electromagnetic radiation.

Ed is very active in the IEEE in the EMC Society. He is currently Chairman of the EMC Abstracts Committee, he is an IEEE representative from EMC-S to American National Standards Committee C63, and he is serving on the EMC-S Panel on Energy. He was Chapter Chairman of the Central Texas EMC Chapter in 1970-71 and served as the Chapter's Secretary in 1971-72. He was Publicity Chairman for the 1970 Regional EMC Symposium in San Antonio, and was Secretary for the 1975 International EMC Symposium. Ed has organized and chaired two EMC sessions at MIDCON and chaired an EMC Session at NTC '80. He has authored 23 papers in professional publications; 16 as the principle author. He has made 19 formal paper presentations, and has participated as a panelist in three EMC workshops at International EMC Symposia.

In addition to being a member of the IEEE and the EMC Society, Ed is a member of Committee C63 of the American National Standards Institute (ANSI) and he is Chairman of ANS C63 Subcommittee 1 on Techniques and Developments. He is also a member of Subcommittee 2 on Definitions. He is a member of the EMI Standards and Test Methods Subcommittee of the SAE Electronics Systems Committee. As a member of the Association of Old Crows, he was President of the Billy Mitchell

Club from 1976-78 and is Technical Program Chairman of the Western Region AOC Technical Symposium, 1979 and 1981. As a member of the Radio Technical Committee for Aeronautics, he served on SC-127 and assisted in developing the EMC requirements for Emergency Locator Transmitters. He is also a member of the American Radio Relay League and Alpha Phi Omega.

Ed was awarded the Bronze Star Medal and the Air Force Commendation Medal during his service in the US Air Force, and has since been awarded a Certificate of Appreciation for his contributions to the EMC Society. His biographical sketch is contained in Who's Who in the South and Southwest, the Dictionary of International Biography and Men of Achievement.

Ed and his wife, Gerrie, celebrated their 25th wedding anniversary on December 10, 1980. They have two daughters, Cecilia (Mrs. J. K. Snodgrass) who is a full-charge bookkeeper, and Dana who is studying Floriculture at Texas A & M University.

Ed is a member of Oak Hills Presbyterian Church and is a member of the church choir and bass soloist. His hobbies are music, amateur radio experimentation, camping, and automobile mechanics.

## REPORT ON EMC SYMPOSIUM & EXHIBITION ZURICH - MARCH 10-12, 1981

The Fourth Electromagnetic Compatibility Symposium and Technical Exhibition was held at the Federal Institute of Technology Zurich (ETHZ), Switzerland from March 10-12, 1981. With an attendance of 529 participants from 25 countries and 25 exhibitors, it has been the largest of all preceding conferences and may at present be regarded as the most significant international event in the field of EMC.

The Symposium was sponsored by the Association of Swiss Electrotechnicians (SEV/ASE) and organized by the Institute for Communication Technology of the ETHZ under the auspices of Mr. F. Locher, Director-General of the Swiss PTT. President of the conference was Prof. Dr. P. Leuthold, Organizing Chairman Dr. T. Dvorak and the Program Committee was chaired by Prof. Dr. F. L. Stumpers. Workshop organizer was Mr. H. K. Mertel. A number of international and national organizations cooperated technically.

At the opening plenary session, Prof. M. Cosandey, President of the Council of Swiss Federal Institutes of Technology discussed the technical and administrative aspects of research in modern society and Mr. Locher reviewed the development and future tasks of the EMC discipline.

The 97 papers offered at the Symposium were delivered in 18 sessions and three workshops were organized. Post-Symposium technical excursions included a tour of the Federal Institute of Technology at Zurich and visits to the laboratories of Brown, Boveri & Cie., AG at Baden and of Siemens-Albis at Zurich.

The Program Committee of the Symposium awarded the following papers: C. R. Paul, "Adequacy of Low-Frequency Crosstalk Prediction Models"; F. M. Tesche, T. K. Liu, "Recent Developments in Electromagnetic Field Coupling to Transmission Lines"; R. Bersier, "Measurement of the Immunity of TV Receivers to AM, RF Fields in the 3 to 30 MHz Range, Including the Influence of Connected Cables"; M. L. Crawford, "Options to Open-Field and Shielded Enclosure Electromagnetic Compatibility Measurements"; M. Borsero, E. Nano, "Comparison Between Calculated and Measured Attenuation of the Site Recommended by IEC for Radiation Measurements"; and, B. Demoulin, P. Degauque, M. Cauterman, "Shielding Effectiveness of Braids with High Optical Coverage." The first three papers also received monetary prizes.

All papers presented at the Symposium have been included in the 563-pages Proceedings: "Electromagnetic Compatibility 1981" available at Swiss Francs 100. (including postage and handling costs) from: Dr. T. Dvorak, ETH Zentrum-IKT, 8092 Zurich, Switzerland.

The next EMC Symposium again will be held at Zurich and is scheduled for March 8-10, 1983. A Call for Papers will be issued by the end of 1981 and abstracts will be due by March 1982.

#### STAFF REPORT ON RADIO INTERFERENCE ISSUED

The FCC has issued a report by its staff on radio frequency interference (RFI) and has adopted a further notice of inquiry to receive more comments on this problem. The original notice of inquiry in this matter was issued on November 14, 1978, in response to the large number of complaints about RFI to home electronic entertainment equipment. The staff re-port was written jointly by the Office of Science and Technology, Field Operations Bureau, Office of Plans and Policy and the Office of Public Affairs. It contains a summary of comments received in this docket, an explanation of the problem and its current status and the reasons why RFI is becoming an increasingly important issue.

The staff report singled out interference to televisions caused by CB transmitters as the predominant source of complaints. This type of interference is responsible for about 30% of all interference complaints. The staff went on to identify five specific policy alternatives that could be used to reduce RFI:

- mandatory performance standards
- voluntary standards
- shared liability between transmitter and receiver
- strict transmitter liability, and a Commission sponsored labeling
- program

The Commission asked for comments on these alternatives, emphasizing the costs of each policy to consumers, service providers, equipment manufacturers, and the FCC. It noted that publication by the EIA of a performance guideline in this area gave hope that significant improvement was possible. The FCC asked for comments on this guideline, specifically on appropriate criteria for evaluating susceptibility and test procedures.

The Commission stressed that although the emphasis of the staff report was on CB-related TV interference, RFI is a complex problem, requiring more than a single solution. It said CB interference to television was a well documented, well recognized and prevalent problem that continues to dominate Commission interference activities. However, it said, solving this problem would not solve all RFI problems and further work must continue on the other causes and manifestation of interference described in the staff report.

For more information, contact Michael Kennedy at 202-632-7073 or Alex Felker at 202-653-5940.





EDWIN (ED) BRONAUGH

In this issue we are publishing 54 abstracts. These are abstracts on various EMC topics. We plan to continue publishing abstracts of papers from previous EMC Symposia and from other conferences. The EMCABS committee is composed of the members listed below. By way of introduction to the community, they are listed with their company affiliations.

- L. F. Babcock, Bell Aerospace Textron
- E. L. Bronaugh, Southwest Research Institute
- R. N. Hokkanen, Naval Training Equipment Center
- R. Jacobson, Sperry Flight System
- D. R. Kerns, Southwest Research Institute
- S. Kuniyoshi, Scripta Technica, Inc.
- R. B. Schulz, IITRI/ECAC
- R. M. Showers, University of Pennsylvania

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Lightning Surge Waves induced on Overhead Lines.	Microwave Health Arguments Intensify
Hiroaki Koga, Tamio Motomitsu and Morihiko Taguchi. Electrical ACCESSION NO. Communication Laboratory, N.T.T. Ibaraki 319-11 Japan Trans. EMCABS 9-1-81	. Martha Smith, Associate Editor EMCABS 9-4-81
I.E.C.E. of Japan Vol.E 62, No.4 pp.216-233, April 1979.	MSN, Vol. 11, No. 5, May 1981, pages 19-32
<b>ABSTRACT:</b> The lightning surges induced on overhead lines are analyzed by calculating vertical and horizontal electric fields generated by return strokes. in case of finite ground conductivity. The dependences of lightning surges on the distance between a strike point and the cable, the cable length, the ground conductivity, the cable terminal earth resistance and the cable height above the ground are clarified. The probability distribution for peak values, the wavefront time and the time to half value of the wavefront are obtained theoretically as well as experimentally. The data concerning a standard lightning surge wavefrom expressed in terms of the peak value, the wavefront time and the time to half value may be obtained from the relation between the blown fuse rate and lightning surge occurrence rate.	ABSTRACT : While slow, steady research continues, the public is led to think that microwaves are deadly. So far, few hard facts exist.
INDEX TERNS: Lightning surges, overhead lines. Lightning protection.	INDEX TERNS: Biological effects, RF energy, microwaves, safety limits.
Application of Two-Dimensional Multiple Scattering theory to	Were You Zapped?
calculation of Scattered Fields by Polygonal Cylinders. Kohei Hongo and Masaru Takahashi. Faculty of Engineering	Joseph F. White, Consulting Editor
Shizuoka University, Hirokazu Kobayashi, Fujitsu Co.Inc. Technical Report of I.E.C.E. and I.E.E. Japan Vol.80 no.181	Microwave Journal, Vol. 24, No. 1, Jan. 1981, pp 16-24
EMCJ 80 69-76. pp.31-35	ABSTRACT :
are formulated into simple expressions containing scattering pattern functions	It is four years since the publication of "The Zapping of America,
equations which are in agreement with the results derived from the ray theory in geometrical optics. The results are applicable to the multiple scattering	paper stories of citizens opposing the PAVE PAWS Radars at Otis Air Force Base on Cape Cod, MA and Beale AFB in CA. Now all those undefined fears
problem by cylindrical objects with arbitrary cross sections by modifying the	of microwave have died out - or have they really?
approximated as the diffraction by polygonal cylinders. Several numerical exam-	
tering problem by polygonals.	
INDEX TERNS: Multiple scattering theory, polygonal cylinders, infinitely long parallel slits.	INDEX TERNS: Safety, microwave energy, biological effects, standards, thermal effects, limits.
Ferrite Materials Suitable for Microwave Magic Mantle and	Electromagnetic Waves and Biology - International
Kunihiro Suetake and Yoshihiro Motegi; Tokyo Institute of ACCESSION NO.	F. E. Gardiol, Lausanne, Switzerland
Technology. Ken Ishino; TDK. Technical Report of I.E.C.E. and I.E.E. of Japan. Vol.80,	Microwave Journal, Vol. 24, No. 1, Jan. 1981, pp 63-64
no.73, EMCJ 80-34. pp.31-38.	ABSTRACT :
and towers of transmission lines can be reduced by wrapping steel rods of	Mr. Rechen, of the Bureau of Radiological Health discussed the outstanding
effective inductance around steel rods and reduces wave reflection. This	experiments, the tolerated radiation levels in different countries would
paper presents the results of experimental investigation on ferrite materials suitable for suppression of wave reflection. The investigation reveals that	vary over a range of roughly 1000 to 1?
ferrite rings with small air gaps (2-3 mm) can effectively reduce the wave	
1	1
INDEX TERNS: Ferrite, microwave magic mantle.	INDEX TERNS: Biological effects, microwave energy, Russian limits, US limits, safety.

Correspondence in the

	DOE Studies 10 mb/cm2 Standard	Static Electricity in the Production Environment
		ACCITES TON NO
	EMCARS 0.7.91	EMCAPS 9-10-81
	Microwaves, Vol. 20, No. 1, Jan. 1981, p. 32	Insulation/Circuits, Vol. 27, No. 2, Feb. 1981, pages 15-17
	AFSTRACT :	ABSTRACT :
	To a large extent, Eastern and Western standards differ because of con- trasting philosophies. The US has accepted a low-risk/high-benefit view, while the Soviets believe that any deviation from a "normal" environment is hazardous.	The presence of static electricity is a serious and expensive problem in electronics manufacturing. This article will discuss various ways of recognizing sources of static in manufacturing situations and some methods used to prevent the occurrence of destructive static charges.
	INDEX TERNS: Microwave radiation, limits, Russia, US, standard, safety.	INDEX TERNS: Static electricity, electronics manufacturing, carpets, clean rooms, plastic, alarms, measurement.
	Carbon Fiber Parts Solve ESU/EMI Problems	Good Shielding Techniques Control EMI and RFI
	Evaluation Engineering, Vol. 20, No. 3, May/June 1981, page 33 AFSTRACT:	Bernard S. Matisoff, Consultant EDN, Vol. 26, No. 4, Feb. 18, 1981, pp. 123-128
	Carbon fiber reinforced thermoplastic composites are emerging as the "best way to go" in molding of parts requiring electrostatic dissipation and/or EMI attenuation.	Tighter FCC specifications force designers to pay more attention to EMI/RFI problems. Fortunately, you can employ several useful techniques that prevent unwanted radiation from degrading system performance or escaping into the environment.
Ì		
	INDEX TERNS: Shielding, conductive plastic, electrostatic dissipation, carbon fiber composites	INDEX TERMS: Shielding, material, thickness, design, air vents, gaskets, spring fingers.
	Arcsprayed Metal Coating for EMI/RFI Shielding	Shielding and Grounding Plastic Enclosures
	Merle L. Thorpe, TAFA Metallisation, Inc.	Joseph P. Kosjarski, Tecknit Inc.
	Microwave Journal Vo 24 No 5 May 1981 mages 133-138	EMCABS 9-12-81
	ADSMD ANT .	Design News, Vol. 3/, No. 3, 2/2/81, pp 44-49
	Conventional shielding methods include foil, tape, screening, plating, vacuum metallizing, conductive paint coatings and metal spraying. The Arcspray process discussed here is a significant improvement over con- ventional metal spraying techniques.	ABSTRACT: Use of electrically conductive, organic surface coatings help protect people and equipment from EMI.
		L3
	INDEX TERNS: Shielding, flame spraying, Arcspray, conductive finishes	INDEX TERNS: Shielding, plastic enclosures, conductive coatings, paint.

	Bilevel Resistor Protects Transceiver from Current Surges		Digital Compatibility and Freedom from EMI Make Solid State Relays a Logical Choice for Design Engineers	
	David J. Bak, East Coast Editor	ACCESSION NO.	- Vince Coughlin, Associate Editor	ACCESSION NO.
	Design News, Vol. 37, No. 3, Feb. 81, pp 86-87.	EMCABS 9-13-81	Design Engineering, Vo. 52, No. 3, March 1981, pages 61-64	EMCABS 9-16-81
	APSTRACT: Changing from a very low to a very high resistance state, when to a current surge above its "switching" point, the device eff blocks battery current drain due to short circuiting.	exposed Fectively	AFSTRACT: There are a growing number of applications in which the SSR is practical device. These are where there are simultaneous requ for high reliability, long life, high speed, digital compatibi freedom from electromagnetic interference.	the only irements lity and
	INDEX TERNS: Protection, fuse, current surges, suppression.		INDEX TERNS: Zero cross over, interference emission, switchin	a. solid
	×		state relays.	,
	Applications for Spectrum Analysis Measuring Noise, Distortion		ASCR Sine-wave Inverters Produce Low EMI	
	and Interference An Electronics Test staff report	ACCESSION NO.	Zung T. Chang, RCA Solid State Div.	ACCESSION NO.
	Electronics Test, Vol. 4, No. 5, May 1981, pages 44-58	EMCABS 9-14-81	Electronic Design, Vol. 29, No. 5, March 5, 1981, pp. 99-102	5-17-01
	ABTRACT :		ABSTRACT :	
13	Today's versatile spectrum analyzers can take a lot of the gue of such tricky areas as distortion measurement, noise figure m and field strength evaluation. This article discusses the the offers practical, application-oriented advice on how to use sp analysis techniques.	esswork out leasurement cory and then bectrum	Because ASCRs can turn off quickly, they make excellent switch high frequency sine-wave inverters, which feature low EMI and lightweight transformers and inductors.	es for small,
			INDEX TERNS: SCR's ASCR's switching DC to AC, inverters, su	ppression.
	INDEX TERNS: Spectrum Analysis, Measurement, Time domain sig strength, harmonics, spurious emission, intermodulation Connector Eliminates Expensive Filters, Bulky Housings	nals,field	Error Criteria and the Use of Reference Waveforms, Techniques for Time-Dependent Measurements Norris S. Nahman, NBS	ACCESSION NO.
	David J. Bak, East Coast Editor	ACCESSION NO. EMCARS 9-15-81	Electronics Test, Vol. 4, No. 2, Feb. 1981, pp 72-74	EMCABS 9-18-81
	Design News, 5/4/81, p. 78-79, Vol. 37, No. 9 ABSTRACT: A new series of connectors incorporates RFI shielding in the p physically altering original connector design.	lug without	ABSTRACT: Engineers have traditionally employed a few pulse or time domain to describe the key attributes of waveforms (e.g., rise/fall ti overshoot/undershoot, sag, full-width-at-half maximum, etc.). Standard 194 (revised) has renamed and consistently defined a m these terms, and IEEE Standard 181 (revised) <sup>1</sup> offers guidelines determination and application.	n parameters me, IEEE umber of for their
		1	5	
			INDEX TERMS . How Commenter	
	INDEX TERMS: Cable shields, connectors, molded plugs		waveforms, time domain, measurement, standards.	

	Design 7-Element Low-Pass Filters Using Standard-Value	Alternate Approaches to System EMP Response Assessment
	Capacitors	K. M. Bevensee California Univ., Livermore.Lawrence Livermore Lab.
	Edward E. Wetherhold, honeywerr, Inc.	Contract W-7405-ENG-48, UCID-18522, PC A02/MF A01, EMCAES 9-22-81
	EDN, Vol. 26, No. 1, Jan. 7, 1981, pp 187-190	25 Jan 80, 19p
	ABSTRACT :	ABSTRACT: The outlined assessment approaches of system EMP response as developed
	It's hard to beat the performance of LC passive filters in nonstringent	by LLL are based on either experimental low-level simulator excitation or sur-
	filtering applications. Two handy tables simplify the design of such	electromagnetic pulse assessment techniques by other organizations are noted.
		Subthreat excitation of a full-scale system or of scale model on a transient
		electromagnetics facility is described. This assessment yields the linear ex-
		testing (SCIT) of either a full-size or scale model system at the subthreat
	×	level or a full-size system at the threat level is discussed. The full-threat
	i i	the modeling errors involved in the assessment of EMP response of a real sys-
		tem in a threat environment are briefly discussed.
	INDEX TERMS: Suppression, filters, low pass, Chebyshev, design.	INDEX TERNS: Assessment, system EMP, testing, assessment techniques, transient
	Test Procedures for Shipboard Transient Protective Devices	DNA EMP Awareness Course Notes Supplement to Third Edition
1	(TPD's).	T N Windol
	J. F. Inelsen, and R. W. Frather Naval Ocean Systems Center, San Diego, CA	IIT Research Inst., Chicago IL
1	Report No. NOSC-TR-464, Nov. 1, 1979, 38p NTIS	Topical Rpt. Jan-Jul 78, 36p, DNA-2772T-SUPPL, AD-E300 640
1	Final Rpt.,Oct. 78-Aug-79,AD-AO79 533/6,PC AO3/MF AO1	Cont.DNA001-/8-C-0004, Sup.to Rpt.dtd Oct//,ADA058 36/ ADA083 485/2 PCA03/MFA01
	cedures required to determine the effect of hf and vhf, shipboard-antenna trans-	attending the DNA EMP Awareness Course. The text serves as an engineering
	which communication systems. This is essentially a compatibility test-procedure	introduction to the EMP systems design problem and provides a survey of tech-
	development program. A significant portion of the energy released during a	aspects of EMP, from the environment through system design and testing.
	components at the same frequencies as those employed by many military communica-	
	tion and other electronic systems. Protection of these systems against this	
	capability during and after a critical period. The objective of this report is	
7	to document how to determine that a protective device is compatible with system requirements and that it indeed does offer protection from a typical, high-level	
	EMP. Requirements for transient protective devices and the test procedures and	
	of selected TPD's for hf and uhf communications are listed and described.	INDEX TERNS: EMP. text. techniques
	INDEX TERMS: Transient protective devices, shpbdantenna, hf, vhf, comm.sys., com- patibility, electromagnetic pulse.	
	EMP Facilities Interaction	Electromagnetic Shielding Formulae
	PARTA PAT NA	E. Dahlberg
	Loran E. Rhine	Royal Inst. of Tech., Stockholm (Sweden). Institutionen foer EMCAES 9-24-81
	Rpt. no. FC/EFI-1, 47p, 1 Mar 80, AD-A083 316/0 PC A03/MFA01	TRITA-EPP-79-01 PC A)3/MF A01 Feb 79, 40 p.
	ABSTRACT: Electromagnetic Interaction of EMP facilities on Kirtland AEB was	ABSTRACT: This addendum to an earlier collection of electromagnetic shielding
	investigated and evaluated. Personnel safety from a physiological viewpoint is	formulae (TRITA-EPP-75-27) contains simple transfer matrices suitable for cal-
	addressed and energy comparisons made.	and axial-field cylindrical and spherical shields, as well as for estimating
		leakage fields from long coaxial cables and the normal incidence transmission
		larities between these cases are illustrated by means of equivalent circuits
		and transmission line analogies. The addendum also includes a discussion of a
		10:478023)
		1 L7
	INDEX TERNS: Electromagnetic interaction of EMP facilities	INDEX TERNS: Electromagnetic shielding formulae, matrices, shielding
		criticioney, reakage

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Electromagnetic Shielding.1972-May, 1980 (Citations from the NTIS Data Base). William E. Reed

National Technical Information Service, Springfield, VA. EMCABS 9-25-81 Rept. for 1972-May 80. Supersedes NTIS/PS-79/0526 & NTIS/PS-78 0524.See also 1964-1971,NTIS/PS-75/366. PB80-810849 PC NO1/MF NO1 ABSTRACT :

The bibliography presents research on electromagnetic shielding of electronic and electrical equipment, personnel and ordnance. The shielding effectiveness of materials and structures is covered. Nuclear electromagnetic pulse shielding is included. (This updated bibliography contains 301 abstracts, 19 of which are new entries to the previous edition.)

INDEX TERMS: Bibliography, electromagnetic shielding, ordnance

Instrumentation Validation

1

Teledyne Brown Engineering, Huntsville AL Electronics Div. Technical Rept. Mar-Apr 79, 78p Rept.No. ED79-ADTC-2334, Contract F08635-77-C-0293/AD-A083 454/9 PC A05/MF A01

ABSTRACT: An analytic and test validation was performed on the GVT facility instrumentation. The purpose of the test was to determine the capability of the ABSTRACT: In 1972, a study was performed to assess the susceptibility of the GVT system to perform its intended mission of dynamic analysis of aircraft structures. Each element of the system was examined to determine its individual function as well as its intended and unintended interaction with every other element of the system. The system was tested for signal input accuracy, cable integrity, grounding, noise susceptibility, and output signal integrity. All components were found to be well-maintained and functioning properly. The only discrepancies found in the system relate to system analog grounding. Recommended corrective measures to eliminate these discrepancies are outlined. With the implementation of the recommendations contained in this report, the GVT should be an excellent tool for dynamic analysis of aircraft structures and the instrumentation should provide constant, repeatable results under all test conditions.

INDEX TERMS: Instrumentation, cable integrity, noise susceptibility, analog grounding.

Dead-Faced Electrical Connector with Electromagnetic Vulnera-	
bility Protection.	ACCESSION
Department of Navy, Washington DC (Patent Application, filed	EMCABS 9-
18 Jun 80, 16p, AD-D007 298/3)	

PAT-APPL-6-160 697 PC A02/MF A01

for foreign licensing.Copy of application available NTIS.

ABSTRACT: An electrical connector assembly is disclosed in which the receptacle components are shielded by an electromagnetic radiation mask and in which no power is present at the front end of the receptable when the receptacle is not connected to its mating electrical plug. Intermediate electrical contacts in the receptacle portion of the connector assembly completely close apertures in the mask when the receptacle is not mated and are moved from the mask apertures and into contact with the internal electrical conductors of the receptacle when engaged with the male electrical plug portion of the assembly.

E-3A EMP Evaluation Program J.R. Anderson EG and G Inc Albuquerque NM

ACCESSION NO.

ACCESSION NO.

EMCABS 9-26-81

27-81

19

ACCESSION NO. EMCABS 9-28-81

Final Rpt. Nov 77 -Feb 79, EG/AG-1394, Jan 80, 104p, AFWL-TR-79-115, AD-E200 458, Cont. F29601-78-C-0013 AD-A081 725/4 PC A06/MF A01

AFSTRACT: This document is the Final Report of the E-3A EMP Evaluation Test Program conducted for the AFWL, at Kirtland Air Force Base. The report is divided into four sections. The Test Planning Section emphasizes the importance of pretest activities, demonstrates what can happen if critical items (such as connectors) are not identified early, and makes recommendations for future tests. The Test Procedures Section gives a step-by-step detailed explanation for performing an EMP test on a large test object. A great number of the problems the test crew encountered on this program are pointed out and solutions are recommended. A brief discussion on power-on testing and breakout box qualification tests are included at the end of the section. The most detailed section in the report is Section IV, Data Management. Virtually every function of Data Management is covered in this section; examples of typical response data, 284 calibration data, Daset log sheets and Adset log sheets are given and explained. The final section, Test Activities, explains to the reader the mechanics of performing a test at the HPD facility.

INDEX TERMS: Test Planning, Test Procedures, Data Management, Test Activities

Federal Aviation Administration Electromagnetic Pulse (EMP) Protection Study: A Reexamination and Update. Chin-Lin Chen, & Warren D. Peele Rome Air Development Center, Griffiss AFB NY

ACCESSION NO. EMCABS 9-29-81

Cont. DOT-FA72WA1-356, Nov 79, 160p FAA-RD-80-11, AD-A083 072/9 PC A08/MF A01

FAA system to the electromagnetic pulse (EMP) phenomenon. The purpose of the present investigation is to update the previous study by incorporating existing and newly published results of EMP and its effect on new equipment. The particular EMP model which has been used is based upon the environment anticipated for a typical high altitude nuclear burst. Out method of susceptibility assessment of the system has been to determine the effectiveness of protection at each of the various types of facilities in the FAA system. These have included the control centers and supporting computer, the remote radars, short range radars, RCAG sites, the remote microwave relay sites (RML), control towers, RVR, Instrument Landing Systems, IFR rooms and related computers (ARTS III), runway and approach light systems. The EMP threat is actually a subset of the total Electromagnetic Radiation (EMR) problem which can be overviewed as shown here. INDEX TERNS: Susceptibility, electromagnetic pulse (EMP), FAA system

1	An Investigation of the Relationship Between EMP Grounding	1. Grittan
1	Practices and MIL-STD-188-124	
	J.A. Woody and H.W. Denny,	ACCESSION NO.
	Georgia Inst of Tech Atlanta Engineering Experiment Station	EMCABS 9-30-81
	TIR/EES-A-2183-1, DNA-4903F, AD-E300 693 Contract DNA 01-78-C-	
į	0390 Final Rpt. 1-7-78/2-28-79, 69p. AD-A082 315/3 PC A04/MF A0	L

Availability: This Government-owned invention available for U.S. licensing and, AFSTRACT: This program was performed to assist and advise the Defense Nuclear

Agency (DNA) in identifying facility grounding, bonding, and shielding measures appropriate for electromagnetic pulse (EMP) protection and for electromagnetic interference (EM) control, i.e., electromagnetic compatibility (EMC). From a review of various EMP literature, a consolidated summary of the EMP grounding and shielding philosophy, requirements, and rationale was developed. The requirements for achieving power safety, lightning protection, and generalized EMC have recently been set forth in MIL-STD-188-124. Based on this summary of the EMP requirements, the areas in which differences exist were defined. The relationships between the two sets of requirements in each difference area and the reasons for the differences. Specific changes in MIL-STD-188-124 and potential approaches are recommended to resolve the differences; for the differences which are not as easily resolved, specific further investigations are recommended.

INDEX TERMS: Grounding, bonding, shielding, electromagnetic pulse (EMP), electromagnetic interference (EM) control, compatibility (EMC)

Electromagnetic Shielding. 1972-May, 1980 (Citations from the NTIS Data Base). William E. Reed

EMCABS 9-25-81 National Technical Information Service, Springfield, VA. Rept. for 1972-May 80. Supersedes NTIS/PS-79/0526 & NTIS/PS-78 0524.See also 1964-1971, NTIS/PS-75/366. PB80-810849 PC NO1/MF NO1 ABSTRACT :

The bibliography presents research on electromagnetic shielding of electronic and electrical equipment, personnel and ordnance. The shielding effectiveness of materials and structures is covered. Nuclear electromagnetic pulse shielding is included. (This updated bibliography contains 301 abstracts, 19 of which are new entries to the previous edition.)

INDEX TERNS: Bibliography, electromagnetic shielding, ordnance

Instrumentation Validation

Teledyne Brown Engineering, Huntsville AL Electronics Div. Technical Rept. Mar-Apr 79, 78p Rept.No. ED79-ADTC-2334, Contract F08635-77-C-0293/AD-A083 454/9 PC A05/MF A01

ABSTRACT: An analytic and test validation was performed on the GVT facility instrumentation. The purpose of the test was to determine the capability of the GVT system to perform its intended mission of dynamic analysis of aircraft structures. Each element of the system was examined to determine its individual function as well as its intended and unintended interaction with every other element of the system. The system was tested for signal input accuracy, cable integrity, grounding, noise susceptibility, and output signal integrity. All components were found to be well-maintained and functioning properly. The only discrepancies found in the system relate to system analog grounding. Recommended corrective measures to eliminate these discrepancies are outlined. With the implementation of the recommendations contained in this report, the GVT should be an excellent tool for dynamic analysis of aircraft structures and the instrumentation should provide constant, repeatable results under all test conditions.

INDEX TERMS: Instrumentation, cable integrity, noise susceptibility, analog grounding.

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PAT

INDEX TERMS: Electrical connector, shielded

E-3A EMP Evaluation Program J.R. Anderson

ACCESSION NO.

ACCESSION NO.

EMCABS 9-26-81

EG and G Inc Albuquerque NM

Final Rpt. Nov 77 -Feb 79, EG/AG-1394, Jan 80, 104p, AFWL-TR-

79-115.AD-E200 458. Cont. F29601-78-C-0013 AD-A081 725/4 PC A06/MF A01

ABSTRACT: This document is the Final Report of the E-3A EMP Evaluation Test Program conducted for the AFWL, at Kirtland Air Force Base. The report is divided into four sections. The Test Planning Section emphasizes the importance of pretest activities, demonstrates what can happen if critical items (such as connectors) are not identified early, and makes recommendations for future tests. The Test Procedures Section gives a step-by-step detailed explanation for performing an EMP test on a large test object. A great number of the problems the test crew encountered on this program are pointed out and solutions are recommended. A brief discussion on power-on testing and breakout box gualification tests are included at the end of the section. The most detailed section in the report is Section IV, Data Management. Virtually every function of Data Management is covered in this section; examples of typical response data, 284 calibration data, Daset log sheets and Adset log sheets are given and explained. The final section, Test Activities, explains to the reader the mechanics of performing a test at the HPD facility.

INDEX TERMS: Test Planning, Test Procedures, Data Management, Test Activities

Federal Aviation Administration Electromagnetic Pulse (EMP)	T
Protection Study: A Reexamination and Update.	10000
Chin-Lin Chen, & Warren D. Peele	l
Rome Air Development Center, Griffiss AFB NY	ſ
Cont. DOT-FA72WA1-356, Nov 79, 160p FAA-RD-80-11, AD-A083	L

072/9 PC A08/MF A01

ABTRACT: In 1972, a study was performed to assess the susceptibility of the FAA system to the electromagnetic pulse (EMP) phenomenon. The purpose of the present investigation is to update the previous study by incorporating existing and newly published results of EMP and its effect on new equipment. The particular EMP model which has been used is based upon the environment anticipated for a typical high altitude nuclear burst. Out method of susceptibility assessment of the system has been to determine the effectiveness of protection at each of the various types of facilities in the FAA system. These have included the control centers and supporting computer, the remote radars, short range radars, RCAG sites, the remote microwave relay sites (RML), control towers, RVR, Instrument Landing Systems, IFR rooms and related computers (ARTS III), runway and approach light systems. The EMP threat is actually a subset of the total Electromagnetic Radiation (EMR) problem which can be overviewed as shown here. INDEX TERNS: Susceptibility, electromagnetic pulse (EMP), FAA system

d-Faced Electrical Connector with Electromagnetic Vulnera-	An Investigation of the Relationship Between EMP Grounding
ity Protection.	Practices and MIL-STD-188-124
red R. Erbe	J.A. Woody and H.W. Denny,
artment of Navy, Washington DC (Patent Application, filed EMCABS 9-27-81	Georgia Inst of Tech Atlanta Engineering Experiment Station EMCABS 9-30-81
Jun 80, 16p, AD-D007 298/3)	TIR/EES-A-2183-1,DNA-4903F,AD-E300 693 Contract DNA 01-78-C-
-APPL-6-160 697 PC A02/MF A01	0390,Final Rpt.1-7-78/2+28-79, 69p,AD-A082 315/3 PC A04/MF A01
ilability: This Government-owned invention available for U.S. licensing and,	ABSTRACT: This program was performed to assist and advise the Defense Nuclear
for foreign licensing. Copy of application available NTIS.	Agency (DNA) in identifying facility grounding, bonding, and shielding measures
TRACT: An electrical connector assembly is disclosed in which the receptacle	appropriate for electromagnetic pulse (EMP) protection and for electromagnetic
ponents are shielded by an electromagnetic radiation mask and in which no	interference (EM) control, i.e., electromagnetic compatibility (EMC). From a
er is present at the front end of the receptable when the receptable is not	review of various EMP literature, a consolidated summary of the EMP grounding
nected to its mating electrical plug. Intermediate electrical contacts in the	and shielding philosophy, requirements, and rationale was developed. The require-
eptacle portion of the connector assembly completely close apertures in the	ments for achieving power safety, lightning protection, and generalized EMC have
k when the receptacle is not mated and are moved from the mask apertures and	recently been set forth in MIL-STD-188-124. Based on this summary of the EMP re-
o contact with the internal electrical conductors of the receptacle when en-	guirements, the areas in which differences exist were defined. The relationships
ed with the male electrical plug portion of the assembly.	between the two sets of requirements in each difference area and the reasons for
	the differences. Specific changes in MIL-STD-188-124 and potential approaches are
	recommended to resolve the differences; for the differences which are not as
19	easily resolved, specific further investigations are recommended.
W WWW Lostrian connector shielded	TIMEY TERES ( FMP) alectro-

INUER TEAMS : Grounding, bonding, shielding, electromagnetic pulse (EMP), electromagnetic interference (EM) control, compatibility (EMC)



ACCESSION NO. EMCABS 9-28-81

ACCESSION NO.

EMCABS 9-29-81

Design Construction and Evaluation of a TEM Transmission Cell for Field Probe Calibration. (Master's Thesis) Stavros Ioannis Mpoukis Dec 79,118p,Rpt.No. NPS62-79-013 Naval Postgraduate School, Monterey, CA AD-A083 199/0 PC A06/MF A01, Rpt. No. NPS62-79-013,

Dec 79, 118p

ABSTRACT: This paper discusses the design, construction and evaluation of a transverse electromagnetic (TEM) transmission cell for acculate generacion of broadband susceptibility test fields within a shielded environment. A 0.3X0.5X 1.0 m TEM cell, constructed at the Naval Postgraduate School (NPGS). was designed to operate as a 50-ohm impedance-matched system and was used for calibrat ing electromagnetic field probes. According to the basic design, uniform and standard TEM fields can be generated inside the cell for frequencies lower than the cutoff frequency of the device. The high frequency multimode effects can be suppressed by loading the cell with radio frequency (RF) absorbing material thus increasing the useful bandwidth. Measurements of characteristic impedance distributed along the cell, voltage standing wave ratio (VSWR) and tests of field uniformity from 1-1000 MHz were taken and described for both empty and absorber loaded cells. The method and the results of calibrating two types of probes are also discussed.

INDEX TERMS: Transverse electromagnetic (TEM), transmission cell, susceptibility test fields, calibrating, field probes.

Applications of Multiconductor Transmission Line Theory to the Prediction of Cable Coupling. Volume VIII. Prediction of Crosstalk Involving Braided-shield Cables. Clayton R. Paul



Kentucky U., Lexington, Dept. of Elec. Eng. Phase Rpt. RADC-TR-76-101-VOL 8.Aug.80.256p.Contracts F30602-79-C-0011,NTIS F30602-78-C-0120. See also Vol. 1, AD-A025 028.AD-A091 751/8.PC A12MF A01. ABSTRACT: The contents of this report are concerned with the electromagnetic coupling (crosstalk) between braided-shield cables. The effect of pigtails (exposed sections of braided-shield cables in which the shield is stripped back exposing the interior wire) on crosstalk was investigated. It was found that even though the length of these exposed sections constitutes only a very small tfraction of total line length the dominant coupling so the shielded cable can occur via these pigtail sections. If the pigtail sections are eliminated, an additional reduction in crosstalk of as much as 30dB may be realized. The modeling and prediction of this crosstalk was also investigated. A low-frequency model provided accurate predictions for electrically short lines. The multiconductor transmission line (MTL) model was also formulated. The MTL model provided predictions within 1-3dB for electrically short lines and within 6-10 dB when the line was electrically long.

ACCESSION NO.

EMCABS 9-31-81

INDEX TERNS: Prediction, cable coupling, crosstalk, braided-shield cables, modeling, low-frequency model, multiconductor transmission line model.

	A Survey of the High Frequency Effects Associated with the	1	Lightning, Surge and Transient Protection. 1978-April 1980	1
	Lightning Discharge		(Citations from the NTIS Data Base).	
	N.S.J. Braithwaite, & M.J. Cooke, 1979, 47p QUEL-1290/79	ACCESSION NO.	William E. Reed June 80, 113p	ACCESSION NO.
	Oxford U.England, Dept. of Engineering Science	EMCABS 9-32-81	Rept for 1978-Apr. 80. Supersedes NTIS/PS-79/0154 & NTIS/PS-	EMCABS 9-35-81
	N80-23590/6 PC A03/MF A01		78/0187.See also 1964-1977,NTIS/PS-79/0153. PB80-810781	Le marconactorio de la companya de l
			PC NO1/MF NO1	3
	ABSTRACT: The literature on high frequency effects associat	ed with the light-	ABSTRACT: Techniques and devices for the protection of electr	conic and electrical
	ning discharge is reviewed, with emphasis on the possible has	ards to aircraft	equipment are presented in these Federally-sponsored research	reports. The
	from electromagnetic fields. Sources of fast field changes in	i the cloud discharge	citations include research on suppressors, limiters, lightnir	ng arresters,
	and in the discharge to ground are considered in detail, from	a experimental ob-	electromagnetic pulse protection devices, and overvoltage pro	otection networks.
	servations of the far radiation field. Radiation from the ret	urn stroke and from	Electromagnetic shielding is excluded. (This updated bibliogr	caphy contains 44
-	K changes is most important up to 10 MHz, and breakdown proce	esses become impor-	abstracts, 106 of which are new entries to the previous editi	Lon.)
1	tant at higher frequencies. An overall amplitude frequency sp	ectrum is given.		
	Models of the return stroke are briefly reviewed. Measurement	s at lighting cur-		
	rent at ground are discussed, with the airborne survey of lig	thtning fields con-		
	ducted as part of TRIP-76.	1	1	
		1		0
			THESE WERE COMPANY Lighter lighter and the	le otra la constri o
	INDER TERMS: High frequency, lightning, hazards, electromagn	letic fields	THE overvaltage	lectroimagnetic
-	Use of Electro-Optic Tech, to Achieve Electromagnetic Pulse	T T	puise, overvoitage.	1
	Hardness Determinations of the Effectiveness of Opt.Fiber &		Calibration Tests on Magnetic Tape Lightning Current	
1	Hardwired Interface Tech. in Mil.Com.Sys. in a Nuclear Enviro	ACCESSION NO.	Detectors	
	R.A.Greenwell, W.A.Radasky, W.H.Hardwick, T.M.Flanagan	EMCARS 9-33-81	K.E. Crouch	LACCESSION NO.
	JAYCOR, Del Mar, CA	LA DE LOL ATT LOL	NASA ORDER CC-822/9-A, Apr 80, 8/p, NASA-CR-32/0, LT-79-51	EMCABS 9-36-81
	Final Rpt., NOSC-TR-564, Cont. N66001-79-C-0191, NTIS, AD-A089, 850	/2 PC A04/MF A01	NOU-21/21/9 PC AUS/MF AUL	
	ABSTRACT: Fiber optics will reduce the susceptibility of syst	ems to a direct	AESTRACT: The low cost, passive, peak lightning current detec	ctor (LCD) invented
	threat. Long-haul ground systems require only electronics pr	otection; the fiber	at the NASA/Kennedy Space Center, uses magnetic audio recordi	ing tape to sense
1	optic cable is immune to EM pickup and need not be buried for	protection. Fiber	the magnitude of the peak magnetic field around a conductor of	arrying lightning
ł	optic susceptibility is less than that of hardwire to burnout	and upset in sys-	currents. Test results show that the length of audio tape er	cased was linearly
	tems that allow an outage time of 1 ms. In a steady-state or	low-dose-rate en-	related to the peak simulated lightning currents in a round of	conductor. Accu-
	vironment, system vulnerability levels depend on fiber respon	se and design	racies of + or - 10% were shown for measurements made using a	a stopwatch read-
	margin. Fiber optic system electronics are no more vulnerable	to total dose	out technique to determine the amount of tape erased by the 1	Lightning current.
	than those of hard-wired systems. 70 references.		The stopwatch technique is a simple, low cost means of obtain	ning LCD readouts
1			and can be used in the field to obtain immediate results. Wh	nere more accurate
			data are desired, the tape is played and the output recorded	on a strip chart,
			oscilloscope, or some other means so that measurements can be	a made on that re-
			cording. Conductor dimensions, tape holder dimensions, and t	ape formulation
	The state makes a state and		must also be considered to obtain a more accurate result. If	the shape of the
	INDEX TERMS: Electro-optic, electromagnetic pulse, optical f	iber, 21	conductor is other than circular (i.e., angle, channel, H-bea	m), an analysis of
	susceptibility.		the magnetic field is required to use an LCD, especially at 1	ow current levels.
			INDEX TERMS. Lightning, detector, magnetic field	

ACCESSION NO. ACCESSION NO. Contract W-7405-ENG-48, 1 May 79, 20p, UCRL-52771 PC A02/MF A01 ABSTRACT: The problem of protecting communication centers against the threat of high-altitude nuclear electromagnetic pulses (EMP) has been examined. Be- cause such EMP could damage components in an unprotected facility, an approach to develop a set of minimum requirements so that effective hardening procedures can be designed and implemented is described. The approach includes evaluation of currently recommended protection practices, cost analyses, and development of test requirements, plans, and facilities.	DESIGN BUT MAINLY POST DESIGN - EMC CONSIDERATIONS Sqn Ldr C.C. Smith(RAF) and Flt Lt K.Williams (Assoc. Member IERE, [RAF]) Royal Air Force - High Wycombe Proceedings of the Conference on Electromagnetic Compatibility, IERE Conference Proceedings No. 39, pp. 131 - 134 ABSTRACT: The paper entitled System Siting and the EMC Problem presented at the Session on 5th April described the problems encountered in deploying mobile high power radars within the United Kingdom. A number of alternatives' have been considered by the Royal Air Force in an attempt to eliminate or reduce the interference output of these radars by post design modifications to the radars or by other means.
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INDEX TERMS: EMP, protection practices	INDEX TERNS: EMC. Radar, Post Design, Siting, Mobile High Power
Probabilistic Approach to EMP Assessment R.M. Bevensee, H.S.Cabayan,F.J.Deadrick,L.C.Martin and R.W.Mensing California Univ., Livermore,Lawrence Livermore Lab. Cont.W-7405-ENC-48 UCRL-5284 PC A03/MF A01 Aug 79, 50p ABSTRACT: The development of nuclear EMP hardness requirements must account for uncertainties in the environment, in interaction and coupling and in the sus- ceptibility of subsystems and components. Typical uncertainties of the last two kinds are briefly summarized, and an assessment methodology is outlined, based on a probabilistic approach that encompasses the basic concepts of re- liability. Validation of the approach taken for simple antenna/circuit systems is performed with experiments and calculations that involve a Transient Electro- magnetic Range, numerical antenna modeling, separate device failure data, and a failure analysis computer program.	ELECTRO-MAGNETIC COMPATIBILITY IN THE MERCANTILE MARINE SITUATION M. Gibson, C. Eng., M.I.E.R.E.* Marconi International Marine Company Limited Proceedings of the Conference On Electromagnetic Compati- bility, IERE Conference Proceedings No. 39, pp. 135 - 142 AESTRACT: Some idea of the magnitude of the EMI problem and methods of propagation on board ship are given. The present situation relating to marine EMC specifications is described and the need for agreed and accepted marine EMC specifications, not only nationally but internationally, is proposed. Present installation techniques and measures used to minimize EMI on commercial marine installations is given. Specific examples of interference at sea are quoted and some details of a proposed I.E.C. specification are listed. An example is given of the EMC design of a compact R/T equipment.
INDEX TERNS: Nuclear EMP hardness, interaction, coupling, susceptibility survivability, reliability, Transient, failure analysis	INDEX TERNS: EMI, Ship Board, EMC, IEC, Receivers, Transmitters
<ul> <li>DTILIZATION OF CONFORMENT COMPATIBILITY</li> <li>Mr. Marvin A. Skeath* and Mr. John B. Scott**</li> <li>*Deputy Director for Special Projects, Electromagnetic</li> <li>Compatibility Analysis Center, Annapolis, Maryland.</li> <li>**Deputy Director of Tech. Operations, IIT Research Institute, Electromagnetic</li> <li>Compatibility Analysis Center, Annapolis, Maryland.</li> <li>ABSTRACT: Effective electromagnetic compatibility (EMC) analyses of com-</li> <li>munications-electronic (C-E) systems in their planned operational environments</li> <li>can be made through adroit use of computer programs using specially prepared</li> <li>data bases and mathematical models representing interference mechanisms.</li> <li>Automated cull procedures which selectively identify potential interference</li> <li>situations are used in conjunction with engineering analyses and performance</li> <li>criteria to derive recommended solutions.</li> </ul>	OSCILLATOR NOISE LIMITATIONS M.J. Underhill MA., Ph.D., Grad IERE. Philips Research Laboratories, Redhill, Surrey, RH1 5HA, UK. Proceedings of the Conference on Electromagnetic Compati- bility, IERE Conference Proceedings No. 39, pp. 109-118 <b>ABSTRACT:</b> The noise sidebands of the oscillators in a radio system ultimately limit the interference generated on or received from adjacent channels. A new approach is outlined for deriving the fundamental limiting factors for oscillator noise performance. These are shown to be circuit Q, amplifier dynamic range and phase shift, and varactor r.f. voltage handling capability. Practical limitations on these factors are related to the oscillator noise performance required for mobile radio applications.
One area in which these techniques have proved extremely useful is in EMC evaluation of the Air Traffic Control Radar Beacon System (ATCRBS). Computerized performance prediction models are used in EMC analysis of ATCRBS system parameters, system operation, and planned improvements. INDEX TERMS: EMC, Analysis, Communications-electronic environment, mathematical models, interference, ATCRBS, computers	3 INDEX TERMS: Noise Sidebands, Interference, Circuit Q, Dynamic Range, Phase Shifts, Mobile Radio

A CASE STUDY IN ACHIEVING ELECTROMAGNETIC COMPATIBILITY FOR A MAN-PORTABLE RADAR EQUIPMENT P.T. Hibbert* and A.C. Prior* *Marconi Radar Systems Limited, Chelmsford, England Proceedings of the Conference On Electromagnetic Compati- bility, IERE Conference Proceedings No. 39, pp 103-108 ABSTRACT: Operating a man-portable radar set in a battlefield forward area or in a civil application presents wide variations in the frequency distribution of other services which may affect the equipment or be affected by it. Analysis of typical operational situation was undertaken to quantify the problems and develop a specification. Measurements on development models are described, together with the solutions adopted to meet the requirement.	PARAMETER SENSITIVITY ANALYSIS : AN APPROACH USED IN THE INVESTIGATION OF FREQUENCY ASSIGNEMENT PROBLEMS M. J. Dash, M.I.E.R.E.* S. R. Green, B.S.** *Allied Radio Frequency Agcy. EMC Section NATO Headquarters Brussels, Belgium **The ITT Research Institute Staff, Electromagnetic Compatibility Analysis Center, Annapolis, MA USA ADSTRACK&Proceedings of the Conference on Electromagnetic Compatibility IERE Conference Proceedings No. 39, pp. 55 - 64 ABSTRACT: This paper briefly describes an automated frequency assignment system (FAS) developed under contract to NATO for the purpose of assigning frequencies to Air/Ground/Air and Air/Air voice communication circuits in the frequency band 225 MHz to 400 MHz. The paper also shows how an automated frequency assignment system was used to examine assignment parameter sensitivity thereby providing valuable information to the frequency manager, equipment designer and operational expert.
<pre>INDEX TERNS: Radar, Models, Measurements, RFI, Frequency Assignment DIAGNOSIS AND CURE OF SOME EMC AND INTERFERENCE IMMUNITY PROBLEMS E.P. Fowler, C.Eng., M.E.E.E., M.A.* J.R. Taylor* *Control and Instrumentation Division, AEE Winfrith, Dorchester, Dorset Proceedings of the Conference on Electromagnetic Compatibility, IERE Conference</pre>	INDEX TERMS: FAS, Frequency, Assignment, Spectrum, Computers, Frequency Management, Parameter Sensitivity THE APPLICATION OF MATHEMATICAL MODELLING TO EMC ANALYSIS OF SYSTEMS R. Rosenberg, B.Sc., C.Eng., *MIEE - *Hawker Siddeley Dynamics Ltd., Stevenage, Herts. Proceedings of the Conference on Electromagnetic Compatibility IERE Conference Proceedings No. 39, pp. 31 - 44 ABSTRACT: A description of SEMCAP (specification and Electromagnetic Compatibility Analysis Program) is given. The programme uses mathematical models of interference generators and receptors and of the indirect transfer mechanisms linking them. The programme calculates the voltage received at the receptor through capacitive, inductive, E- and H-Field coupling. The application of the programme to the Orbital Test Satellite is described. The accuracy, limitations and cost effectiveness of the programme are discussed.
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INDEX TERMS: Interference, Immunity, Pulses, Digital, Ground Screens	INDEX TERMS: Mathematical Modelling, EMC, Analysis, SEMCAP, E-Field, H-Field, Computers
AN OPERATIONAL EMC MEASUREMENT RELITING TRANSMISSION LINES AND RURAL RESIDENCE Daniel N. March, Ph.D.* *Professor, Electrical Engineering Department, Montana State University, Bozeman, MT 59717 Proceedings of the Conference on Electromagnetic Compatibility, IERE Conference Proceedings No. 39, pp. 87 - 90 ABSTRACT: A measuring technique has been developed and used to determine changes in the electromagnetic communication quality at rural residences caused by extra high voltage transmission lines being constructed nearby. Comparative measurements are made before construction and after the lines have been energized. Public reaction to the tests has been positive.	INTERFERENCE IMMUNITY TESTING REQUIREMENTS E. P. Fowler, C. Eng., M.I.E.E., M.A. Proceedings of the Conference On Electromagnetic Compatibility IERE Conference Proceedings No. 39, pp. 5-22 <b>APSTRACT:</b> A practical guide to interference immunity specification for instrument systems and how such immunity can be achieved. An outline of the larger sources of transient interference is included.
INDEX TERNS: EHV, Electric Power, Transmission Lines, Measuring Technique, EMI	<b>INDEX TERMS:</b> EMC, Susceptibility, Immunity Interference, Specifications, 5

#### HIGH POWER HF AND NOISE CANCELLATION SYSTEM

Samuel H. Harris, and Stephen J. Rosasco Magnavox-General Atronics, Philadelphia, PA Final Tech. Rpt. Oct 78-Jan 80, 48p,GAC-3392-3403-13,RADC-Contract F30602-78-C-0338, AD-A084 016/5 PC A03/MF A01

ACCESSION NO. EMCABS 9-49-81

ACCESSION NO.

EMCABS 9-50-81

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**ISTRACT:** The objectives of this effort were achieved and should permit high power HF (2-30 MHz) transmitters and conventional HF receivers to be collocated on an aircraft and operated simultaneously (full duplex) with appreciably less than 10% frequency separation between the transmit and receive channels. The option of frequency assignment between the Maximum Usable Frequency (MUF) and the Lowest Usable Frequency (LUF) for the transmit and receive frequencies can result in a 40 dB improvement in a duplex circuit, or stated another way, it may be the only way to establish a circuit between two points. One or more full duplex HF circuits can be operated simultaneously on an aircraft. The technique employed is a high power HF Interference Cancellation System which is adaptive and completely automatic. The significance of this effort is that it has direct application to C3 aircraft and collocated ground HF sites, including those sites with transmitters of ultra high power output(>> 1kW). In addition, the technology applied in any frequency range from VLF to UHF.

INDEX TERMS: High Power HF, Duplex Circuit, Interference Cancellation System, Adaptive, Automatic

THE CLOUD EFFECTS PHASE OF THE LASER INDUCED LIGHTNING INVESTIGATION

C. B. Moore, D. N. Holden & James Griswold

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New Mexico Inst. of Mining and Technology Socorro Research & Development Div. Final Rpt. Apr 80, 48p AFOSR-TR-80-0454 Grant AFOSR-78-3722 AD-A085 345/7 PC A03/MF A01

Grant AFOSR-78-3722 AD-A085 345/7 FC A03/MF AOI **ABSTRACT:** A mountain-top laboratory facility has been established in central New Mexico for studies of the effects of high powered lasers on the ionization of the air and on the possible triggering of lightning from thunderclouds overhead. A net of electric field meters and another one with television cameras and video recorders have been established for determinations of the nature of normal and of triggered lightning in the operational area. A special electric field meter carried beneath a captiveballoon to heights of about 600 m above

the facility measured the electric fields there for the entire life of several storms. The field strengths aloft were as much as 6 times greater than those observed at the surface. Lightning discharges were induced twice by the use of wire-trailing French rockets fired into thunderclouds over the Magdalena Mountains. As a result, interesting measurements of the breakdown process were obtained using AF Weapons Laboratory electromagnetic sensors: Magnetic field derivative signals in excess of 17 Teslas/second were observed in one of the triggered discharges.

INDEX TERMS: Lasers, Ionization Lightning Field Meters, Lightning

1	PROTECTION ST	ANDARDS FOR	MICROWAVE AND	RADIO FREQUE	NCY	
	RADIATIONS					
	R. Harlen, MS	Sc Tech,			H	
	The National	Radiological	Protection B	Bd., Harwell,	Didcot,	E

on Bd., Harwell, Didcot, EMCABS 9-51-81

Proceedings of the Conf. on Electromagnetic Compatibility IERE Conf. Proceedings No. 39, pp. 23 - 29

ABSTRACT: Radar as a possible hazard to man was discussed in the scientific literature as early as 1943. The inherent premise of the safe number and therefore of all these standards is that the principal bioeffects are thermal. The main supportive biological work has been concentrated in only a limited range of microwave frequencies. Current research indicates that the VHF region may encompass the most hazardous frequencies with the additonal complication that people are likely to be working in the near field. It then becomes necessary to consider the separate contributions of the E and H Fields. In Eastern Europe notably the Soviet Union, exposure standards are generally much more restrictive They are based largely on subjective epidemiclogical studies of people working with microwaves and on behavioral effects in laboratory animals. EMC IN PERSPECTIVE

L. J. Fountain, C. Eng. MIEE

Head of Army EMC Agnecy

Proceedings of the Conference On Electromagnetic Compatibili ty, IERE Conference Proceedings No. 39, pp. 45 - 54

**ABSTRACT:** In the last decade there has been a spectacular increase of interest in the subject of electromagnetic compatibility. It is of course possible to stimulate interest in a subject artificially by glamourising it and presenting it as being fashionable. You may consider that the general public has on occasion been the victim of such artificial stimulants. Perhaps even engineers and scientists have also succumbed. However, the interest in, and the effort devoted to the achievement of EMC have persisted too long for it to be just a passing fashion. There must, therefore, be a fundamental reason for the increased activity in this facet of engineering. At this point in a paper one might expect the author to define his subject. There have been many attempts to define EMC but none appears to have found universal acceptance. I will not, therefore, attempt to give you a strict definition. It is far more important that we should understand what it means.

INDEX TERMS: EMC, Definitions, Engineering

COMPARISON OF MULTICHANNEL AND SWEPT FREQUENCY RECEIVERS FOR	
THE MEASUREMENT OF ELECTROMAGNETIC INTERFERENCE	
A. J. Maddocks, M Tech, BSc*	ACCESSION NO.
Electrical Research Association Limited	EMCABS 9-53-81
Proceedings of the Conference On Electromagnetic Compatibili	ty, IERE
Conference Proceedings No. 39, pp. 65 - 80.	

**ABSTRACT:** The analysis of disturbances by a presentation in the frequency domain offers many more attractions than measurements in the time domain for the greater part of investigations where the terms of reference cover a very wide frequency range. The alternative to manually tuned radio receivers in assessing radio interference spectra lie in swept frequency receivers of the spectrum analyzer type and multichannel receivers. Spectrum analyzers are in common use for a wide range of tasks including the measurement of electromagnetic interference, and quite detailed instructions and application notes exist for this purpose. Measurements of electromagnetic interference (EMI) are also made with multichannel receivers although they are far less common; the performance of these two basic types of receiver is compared when used specifically for the measurement of EMI. The responses of both types of instrument to welldefined signals are examined.

INDEX TERNS: EMC, Receivers, Spectrum Analyzers, Multi-Channel, EMI, Interference Spectra, Swept Frequency Receivers

A REMOTE SENSOR FOR IMMUNITY MEASUREMENT R. J. Harry, C. Eng. MIEE, DIP EE\* \*Home Office, Directorate of Radio Technology Proceedings of the Conference On Electromagnetic Compatibility, IERE Conf. Proceedings No. 39, pp. 81 - 86 ACCESSION NO. EMCABS 9-54-81

ACCESSION NO.

EMCABS 9-52-81

**ABSTRACT:** Two major problems occur in the measurement of the immunity of television receiver to external fields. First, how to carry out objective measurements without degrading the inherent immunity of the receiver. Second, how to perform the measurement in such a way as to minimize the distortion of the electromagnetic field surrounding the receiver under test. These problems can be partly solved by using subjective assessment techniques. However, the use of subjective measurement leads to an inevitable spread of results even from a single observer and it is unlikely that repeatable results could be determined from a number of observers in different test establishments. A reliable objective method of measurement which avoids these problems is therefore necessary.

INDEX TERNS: Immunity, Televison Receiver, Electromagnetic Fields, Optical Fibre, Remote Sensors, Measurement, EMC

THERE Hazard, Radar, Microwave, Standards, Bioeffects, Near Field,

# CHAPTER CHATTER



by Charles F. W. Anderson

My apologies for no "Chapter Chatter" column either in the Spring or Summer issues of the newsletter; but, much information appears herein.

#### Central New England

Chapter Vice Chairman, Chet Smith, of MITRE Corp., presented a talk on the subject, "An Analysis of Low-Power Source Coupling onto Power Lines in the 100 and 200 kHz Band." This paper was motivated by the WARC '79 deliberations when certain lowpower communications services requested allocations in the LF band. Power distribution interests were concerned that proliferation of such sources would cause problems to carrier current systems. This meeting was held on 15 January.

On February 10th, the Chapter sponsored a meeting at which the topic was "Optimum Satellite Frequency Estimates for North America." The speaker was Paul F. Christopher of MITRE, who discussed requirements and conditions for high-reliability satellite communications in light of the five climate regions of North America. Factors entering into the problem, he stated, are:

- Choice of frequency
- Orbital dynamics
- Local climatic conditions

Relative merits of 12, 15, 27 and above 30 GHz bands in terms of gain/loss margins and local interference also were considered. The Chapter's March 11th meeting featured A. J. Mauriello, of Radiation Sciences. His presentation was "Radiated Electromagnetic Emission Testing of Rail Transit Vehicles."

The Chapter sponsored a tutorial series on "New Applications of Non-sinusoidal Waves in Practical Systems." Starting on April 14th, the series continued on successive Tuesdays, through May 19th. Co-sponsors were the Boston Section and the IT and ASSP Chapters. (Your column editor salutes the CNE Chapter's endeavor!)

981-82 01	fficers ar	e:	
John Cl	larke -	Chai	rman
Bob Bei	rkovits -	Vice	Chairman
Art Mui	cphy -	Secr	etary-Treasurer

As of deadline time, John Clarke reported that CNE Chapter was busy with its efforts in organizing the 1981/82 program. Topics which they hope to be able to have presented include: Radiometry Noise; Shielding Materials (tour of Chomerics facilities); Active Filters; Conducted Measurements for Transit Systems; RFI Sources in Homes; Advances in Lightning Phenomenology; and, Use of TI Programmable Calculators for EMC Analysis. Sounds as if John and his program committee will have a most interesting '81-'82 season!

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#### San Diego

John Hafer, of General Dynamics, succeeded Abul Rashid as Chairman of the Chapter in May 1980. Other officers are: Bill Johnson (EM Technology) as Vice Chairman; Duane Mealey (General Dynamics) as Treasurer; and, Jim Knighten (IRT Corp.) as Secretary. Herb Mertel, Lou Messer and Roger Hendricsen serve as Program, Publicity and Arrangements Committee Chairmen, respectively. They had 27 members (as of early 1981) and have been averaging about 20 attendees at their meetings. Programs this year have included the following:

January - Fred Nichols, speaking on "Facts and Myths of RF Shielding" February - Joe Fischer, speaking on "RFI Testing of Computers"

March - Bill Johnson, speaking on "Shipboard EMI Problems"

May - Edith Kamm (Naval Ocean Systems Center) speaking on "New Military EMI Specifications Affecting the Input Circuit Architecture of AC to DC Converters" (Mrs. Kamm is an Electronics Engineer at NOSC, involved in the rewrite of MIL-HDBK-241, the power supply EMI reduction design guide.) June - George Kunkel, speaking on

"Electromagnetic Shielding" September - Lou Messer (Teledyne Ryan), speaking on "Specifying Filters for the Power Supply Designer." Lou prepared another of his famous gourmet buffets before the start of the technical session.

All of the meetings have been held at the GD Electronics Division, and are usually on the second Wednesdays. Check with John Hafer at 714-692-7365 for further information, if you're going to be in the San Diego area and would like to attend one of the meetings.

#### Los Angeles

The Chapter's '81-'82 officers, per Bill Parker are:

Chairman - Frank Martinez (Genisco Technology) Vice Chairman - Larry Toller (Eaton-Ailtech) Secretary - Cal Ursery (Genisco Techn.) Treasurer - Larry Toller (Acting) On January 21st, Chris Kendall addressed the Chapter's meeting. His topic was: "Mathematical Modeling of EMC Emission and Susceptibility\_Phenomena." He discussed EMCad (Electromagnetic Compatibility Analysis and Design), which is a software implementation of a mathematical model for understanding compatibility problems. Its use in early design efforts to reduce EMC problems through all project phases was emphasized.

The Chapter's 19 February meeting was addressed by Drs. G. T. Inouye and W. L. Powers of TRW DSSG. Their topic was "Spacecraft Charging Effects on Spacecraft EMC." Dr. Inouye discussed effects of spacecraft charging and design aspect of thermal blanket grounding problems.

In May, Janet J. Taylor, Patent Attorney, discussed patent law, trademarks, trade secrets and government patent policy on government contracts.

Another "just-at-deadline" item: On 17 September, Pete Madle (TRW) addressed the Chapter meeting on the topic, "Transfer Impedance of Cables, Connectors and Joints."

The Chapter's meetings are held at the Ponderosa (House of Prime Rib.). Contact Barbara Larson at 213-537-4750 if you are in the Basin area and would like to attend one of the meetings.

#### New Jersey Coast

The March meeting was a field trip to the EMI test facilities at the Bell Holmdel Laboratories. Hosted by our Society President, Don Heirman, the meeting covered several techniques for measurement of emissions and susceptibility. Featured were a large Crawford TEM cell, an absorber-loaded shielded room, a strip-line antenna and a conducted emission test bed. Computer control of instrumentation for testing and on-going instrumentation research also were demonstrated. The April meeting had Barry Cowan of Georgia Institute of Technology speaking on "New Devel-In May, opments in Near-Field Probes." Luke Schimf of Bell Labs presented a discussion of geographical separation for

co-channel base stations in mobile services. In June, the topic was "HF Radio Propagation Modeling," given by Paul Major of Ft. Monmouth.

#### Denver/Boulder

On April 13th, the Chapter, in conjunction with their partner-Chapter, Instrumentation & Measurements, had a dinner meeting at the Hewlett-Packard Small Computer Division's Fort Collins facility, followed by a tour of the facility which featured presentations and demonstrations of interest both to the I&M and EMC disciplines. The Chapter's fifth annual joint EMC/I&M mini-symposium on 29 May was well attended. Chairman Charlotte Tyson and her committee put together a full day's worth of papers covering such topics as EMP, EMI test facilities, lightning, composite materials testing, plus others. (The success of this activity should inspire other chapters to consider sponsoring such symposia.) HOW Charlotte and her cohorts had the time to organize the mini-symposium and put on the national symposium less than three months later just amazes your Column Editor!)

#### Dayton

Officers for 1981 are:

Larry Walko - Chairman Elden Wick - Vice Chairman Dr. Gary Thiele - Secretary

No other news to date.

#### Santa Clara Valley

Al Johnson, retiring Chapter Chairman, reported that the officers for '81-'82 are:

David Hoffman	 Chairman
Jesse Marquez	 Vice Chairman
Robert Bly	 Treasurer
Allan Woldow	 Secretary

They are busy preparing for the 1982 Symposium.

#### Japan

From January to July of this year, the Tokyo Chapter was able to hold their

monthly Chapter meetings successfully. The average attendance was typically from 40 to 50 persons. Meetings covered various EMC topics, such as: Unintentional EM Energy Radiations; EM Energy Coupling to Lines; Lightning; Electric Discharges; Interference and Biological Effects of EM Energy.

In February, a special session on "Noise Immunity" was held, with approximately 70 persons in attendance. The list of papers presented at the Chapter's monthly meetings continue the standards of technical worth and diversity of subject which your Column Editor commented on previously. A sampling of the topics to give some idea of the breadth of EMC/EMI activities in Japan follows:

- Motorcycle Ignition Noise
- Broadcasting Interference to Submarine Cables
- IR Beam Communications
- Reduction of Reflections from Buildings
- Relay RF Noise Properties
- Urban Radiated Noise Measurements

#### Mohawk Valley

On November 12th, the Chapter will present the "First Mohawk Valley Symposium on EMC" at the Officer's Club, Griffiss AFB in Rome, NY. Papers (which should be typed on standard 8" X 11" paper, double spaced and should not exceed 20 pages, including diagrams of figures) are invited on the following topics:

- Electronically Tunable Filters
- VCO Technology Interference Cancellation System
- EMC in Microelectronics
- EMC & Computers
- Printed Circuit Boards
- Nonliner Circuit Analysis
- ARC-164

Registration is \$25 per person, and includes luncheon and symposium record. To register - by October 30, 1981 - contact: Carmen Paludi, RADC/RBCT, Griffiss AFB, NY 13441; Tel.: 315-330-2563/AV 587-2563, or John Dobmeier, RADC/RBCTI, Building 104, Griffiss AFB, NY 13441; Tel.: 315-330-7168/ AV 587-7168.





by Jim Hill, EMXX Corporation

In this issue, we have the book review by Dick Schulz of a thought provoking book on the technology of nonsinusoidal waves: a book containing alarming ideas for the sinusoidal wave conformist, but with practical applications of the nonsinusoidal wave technology that he can grasp. In earlier times, the title of this book might have included the words "Walsh Functions," but these are the 80s and we have left behind the shackles of the 60s and 70s. Dr. Harmuth is Professor of Electrical Engineering at The Catholic University, Washington, D.C. and as a pioneer and innovator in the field of nonsinusoidal wave technology and theory, he is well qualified to write on this subject.

In addition, we have a short announcement of a new EMC book release from the IEEE Press which will be of interest to our readers.

> "Nonsinusoidal Waves for Radar and Radio Communication"

#### ВУ

Henning F. Harmuth

Published by Academic Press 111 Fifth Avenue, New York, NY 10003 Hardbound (416 pages): \$45.00

Reviewed by Richard B. Schulz IIT Research Institute, Annapolis, MD

In the opinion of the reviewer, this book is intended for electronics engineers who refuse to remain fettered to conventional engineering approaches, specifically in the areas of radar and radio communications. Even the introductory chapter challenges the engineer with thoughts such as:

- For lumped circuit components, linear differential equations with constant coefficients can exhibit resonance only with sinusoidal force functions.
- The concept of resonance is more general and for lumped circuits is not restricted to sinusoidal functions. Resonance also applies to linear differential equations with variable coefficients, which describe lumped electronic circuits with linear, <u>time-variable</u> <u>components</u>.

- 3. Such distinctions do not apply to distributed circuits. Reasons: Lumped circuits are described by <u>ordinary</u> differential equations, whereas distributed circuits and structures are described by <u>partial</u> differential equations. Any <u>peri-</u> odic function can resonate with a distributed circuit, whereas only sinusoidal functions can resonate with a lumped circuit.
- 4. The conventional product (Bernoulli) solution of Maxwell's equations must be avoided for nonsinusoidal signals or those with a large relative bandwidth. Reason: Use of Bernoulli's product yields only particular solutions, not the general solution.

The value of this book lies in its forwardlooking presentation of advance concepts and their comparison with conventional approaches. Basic theory applicable to radar and radio communication is brought into focus so that it can be mastered without undue investment of time. Major potential applications for such theory are described, and several cases of reduction to practice are noted. One surprising potential application, surprising because of its military security implications, is an entire chapter on radio communication with submarines.

Basic principles pertinent to subsequent material are presented in Chapter 1, "Introduction." A sample of such basics already has been given, and the overall coverage is well illustrated by section headings:

- The origins of sinusoidal waves in radio transmission
- Lumped, time-variable resonant circuits
- Distributed, time-invariant resonant circuits
- Relative bandwidth
- Attenuation of waves, noise, and distrotions
- When to use nonsinusoidal waves

Chapter 2 on "Radio Signals with Large Relative Bandwidth" presents some more basic concepts relative to radiation of a pulse from an antenna, with special considerations for radar. Consideration also is given to the characteristics of carrierfree signals. Sinusoidal carriers are discussed with respect to modulation and demodulation characteristics, specifically the difficulties for large bandwidth. Analogously, the modulation and demodulation of nonsinusoidal carries also is discussed.

"Radiators and Receptors" are the subjects of Chapter 3. Since the book focuses on nonsinusoidal waves, frequency-independent antennas, such as the biconical, the planar log-spiral, and the log-periodic dipole, are examined. Next presented is the Hertzian dipole and how to make it frequencyindependent for pulses. Since the dipole field is proporational to the derivative of the antennas current, one feeds it with the integral of the wanted variations of field strength in the far zone. Using this principle, a wide variety of dipole arrays are discussed, together with their directivity characteristics. For feeding low-input-impedance antennas, the source must operate with an extremely low impedance (ideally, zero). Such a generator exists in the form of a thin-film Josephson tunneling junction, and due consideration is given to it. Resonating radiators for nonsinusoidal signals are described, and basically use a feedback loop with delay time equal to the period of the driving current. Receiving antennas are different. Reason: Transmitted field strengths are proportional to the first derivative of the source current, whereas the current in a receiving antenna is not the integral of the received field, contrary to popular belief. Read the book to find out why.

Chapter 4 deals with "Selective Receivers." Receivers for general preiodic waves may be largely synthesized by appropriate analogy to classical receivers for sinusoidally periodic waves, with stages involving time-sequence (or sequency) operation replacing conventional frequency operations. Requirements are presented for various receiver components: radar-sequency filter, sequency converter, intermediatesequency filter, and waveform discriminator. Consideration for selective receivers for non-periodic radio signals is introduced here, to be expanded in Chapter 6.

The primary applications portion of this book is Chapter 5, "Applications in Radar." Material in this chapter takes full advantage of differences between sinusoidal and nonsinusoidal waves. It is usual to consider a difference between radiated and returned sinusoidal waves to be a phase reversal or 180°. Actually, the difference is not a phase reversal, but, an amplitude reversal. The difference is normally not distinbuishable for sinusoidal waves; but, is dramatically different for nonsinusoidal waves. This difference, among others, is exploited in the various types of radar: low-angle tracking, synthetic aperature, tracking and beam rider, and look-down radars.

Chapter 6 is concerned with "Advanced Signal Design and Processing." Major topics are:

- Carrier coding and baseband-signal coding
  - Thumbtack ambiguity function
  - Velocity and acceleration processing

The book concludes with a new perspective on "Radio Communications with Submarines" in the last chapter, Chapter 7. Topics for this chapter are:

- Bandwidth required for teletype and data links
- Attenuation in seawater and antenna gain
- Distortion of signals in seawater
- The best frequency band as a function of depth
- Typical circuits
- Comparison of various systems
- Local and distant noise
- Radiation from a submarine

In summary, this is a clearly written thought provoking book for forward-looking engineers, especially for those interested in radar and radio communication. Even for those with peripheral interest in these areas, it makes worthwhile reading because it lays the basic groundwork for a new generation of such systems. For all, it provides a glimpse into the future.

\* \* \* \*

"Interference Analysis of Communication Systems"

#### EDITED BY

#### Peter Stavroulakis

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"Interference Analysis of Communication Systems" is a collection of reprints, edited by Peter Stavroulakis of Oakland Univ. The effort was sponsored by the Electromagnetic Compatibility Society.

Interference is an ubiquitous property of the environment in which communication systems must operate. Since interference mechanisms impose an unavoidable limitation on the capacity, efficiency, reliability and cost of communications, they must be fully understood before optimal communication systems can be designed. The material in this book was assembled to allow the reader to gain this understanding.

The 4l papers reprinted in this volume are arranged by subject into the following four parts: Analog-Signal Interference; Digital-Signal Interference; Interference Reduction/Cancelling; Computer Simulations. The papers in each part are preceded by introductory comments by the editor. A special effort was made to include as many key original contributions, tutorial treatments, and papers with bibliographies as possible.

# WROCLAW EMC SYMPOSIUM ISSUES CALL FOR PAPERS

The Sixth International Wroclaw Symposium on Electromagnetic Compatibility is scheduled to be held on June 22-24, 1982 at Wroclaw, Poland. The symposium is open to all engineers and scientists throughout the world. Papers will be presented in English or Russian language with simultaneous translation provided. Topics will include all aspects of EMC theory and practice. EMC is understood in a broad sense . as the ability of a device or system to function in its electromangetic environment without introducing or suffering intolerable disturbances. The symposium program includes technical exhibits and visits to places of technical interest.

Prospective authors are invited to submit original, unpublished papers concerning research, technological and operational aspects of EMC. Suggested topics include, but are not limited to, the following: Systems EMC, Equipment EMC, Spectrum Utilization, Radiation Hazards, EM Noise Sources, Measurement Technology and Spectrum Monitoring, Antennas and Propagation, EMC Standards, Lightning and EMP, EMC Aspects of Application of New Concepts, Computer Aided EMC Analysis and Design. A special session on Bioeffects is planned which will be held under the auspices of the Nonionizing Radiation Commission of the Polish Academy of Sciences.

Authors are requested to submit a one-page summary in English. It should explain clearly that new and significant results have been obtained and why they are important. If poster presentation and/or non-commercial instrument demonstration is desired, please indicate this in the material submitted. Please indicate, also, when film show is to be offered.

One copy of the summary should be sent to Prof. F. L. Stumpers, Eizentiaan 11, Eindhoven, The Netherlands, and four copies to Prof. R. Struzak, EMC Symposium, Box 2141, 51-645 Wroclaw 12, Poland. Notification of acceptance and authors kit will be mailed by November 21, 1982.

# TWO VOLUME POLISH 1980 EMC SYMPOSIUM RECORD ON SALE

The printed record of the Fifth International Wroclaw Symposium on Electromagnetic Compatibility, in two volumes, is now available for sale in the United States. The Record of the symposium, held in Wroclaw, September 17-19, 1980, contains the full text of all papers delivered. Of the 96 papers making up the technical program, 57 are in English and 39 are in Russian. Each Russian paper is accompanied by an abstract in English. While the papers are given either in English or Russian, they represent the research going on in many other countries such as USA, Hungary, Italy, Germany F.R., Germany D.R., France, Japan, United Kingdom, and Yugoslavia. Quite a number of the papers deal with CISPR limits and measuring methods, including Paolini's paper on the use of reverberating chambers in field measurements. The opening paper by CCIR Secretary Richard C. Kirby discussed the results of the World Administrative Radio Conference, Geneva 1979 with particular regard to its influence on future policy in the field of EMC. General guidelines concerning the investigations aiming to reduce the EMC environment pollution, and improve spectrum utilization are given in the conclusion.

Orders for the two volume set should be sent (payment enclosed) to James S. Hill, The EMXX Corp., 6706 Deland Dr., Springfield, VA 22152. The price to members is \$20.00; to non-members, \$25.00. Please make checks payable to "EMC Society, IEEE." Shipment will be postpaid to any address in the USA.

# **EMC STANDARDS ACTIVITIES**



#### by Richard B. Schulz

EMC standards, like other types, are provided or revised at the expense of considerable technical effort and much discussion necessary to arrive at a concensus agreement among engineers holding diverse viewpoints. Accordingly, the time lapse from inception to completion of a standard is appreciable (in other words, frustratingly long!). Nevertheless, a perspective view indicates substantial progress. A perspective of accomplishments during 1980 and, thus, far into 1981 can illuminate the progress made. Among such recent changes in standards are those listed in TABLE 1. (Incidentally, not only do standards change; but, also the names of organizations responsible for them. The former Society of Automotive Engineers is now simply SAE.)

#### TABLE I

#### MAJOR CHANGES IN EMC-RELATED STANDARDS

(Ja	nuary 1980 through June 1981)			
NO./DATE _AMERI	TITLE_ CAN NATIONAL STANDARDS INSTITUTE	COMMENTS		
C63.2-1980	Specifications for Electromagnetic Noise and Field Strength Instru- mentation, 10 kHz to 1 GHz	Supercedes C63.2-1963 and C63.3-1963		
C63.4-1981 11/20/80	Methods of Measurement of Radio Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 10 kHz to 1 GHz	Revised Standard		
ELE	CTRONIC INDUSTRIES ASSOCIATION			
RS 204 B 4/80	Minimum Standards for Land-Mobile Communication FM or PM Receivers, 25-947 MHz	Revision B		
INSTITUTE O	F ELECTRICAL AND ELECTRONICS ENGINEE	RS		
IEEE 469-1977	Voice Frequency Electrical Noise Tests of Distribution Transformers, Required	ANSI Approval Withdrawn 2/26/81		
IEEE 377-1980	Recommended Practice for Measure- ment of Spurious Emission from Land-Mobile Communication Transmitters	New Standard		
RADIO TECHNICAL COMMISSION FOR AERONAUTICS				
D0160A-1980	Environmental Test Conditions and Test Procedures for Airborne Equipment	Revision A		
SAE (forme:	rly Society of Automotive Engineers)			
ARP 1705 6/1/81	Coaxial Test Procedure to Measure the RF Shielding Characteristics of EMI Gasket Materials	New Recommended Practice		

J551g-1980 Measurement of Electromagnetic Revision g Radiation from Motor Vehicles Referenced (20-1000 MHz) in MIL-STD-461B

	DEPARTMENT OF DEFENSE	
MIL-STD-461B 4/1/80	Electromagnetic Emission and Susceptibility Requirements for the Control of Electromagnetic Interference	Revision B
MIL-STD-704D 9/30/80	Aircraft Electric Power Characteristics	Revision D
MIL-STD-1757 6/17/80	Lightning Qualification Test Procedures for Aerospace Vehicles and Hardware	New Standard
MIL-HDBK-237A 2/2/81	Electromagnetic Compatibility Management Guide for Platforms, Systems and Equipment	Revision A
MIL-HDBK-241A 4/1/81	Design Guide for Electromagnetic Interference Reduction in Power Supplies	Revision A

SCHEDULED MEETINGS OF EMC STANDARDS COMMITTEES

	COMMITTEE	NAME		NEXT MEETING
	ANSI C63	Radio Elec. Coord. Tech. & Develop.	9/1 EMC San	1/82 '82 ta Clara
	ANSI C68	High-Voltage Testing Techniques	Jun Ft.	e 1982 Lauderdale
	ANSI C95	Radio Frequency Radiation Hazards	Uns (Fa	cheduled 11)
	ANSI MD 105	Medical Electronics	Spr San	ing 1982 (AAMI) Francisco
	CBEMA ESC5	Environment & Safety CommSubcommittee 5	11/ Was	17-19/81 (CBEMA) hington, DC
	EIA G-46	Electromagnetic Compatibility	Una	vailable
	EIA R-2	Consumer Electromagnetic Compatibility	Uns	cheduled
	EIA TR8.10	Vehicular Electrical Inte ference & Electromagnetic Compatibility	r- Uns	cheduled
	IEEE S27	EMC Standards Committee	Uns	cheduled
	SAE AE-4	Electromagnetic Compatibi	lity May Was	1982 (Tentative) hington, DC
	SAE ESC/SC	Electronic Systems Comm/E Standards & Test Methods Subcommittee	MI Una	vailable
	SAMA PMC 33	Process Measurement & Con	trol 10/ Was	14-15/82 (SAMA) hington, DC
a kan anakan sebat ka k ti ini katalo		TECHNOLOGY ALERTING	INDEX	and and a second se
(Manuscripts received for EMC Transactions, June-September 1981. Draft copies may be available, upon request, from authors.)				
	MS No. Date	Title	Primary Author	Coauthors/ Notes
	01 00 -		- cost result	

81-23 7/14/81	A System for Shipboard RFI Measurements at Microwave Frequencies 7, 20 and 40 GHz	Kenneth G. Gray John E. Olson Elec. Engrg. Dept. Stanford Tele- Naval Postgraduate communications School Sunnyvale, CA Monterey, CA 93940 94086	
81-24 7/14/81	A Characterization Pro- cedure for a Bandpass Nonlinearity from Inter- modulation Measurements	M.T. Abuelma'atti John C. Gardiner Univ. of Riyadh Univ. of P. O. Box 800 Branford Riyadh, Saudi Richmond Rd. Arabia Bradford - West Yorkshire BD7 1DP United Kingdom	
81-25 7/20/81	Induced Charges on a Cyl- inder Excited by Standing and Traveling Waves in an EMP Simulator	Ronald W.P. King Gordon McKay Lab. Harvard Univ. Cambridge, MA 02138 617-495-4468	
81-26 7/28/81	Calculation of Fields in Tropospheric Ducts	Sherman Marcus IIT Research Inst. 185 Admiral Cochrane Dr. Annapolis, MD 21401 301-266-0705	
81-27 7/31/81	Detector Mount for Twin-Mode Waveguide	Amiya K. Mallick Dept. of Electron. & Electrical Comm. Engineering Indian Institute of Tech. Kharagpur 721302 West Bengal India Phone: Kharagpur 221-224	
81-28 7/31/81	Generalized Parametric Analysis of Charged Periodic Structures for Reducing Backscatt- ering in EMP Simulators	Shyam H. Gurbaxani Donald E. Jones Dept. of Electrical(Same address) Engrg. & Computer Science The Univ. of New Mexico Albuquerque, NM-87131 505-277-4924	
81-29 8/31/81	The Range-Doppler Reso- lution Properties of Welti Waveforms	Soon H. Leong Naval Surface Weapons Center Dahlgren, VA 22448	
81-30 9/2/81	The Effects of Resis- tive Loading of TEM Horns	Motohisa Kanda Electromagnetic Fields Division National Bureau of Standards Boulder. CO 80303	
81-31 9/3/81	Signal Reflections in a Shielded Enclosure	<pre>lLt. Bruce R. Archambeualt Electromagnetic Sciences Division Rome Air Development Center Hanscom AFB, MA 01731</pre>	

# NOTES FROM SEQUENCY UNION



G. Robert Redinbo

Professor Harmuth, who, as you have noted from the Summer Edition of this Newsletter, has been visiting China, and has agreed to give us his observations about the activities involving nonsinusoidal functions in China.

## SEQUENCY THEORY IN CHINA H. F. Harmuth

China is making an all-out effort to advance its education, research and development to the world level. Even though about 80% of its population still is working in agriculture, the remaining 20% amounts to about 200 million people, which is in the order of the non-agricultural population of the Soviet Union. Hence, there are enough people to be active in any field of science and engineering.

Let us first look at publications. The book "Sequency Theory" (Harmuth, Academic Press) was translated into Chinese; 8300 copies were printed, compared with 2500 copies of the US and 5000 copies of the Soviet editions. The book "Orthogonal Transforms for Digital Signal Processing" (Ahmed - Associate Editor for Walsh Functions of the IEEE Trans. EMC - and Rao, Springer-Verlag) is about to be published in Chinese, while the book "Nonsinusoidal Waves for Radar and Radio Communication" (Harmuth, Academic Press) is being translated. Original Chinese work includes a publication with 304 pages and the impressive title "Proceedings of (1) the Third Annual Meeting of the Chinese Electrical Institute, Information Theory Professional Society, (2) the Chinese Communication Theory Institute - Meeting During the Formation of the Communication Theory Professional Society, (3) the Chinese Electronic Society Conference on Walsh Functions.' A textbook currently is being written by Zhang Qishan of Beijing Institute for Aeronautics and Astronautics.

- He most advanced equipment development is a 16 channel sequency multiplexer for telemetry at the Beijing Institute for Aeronautics and Astronautics, which is headed by Zhang Qishan. This equipment is ready to go into production. As a result of this successful development, a 5-10 year plan for R and D in the field of sequency theory was authorized at this institute. Sequency multiplex equipment for digital telephone signals was developed at the Northwest Telecommunication Engineering Institute in Xi'an under the leadership of Hu Zheng (Vice President of the Institute) and Fan Changxin. The equipment multiplexes 12 telephone channels. Two pairs of this equipment have been built. A picture of the one terminal of such a pair is shown.



TWELVE CHANNEL SEQUENCY MULTIPLEX EQUIPMENT FOR DIGITAL TELEPHONE SIGNALS

Work on nonsinusoidal electromagnetic waves is carried on at the Chengdu Institute of Radio Engineering in Chengdu, Sichuan, under the leadership of Xie Chufang, Professor, and Gu Deren, Vice President, as well as at the Northwest Telecommunication Engineering Institute and the Beijing Institute for Aeronautics and Astronautics. Xie Chufang, with the help of a graduate student Nie Zhai-ping, showed that a travelling wave antenna first proposed in the book "Sequency Theory" (p. 310, Fig. 344-5) does, indeed, radiate nonsinusoidal waves distortion-free along the axis of radiation. Other radiators, such as the log-spiral antenna, were used successfully for non-sinusoidal waves, and the development of the most difficult part of the carrier-free radar is, thus, well under way.

For a survey of other work, we list a few recent journal publications; all are in Chinese:

1. Wang Zhaohua: An Analysis of Color Composite Video Signals by Two-Dimensional Walsh Functions. Journal of the China Institute of Communications 2(1981), April, pp. 50-57.

2. Liu Zhong-kan and Zhang Qishan: Walsh Cross Correlation Functions and the Choice of Walsh Subcarriers. Journal of the Beijing Institute of Aeronautics and Astronautics 1(1980), Nov., pp. 73-81.

3. Qiu Yu-hai: A Study of the Phase Switch

美国哈姆斯博士来华讲苦合彩。 1931年6月3日北电视工程学院

PARTICIPANTS OF THE COURSE "NONSINUSOIDAL WAVES FOR RADAR AND RADIO COMMUNICATION" IN XI'AN (THE CHINESE CHARACTERS SAY: GROUP PHOTO, DR. HARMUTH COMES TO CHINA FROM US TO LECTURE. 1981 JUNE, NORTHWEST TELECOMMUNICATION ENGINEERING INSTITUTE).

Technique for the Correlation Radio Telescope. Publications of the Beijing Astronomical Observatory 1(1979), pp. 76-85.

4. F. Zhao and Q. Li: Walsh Transform and Its Application to Seismic Data Processing. Journal of Qinghua University 17 (1979), No. 1, pp. 48-59. 5. Xiangwen Zhao: Results on the Correlation Functions of Walsh Functions. Space Electronic Techniques 2(1979), pp. 1-6.

 Zhang Qishan: Walsh Telemetry System, Telemetry Engineering 1(1980), No. 3, pp. 8-11.

7. Fan Changxin: Progress in the Research of the Applications of Walsh Functions. Journal of the Northwest Telecommunication Engineering Institute, Xi'an (1977), No. 3-4, pp. 8-33.

Let us end with a picture that shows some of the leaders in the field of sequency theory in China. In the front row, the first person on the left is unidentified; the two females are Chen Zhenghuai and Zhou Zhongmin of Nei Jiang, Sichuan; number 4 is Zhang Qishan of Beijing Institute for Aeronautics and Astronautics, number 5 is Hu Zheng of Northwest Telecommunication Engineering Institute, Xi'an; number 6 is the author; numbers 7 and 8 are Fan Changxin and Quiang Bohan of Northwest Telecommunication Engineering Institute; number 9 is Chen Dei-lian of Jiao Tong University, Shanghai; numbers 10 and 12 are Zhang Caian and Li Yihua of Beijing Institute for Aeronautics and Astronautics. In the second row, number 4 is Nie Zhai ping of Chengdu Institute of Radio En gineering. Missing in the picture is Chang Tong of Qinghua University, Beijing, one of the most important persons in the field of sequency theory in China; he received a Ph.D. from MIT some 40 years ago, and is now a member of the Chinese Academy of Sciences.

## 1982 IEEE MTT-S INTERNATIONAL MICROWAVE SYMPOSIUM

The 1982 IEEE MTT-S International Microwave Symposium will be held in Dallas, Texas on June 15-17, 1982 at the Hyatt Regency Hotel. The Symposium theme, "Thirty Years of Microwaves," will feature a review of the past, an assessment of today's state-of-the-art, and a glimpse into the future.

Papers are solicited describing original work in the field of microwaves. Material submitted should not have been previously published or presented. Although any papers concerned with microwave techniques, devices, systems, and applications will be considered, the following subject areas are regarded as particularly appropriate for this conference.

- Computer-Aided Design and Measurement Techniques
- Radiometry and Remote Sensing
- Microwave Field and Network Theory
- High Power Amplifiers, Circuits and Systems

- Integrated Optics, Fiber Optics and Optical Techniques
- Low Noise Techniques
- Microwave Passive Components and Networks
- Microwave and Millimeter-Wave Integrated Circuits
- Satellite Communications/Microwave Systems
- Microwave Biological Effects
- Technology Breakthroughs

Tutorial papers which review the maturation of the listed fields during the past thirty years also are requested.

Authors are requested to submit both a 35 word abstract and a 500-1000 word summary (up to six illustrations) clearly explaining their contribution, originality, and relative importance. Five (5) copies of the abstract and summary must be received <u>on or before January 8, 1982</u> by:

> Steven L. March TPC 1982 MTT-S Symposium COMPACT Engineering Div., GGIS P. O. Box 401144 Garland, Texas 75040

# 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/EMO, shield, enc. consult. test. & anal.; Scrn. rm. (incl. for large veh.); Comp. instr. for Mil. EMI test.

> 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.

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

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