

Electromagnetic Compatibility Society

Newsletter



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EDITOR: ROBERT D. GOLDBLUM

BOARD OF DIRECTORS NOMINATIONS/ELECTIONS

As provided in the EMC-S Bylaws, there will be an election for six members of the Board of Directors to serve three-year terms beginning in January 1983. Nominations by normal petition will be accepted by the Nominations Committee. Other candidates may be selected by the Committee; so, if you are interested in running for the BoD, call or write any of the members of the Committee (see below). It was the consensus of the Board at its February 11th meeting that the election should be held at a time consistent with attendance of the newly-elected members at the Board meeting in September in conjunction with the Symposium. Therefore, the Committee has opted for the following nominations and election schedule, which will allow notifications of the successful candidates at least a month prior to the Board meeting.

Publication of this Notice in EMC-S Newsletter	April, 1982
Closing date for receipt of nominating petitions	April 30, 1982
Ballots mailed from IEEE headquarters	June 4, 1982
Last date for receipt of ballots at IEEE headquarters	July 6, 1982
Mailing of notifications to successful candidates and BoD/Committee members	August 6, 1982

Qualifications for candidates are:

- Membership in IEEE and EMC-S - *current, paid-up*
- Willingness and resources to attend BoD meetings and participate in BoD activities

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OPINION ARTICLES SOLICITED FOR FUTURE NEWSLETTERS

The Editorial Staff of the EMCS Newsletter solicits responsible opinions from EMCS members on topics of interest and importance to our members. If you have opinions that you would like to express in this column, contact the Editor, Bob Goldblum.

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HR BILL TO AMEND COMMUNICATIONS ACT

The process for authorization of radio frequency equipment and testing might change considerably. In a proposed amendment to the Communications Act of 1934, House of Representatives Bill #5008 would override some of the protective provisions of the original legislation.

Under H.R. #5008, "Private Testing of Interference Potential of Certain Devices," the Federal Communications Commission (FCC) would authorize selected private laboratories as certification agents for the issuance of compliance grants. The criteria by which these agent labs would be chosen is not defined. Where procedures for appeal through the Federal Courts exist under the current rules, H.R. #5008 provides no such recourse. Nor is there any provision under which a grant might be cancelled if the equipment as marketed fails to comply with the requirements.

By delegating critical responsibility to private contracting agents, the FCC is effectively relieved from its obligation to monitor compliance standards. Applicants would find themselves having to pay competitors to conduct evaluations essential to the survival of their business.

H.R. #5008 is sponsored by Representative Timothy Wirth of Colorado. No action has yet been taken on the bill. It has not been referred to subcommittee, and no hearings have been scheduled. For information and reply, contact Congressman John Dingell, Chairman, House Energy Commerce Committee, Room 2125, Rayburn House Office Building, Washington, DC 20515; 202-225-2927.

The American Council of Independent Laboratories has expressed concern about the bill's impact and conducted a discussion meeting on April 1, 1982. Additional meetings are planned and concerned parties should contact Joseph O'Neil at 202-887-5872.

COMMUNICATION ACT REFORM

The Telecommunications Competition and Deregulation Act of 1981 (S.898), the rewrite to the 1934 Communications Act, has been introduced in various forms over the past six years; but, never has reached a floor of Congress for a vote. The bill seeks to substantially deregulate the rule-laden telecommunications industry.

Recently, Senator Thurmond (R-SC), Chairman of the Senate Judiciary Committee, stated that he is stopping further progress by barring the Senate from voting on the measure until hearings have been held on the anti-trust aspects of the bill.

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OPEN LETTER

The following letter pertaining to FCC cutbacks and deregulation should be of interest to all members of the EMC-S who are concerned with the control of EMI. You are encouraged to express your views to your legislators and in the EMC-S Newsletter.

Hon. John C. Stennis
Senate Office Building
Washington, DC 20515

Dear Senator Stennis:

As part of President Reagan's program of reduction of government expenditures, I understand that it is proposed to reduce the 1982 and 1983 appropriations for the Federal Communications Commission, with a reported reduction of as much as 35% of the staff to be required within this fiscal year.

I fully recognize the need for economy in government operations, as well as the fact that agency heads must be given reasonable latitude in apportioning the resources made available to them.

The problem that I wish to call to your attention in this connection is that information available to me indicates that one part of the FCC response to this reduction will be to substantially change the existing program of equipment authorization for radiofrequency devices. This is managed by the Authorization & Standards Division of the FCC Office of Science & Technology. It is aimed at assuring that transmitters, receivers, medical diathermies, microwave ovens, and other devices which generate radiofrequency energy comply with technical standards intended to minimize the potential for interference which these devices may cause to communication services.

When the FCC first began regulating these devices some 40 years ago, compliance with the then loose regulations was voluntary as far as the manufacturer was concerned. The user had the responsibility for correcting any interference problems, although few, if any, users have any competence in this field. Since those days, these devices have greatly increased in numbers and are widely used by consumers for a variety of purposes. It was evident that control of interference could best be attained by incorporating proper design and shielding in the devices. Recognizing this, the FCC in 1968 requested Congress to amend the Communications Act of 1934 to permit the FCC to adopt rules placing the compliance with technical standards as a responsibility of the manufacturer or marketer, and to have authority over importation of these devices as an aid to assure compliance of foreign manufacturers. Rule provisions were subsequently adopted which required the manufacturer or marketer to obtain a grant of equipment authorization for his device, and to restrict the importation of devices not so authorized.

As I understand the FCC's plans, it is proposed to change the existing procedure which permits marketing devices only after a receipt of a grant of equipment authorization by the FCC, issued after a review of an application containing technical data, including results of tests, and other information on the device. The technical standards which set limits on radiation, etc. are, in most cases, aimed at restricting the interference potential of the device; performance requirements are specified only for those devices used in safety communications services under provisions of law or treaty.

The rulemaking process will be used to propose changing to a procedure in which the party marketing the device would file with the FCC a notice that a particular device is to be marketed, with rather limited details of specifications, etc.; but, without filing the results of tests previously used to show compliance of the device with the technical standards. I understand that the rules specifying the technical standards are not proposed to be changed; but, the FCC will have no evidence that compliance has been assured, nor any basis for a conclusion to this effect. In essence, this would be a reversion to the self-certification procedure which the FCC found so unsatisfactory in the 1960's that it supported changing the Communications Act in 1968 to enable the equipment authorization procedure now in effect, which would largely be supplanted by the proposed changes. Many instances of non-compliance with the technical standards are likely to occur, particularly in the case of foreign manufacturers.

In recent years, the ability of the FCC Field Operations Bureau (FOB) to locate and correct interference problems has been diminished by reductions in staff and resources. I understand that further reductions are in prospect for the FOB. As it has the primary responsibility under FCC rules for enforcement in interference cases, its ability to respond to these will be further diminished.

Taken together, I strongly believe that these changes in program and reduction in staff and resources are certain to result in substantial increases in cases of interference to safety and other communications services. While the likelihood is somewhat less for equipment types of established design and uses, the outcome is far more certain for equipment of new and sophisticated design. These often have unanticipated peculiarities, and the technical standard may not cover all aspects of the performance of the device.

As an example of the sort of situation that can arise, there was an interference problem during the landing phase of the NASA shuttle at Edwards Airbase. Telemetry of essential data from the shuttle as it neared landing was greatly impaired by interference. FCC investigators with microwave equipment were hastily dispatched to the scene. It was found that the interference was emanating as spurious emissions from certain portable camera/transmitters used by the several news organizations at the site. Although these were, in fact, operating on their assigned frequencies, they employed new frequency-generating techniques which produced spurious emissions on frequencies used for the shuttle telemetry.

The Chairman of the FCC issued an order that required termination of use of the cameras. This incident was included as a lead item in an NBC news program on radiofrequency interference that was broadcast in the first week of September, 1981.

Existing FCC rules did not require type acceptance of those camera/transmitters, or that technical data be submitted to the FCC staff for evaluation. The rules did impose a limit of radiation on frequencies outside the authorized band, and later tests showed that this radiation was present. The point of this is that these devices were in use under what was essentially self-certification, a procedure not essentially different from that expected to be proposed when the FCC moves to change the equipment authorization program.

This change is to be proposed because the FCC management has apparently decided to apply most of the reduction in staff and resources to the Authorization and Standards Division. It is one of three divisions of the FCC Office of Science & Technology, each of which has 30/35 persons assigned. OST also has three staff groups (International, Spectrum Management, and Technical & Planning) with about 10 persons each.

In my view, allocating most of the reduction to equipment authorization (and necessarily changing the program) will bring into being many electronic devices capable of producing interference. Since they are generally used for many years, the adverse effects will continue, even though the results might cause changing the program back to the current forms. I believe that it would be preferable to spread the reduction more evenly in OST. Particularly, there is, in my mind, a substantial question whether in present circumstances the FCC should devote much of its limited resources to research. Research expenditures by industry in recent years has been far greater than that possible by the FCC. The consequences of the probable increase of interference to communications clearly indicate that it would be in the public interest not to make so drastic a change in the equipment authorization program.

I have attached a summary of the history of federal regulation of radiofrequency devices. As defined in FCC rules, these include transmitters, receivers, as well as a great variety of devices that generate radiofrequency energy; but, which are not used for communications.

My interest in this is as a consultant in electromagnetic compatibility, with more than 40 years of experience in this field. I entered Federal service as a Radio Inspector for the FCC in 1938. From the early 1950's to 1973, I was in charge of type approval testing at the FCC Laboratory, served as Assistant Chief of the Division 1973/74, was appointed Asst. Chief Engineer of the FCC in charge of the Laboratory Division in 1974, and served in that capacity until my retirement in early 1980. I am now a consultant to the Authorization & Standards Division (without compensation), primarily in regard to test methods and facilities.

During my tenure as Director of the Laboratory, in one two-year period we tested some 2000 pieces of equipment in the sampling part of the program. More than 200 of these were tested by myself. About 75% of the units tested were

sampled because of the rule changes at the time the number of CB channels were increased to 40; the technical standards were changed to further minimize interference from CB equipment.

In that test period, I personally inspected many of the test samples. It was unfortunately not uncommon to find that the sample different in construction from the description or photographs in the application. This was more often the case in which the manufacturer was foreign, and the equipment was made for sale under the trade name of some U.S. marketer. It was rare to find that the latter had any information as to these differences or the reasons for them. I can only expect that instances of non-compliance with technical standards are likely to increase, particularly for devices of foreign origin. Consequent increases in interference can be expected. The reduction in FOB staffing and resources will certainly make control of such interference more difficult.

Your consideration of the points mentioned in this letter will be appreciated. If there should be any need to provide further information I will be pleased to do so insofar as possible.

Sincerely yours,

Milton C. Mobley
(301) 725-2056

HISTORICAL SUMMARY OF FEDERAL REGULATION OF RADIOFREQUENCY DEVICES

- 1920 - Beginning of broadcasting. First reported use of RF energy for non-communications applications (medical diathermy, RF heaters).
- 1927 - Federal Radio Commission established by act of Congress, with authority over licensing of radio stations. Operator licensing remained with Department of Commerce.
- 1934 - Communications Act of 1934 established Federal Communications Commission (supplanted FRC), with authority over radio and wire communications, licensing of stations and operators.
- 1935 - Increased use of non-communications devices caused widespread interference to communications. FCC developed techniques for locating interference sources. Regulations made no provision for radiation by non-communications devices, or procedure for lawful use.
- 1938 - Petition filed for rulemaking by FCC to provide for unlicensed use of low-power communication devices. FCC adopted Part 15 of Rules, which permitted such operation, provided radiation did not exceed 15 microvolts per meter at a distance of $\gamma/2$ (approx. $1/6$ wavelength). Essentially a self-certification process.

- 1939 - Service rules amended to provide for manufacturers to file technical information on transmitters for reference in connection with applications for station licensing. Provisions also made for type approval of broadcast station modulation and frequency monitors (based then on the results of tests performed for FCC by the National Bureau of Standards).
- 1947 - Recognizing that increased use of RF energy for non-communication purposes after WWII would require regulation, FCC adopted Part 18 of Rules. This set technical standard providing frequency bands for use of industrial, scientific, and medical devices (ISM), with limits on out-of band radiation. The Commission then had no authority over manufacture of equipment, thus, responsibility for interference was on the user. Rule provided for voluntary type approval of diathermies and some other devices operated in authorized frequency bands; all other devices were to be certificated after measurements made at the premises of use.
- 1950 - Part 18 amended to provide for type approval of ultrasonic medical and industrial equipment, with certification as alternate.
- 1955 - Rules for various operating services (broadcast, land mobile, etc.) amended to provide for type acceptance of transmitters based upon FCC staff review of application and technical data submitted by manufacturer.
- 1956 - Part 15 amended to provide for certification by manufacturer of VHF/UHF receivers. Rulemaking due to to of interference to safety and broadcast reception due to radiation of signals from receivers used by others.
- 1968 - Communications Act amended to enable FCC to adopt regulations, placing responsibility for equipment compliance upon manufacturer, rather than user. Rules were amended to require certification, type approval or type acceptance by FCC, and to give FCC authority over importation of radiofrequency devices. Arrangements made for interchange of information on importations between FCC and U.S. Customs.
- 1975 - FCC Laboratory (then a division of Office of Chief Engineer), originally established in 1946 to conduct research in areas of interest to FCC and to administer type approval of equipment under Part 18 Rules, was enlarged by construction of a new building. All equipment authorization activities were concentrated at the laboratory. The previously limited program of sampling devices to verify compliance was increased.
- 1977 - FCC adopted Part 68 of Rules, with regulations covering devices to be connected directly to the public telephone network. Administration of technical part of these rules was assigned to the Laboratory.

1981 - Current rules require equipment authorization for nearly 100 classes of radiofrequency devices. Approximately 8 to 10 thousand applications are handled each year. About 85% of these are in the certification category. Some 500 devices are tested for type approval (in which FCC tests are required), and a few hundred sampling tests are conducted on other devices. This program is the principal way in which the FCC obtains assurance that devices going into the market may reasonably be expected to comply with technical standards aimed at minimizing interference to communications services.

MUCH WORK STILL AHEAD ON PENSION ISSUES, ACCORDING TO TASK FORCE

Having recently accomplished one of its principal goals, the USAB Pension Task Force appears to be losing no time in pursuit of its other important goals toward the achievement of equitable pension rights for engineers. One month after the new tax bill providing a universal IRA was signed into law, the Task Force met on Sept. 13 to redefine and strategize its activities, now that the IRA issue has been resolved.

National PAC leaders were invited to join Task Force members in identifying and prioritizing remaining issues. What emerged was a "wish list" of 30 issues, which the Task Force was able to categorize under three major thrusts for continued development; portable pensions, education, and related issues to be supported in cooperation with other committees and task forces.

Under portable pensions, the Task Force will promote shorter vesting periods, address the problem of voluntary vs. involuntary vesting, encourage "cash outs" as well as company contributions to employee IRAs, study the indexing of pensions, and monitor participation in IRAs.

Educational activities include development of an outline of "good plan" characteristics that would allow individuals to analyze their own plans, continuation of the column on pensions in *The Institute*, and the development of educational materials for use by PACs in promoting a better understanding among members of the complexities of pension and retirement systems.

Related issues, such as the practice of "pension busting," would have to be addressed in cooperation with the Service Contracts Task Force.

PAC leaders usually do not require a special invitation to express their views. Any thoughts or comments may be addressed to the Task Force Leader, Dr. David C. Lewis, in care of the IEEE Washington Office.

Book Reviews



by Jim Hill, EMXX Corporation.

In this issue, we review two unusual books, "Sequency Theory Foundations and Applications" and "Electromagnetic Interference Control in Boats and Ships."

According to Dr. Henning Harmuth, sequency theory has been slow in acceptance and application in this country. The recent crash of Air Florida Flight 90 in the Potomac River brought attention to sequency theory as a carrier-free radar belonging to the US Army, used to look through the river ice and water to locate the flight-recorder and other equipment in the wrecked aircraft on the river bottom. Other types of locating devices had been unsuccessful in their search. This may be just the impetus that is needed to foster additional practical applications of sequency theory.

In another interesting sidelight on sequency theory, we found that the American edition of this book was printed in 2500 copies with a bookstore price of \$65.00. "Sequency Theory Foundations and Applications" has been translated by the Russians and Chinese into their native languages. The Russians printed 5200 copies priced at the equivalent of \$6.00. The Chinese printed 8300 copies priced under \$2.50. In these two countries, there is a policy of subsidizing textbooks to promote the advance of science and technology. Why aren't we subsidizing in this country what is so vital to the future of our country?

We are indebted to Dick Schulz for the review of "Sequency Theory Foundations and Applications." "Sully" Sullivan has prepared an excellent review of "Electromagnetic Interference Control on Boats and Ships" in which he finds that not only the hardware aspects are discussed; but, there is also consideration of the cost factors, a feature which will be appreciated by project managers.

*"Sequency Theory
Foundations and Applications"*
BY

*Henning F. Harmuth
Published by Academic Press
111 Fifth Avenue, New York, NY 10003
Hardbound (505 pages): \$65.00
Reviewed by Richard B. Schulz
IIT Research Institute, Annapolis, MD*

Although this book was not written expressly for EMC engineers, it should interest them in expanding their perspective of engineering and physics, and in learning more about nonsinusoidal functions and major applications of them. It was written more broadly for electrical engineers, particularly those working in electronics, computers, and communications, and also for underwater acousticians, theoretical physicists, and applied mathematicians. This book introduces ideas new to many of us. Such ideas tend to be unaccepted, or at least resisted, until they are proven to have practical merit. To help overcome such resistance, the author

presents not only theoretical developments, but also practical applications* of sequency theory. These aspects are presented in a format such that they can be read independently.

The preface to the book should not be overlooked, since it contains a brief history of sequency theory, which started a decade before publication of the book.

The Introduction clearly describes limitations to our thinking circumscribed by sinusoidal functions, which permeate much engineering effort. It does not discredit the use of sinusoidal functions for appropriate applications, but it does reveal their limitations for other uses. For instance, "Sinusoidal electromagnetic waves cannot be used to discriminate between a reflector and a scatterer, or between a conducting and a nonconducting scatter." These can be distinguished by the use of Walsh functions which are characterized by the location of zero crossings or sign changes. For these, sequency is defined as one-half the average number of zero crossings per second. One of the best results of sequency theory is a method for the generation of moving images by means of sound waves, using two-dimensional spatial electric filters and TV-type display. Several quotes from this chapter follow:

"The velocity of propagation of a zero crossing does not cause problems as phase and group velocity do." (Page 9)

"The derivative or the integral of a sinusoidal function is the same sinusoidal function with a time shift and a changed amplitude. The shape of the function is not changed. The shape of Walsh functions, on the other hand, is changed by differentiation or integration." (Page 12)

"An amplitude reversal of a sine wave is equivalent to a time shift. No such equivalence exists for waves that are not polarity symmetric." (Page 13)

A chapter on Mathematical Foundations discusses orthogonal functions, some topics of Walsh-Fourier analysis, shift invariance and topology, and applications to signal processing. Orthogonality relationships are examined for both sinusoidal and Walsh functions. This classical theory of orthogonal series expansions is followed by series expansions for a finite number of sampling points, and the corresponding meaning of orthogonality. It turns out that the orthogonality equations are exactly what one needs for experimental use and, at the same time, are what a computer calls for. One set of orthogonal digital functions is called Walsh functions, in which $\text{cal}(i, \emptyset)$ and $\text{sal}(i, \emptyset)$ are analogous to cosine and sine functions; they may be combined to $\text{wal}(j, \emptyset)$. Various operations of these functions include multiplication and addition modulo 2, as well as more complicated operations. For matrix representations of Walsh functions, Hadamard matrices are used. For a better representation of certain sections of a function, Haar functions having more than two values may be preferred. Other orthogonality topics include functions with several variables, and carry-free operations. Some topics of Walsh-Fourier analysis include orthogonal expansions in finite and infinite intervals, sample and energy axioms, the fast Walsh-Fourier transform, the fast Haar-Fourier transform, the carry-free fast Walsh-Fourier transform, dyadic shifting, and dyadic correlation. Topics of shift invariance and topology include time variability and shift invariance, some features of space-time having the topology of the dyadic group with Hamming distance, and standing waves in dyadic space-time. For applications to signal processing, topics are detection of Reed-Muller coded signals by means of the carry-free fast Walsh transform, dyadic correlation for radar signal processing, multiple decisions based on dyadic correlation, and circuit and general signals for dyadic correlation. Some quotes from this chapter follow:

"Carry-free algebra can lead to a simplification of practical circuits." (Page 111)

"Time-invariant thermal noise ... is not often dominant or important in real channels. Dyadic correlation provides in these practical cases information about the noise and thus the basis for improved error reduction." (Page 119)

"Nonsinusoidal waves are a vastly superior means to improve radar than any baseband signal processing." (Page 121)

The next chapter is on Electric Filters for Time and Space Signals. Major topics are filters for time signals, generators for time and space functions, filters for two-dimensional space signals, two-dimensional filters for acoustic image generation, and filters for three- and four-dimensional signals. Both concepts and electronics hardware are described. Some quotes from this chapter indicate the nature of its content:

"Integration is preferred for time signals..., since it can actually be done by electronic circuits, while summation is preferred for space signals..., since spatial signals are always obtained in the form of samples." (Page 123)

"Another way (ed. note: to obtain a correct description of transients) is to design a filter so that the conditions ... are satisfied in the whole time interval $-T/2 < t < T/2$ and not just sufficiently far from its limits $-T/2$ and $+T/2$. This approach requires time-variable elements in the filter... hard to build for sinusoidal functions, but... quite easy to build for Walsh, Haar, and similar functions." (Page 126)

"We have seen how the filter... can be made more practical by means of the fast Walsh transform and its inverse." (Page 134)

The next chapter on Electromagnetic Waves with General Time Variance begins with Maxwell's equations and presents solutions to them (developed in prior literature) in a form more general than that used for sinusoidal functions, and required for nonsinusoidal functions. (A minor difficulty the reader may have is with an unconventional notation for the scalar product of two vectors where $s \cdot r$ is used for $s \cdot r$.) This chapter extends from a basic theoretical foundation to practical applications which rest upon it. Major subjects covered are on the dipole and multipole radiation of a current $i(t)$, some features of general electromagnetic waves, practical radiators, practical receivers, applications to radar, angular resolution of sampled receptor arrays, and tutorial remarks. Of particular interest to your reviewer, was material concerned with some features of general electromagnetic waves. Subtopics treated are:

(1) Radiation and reception of a line array of spherical radiation where it is shown that "the simplest example of a time-variable antenna array for reception is simpler than that of a time-invariant array" (Page 267). Another observation is that "such a fundamental concept as the reciprocity theorem cannot be used carelessly if one goes beyond sinusoidal functions and time-invariant systems" (Page 267).

(2) The doppler effect, for which "an observer cannot tell whether the observed sine function $\sin 2\pi(6f/3)t$ was produced by a transmitter without relative velocity radiating the function $\sin 2\pi(2f)t$ or one with relative velocity $-v/c=5/13$ (ed. note $1/3$) radiating the function $\sin 2\pi(3f)t$. In the case of the Walsh function there is no difficulty telling that $\text{sal}(3, t/T)$... was caused by $\text{sal}(3, t/T)$ and not by $\text{sal}(2, t/T)$. The same applies to the derivatives of Walsh functions." (Page 272)

(3) Circular polarization.

(4) Interferometry

(5) Discrimination between a radar reflector and a scatterer, where "electromagnetic waves with nonsinusoidal time variation have different summation theorems. As a result, a reflected wave will have the same time variation as the incident wave, but a scattered wave will not. This effect permits the discrimination between a reflector and a scatterer" (Page 280). Also, "a Walsh-wave radar can distinguish small and light-weight radar reflectors from the real thing, while a sine-wave radar requires secondary effects, e.g., different velocity caused by air drag" (Page 282).

(6) Nonsymmetric polarity effects, including the following quotes: "Consider now ground clutter in radar... A wave with nonsymmetric polarity... would be returned from the ground with the amplitude shown, while a metallic airplane would return the wave with reversed amplitude" (Page 284).

"A wave with nonsymmetric polarity cannot fade away due to multipath transmission unless some of the paths cause amplitude reversals and some do not" (Page 284).

(7) Increasing the number of independent radio channels. One basic principle is to use the coding of carriers to replace the coding of signals. Another application is to spread-spectrum transmission.

For additional flavor of this chapter, the following quotes are provided:

"Most books use Bernoulli's product method to separate the variables, which leads only to those particular solutions that can be represented by a superposition of sinusoidal functions." (Page 236)

"(ed. note. For a Walsh-shaped dipole current) E and H can be separated into... components by gating circuits. Hence, one would expect to find effects making use of the separability of near-zone and wave-zone components that do not exist for sinusoidal currents. This makes it worthwhile not to ignore the near-zone components" (Page 238).

"The relations... for the sine current depend on its frequency f alone, while the relations... for the Walsh current depend on frequency ϕ and switching time Δt " (Page 244)

"The different time variation of the near- and wave-zone components of Walsh waves makes it possible to design receivers that distinguish between them" (Page 246).

"A current with a large first derivative and small higher derivatives may then be used to radiate most of the power into the near zone... One can operate more communications links without interference or one can limit the range within which a transmission can be received." (Page 248)

"The field strengths of a quadrupole radiation vary proportionately to d^2i/dt^2 ... These field strengths will be orthogonal to each other at any point in space for a Walsh-shaped antenna current. They may thus be received independently and their average power may be compared. This is a second effect that indicates the distance from the transmitter." (Page 257)

"The delay line and the hybrid coupler extend the principle of the resonant dipole from sinusoidal waves to general periodic waves." (Page 302)

The last chapter is on Concepts of Communications Applied to Physics. Topics covered include the spectral decomposition of light, the topology of space-time, Schrödinger and Klein-Gordon difference equations, the same equations with Coulomb fields, Dirac difference equations with Coulomb field, and mathematical supplements. One quote is provided for this chapter:

"An obvious advantage of time-variable spectrometers would be that they would not only show the relative power of different spectral components but they would also uncover any relationship between the times of emission." (Page 404)

In conclusion, this is an informative book that presents a new and refreshing outlook on our technology.

* A recent practical application was the use of carrier-free radar to locate the flight-recorder of an Air Florida airplane which had crashed into the Potomac River.

"Electromagnetic Interference Control in Boats and Ships"

BY

Russell V. Carstensen

Published by

Don White Consultants, Inc.

State Route 625

P.O. Box D

Gainesville, Virginia 22065

Hardbound (265 pages) (1981): \$34.00

Reviewed by A.H. Sullivan, Jr.

Pres., Sullivan Associates

This book is an excellent example of directing EMC thinking to the specific problems of a particular category of communications/electronics systems and equipment — in this case, the systems and equipments on board boats and ships.

In a sense, boat and ship communications/electronics systems can be classified as surface systems, as opposed to airborne or aerospace systems. However, the boat and ship systems have unique characteristics and problems due to: water and hull conductivity; restricted real estate for large numbers of radiators and receivers, and their fundamental frequencies, harmonics and spurious emissions; and a large

variety of waveforms in the radiations of radars, communications equipments, radionavigation devices, power equipment and circuitry, and audio systems. Add to this the always present corrosive effects of salt water on connections, conductors and components and it is obvious that boats and ships have some specialized EMC problems.

This book addresses boat and ship EMC in a thorough manner by an author who has evidently had much engineering experience in ship layout and planning, and in EMC design, measurement and test procedures. As might be expected in a logically organized volume of this type, the first chapter discusses basic EMI problems and sources of EMI. This chapter and the following Chapter 2 should be required reading for everyone involved in ship design, building and operating. Chapter 2, entitled *EMI Control in Equipment*, would be better off with a different title - the chapter addresses commercial and naval equipment specifications, acceptance tests, and tests for susceptibility and vulnerability. Thus, we find that Chapters 1 and 2 provide key material for a basic understanding of EMI on ships as discussed in the following chapters of the book.

Chapters 3 through 12 address the many aspects of electromagnetic compatibility as they pertain specifically to shipboard. Included is material on internal system installation design, unique considerations for shipboard antenna systems, discussions of coupling paths, shielding, gasketing, and a definitive discussion of "rusty bolt" effects. Other material covers: EMP generation, propagations, and methods of hardening to prevent EMP effects; sonar and VLF considerations; problems and cures in ships with non-conductive hulls; special considerations for recreational craft; and electromagnetic radiation hazards.

The last chapter discusses EMI test methods and inspection requirements. The chapter not only addresses the technical aspects of testing; but, also contains material concerning personal safety (an important matter on shipboard) and weather conditions.

Chapter 10 I have left until last since it is almost unique in EMC literature. This chapter contains a very complete dissertation on the economic and financial aspects of EMC engineering and installation on boats and ships. It deals with cost estimates, EMI reduction alternatives and matters such as installation man-hours, craft analysis work-sheets, and cost of EMI shielding conduit. Cost, engineering, construction, and connection of cables and cable runs on board ship are problems of the first magnitude. Chapter 10 provides specific guidance in this area and shows how to go about estimating costs with particular consideration for EMI reduction. For the electrical and other engineers who are regularly involved with equipment installation and the reduction of EMI, the information in this chapter on costs and personnel/material trade-offs is probably worth more than the cost of the book.

In general, I found this book to be a first class presentation of problems and fixes for EMI on boats and ships. It covers both the philosophy of ship EMC and the detailed application of technology, engineering and economics to shipboard

EMI reduction. As mentioned previously, the material is well organized and the author sticks to his path as the reader is carefully led through the discussion of the subject matter. If the reader has little familiarity with complexities of shipboard electronics, this book will certainly provide an in-depth education. I can't put it any better than the author who says in the preface: "Electromagnetic interference, at the very least, makes successful operation of electrical and electronic equipment difficult. In extreme cases, EMI can render entire systems inoperative, leaving vessels unable to navigate, communicate, susceptible to collision and virtually helpless." I highly recommend this book; but, not just for EMC specialists. It should also be ready by planners, designers, builders and operators in order that they can fully understand the threat of electromagnetic interference.

EDUCATION COMMITTEE NEWS

The following lists some of the short courses being offered in the near future on EMC related topics.

McGraw Hill Seminar Center is presenting a course on *Controlling Electromagnetic Interference* on May 3-4 in New York and on July 13-14 in Los Angeles. The seminar leader is Ernest R. Freeman. For more information, contact McGraw-Hill at 212-687-0243.

The Center for Professional Advancement is sponsoring a course, *Electromagnetic Compatibility Engineering*, to be presented on August 23-26 in New Jersey. The instructors will be Henry Ott and Don Heirman. For more information, contact the Center at 201-249-1400.

Don White Consultants will be offering *Interference Control: An Introduction to EMI/RFI/EMC* in Washington, DC on May 25-27. *EMC Design & Measurement for Control of EMI* is scheduled on June 15-18 in Washington, DC. *TEMPEST-Design, Control and Testing* will be offered May 17-21 in Washington, DC. *EMI - Control & Noise Mitigation In Power & Telephone Systems* is scheduled for June 22-24 in Washington, DC. *EMC Project Management* will be presented in San Francisco on May 10-11 and in San Diego on May 13-14. For more information, call 703-347-0030.

In order to be included in the newsletter, information on courses and seminars must reach me by December 1 for the winter issue, March 1 for the spring issue, June 1 for the summer issue, and September 1 for the fall issue.

Henry Ott
Chairman, EMCS
Education Committee
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201-386-6660

DESIGN FOR COMPLIANCE WITH FCC PART 15 SUBPART J REQUIREMENTS

Reports have surfaced indicating that a number of equipments which have been qualified and certified for compliance to the FCC rules governing computing devices have been retested by independent test laboratories and have been found not to be compliant with the subject rules. An independent test laboratory reports that they have supressed equipment and requested that the manufacturer implement the suppression techniques. When the equipment was resubmitted for test, it still failed the requirements and, on occasion, the emissions were higher than before the equipment was originally suppressed. At first, the laboratory thought that there may be a problem in the repeatability of their tests; however, they soon learned that subtle and seemingly minor changes to the circuit design were sufficient to alter the entire EMI emission characteristics. The clients who implemented the recommended modification also took the opportunity to change logic, to layout the board differently, or to do some point-to-point wiring and to make other changes which they felt to be insignificant. Unfortunately, these changes were not insignificant where they pertained to radiated emissions from computing devices housed in non-metallic enclosures.

With military electronics, equipment is frequently requalified for EMI compliance through similarity. Military equipment is contained in metallic enclosures, uses EMI gaskets and EMI filters, and, in effect, is over-designed with considerable margins of safety. Thus, the change of logic, with a re-layout of a printed circuit board, will have no effect relative to the emissions characteristics; however, this is not the case with commercial digital equipment. Seemingly minor changes can totally alter both conducted and radiated emission profiles.

This is believed to be a significant problem for the FCC. Many companies are not cognizant of the impact a minor change will have. Companies who verify their equipment based on prototype and pre-production design often make changes in circuit board layout and logic selection in the actual production. These changes will, in turn, change the EMI characteristics of the equipment and could cause the equipment to fail to meet the FCC requirements.

The solution to this problem appears to be that reverification or recertification be implemented by companies, the FCC, or both, based upon either the quantities produced or the lapsed time between production lots. In the future, the FCC surely will be checking equipments which have been previously certified and verified. It is, therefore, in the best interest of manufacturers, periodically to spot-check their equipments in production to assure that they are still in compliance.

EMCABS

In this issue we are publishing 24 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



EDWIN (ED) BRONAUGH

D.R. Kerns, Southwest Research Institute
S. Kuniyoshi, Naval Sea Systems Command
R.B. Schulz, IITRI/ECAC
R.M. Showers, University of Pennsylvania

"HOW CAN I GET A COPY OF AN ABSTRACTED ARTICLE?" This question has come up several times since we have been publishing abstracts, so the following general answer is presented.

Most large public libraries, some small public libraries, all engineering school libraries, and most other college or university libraries have copies of publications in which articles appear. If they happen not to have the desired publication, such libraries usually can obtain it or a copy of the article from other libraries or sources. Many company libraries, both large and small, also have such arrangements. Many articles also are available from the National Technical Information Service (NTIS) and/or the Defense Technical Information Center (DTIC). To retrieve an article or publication containing an article abstracted in EMCABS, it is suggested that you contact your company library, a nearby engineering school library, a university library, or your municipal public library. If the library does not have the publication, go to the librarian, explain what you need and he or she will help you get the publication on loan, perhaps, from another library, or for a nominal charge, from NTIS. If you have a Department of Defense contract, the contracting officer, or your company librarian, can help you get publications from DTIC. The information needed is contained in the EMC abstract heading.

EMCABS 1-3-82

Electromagnetic Compatibility From The Design Engineer's Point of View
B. Priestley, B. Sc., C. Eng. MIERE.

EMI Electronics Ltd.

Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower Street, London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1978, pp. 157-168

ABSTRACT: Ideally Electromagnetic Compatibility should be designed into a system ab initio rather than tested and modified into it at a later date. This requires a broad awareness of EMC technique on the designers part which is often only acquired by experience. Based on experience both of general design and EMC work several areas of knowledge are highlighted whose neglect contributes to present day EMC problems.

INDEX TERMS: Electromagnetic Compatibility, EMC, design, EMC Techniques

EMCABS 4-3-82

Industrial Process Heating Equipment. Its Environmental Effect in the
Frequency Range 100 kHz-100 MHz

R. Colley, C. Eng., F.E.E.R.E.

Strayfield Ltd., Reading

Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower St., London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1978, pp. 175-182

ABSTRACT: The above frequency spectrum has been selected because it contains the largest proportion of industrial process heating equipment in terms of numbers of generators, output powers, and potential interference capability.

INDEX TERMS: EMI, ISM, RF Heaters, Induction Heating, Sealing

EMCABS 2-3-82

Electromagnetic Compatibility in Warship Design

Captain J.C.G. Field, MSc, FIEE, RCNC, RN (Retd)

Procurement Executive, Ministry of Defence (Ship Dept., Foxhill, Bath)

Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower St., London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1982, pp. 161-168

ABSTRACT: The paper traces the evolution of the philosophical basis of electromagnetic compatibility engineering in warship design from pre-1939 to the present day. The concept of the electromagnetic environment is introduced, and its relationship to the choice of specification levels for both emission and susceptibility is discussed.

INDEX TERMS: Electromagnetic Compatibility, EMC, Susceptibility, Cabling, Electromagnetic Environment, Shipboard

EMCABS: 5-3-82

Colour Multiplexing Techniques and Applications in Optical Waveguides

D.A. Kahn, M.Sc., B.Sc.

Negretti & Zambra (Aviation) Ltd.

Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower Street, London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1978, pp. 183-188

ABSTRACT: The feasibility of colour multiplexing is established by a review of the currently available components i.e. sources, detectors, waveguides, and colour splitting/combining elements. Operational systems employing colour multiplexing and developed in the author's laboratory are then described. Finally, an assessment of the technique and the identification of the most likely application areas is given.

INDEX TERMS: Communications, Critical fibre, Crosstalk, Isolation

EMCABS 3-3-82

A Practical Approach to the Solution of EMC Problems in Ships and
Shipboard Equipment

F.J. Derham

Aish & Company Limited

Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower St., London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1978, pp. 169-174

ABSTRACT: Correct application of principles and practice is essential for successful cost effective solutions to EMC problems arising in equipment and systems designed for use in ships. Experience has shown that guidance is necessary from the design inception to the final installation in order to achieve the required grade of compatibility with the ship's electromagnetic environment. Guide lines are given on design, suppression techniques, screening, cable selection and earthing which should enable designers to avoid many of the common pitfalls found in practice. The approach is general and applicable to a wide range of equipment although of necessity not exhaustive due to the complexity of the subject.

INDEX TERMS: EMC, Shipboard, Electromagnetic Environment, Immunity, Suppression, Screening

EMCABS 6-3-82

The Determination of Margins of Safety for Critical Aircraft Systems

G.M. Smith, CEng MIERE

Procurement Executive, Ministry of Defence, A & AEE Bascombe Down

Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower St., London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1978, pp. 189-196

ABSTRACT: The problems of the certification of the fitness of military aircraft to enter service have increased significantly with the introduction of electronic equipments into areas of the aircraft which directly relate to primary flight safety. In addition to the effects of the self generated electromagnetic environment, those due to the external environment must also be considered. The design of meaningful aircraft tests, leading to the establishment of an adequate margin of safety, requires an understanding of the ways in which the individual equipments may be upset. Present equipment test specifications, particularly the radiated susceptibility tests which cover the control and signal inputs of an equipment, are inadequate for this purpose. The problem is reviewed and an alternative approach suggested.

INDEX TERMS: EMC, Radiated Susceptibility, Safety, Electromagnetic Environment, Standards, Fiber Optic Links

EMCABS 7-3-82

Aircraft EMC Design and Testing Considerations
D. Ramsbottom

British Aircraft Corporation Limited (MAD)

Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower St., London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1978, p. 197

ABSTRACT: This decade has witnessed the consolidation of interference control techniques into the framework of an organized discipline. The aerospace industry has forged this process insisting on the inclusion of EMC design, control and testing as an integral part of its program in an attempt to eliminate as many variables as possible. To what extent have the adopted techniques been successful and moreover to what degree may the approach be considered either justified or adequate. While it may be premature to attempt a simple answer to these questions this paper is an attempt to examine some of the salient techniques of EMC engineering being considered and applied to advanced military aircraft, in the light of experience gained to date.

INDEX TERMS: Interference Control, EMC, Aircraft, Testing

EMCABS 10-3-82

Superscreened Cables

E.P. Fowler, C. Eng., M.I.E.E., M.A.

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Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower St., London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1978, pp. 213-228

ABSTRACT: The fundamental phenomena involved in the screening of braided cables are discussed and knowledge of these is shown to aid in improving this screening as expressed in terms of surface transfer impedance. It is shown how the use of magnetic materials between two braids, coupled with knowledge of the above optimisation techniques can lead to enormously improved screening which can be maintained by proper application of the magnetic tape.

INDEX TERMS Shielding Cables, Coupling, Transfer Impedance, Braided Shields

EMCABS 8-3-82

The Investigation of Aircraft Interference Problems

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MIERE

Procurement Executive, Ministry of Defence, A & AEE Boscombe Down

Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower St., London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1978, pp. 199-204

ABSTRACT: The effective solution of interference effects found in military aircraft requires that such effects be reproduced in a laboratory where access to the equipment is possible. The results of an initial investigation into the form of interference likely to be incident upon an installed equipment are shown together with the results of investigations into the form of equipment susceptibilities. Some general principles on design considerations for analogue equipments are given.

INDEX TERMS: Interference, Aircraft, Susceptibility, RF Fields

EMCABS 11-3-82

Electrical Bonding Problems in Aircraft

Dr. J. Brettle B.Sc., Ph.D., M.I. Corr. S.T.

The Plessey Co. Ltd Allen Clark Research Centre

Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower St., London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1978, pp. 229-237

ABSTRACT: The achievement of reliable low impedance electrical bonds is of importance in advanced aircraft because: 1. There is an increased use of high power avionic equipment where the potential for interference emission is high; 2. There is an increased use of low voltage and low current signal transmission over a wide frequency; 3. Modern military aircraft tend to have increased avionics packed into a smaller space; 4. The greater use of electrical and electronic equipment has brought about an increase in the number of control and signal lines. Good grounding is also required for safety reasons, i.e., to protect against hazards arising from lightning strike, fault currents in equipment and the build up of static charge in sensitive areas, e.g. fuel tank air spaces. Discussed in this paper are the general requirements for electrical bonds in aircraft and a more detailed consideration of the requirements for specific types, e.g. lightning conduction, static grounding etc.

INDEX TERMS Bonding, Grounding, EMC, Susceptibility, Interference

EMCABS 9-3-82

The EMC Design Philosophy of the Ptarmigan Switch

M.T. Batt, HND

The Plessey Company Limited

Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower St., London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1978, pp. 205-212

ABSTRACT: This paper describes the philosophy behind the design of a Military Mobile Trunk Switch using state of the art electronic design techniques to produce a vehicle installation meeting EMC requirements. At the onset of the project it was essential to adopt an EMC control plan defining design and test rationale. The equipment practice described includes the main enclosure with its constituent units and power supplies. The earthing system described is based on the 'Tree' system reducing susceptibility to electromagnetic fields. The design techniques adopted have produced a complex electronic installation maintaining military EMC standards.

INDEX TERMS: EMC, Control Plan, Design Techniques, Specifications, Earthing

EMCABS 12-3-82

Installation of Sensitive Equipment in Sea Going Ships

J. Ludbrook, Ltd. Cdr. RN(RTD) M.I. Plant E.

Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower St., London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1978, pp. 239-242

ABSTRACT: The installation of sensitive equipment in a sea going ship calls for much care to prevent interference problems. The rules generally are based on commonsense ship husbandry and providing the ship designers take into account the equipment parameters then most of the problems can be allayed. This short paper attempts to cover some aspects of equipment installation.

INDEX TERMS EMC, Mutual Interference, Shipboard, Cables, Connectors, Bonding, Coupling, Earthing

EMCABS 13-3-82

Intermodulation Product Generation Studies on Materials, Connectors and Structures

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Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower St., London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1978, pp. 243-250

ABSTRACT: Intermodulation Product Generation has been studied in bulk materials, cables and connectors typically used in either coaxial transmission systems or in the proximity of transmitting or receiving aerials. The effects of surface films, r.f. power and contact pressure have been determined and recommendations made to reduce intermodulation products to acceptable levels. Problems in cables, connectors and real structures are outlined and some suggestions made as to how to reduce them.

INDEX TERMS Intermodulation, Interference, Cables, Connectors, Non-linear Materials

The Penetration of Electromagnetic Fields into Aircraft From Externally Mounted HF Antennas

M.S. Smith, M.S., Ph. D., M. Inst. P.

Radio and Navigation Dept., Royal Aircraft Establishment, Farnborough, Hants, UH

Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower St., London WC1E 6AZ

IERE Conference Proceedings No. 39

ABSTRACT: Aircraft HF radio is a source of interference to the rest of the avionic installation. An approximate analytical/numerical treatment has been evolved for the calculation of electric and magnetic fields outside the aircraft due to HF transmissions. Penetration of these fields into the aircraft interior via electrical apertures in the aircraft skin is analyzed by a quasi-static method. Electromagnetic fields in the cockpit area of a small aircraft fitted with a tail-fin HF notch antenna have been determined; values of about 5 V/m are obtained inside the cockpit at frequencies near the aircraft resonance. Implications on electromagnetic susceptibility specifications are discussed.

INDEX TERMS Avionic interference, EMC, susceptibility, calculated fields, electric fields, magnetic fields

EMCABS 16-3-82

EMCABS 14-3-82

Performance of Long Dipoles as Unintended Receiving Antennas

P.S. Excell BSc, Prof. D.P. Howson DSc CEng FIEE FIERE

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Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower St., London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1978, pp. 251-258

ABSTRACT: In order to assess the extraction of power from electromagnetic fields by industrial structures when these are 'electrically large' (i.e. many wave-lengths in length) the symmetrical long dipole antenna was considered as representing a reasonable worst case. This choice was dictated by the fact that dipole theory is better developed than that of other primary antennas. The performance of electrically long dipole antennas has been computed for a range of parameters, mainly using the theory of TT Wu. The characteristics computed have been chosen to give an indication of the performance of accidentally occurring structures approximating to dipoles and having arbitrary resistive loads: graphs of maximum directivity (from which effective aperture can be derived), terminal impedance, matching factor and effective length are presented. Some discussion of the performance of non-collinear dipoles is included.

INDEX TERMS: EMI, Simulation, Electromagnetic fields, Safety, Electromagnetic Compatibility

EMCABS 17-3-82

Radio Frequency Field Strength Measurement In Proximity of Reflecting Ground

R.J. Hasler

Home Office, Directorate of Radio Technology

Proceedings of the Conference on Electromagnetic Compatibility

IERE Conference Proceedings No. 39, pp. 281-301

ABSTRACT: The measurement of field strength on test sites is prone to many errors. The ideal site is briefly discussed and the effects of imperfect ground reflections, wave polarization, extraneous signals, unwanted reflections, mismatch effects and small aerial spacings are considered. Methods are described for estimating the magnitude of the errors involved and minimizing their effects. The relationship between field strength and power measured at the receive aerial terminals is also discussed.

INDEX TERMS: Open area test sites, site calibration, errors, measurement problems.

EMCABS 15-3-82

Characterization of Impulsive VHF Radio Interference in Motor Vehicles

M. Brain, A.N. Kent, MSc, C Eng., MIEE

Directorate of Telecommunications, Home Office, LONDON

Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower St., London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1978, pp. 261-269

ABSTRACT: Two techniques are described for characterizing radio interference generated by a motor vehicle. These techniques were evolved in parallel with studies and experiments concerning VHF mobile radio data communication systems. However, the information which they provide may also be used with benefit for conventional mobile radio speech systems by characterizing the type of interference encountered and indicating the need for, and the effectiveness of, particular vehicle suppression fits.

INDEX TERMS: Motor Vehicle Interference, EMC, Mobile Radio Interference, Mobil Communications

EMCABS 18-3-82

Aerial Isolation: A Study of the Interaction Between Co-Sited Aerials

D.A. Bull and B.W. Smithers

The Electrical Research Assn. Limited

Proceedings of the Conference on Electromagnetic Compatibility

IERE, 99 Gower St., London WC1E 6AZ

IERE Conference Proceedings No. 39, April 4-7, 1978, p. 259

ABSTRACT: The increased complexity of modern aircraft has resulted in a proliferation of aerials sited in close proximity to one another, which makes it even more necessary to ensure electromagnetic compatibility while working in a crowded r.f. spectrum. The paper presents the investigations that have been made to determine the degree of isolation between transmitting and receiving aerials in aircraft within the frequency range 2.0 to 1250 MHz. Computer modeling using idealized aircraft shapes together with practical measurements on cylinders, flat ground planes and actual helicopters and fixed wing aircraft have been made and the results compared. The emphasis of the practical work has been made towards determining the in-band and out-band aerial isolation associated with various communication bands. Recently developed combination aerial having a fixed high isolation between elements together with band pass and band stop filters have been examined.

INDEX TERMS: Electromagnetic Compatibility, EMC, Computer modeling, Transmitter Harmonics, Isolation

EMCABS 19-3-82

System Siting and the EMC Problem

Flt. Lt. K. Williams (Assoc Member IERE (RAF)) and SQN Ldr. C.C. Smith (RAF)

Royal Air Force, High Wycombe

Proceedings of the Conference on Electromagnetic Compatibility

IERE Conference Proceedings No. 39, pp. 311-313

ABSTRACT: The Royal Air Force operates a number of mobile radar systems in the United Kingdom. The increasing number of radio stations and microwave links being installed countrywide poses problems whenever these radars are deployed to temporary sites. The Royal Air Force is very much aware of its responsibilities in contributing to the achievement of electromagnetic compatibility with other users of radio frequency bands.

INDEX TERMS: EMC, electromagnetic compatibility, radar, microwave, radio frequency

EMCABS 22-3-82

Indirect Lightning Surges Induced in Overhead and Underground Hybrid Transmission Lines.

Nubuo Kuwabara, Hiroaki Koga, Tamio Motomitsu and Mirihiko Taghuchi, Ibaraki Electrical Communications Laboratory, NTT Ibaraki, 319-11, Japan. Trans, IECE Japan, Vol. J65-B, No. 1, pp. 31-38 (Jan. 1982)

ABSTRACT: A model study is made for lightning surges induced in overhead and hybrid transmission lines. Both lines are extended in parallel to the ground plane. The overhead cable sheaths are installed at every ten to hundred meter intervals. The surge voltage, surge front time and time to half value are calculated as functions of the distance to strike point and sheath ground resistance. The cumulative surge occurrence rate is obtained for lines with the sheath ground resistance 2 ohms/km. A good agreement is seen between the analysis and observations results. This paper provides data for lightning sure protection in the design of overhead and underground hybrid transmission lines.

INDEX TERMS: Lightning surges, overhead and underground transmission lines, lightning protection.

EMCABS 20-3-82

Some EMC Management Problems - Authority, Responsibility, Planning and Costs

E. Thomas Chesworth, Ph.D., P.E.

Seven Mountaint Scientific, Inc, Boalsburg, PA

EMC Technology & Interference Control News

Vol. 1, No. 1, January, 1982

ABSTRACT: The management of electromagnetic compatibility (EMC) programs is different from other electronics research and development operations. These differences are there primarily because of two technical facets in EMC, and these must be included in formulating alternative approaches to a successful, efficient, cost-effective and timely completion of the EMC task.

INDEX TERMS: EMC management, authority, organization

EMCABS 23-3-82

EMI Control in the Design of Printed Circuit Board

Donald R.J. White;

Don White Consultants, Inc.

EMC Technology and Interference Control News, Vol. 1, No. 1 (Jan. 1982) pp. 74-83

ABSTRACT: The procedures, parameters and techniques essential for EMI control in the design of printed circuit boards are described. Basic consideration is given to reduction of susceptibility level from printed circuit boards. The importance of controlling the characteristic impedance of both the power distribution lines and return paths is demonstrated. The impacts of internal self-jamming and crosstalk on the design of printed circuit boards are illustrated with several examples. The discussion is centered on double-clad single-layer boards. The performance prediction and design considerations are made as a function of logic speed and board size. The design methods aim to meet FCC, VDE, CISPR recommendations and MIL-STD-461B.

INDEX TERMS EMI Control, Printed Circuit Boards, Crosstalk and Internal Self-jamming

EMCABS 21-3-82

Measurement of Surface Current on Automobile

Toshiharu Fujiwara, Yogi Nagasawa, Risaburo Sato

Tohoku Institute of Technology, Faculty of Engineering

Tohoku University, Report of Technical Group on EMC, IECE, and IEE of Japan

Vol. 81, No. 238, EMCJ 81-75, pp. 13-18

ABSTRACT: One of the sources of noise radiation from automobiles is the current induced on the exterior surface of the body. The measurement of the surface current was carried out using a detector. The result indicates that the surface current greatly depends on slits between bonnets and fenders and the shape and size of automobiles. The noise source can be detected from the measurement of the amplitude and direction of the surface current of the body.

INDEX TERMS EMI Control, Automobiles, Surface Current.

EMCABS 24-3-82

CISPR Publication 10 - Organization, rules and procedures of CISPR

International Special Committee on Radio Interference (CISPR)

International Electrotechnical Commission

3rd Edition, 1981, 33 pages

ABSTRACT: Incorporates further changes in the membership of the CISPR and methods of working as agreed at meetings of the CISPR Plenary Assemblies held in 1979 and 1980. It deletes the International Commission for Conformity Certification of Electrical Equipment (CEE) and adds the International Union for Electroheat (UIE). Changes have also been made to include cooperation between CISPR and ICAO (International Civil Aviation Organization). SC A title has been changed to include reference to statistical methods. SC B terms of reference amended to include study of interference from data processing equipment. The main change in CISPR Publication procedures has been to extend the IEC Six Months' Rule to include CISPR Recommendations.

INDEX TERMS Standards, ISM, Instrumentation, Measurement techniques, Appliances, Motor Vehicles, High Voltage Equipment, Receivers

EMC PERSONALITY PROFILES

by William G. Duff



RALPH E. TAYLOR

The EMC Personality Profile in this issue is Ralph E. Taylor. Ralph received a Bachelor of Arts Degree in Physics, in 1951, from The George Washington University. However, his professional career began earlier, in 1942, at the U.S. Naval Research Laboratory. In 1948, he became a supervisory electronics engineer at the National Bureau of Standards, and in 1953, a project leader at the U.S. Army Diamond Ordnance Fuze Laboratories (now known as Harry Diamond Laboratories). In 1960, he became a section head, and later a program manager, at the National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, MD, until the present time.

Some of the more interesting and significant projects that Ralph has been involved in include:

- Design of U.S. Navy shipboard electromagnetic countermeasures equipment during World War II
- Design of airborne antennas at L-Band for telemetering data from captured German V-2 rockets tested at White Sands, NM
- Design of radar proximity fuzes for U.S. Army guided missiles and rockets
- Design of VHF, UHF autotrack receiving systems for NASA satellite world-wide tracking stations
- Development of EMI standards for NASA satellite tracking stations
- Development of VHF, UHF antenna calibration techniques using radio stars
- Development of aircraft and shipboard satellite navigation systems
- Airborne measurement of VHF, UHF and microwave emissions from U.S.A. urban, suburban areas
- Design of mobile communications terminal for NAVSTAR global positioning satellite system (GPS)
- Conducted NASA studies for satellite data collection at UHF from oceanographic buoys and meteorological balloons

Ralph holds five U.S. patent inventions for antennas and radio-frequency receiving systems. In 1981, he was awarded a Certificate of Recognition from NASA for the disclosure of an invention of low-cost, NAVSTAR GPS mobile terminals.



During his career, Ralph has authored or co-authored fifty technical publications, including twenty two papers in technical journals. Some of his more notable publications include a radio-frequency interference handbook, *NASA Special Publication SP-3067*, published in 1971, still in demand, especially in foreign countries. Also, he edited Chapter 29, "Radio Noise and Interference, Reference Data for Radio Engineers," *ITT Handbook, Sixth Edition*, 1975.

He authored Part Four "Tracking Navigation and Data Relay Satellite Systems," in a *Review of Satellite Systems Technology*, published in 1972 by the IEEE/AES Group, and co-authored *Addendum Observation, Experimentation, Tracking and Navigation Satellite Systems, Communications Satellite System: An Overview of the Technology*, IEEE Press, 1975.

Ralph was the principal investigator for the NASA airborne electromagnetic environment survey experiment, a simulated space shuttle/spacelab mission, consisting of a series of aircraft flights known as ASSESS II, over the western United States in 1977. Jim Hill, The EMXX Corporation, was the contract manager and participated in the ASSESS II flights and in other aircraft flights under Ralph's direction for measuring the electromagnetic environment from cities. Ralph and Jim authored jointly eight papers published at IEEE International EMC Symposia.

Ralph is the Subcommittee Chairman for Radio Transmitters, IEEE EMC Society Standards Committee, resulting in the IEEE standard measurement procedure for a field disturbance sensor (RF intrusion alarm), IEEE Standard 475, to be issued in 1982. He was a panel member, Subcommittee: IEEE/AES Society, Satellite Systems Committee, 1971 to 1978.

In 1977, Ralph received the Certificate of Merit Award from the IEEE Group on EMC for outstanding leadership in the space program application of EMC technology. In 1981, he received the Richard R. Stoddart Award of the IEEE EMC Society for contributions in the control of EMI and measurement of the electromagnetic environment.

Effective January 1, 1982, Ralph was elected a Fellow member in the IEEE for his contributions to EMI prediction. He has been a Senior Member of the IEEE since 1954.

Ralph and his wife live in Silver Spring, MD and are active in church and public service activities. However, after forty years of service with the Federal Government, Ralph expects to retire this year and to move to their home town of Hickory, NC.

CHAPTER CHATTER



by Charles F.W. Anderson

Central New England

Nominations for the '82-'83 Chapter officers are as follows:

Chairman: John M. Clarke (USAF/ESD)

Vice-Chairman: Arthur W. Murphy
(GTE-Sylvania)

Secretary/Treasurer: Lennart Long (USDOT)

The election will be held at the next Chapter meeting, which is scheduled for April 21st. Speaker at that meeting will be Ron Richard of IFI, whose topic will be Crawford Cells. A May 19th meeting also is scheduled, with Pamela Waterman of MITRE discussing a radiometry noise problem. (Thanks to John Clarke for the input.)

Chicago

Looks as if we will have a reactivated Chapter shortly! Bob Hofmann reports that they have planned a meeting for March 18th, which will feature a presentation on the Bell Labs-Naperville EMC group's relation to the parent organization, its objectives and its facilities and equipment. A facilities tour is to follow the presentation.

Dayton

Chapter Chairman Eldon Wick reports that they held a meeting on March 2nd, at which there were 15 attendees, including Dave McElvein and Al Booth of Chomerics. Steven Davidson, of ASD's EMC and Power Branch (ASD/ENACE), presented a talk on the subject "Advanced Antenna-to-Antenna Compatibility Analysis Program Plus Graphics (AAPG)." This program, which analyzes EMC problems between transmitting and receiving antennas on aircraft, is designed to be used in connection with an interactive graphics display terminal (e.g., Tektronix 4014) on a large-frame computer. Also discussed at the meeting were the possibility of sponsoring an EMC National Symposium, the EMC-S Newsletter format and content, and programming of future meetings. The Chapter is sponsoring a session at the Aerospace Electronics Conference in Dayton in May. For September or October, a meeting on the topic of rocket-triggered lightning is scheduled; with the December meeting to be elections plus a yet-to-be-selected speaker/topic. Committee chair assignments, as follows, have been made:

Administrative: Eldon Wick

Membership: Vic Morats

Meetings and Papers: Gary Thiele

Publicity: Rudy Beavins

Standards: Charlie Seth

Chapter Bylaws: Peter Marth

Los Angeles

Speaker at the March 18th meeting was Steve Jensen whose topic was "Spurious and Undesired Responses in Current Probes." Steve is an independent EMC consultant, active both in military and commercial EMC areas. Formerly V.P. of Engineering with Gensico Technology Corp., Steve has a B.S.E. from UCLA and is a UCLA Executive Program Graduate. He has been active in EMC related activities for 20 years. The meeting was held at the Ponderosa in Culver City, with cocktails and dinner preceding the meeting.

San Diego

Under Chairman Bill Johnson, the Chapter continues its monthly meetings. In January, George Kunkel presented "Electromagnetic Shielding Using Transfer Impedance Test Data." The technical program was preceded by sandwiches/hors d'oeuvres. February's meeting featured Navy Joe Fisher, who presented the Naval Air Systems Command's approach to EMC problem resolution and overall EMC control. Again, sandwiches and hors d'oeuvres were the preliminaries. The March meeting started off with another of Lou Messer's gourmet buffets. Lou wore two hats - in addition to his chef's toque for the buffet, he donned his Systems Engineering hat to present a talk on the topic "Exploding Some Popular Myths in Aircraft Wiring Habits." All the meetings were held at IRT's Convoy Court facility. (Some day, your Column Editor hopes to make one of Lou's famous "spreads.")

Tokyo

Professor Sato and his colleagues across the Pacific continue to hold their high quality technical meetings. Topics presented range from a variety of theoretical papers to such pragmatic ones as investigations of electromagnetic absorbers using carbon black and carbon fibers.

SPECIAL NOTE: On March 12, 1982, the IEEE approved the establishment of the Electromagnetic Compatibility Chapter in the Central Texas Section. Edwin L. Bronaugh of Southwest Research Institute will be the interim chairman until an election of officers is held.

ACCREDITATION OF EM CALIBRATION SERVICES

Laboratories that provide electromagnetic calibration services may be obliged to seek accreditation in order to continue measurement testing. While federally regulated compliance requirements may be a long way into the future, the voluntary Laboratory Assistance Program (LAP) is a nearer possibility.

In what is termed a "final finding of need," the Department of Commerce (DOC), under the procedures of the National Voluntary Laboratory Accreditation Program (NVLAP), has gathered compelling evidence to support the setting of nationally recognized performance standards for electromagnetic calibration equipment and testing services.

From testimony given at an informal hearing conducted by the DOC and written statements submitted in response to a formal request emanating from the private sector and published in the Federal Register, the needs-assessment suggests that our reputation abroad may be suffering from the lack of a performance prototype, while clients contracting for services at home might, in the absence of quality control, be paying for unverifiable results.

Although compliance requirements now exist at the federal level, as exemplified in the Federal Communications Commission (FCC) standards regulating power and attenuation measurements, and the Occupational Safety and Health Administration (OSHA) regulations limiting radio frequency and microwave radiation levels, no existing US programs offer to examine and accredit public and private sector laboratories which provide electromagnetic calibration services.

In announcing the establishment of the British Calibration Service (BSC), the British Government stated:

"The state of measurement science and practice in a country is one of the surest signs of its technical efficiency. Modern industrial technology depends on accurate measurement."*

To keep pace with international developments and to answer an internal need, the DOC has turned to the standards of the IEEE, the Department of Defense (DOD), and the National Bureau of Standards (NBS) in an attempt to establish applicable measurement standards.

1. "IEEE Standard Application Guide for Biometric Power Meters' (IEEE Std 470-1973) and

'IEEE Standard Specifications and Test Methods for Fixed and Variable Attenuators DC 40 GHz' (IEEE Std 470-1972) are identified as the applicable standards in establishing this LAP."*

2. "In order to assure the quality of its own calibration services, DOD has found it necessary to provide in-house audit systems (assumed to be equivalent to accreditation systems) for its calibration laboratories. It is apparent that DOD believes that the benefits of its audit systems outweigh the costs."*
3. "Since the NBS enabling legislation assigns to it responsibility for the integrity of the nation's measurement system, and since NBS provides the basic reference calibrations for the nation, DOC believes that it is appropriate for NBS to review and recognize evolutionary calibration test methods (e.g., as may be identified by applicant laboratories) which are found to be adequate for NVLAP purposes in the same areas as those described in the IEEE standards for electromagnetic calibration services."*

Efforts are under way to include modifications and additions to accreditation criteria. Both must be accompanied by full documentation and completely described test methods, and are subject to NBS review. Additions must be formally added to the laboratory accreditation program through NVLAP procedures, having first been approved by the NBA. All proposed changes will be published in the Federal Register for comment, before any action is taken.

Much remains to be decided in the administration of this LAP. The administering agent is yet undetermined, as are the terms of accreditation, provisions for renewal, upgrading of equipment and inspection requirements, and reporting and accountability procedures. Although there are allowances for modifications of and additions to the accreditation criteria, independent laboratories might find the expense incurred by documentation prohibitive. Dwindling competition might pave the way toward government regulation.

Both public (the BCS) and private (West Germany's VDE) standardization models exist in the international community. This proposed voluntary LAP represents a consolidation of both sectors in this country.

STEINMETZ AWARD



Dr. Ralph M. Showers has been named the recipient of the 1982 Charles Proteus Steinmetz Award with the following citation:

"For leadership in the development of standards for measurement of radio interference."

The award will be presented at ELECTRO in Boston, MA on May 23, 1982.

Dr. Showers received the Ph.D. degree in 1951 from the University of Pennsylvania, where he is a Professor of Electrical Engineering in the Moore School of Electrical Engineering. In 1940 and 1941, he was with the General Electric Co., in Philadelphia, PA and Schenectady, NY. During World War II, he was temporarily with the Office of Field Service of the Office of Scientific Research and Development in connection with research in the general field of short-range communications.

His areas of research have included microwaves, systems engineering, physical and solid-state electronics, and radio interference.

Dr. Showers is Chairman of the International Special Committee on Radio Interference (CISPR); Vice President of the U.S. National Committee of the International Electrotechnical Commission (IEC); Chairman of the IEC Committee of Action Special Working Group on Electromagnetic Compatibility; Technical Director for Technical Services of the IEEE EMC Society; Chairman of the Standards Coordinating and Liaison Committee of the IEEE Communications Society; and, Chairman of American National Standards Committee C63, Radio-Electrical Coordination. He was a member of the committee that prepared the report published by the Joint Technical Advisory Committee (JTAC) of the IEEE and EIA titled "Spectrum Engineering—The Key to Progress, a Report on Technical Policies and Procedures Recommended for Increased Spectrum Utilization," 1968. Dr. Showers is currently a member of the IEEE Committee on Communications and Information Policy, and is a long-standing member of the EMC Society.

IEEE HONORS 130 MEMBERS WITH ELECTION TO FELLOW GRADE

The IEEE has elevated 130 of its members to its most distinguished membership grade, IEEE Fellow. Fellows are named annually by the Board of Directors after election by a committee of peers.

A mark of unusual distinction, Fellow grade is conferred only upon persons of outstanding qualifications and experience in their particular fields. Of the more than 220,000 members of the IEEE, less than 2 percent are Fellows.

This year's Fellows, each of whom will receive a certificate and a pin with special recognition during various IEEE meetings, were cited for achievements in specialized fields within the electrical, electronics, and computer disciplines. These disciplines include communications, computers, power engineering, biomedical engineering, control systems, information theory, and allied areas, as well as for outstanding contributions to engineering education.

The three EMC-S members elected to Fellow in 1981 are as follows:

FERDY P.M. MAYER: For contributions to the theory of ferromagnetics and to the development of materials for the suppression of electromagnetic interference

RALPH E. TAYLOR: For contributions to electromagnetic interference predictions

GARY A. THIELE: For contributions to computational methods in electromagnetic theory

CALL FOR ASSISTANCE

The EMC-S Standards Committee needs help in developing an important series of standards covering limits and methods of measurement, including the following:

Interference emission, Interference immunity, Conducted interference and the Line Impedance Stabilization Network, Open site measurements, Vehicular interference, Shielding enclosures, Electromedical devices, Signal grounding, Surge protectors, Home appliances, Others

Members of EMC-S who are willing to participate in these activities should send a note to Mr. Harold E. Taggart or call him at the address and telephone number listed below. It would be most helpful if you would identify any area or areas in which you are interested when contacting Mr. Taggart.

Harold E. Taggart, Chairman,
EMC Standards Committee
National Bureau of Standards
Division 723-03
325 Broadway
Boulder, CO 80303
303/497-3462

TECHNOLOGY ALERTING INDEX



Richard B. Schulz
IIT Research Institute
Annapolis, Maryland

Code symbols for the Technology Alerting Index are incomplete at this time and will be presented in the next Newsletter issue. Meanwhile, an uncoded listing of recent manuscripts submitted for the EMC Transactions is presented below. For draft copies, authors should be contacted.

MS No. Date	Title	Principal Author	Coauthors/ Notes
81-33 9/15/81	Semiconductor Long- and Multiple-Pulse Suscepti- bility Levels	Gregory A. Hjellen MS 4K-16 Boeing Aerospace Co. P.O. Box 3999 Seattle, WA 98124 (206) 251-0223	
81-34 9/21/81	Circuits for Beam Forming with Nonsinusoidal Waves	Henning F. Harmuth Dept. of Elec. Eng. The Catholic Univ. of America Washington, DC 20064 (202) 635-5193	
81-35 9/30/81	The Rhombic EMP Simulator	Hao-Ming Shen Gordon McKay Lab. Harvard University 9 Oxford Street Cambridge, MA 02138 (617) 495-4468	Ranola W.P. King (same address)
81-36 10/1/81	Statistic Modelling of Urban Man-made noise	A.U.H. Sheikh Dept. of Systems & Computer Eng. Carleton Univ. Ottawa, Ontario KS 5B6 Canada (613) 231-3625	S.J. Ashraf Faculty of Science Univ. of Garyounis P.O. Box 9480 Benghazi, Libya
81-37 10/2/81	Finite-Difference Analysis of EM Fields Inside Complex Cavities Driven by Large Apertures	David E. Merewether Electromagnetic Appli- cations, Inc. P.O. Box 8482 Albuquerque, NM 87198 (505) 265-3538	
81-38 10/3/81	On the Effect of Absorbing Materials of Electromagnetic Waves with Large Relative Frequency Bandwidth	Henning F. Harmuth (see 81-34)	
81-39 10/4/81	A New Method of Calculating 3-Meter Site Attenuation	Keiji Fukuzawa TV Dev. Dept. Sony Corp. 10-14, Osaki 2-chome Tokyo, 141, Japan (03) 493-3731	Mashahiro Tada Takashi Yoshikawa Koji Ouchi Shinagawa-Ku Risaburo Sato Tohoku Univ.

81-40 11/13/81	Radiation Charac. for Traveling Wave Antenna Excited by Nonsinusoidal Currents	Nie Zaiping Dept. of Electro- magnetic Field Eng. Chengdu Institute of Radio Engineering Chengdu, Sichuan People's Republic of China	
81-41 11/13/81	The Meas. of Lightning Environmental Parameters Related to Interaction with Electronic Systems	Carl E. Baum AF Weapons Lab. Kirtland AFB, NM 87117 (505) 844-9816	Edward L. Breen AFWL Felix L. Pitts NASA Langley Gary D. Sower EG&G Albuquerque Mitchell E. Thomas NASA Langley
81-42 11/6/81	A Black Box Approach to Semiconductor Device Thermal Response Electrical Analogs	Gregory A. Hjellen (see 81-33)	
81-43 11/6/81	Experimental Investigation of the Rhombic EMP Simulator; Comparison with Theory & Parallel-Plate Simulator	Hao-Ming Shen Gordon McKay Lab. Harvard Univ. 9 Oxford Street Cambridge, MA 02138	Ronald W.P. King (same address) (617) 495-4468
81-44 12/7/81	LORAN-C Positioning Errors Caused by Scattering from Wires Above the Earth	Robert G. Olsen Dept. of Electrical Eng. Washington State Univ. Pullman, WA 99164 (509) 335-4950	A. Aburwein (same address)
81-45 12/7/81	A Review of Natural Lightning: Experimental Data and Modeling	Martin A. Uman Dept. of Elec. Eng. Univ. of Florida Gainesville, FL 32611 (904) 392-0911	E. Philip Krider Univ. of Arizona
81-46 12/7/81	Antennas for Nonsinusoidal Waves: I. Basic Large Current Dipole	Henning F. Harmuth (see 81-34)	
81-47 12/7/81	Voice Comm. System Performance in the Presence of Automotive Ignition Noise	A.D. Spaulding NTIA Boulder, CO 80303 (303) 497-5201	
81-48 12/7/81	Using Free-Space Transmission Loss for Evaluating Anechoic Chamber Performance	Richard G. Fitzgerald National Bureau of Standards Boulder, CO 80303 (303) 497-3737	
81-49 12/10/81	Assessment of Aircraft Susceptibility/Vulnerability to Lightning and Development of Lightning Protection Design Criteria	John C. Corbin, Jr. Aeronautical Sys. Division Wright-Patterson AFB Ohio 45433 (513) 255-5078	William W. Cooley Boeing Military Airplane Co.

This particular column not only lists scheduled meetings of EMC standards committees; but, also highlights recent developments concerning EMC standards.

RECENT DEVELOPMENTS CONCERNING EMC STANDARDS

ANSI C63. Subcommittee 1 on Techniques and Developments has a number of standards projects underway, as follows:

1. Development of U.S. National EMC Standard: This is an umbrella EMC document that will include both general test procedures/limits and those for specific applications, possibly by reference to other documents outside ANSI. A very rough and incomplete first draft has been prepared and will be circulated for comment.
2. Development of Immunity Measurement Techniques: Many inputs have been received from working-group members and other committees, such as Computer and Business Equipment Manufacturers Assoc., Environment and Safety Committee. A first rough-draft document should be prepared soon.
3. Open Area Test Sites, an addition to ANSI C63.4, Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 10kHz to 1GHz. A 4th draft of this document is available and is expected to be revised in keeping with comments received. Revision due 4/15/82.
4. Four documents covering extensions below 10kHz and above 1GHz for ANSI C63.2, Specifications for Electromagnetic Noise and Field Strength Instrumentation, 10kHz to 1GHz, and ANSI C63.4 are out for subcommittee ballot.
5. Automatic Test Equipment. Work is proceeding on spectrum-analyzer and automatic-scanning receivers.

LIST OF RECENTLY APPROVED EMC STANDARDS

At printer; not yet available:

IEEE 473-1981. Electromagnetic Ambient Site Surveying
IEEE 475-1981. Measurement Procedure for a Field-Disturbance Sensor

Published:

RTCA DO176-1982. FM Broadcast Interference Related to Airborne ILS, VOR and VHF Communications
SAE J1338-1981. Open-Field Whole-Vehicle Radiated Susceptibility 10kHz to 18GHz, Electric Field

COMMITTEE	NAME	NEXT MEETING
ANSI C63	Radio Elec. Coord. Tech. & Develop.	9/11/82 (Subcom) EMC '82 Santa Clara
ANSI C68	High-Voltage Testing Techniques	Sept. 1982 Ft. Lauderdale (Probable)
ANSI C95	Radio-Frequency Radiation Hazards	Unscheduled
ANSI MD 105	Medical Electronics	5/11/82 Hyatt Regency Embarcadero San Francisco
CBEMA ESC5	Environment & Safety Comm. - Subcom. 5	Unavailable
EIA G-46	Electromagnetic Compatibility	Unavailable
EIA R-2	Consumer Electromagnetic Compatibility	4/19-21/82 San Antonio
IEEE S27	EMC Standards Committee	EMC '82 Santa Clara

SAE AE-4

Electromagnetic
Compatibility

5/17-19/82
Orlando

SAE ESC/SC

Electromagnetic Systems
Comm/EMI Standards &
Test Methods Subcom.

9/7/82
EMC '82
Santa Clara

SAMA PMC 33

Process Measurement
& Control

10/15-15/82 (SAMA)
Washington, DC

Subcommittee 2 on Terms and Definitions expects to have an updated set of definitions by September 1982.

Subcommittee 3 on International Standardization will meet in August to prepare for a September CISPR meeting in Stockholm.

Subcommittee 4 on High-Voltage Apparatus and Powerlines is working on a new HV document.

PAPERS PRESENTED AT THE RESEARCH MEETING ON EMC JAPAN

Dec. 15, 1981, Nagoya

1. "Fundamental Properties of Scattering of Electromagnetic Waves by Automobile Using Microwave Simulation," by Masaoki Tanaka, Yasumitsu Mayazaki (Toyohashi Univ. of Technology)
2. "A Countermeasure for Elimination of Ground or Surrounding Reflected Waves and Rating of Equipment in UHF Band Antenna Gain Measurement," by Toshikazu Korekado and Kikyshi Okuno (Osaka Electro-Comm. Univ.)
3. "Reflection and Transmission Characteristics of Electro-Magnetic Absorbers using Carbon-Black and Styrene," by Syooji Tominaga, Masaoki Tanaka, Yasumitsu Miyazaki (Toyohashi Univ. of Technology)
4. "Electromagnetic Field Around Japan Islands, Induced and Radiated from Power Lines," by Ichiro Tomizawa, Takeo Yoshino (Univ. of Electro-Comm.)
5. "Absorbed Power of Insect Pupae Exposed to Microwave Fields," by Osamu Fujiwara, Yoshifumi Amemiya (Fac. of Engg. Nagoya Univ.)
6. "A 1-2GHz Radiometer for Subcutaneous Tissue Temperature Measurements," by Hideo Harada, Masaharu Sawamura, Yoichi Maeda, Shizuo Mizushima (Res. Inst. of Electronics, Shizuoka Univ.)
7. "Thermometry of Hot Spot using NMR for Hyperthermia," by Yoshifumi Amemiya, Yoshitsugu Kamimura (Fac. of Engg. Nagoya Univ.)
8. "Studies on Interference Cancellation System," by Takeo Inoue, Toshiyuki Kaitsuka (Yokosuka Elect. Comm. Lab., NTT)
9. "Constitution and Performance of Interference Cancellation System," by Toshiyuki Kaitsuka, Takeo Inoue (Yokosuka Elect. Comm. Lab., NTT)
10. "Measurement of Electric Field Strength around an Automobile with a Near-Field Probe," by Shin Yama-

moto, Osamu Ozeki, Kunitoshi Nishikawa (Toyota Central Res. and Development Lab., Inc.)

11. "Wave Absorbing Characteristics of Concrete Mixed with Carbon Fiber and Beads," by Yasutaka Shimizu (Tokyo Inst. Tech.), Nobuo Maruyama (Kureha Chemical Industry Co.), Akira Sugiyama (Chichibu Cement Co.)
12. "Radio Wave Propagation Along Coal Mine Gallery," by Tadasi Suzuki, Takehiro Isei (National Res. Inst. for Pollution and Resources), Kuniaki Yosidomi, Kazuo Aoki (Kyushu Univ.)

For information on obtaining copies of the papers, contact Prof. Risaburo Sato, Tohoku University, Dept. of Electrical Communications, Faculty of Engineering, Sendai, Japan 980.

HARDENED ELECTRONICS AND RADIATION TECHNOLOGY CONFERENCE:

A conference on Hardened Electronics & Radiation Technology is scheduled for 23 July 1982 in Las Vegas, NV. Topics to be covered include:

- Circuit Design & Device Processing
- Electromagnetic Effects (EMP, SGEMP, IEMP, & Source Region)
- "Environmental Threats" and "Simulation Capabilities" will be presented as survey papers

Co-sponsors for the Conference are Sandia National Laboratories and the Defense Nuclear Agency (DNA).

This conference is classified as *SECRET*. In addition to having DOD or DOE secret clearances, all attendees must establish a specific visit clearance from the DNA by forwarding clearance requests through their appropriate channels. For further information, contact: Jerry Hood at 505-844-3744; LCDR Bill Mahr at 202-325-7026; or, Jim Ramsey at 812-854-1854.

1982 IEEE ANNUAL CONFERENCE ON NUCLEAR and SPACE RADIATION EFFECTS

The 1982 Conference on Nuclear and Space Radiation Effects will be held July 20th through 22nd at Caesars Palace in Las Vegas. It will cover nuclear and space radiation effects and electromagnetic pulse effects on electronic devices, materials, circuits, and systems, as well as semiconductor processing technology and techniques for producing radiation-tolerant (hardened) devices, integrated circuits, and memories. The program will consist of six to eight sessions of contributed papers, several invited papers, and a poster session. In addition, a Short Course on radiation effects will be offered on July 19th.

Papers describing significant findings in the following or related areas will be presented:

- Basic Radiation Effects Mechanisms for Materials and Devices
- Space Radiation Effects and Spacecraft Charging
- Radiation Transport, Energy Deposition, Dosimetry, and Radiation Facilities
- Manufacturing Technology for Radiation-Hardened Electronic Devices, Integrated Circuits, and Systems
- Radiation Effects on Electronic Devices and Components
- Radiation Effects on Integrated Circuits and Systems
- Single Event Phenomena
- Upset & Latchup Phenomena
- Hardness Assurance Technology and Testing Techniques
- Electromagnetic Pulse Phenomena (EMP, IEMP, SGEMP)
- Electromagnetic Pulse Coupling Assessment and Measurement Technology
- Radiation Hardened Instruments for Nuclear Power Plants
- New Developments and New Technologies of Interest to the Nuclear and Space Radiation Effects Community

For additional information, contact the Publicity Chairman, A. Ochoa, Jr., CRM Div. 2144, Sandia National Laboratories, Albuquerque, NM 87185; Tel. 505-844-6648.

GUIDE TO PUBLIC RELATIONS AVAILABLE

IEEE has published a *Public Relations Guide* for use by Sections, Societies, Councils and other units. The Guide tells how to apply PR techniques to a broad range of situations and what you need to know to be successful as your unit's PR officer. The Guide lists do's and don'ts and explains how the media works. If you are interested in obtaining a copy of this publications, contact the IEEE Washington Office.

AEROSPACE AND GROUND CONFERENCE ON LIGHTNING AND STATIC ELECTRICITY

The Eighth International Aerospace and Ground Conference on Lightning and Static Electricity is scheduled for June 21, 22, 23, 1983. As plans become more specific, they will be reported in this newsletter. This conference is being sponsored by the EMCS of the IEEE, Air Electrical Working Party of NATO, Committee AE-4 of SAE, and the AIAA in cooperation with six other organizations.

Conference Coordinator is Walter D. McKerchar; Chairman is Nick Rauch; with J.J. Risher as Vice Chairman. A Call for Papers, with the Abstract and Summary (3 copies required) due by October, 1982, has been issued for the following topics: P-Static; Helicopters; Ordnance; Standards; Phenomenology; Personnel Hazards; Shipboard Installations; Structures and Materials; Ground Systems Protection; Management Responsibilities; Protection of Aerospace Vehicles; Protection of Fuel Systems; Channel Modeling and Coupling Analysis; Hardening of Airborne Equipment; Test Criteria and Techniques.

Inquiries, abstracts and summaries should be directed to: Nick Rauch, Chairman, Eighth International Lightning Conference, ACT 340, FAA Training Center, Atlantic City Airport, NJ 08405. Notifications of Acceptance will be forwarded by January, 1983.

RETIREMENT PLAN TO BE OFFERED

The IEEE soon will be adding a program for Individual Retirement Account (IRA) and Keogh pension plans to its list of member benefits. The Board of Directors has approved the IRA/Keogh program, subject to legal review. The IEEE will be the sponsor, with funds invested through the Dreyfus Corp. and T. Rowe Price Associates.

Information about the plan will be sent to members in the Fall, and the program is expected to be operating by the end of the year, according to a spokesman for Smith-Sternau Organization Inc., the New York program consultant.

The funds invested and interest on those funds are tax-deferred. They are taxed when the money is withdrawn, presumably when the investor is in a lower tax bracket.

Additional information about the IEEE IRA/Keogh plan will come from Smith-Sternau as soon as the plan is available. Information about IRAs and Keogh in general and Government legislation concerning pensions can be obtained from W. Thomas Suttle, IEEE Washington Office, 1111 19th St. N.W., Washington, D.C. 20036; 202-785-0017.

REPORT ON EMC-S BOARD OF DIRECTORS MEETING

February 11, 1982

President Bill Duff presided over his first Board meeting with 15 of the 21 Board members present for the meeting in Washington, D.C. At Bill's request, Don Heirman reported the highlights of this meeting and will report on future meetings, for the Newsletter.

The following briefly describes key discussions held at our first 1982 Board meeting:

1. Warren Kesseman, EMC-S Treasurer, indicated that our uncommitted balance as of 31 October 1981 was \$93,900. He also suggested, and the Board agreed unanimously, to invest \$20,000 of our savings to higher percentage savings option which will double the present interest rate. Preliminary budgets for 1983 were requested. Those who chair committees should submit their needs to their respective Technical Director as soon as possible.

2. Special recognition was given to the new look that Bob Goldblum, Newsletter Editor, brought to our Winter EMCS Newsletter. All were impressed with the format and the look.

3. Dick Schulz reminded each Technical Director that there was a good chance that up to 4 pages of appropriate material can be placed in the EMCS Transactions to fill blank pages. If our members have ideas on what could be placed in the Transactions, please contact Dick on 301-267-3218.

4. It was noted that correspondence has been received both from the Wroclaw EMC Symposium and the Zurich EMC Symposium and Exhibition Committees accepting our offer to cooperate with them for these two immediate symposia in 1982 and 1983, respectively.

5. The Atlanta Section has requested to host the 1987 EMC Symposium. The Board requested that a preliminary budget be presented in September at the annual symposium Board meeting for approval.

6. Any comments you may have regarding improving the organization, operation, and technical program of our symposia are most welcome. A revised policy on such matters is being worked on by Gene Cory. Send your comments to Gene at SWRI, P.O. Drawer 28510, San Antonio, TX 78284.

7. Due to the budget surpluses following the Baltimore and Boulder symposia, the Board moved that the 1982 Santa Clara symposium establish a break-even point on the basis of 450 attendees. This should hold the line or lower the amount for registration fees.

8. The Standards Committee report indicated a still urgent need for volunteers. Here is a chance for individuals to work on standards that may directly affect your work or that of your employer. Why not call Bud Taggart 303-497-3462 and find a match for your interests?

9. Jim Toler continues his fine work on nominating candidates for Fellows from our Society (seven are in process) and developing new membership ideas. He suggested that large companies with active EMC efforts be approached to help recruit new members. Those of you who are employed by

such companies are encouraged to contact Jim 404-894-3964 and discuss a course of action.

10. Our Constitution and By-laws are being reviewed by Hugh Denny 404-894-3535. Changes being considered are in the areas of establishing limits to officers' terms of office, allowing mail balloting for President and Vice-President, and reevaluating eligibility for Secretary and Treasurer. Send Hugh your ideas now.

11. The Board has expressed its interest in furthering the work of our Public Relations Committee which recently has been taken over by Peter Grant 201-272-5500. Peter is looking for ideas and volunteers.

12. Spread spectrum and broadband measurement progress report was given in a report by Paul Newhouse of ECAC, Annapolis, MD. The Board has an outstanding action item to answer the FCC Chief Scientist request for assistance from the EMC Society in this area. Any inputs or questions on this topic should be addressed to Paul or Gene Knowles 206-575-5280.

13. President Duff made three appointments:

- a. Dr. Woody Everett - EMCS representative on the IEEE R & D Committee
- b. Low Lowbello - Chairman of the EMCS Intersociety Relations Committee
- c. Don Heirman - EMCS Representative to the IEEE Standards Board
(appointment made subsequent to the meeting)

Please give them your support and encouragement.

Bill also presented the EMCS immediate Past President, Don Heirman, with an engraved plaque for his contributions to the Society in the past two years.

14. The Board was presented with the plans for the celebration of the IEEE Centennial in 1984. The EMCS will be actively engaged in the Centennial celebration during our 1984 symposia. Further details will be made available as they progress.

15. The Board voted to cooperate with the "8th International Aerospace and Ground Conference on Lightning and Static Electricity" to be held in June 1983. Further details can be obtained from Art Wall 202-653-8247.

16. A proposed IEEE Press Book on Spectrum Engineering and Management is being written by Fred Matos of NTIA. The Board approved EMCS sponsorship subject to prior review of the manuscript by the Board.

The next Board meeting will be held on Thursday, 10 June 1982, in Houston, TX, between 1:30 P.M. and 5:00 P.M. This meeting coincides with the National Computer Conference. We hope Society members in the Houston area at that time will attend and see first hand how your Board works for you. The new officers and committee chairmen can be identified in the 1982 version of the EMCS Committee Directory available free from the Secretary, Art Wall, 202-653-8247. Get yours now and contact those in charge of activities you want to participate in. See you in Houston.

Don Heirman
Immediate Past President

IEEE AGE DISCRIMINATION PROGRAM IN SCHENECTADY DRAWS HUGE ATTENDANCE

The IEEE Schenectady Section sponsored a lecture on age discrimination in engineering employment on October 28. Despite competition from the final game of the world series, plus typical Schenectady weather, over 130 members attended. To put this meeting in perspective, a large IEEE-sponsored technical meeting in Schenectady may be attended by about 40 people, while most events attract between 10 and 20. The attention given to this subject is perhaps indicative of the extent of the age discrimination problem in this region.

The meeting consisted primarily of a 90-minute presentation by James F. Fairman, a practicing attorney and IEEE member from Washington, D.C. Mr. Fairman is the author of the *IEEE Age Discrimination Digest*. (The *IEEE Age Discrimination Digest* is available from the IEEE Service Center in Piscataway, NJ. Request IEEE Catalog No. UH0138-8; price is \$16.50 for members and \$22 for nonmembers.)

Initially, Mr. Fairman addressed the demographics associated with the technical work force, particularly noting that the fraction of workers in the 40-65 age group is increasing. Following this information, he discussed the grievance procedure in the State of New York for those who wish to exercise their legislated rights. Following this, he described the Federal Age Discrimination in Employment Act (ADEA) of 1967 and how this may be used to protect workers' rights. He also noted a 100% increase in age discrimination complaints in the U.S. from 1979 to 1980.

Another important phase of the talk included a list of five practices by employers which are specifically prohibited by the ADEA in terminating or demoting employees. In describing typical practices used by employers in reducing employment and payroll costs, Mr. Fairman emphasized that the ADEA is not intended to interfere with employer decisions caused by adverse economic circumstances.

In concluding his presentation, Mr. Fairman reemphasized the need for an advocacy organization in government to protect the economic rights of workers between the ages of 40 and 65. He compared this need to the roles filled by NOW and "Ralph Nader" types of organizations.

The Schenectady Section of IEEE and the Schenectady General Electric Engineers and Scientists Association are grateful to Chuck Olsefsky, USAB Age Discrimination Task Force Leader, for supporting this program, as well as to Mr. Fairman for donating his services.

IEEE FELLOW TO HEAD URSI

Professor William E. Gordon (F'61) was elected 1981-1984 President of the International Union of Radio Science (URSI, after the French name, Union Radio Scientifique International) during its twentieth Tricentennial General Assembly in Washington.

Nearly 1500 URSI members, representing 36 national committees, and guests met for ten days to discuss the latest developments in the fields of radio science, including: electromagnetic metrology; biological effects of electromagnetic waves; fields and waves; signals and systems; physical electronics; electromagnetic noise and interference; wave phenomena in nonionizing media; ionospheric radio and propagation; radio waves in plasmas; and radio astronomy.

Professor Gordon, in his closing remarks, stated that "...radio in radio science has expanded to include optics as telecommunication sciences grow, and remote sensing now ranges from the solar system on the one hand to exploring the human body on the other hand."

Other officers elected were from the United Kingdom, India, Japan, Poland and Australia.

IEEE membership was well represented in the technical and management groups of the Assembly. Most of the members of the Organizing Committee were IEEE, with Dr. Geoffrey Hyde of COMSAT Laboratories as Chairman.

This outstanding international event will be held again in Florence, Italy in 1984.

PAC "SOURCE SHEETS" ON PROFESSIONAL TOPICS AVAILABLE

In its continuing effort to provide authoritative, up-to-date information to PACs, USAB published a number of Source Sheets during 1981. A limited supply of additional copies are available on request to the IEEE Washington Office.

The PAC Series of publications includes two booklets: *PAC Guide to Service Contracts* ("Your Rights As A Service Contract Employee") and *PAC Guide to Patents* ("Employed Engineers: Who Owns Their Inventions?") Copies of the booklets are available for sale from the IEEE Service Center in Piscataway, NJ. The Service Contracts Guide is IEEE Catalog No. UH0146-1; price, \$2.25 for members and \$3.00 for nonmembers. The Patents Guide is IEEE Catalog No. UH0147-9; price, \$2.00 for members and \$2.75 for nonmembers.

MEMBERS WANTED

As an IEEE/EMC-S member, you are urged to invite and to encourage your non-member coworkers to apply for membership in IEEE, the world's largest professional, technical engineering society (thereby joining over 215,000 members worldwide) and to affiliate with the Electromagnetic Compatibility Society (EMCS). These memberships certainly will prove to be an investment in their professional future.

Inform your colleagues that IEEE enhances the quality of life for all people throughout the world through the constructive application of engineering technology. It endeavors to promote understanding of the influence of EMC technology on the public welfare. IEEE is dedicated to improving the understanding of electrical and electronics engineering today and its applications to the needs of society.

TECHNICAL/EDUCATIONAL ADVANTAGES OF IEEE MEMBERSHIP INCLUDE:

- *Publication Services* - 15% of the world's total principal technical papers in the electrical and electronics field is published by IEEE. Greatly reduced rates are offered to IEEE members to one of the world's most comprehensive publication operations in EMC, enabling members to keep abreast of the latest technology, news of the profession, and constantly remaining aware of the needs and demands of the profession.
- *Professional Conferences and Meetings* - Reduced rates are extended to IEEE members to attend and to participate in a large number and variety of general and EMC meetings - on local, regional, national and international levels. Provides an excellent means of keeping aware of the latest technical developments in a particular field of interest.
- *Educational Aids* - Wide variety available, enabling IEEE members to avoid technical obsolescence
- *Library Privileges* - Special member rates available for the facilities of the Engineering Societies Library
- Also offered are *short courses, self-study courses, video-tape short courses, pre-college guidance*, and technical competence and manpower required to continually evaluate the ever changing curricula in electrical and electronics engineering and technology in the U.S.

AMONG THE MANY PROFESSIONAL, NONTECHNICAL BENEFITS AND ACTIVITIES OF IMPORTANCE ARE: group annuity plan, charitable or educational annuity, IEEE IRA/Keogh program, low-cost group insurance for IEEE members and eligible dependents; professional publications sent on a regular basis; the sponsorship of Congressional Fellows to provide competent expertise to U.S. Congressional Committees; the continuous and active

updating of a Code of Ethics to improve employee-employer relations; availability, at low cost, of Salary and Fringe Benefit Surveys, manpower reports, manpower monographs, promotion of an understanding of the influence of technology on the public welfare; improvement of employer/employee relations through the promulgation of guidelines for professional employment of engineers.

Pass this issue along to one of your co-workers, enabling that individual to join the IEEE and the EMC-S and to gain the many benefits thereof.

EMCS NEWSLETTER QUESTIONNAIRE

1. I seldomly ☐, frequently ☐, always ☐, read the **EMCS Newsletter**.
2. I believe that the number of **EMCS Newsletter** pages is too great ☐, appropriate ☐, too little ☐.
3. Please indicate below your preferences regarding the regular articles that appear in the **Newsletter**.

	Should Be Dropped	Should Be Reduced	Should Be Maint.	Should Be Increases.
a. A Message from the President	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Feature Technical Articles	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Opinion Articles	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Portpourri	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Chapter News	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. EMC Standards Activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Book Reviews	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. EMC Abstracts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Notices of Meetings & Symposia	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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4. Please suggest, in the space provided below, ideas which you think will improve the Newsletter . Indicate if you would be able to help us implement these ideas.				

Please return this questionnaire to:

Robert D. Goldblum
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1050 Colwell Lane
Conshohocken, PA 19428

INSTITUTIONAL LISTINGS

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

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

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.

TECKNIT EMI Shielding Products, 129 Dermody St., Cranford, NJ 07016
Telephone (201) 272-5500

EMI/EMP/ESD Shielding Materials, Gaskets, Vent Panels, Windows, and Conductive Coatings and Adhesives

HONEYWELL, ANNAPOLIS OPERATION, P. O. BOX 391, Annapolis, MD 21404
Telephone (301) 224-4500
EMI/EMC/TEMPEST, R & D, Test and Analysis, Communication and Digital Design.

SPECTRUM CONTROL, INC., 8061 Avonia Rd., Fairview, PA 16415
Telephone (814) 474-1571 Telex 510/699-6848

EMC test and consulting VDE, CISPR, MIL-461, FCC. Mfr. RF filters, RFI capacitors, chips, variable caps—in stock at HALLMARK.

ELECTROMAGNETICS, INC., 6056 W. Jefferson Blvd., Los Angeles, CA 90016
Telephone (213) 870-9383

RF shielded enclosures, modular, prefabricated & all welded. RFI/EMI power line filters; signal line filters.

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