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Electromagnetic Compatibility Society



Newsletter

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EDITOR: ROBERT D. GOLDBLUM

KEYNOTE ADDRESS

INTERNATIONAL SYMPOSIUM ON ELECTROMAGNETIC COMPATIBILITY REAR ADMIRAL R. J. GRICH, USN ATLANTA, GA, AUGUST 25, 1987

Thank you, Mr. Carlson, for that warm and complimentary introduction. With the recital of one's life history, it almost seems the next event is the wake. But that's far from the case here.

I'm both honored and delighted to have been invited to be with you today. Honored first because the IEEE is the professional organization that I've been affiliated with throughout my 37 years of professional life. Honored secondarily because of the significant importance of the subject matter of this symposium. Delighted because it provides me the opportunity to share some of my thoughts on a subject I've been advocating, sponsoring and proverbially missionizing in the Navy.

Unequivocally, this symposium, whose theme is "Advancing the State of the *Art* of Electromagnetic Compatibility," and those of you who advocate, support and work in the field of electromagnetic compatibility are directing your efforts toward a critical problem of global nature that is increasingly touching every aspect of our lives—civilian and military. You are truly working on the *RIGHT Problem*. Just as we have pressed on a variety of worldwide ecological considerations because of diminishing and limited resources, we have long since passed the

point where due consideration must be given to the electromagnetic environment. We have treated this resource as though there were no limits but we now find, through increasing experience, it is, in fact, limited. As the introduction of and the dependency on electronics pervades almost every aspect of our lives, we are becoming increasingly aware of the mutual susceptibility, incompatibility and, in fact, direct hostility of electromagnetic devices. From electric razors and hair dryers that jam all the radios and TVs in the home to electronic ignition controls that stop cars dead when the CB radio is keyed and, further, to the military and commercial uses where the operational dependency is vital, the EM problems being experienced are pervasive. The point I want to make is that the electromagnetic environment is a limited resource. For each application there is only one environment. You cannot make it bigger, wider or more forgiving. You must share it with both your friends and your enemies. You must accept its realities.

Electromagnetic compatibility became a matter of concern in the early 40's when, during World War II, we developed and introduced many new electronic devices. However, at that time, since devices were tube dependent, simple solutions, such as minor physical separation or

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EDUCATION COMMITTEE NEWS

One of the continuing problems faced by most local EMC chapters has been how to obtain interesting speakers for Chapter meetings. Over the last year the Board of Directors has inaugurated two programs that are intended to help alleviate the problem.

The first is the "Angel" program. Each local EMC Chapter has assigned to it a member of the EMC Society's Board of Directors who acts as the primary point of contact between the Chapter and the Board. The Angel has the authority to approve up to \$500 of EMC Society funds per Chapter per year. The funds can be used to cover expenses associated with a program run by the Chapter, such as travel expenses for a speaker, but not as an honorarium for a speaker. The Board requires that the Chapter try to obtain Section funding for part or all of the expenses before requesting funds through the Angel. Do you know who the Angel for your Chapter is? If not, give me or a member of the BOD a call.

The second is the Distinguished Lecturer Program, where four lecturers will be selected and engaged by the EMC Society to present a maximum of four lectures each per year on subjects relating to EMC. Lecturers shall solicit funds to offset expenses from their affiliation and/or the inviting organization. Non-reimbursed travel expenses will be paid by the EMC Society. Program details and speaker selection are still under determination, but the program should be operational by the beginning of 1988. The topics, abstracts and biographical sketches for each Distinguished Lecturer selected will be published in the EMC Society Newsletter. Anyone interested in participating as a lecturer in the program should contact the Program Chairman, Dave Hanttula, at (408) 986-8500 (office), or (415) 948-5459 (home). After the lecturers are selected, local Chapters can arrange for a lecture by contacting the Distinguished Lecturer directly or by contacting the Program Chairman.

These programs have been set up by the EMC Board of Directors to help local Chapters. However, to take advantage of them the local Chapter must take the initiative in arranging for a speaker. Although the Angel program has been in existence for over a year, only one EMC Chapter has taken advantage of it.

Henry Ott
Chairman, EMC-S
Education Committee
(201) 992-1793

RICHARD B. SCHULZ RETIRES

Richard B. Schulz, Editor of the IEEE EMC Society Transactions, has retired and is now an independent consultant. Those wishing to contact him concerning Transactions affairs may do so by calling (214) 492-0137 or by writing him at 2030 Cologne Drive, Carrollton, TX 75005.

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wide frequency separation, solved the problem and EMC was a low order concern. As technology moved forward in the post-World War II era, we continued to resolve electromagnetic compatibility problems by relatively simple solutions. When necessary, on occasions, we resorted to legislative-type solutions. For example, we developed the doctrine that people with pacemakers could not use microwave ovens. Electromagnetic compatibility in the *totality* of performance was not then and, in many cases, is *not* today a driving *design criteria*. In the early 60's, technology began to move by leaps and bounds and we rapidly transitioned from the relatively rugged tube-device era to the highly capable but highly electromagnetically susceptible solid-state device era. However, we maintained basically the same approach to treating electromagnetic compatibility. On the one hand, we exploited technology by virtually defeating the laws of physics and produced tremendously capable devices. But on the other hand, we've continued to treat the inherent susceptibility of these devices with traditional methods. Simply put, we've not been paying the system back for the downside aspects of the advancing technology—that is, susceptibility to the environment.

In the military we certainly have been exploiting this advancing technology in trying to achieve tremendous increases in warfighting capability. But it has not been working out all that satisfactorily. The old adage, "There's no free lunch" still applies. Even though we didn't recognize the need for a payback for this improved capability, the system is forcing that payback. We find ourselves in the dichotomy of having greater potential capability, but using it produces problems greater than the advantage the technology provides. We in the Navy are spending more money on what we call "fix it" programs to eliminate the symptoms of electromagnetic incompatibility—EMI—than we spent on some of the basic systems. But once the system is designed and installed and there are EM problems, the only alternative to remedy the situation is to reduce operational capability—the very opposite for which the system was intended. On our ships we pump megawatts of energy into the surrounding electromagnetic environment through the dimensions of space, time and frequency and then we hope to extract microvolts of information in return. With this difference of 12 orders of magnitude, EM compatibility, both environment and susceptibility become significant, making traditional solutions insufficient. In the past there were ample frequencies available, blanking of receivers satisfactorily reduced one's own ship's interference and there was enough real estate available. Today, virtually all frequencies are used, the real estate is devoted to more sophisticated weapons, physical constraints limit the size of the mast and there is a finite number of microseconds in a second. In addition to these considerations, the Navy is experiencing many instances where EMI has caused catastrophic losses of performance, personnel and material. We've arrived at the point where unfortunately, unless something else is done, "*more EM is worse.*" Because electronic devices

are used widely throughout a ship, careful attention must now be given to their locations and application. In spite of this concern, interference problems continue to unexpectedly develop. Some examples of wide ranging problems are:

- a. Self-jamming of systems with similar operational missions, requiring they be used separately rather than simultaneously as originally planned.
 - b. High induced voltages, causing equipment and servo malfunctions.
 - c. Direct-beam and lobe-beam coupling, causing equipment front end RF burn out.
 - d. Conducted power line noise affecting critical sensing devices and even disrupting propulsion controls.
 - e. Harmonic and intermod effects rendering certain communications useless.
- and finally
- f. High intensity fields imposing severe personnel and ordnance restrictions.

But we in the Navy do not have a singular lock on this issue. I'm sure my counterparts in the other military services could easily cite their own peculiar problems. As a matter of fact, EM compatibility—or, should I say, incompatibility problems—pervade the military services of other countries as well. If you recall, the British, in the engagement in the Falklands in 1982, lost a destroyer to an EXOCET missile because the onboard anti-missile system and the communications system could not be operated simultaneously due to EMI. At the time of the attack the Battle Group Commander was responding to a radio call from England. For the military the EM problem is indeed critical and has life-threatening implications.

But the problem of advancing technology bringing greater EM susceptibility and thus EM incompatibility is not reserved for the military alone. The effects of the EM environment are cropping up in increasing numbers in our civilian life. I mentioned earlier the classic—people with pacemakers cannot use microwave ovens. We all know that the compatibility issue of remote operators for garage door openers and TV sets were solved a number of years ago by changing to different types of transmissions. A more recent occurrence typifies the overall situation confronting us. In 1986, Paul MacCready and a group of California engineer friends took it upon themselves to leave posterity with a life-size replica of a prehistoric animal—the pterosaur—which is a flying reptile of considerable dimensions. So, they built an operating model of this creature. The model contained significant amounts of electronic components. In January of 1986, they successfully flew it in the El Mirage Dry Lake area outside Los Angeles. The model was then given to the Smithsonian Institution, but that organization wanted to demonstrate its operation by flying it over the city of Washington before putting it on display. Upon launching from Andrews Air Force Base, just outside Washington, DC, the model climbed as programmed to a height of about 50

feet, at which point it lost control, nose-dived and crashed. Much to the chagrin of its developers, it was later determined that an electromagnetic device on the air base hostile to the model's electronic innards had been activated. It's not surprising that the EM environment around Washington and specifically, Andrews Air Force Base, is *significantly* different from that in the desert area of California. This type of interaction, which we in the military see on a regular basis, will become increasingly prevalent in our civilian life as we fill our commercial items, such as automobiles, with more operationally-dependent computers and other electronic devices. Only recently I received a brochure publicizing that the building construction industry was conducting training courses in architectural EMC design. Electromagnetic compatibility in the face of advancing technology that produces more capable devices which have *greater susceptibility* to the *EM environment* is indeed a *rapidly growing challenge*. Much of what I've been describing to you, I'm sure, is not new. In fact, your organization is committed to a resolution of these types of issues. You will be talking and discussing many of the methods and approaches to producing electromagnetic compatibility and thus reducing the counterpoint, *EMI*. Such measures as spectrum management, measurement of the problems as they occur and installation of shielding to mitigate EMI are necessary and the technology to advance the state of the art should be pursued. But they alone, as we in the military have confirmed, are not sufficient to keep pace with the nature of the problem nor achieve or restore the performance that was intended, nor achieve the return on investment we intended when the application of the new technology was designed. Only the addition of proper levels and types of engineering applied in the early stages of development and design can ensure that technology can be utilized to its fullest and that the intended performance can be delivered for a reasonable cost. While this forum is attacking the issue from the *right* direction—electromagnetic compatibility—many, and we in the military are guilty, are coping with it as an *electromagnetic interference-EMI-issue* and then spending considerable effort trying to “fix it.” Today, EMI present in a final product is the result of not having done some part or all of the engineering properly. Once the product is designed, produced and put into application and found to create or suffer EMI there is very little that can be done short of changing the operating characteristics—usually reducing them at great cost. Failure to recognize and incorporate EM environmental considerations in the front-end engineering can be costly and even catastrophic.

I am happy to say that recognition of the need for front-end engineering is beginning to occur within the Navy. I have spent the last five years convincing the Navy hierarchy that we need a new engineering discipline which I call *electromagnetic engineering*, which deals with *EM environment* and *its effects* on board our ships and aircraft. This engineering discipline would encompass all the

requisite scientific, technical and engineering content required to *predict* and *design the EM system environment* and the resultant mission performance in quantitative terms for all the electronic devices, passive and active, collocated on a ship or an aircraft. Without this engineering capability, the employment of advancing technology to improve operational capabilities will, at best, be limited. This engineering discipline will not replace any existing engineering capability, but rather fill a current vacuum in the engineering world of integrating many electromagnetic devices into an optimum configuration aboard a ship or aircraft. This will require that factors such as size, shape, spacing, material and other aspects of the platform and its components are considered from an electromagnetic effect as well as their structural integrity and the like. While certain electromagnetic theories, such as near field, have not been fully defined, we know that solutions to certain electromagnetic compatibility issues aboard our ships and aircraft lie outside the area of electromagnetics and potentially reside in the areas of structures and their shapes and materials.

One might ask, “How did we get to this state of such incomplete engineering capability while we have been advancing technology applications at a galloping rate to individual elements within electronic devices?”

The answer is not simple.

As I mentioned previously, the EM environment has always been with us. But today's population density of all types of emitters has increased while at the same time the susceptibility of the electronic devices that are put into this dense environment has also increased but by an even *greater order of magnitude*. So until this situation became more evident and more difficult to handle with *reactive approaches*, there was not enough cause to address the cost to “*engineer*” EM consideration during the design and production of new technology. In essence, we took the “free lunch” and *forgot* to pay the R&D system back.

So what needs to be done? There is a two-fold approach which I believe is required. EM environment as a system engineering discipline needs to be developed, taught in our academic institutions and practiced in our development, design and production industries. In parallel, you need to continue your accomplishments in the areas this symposium is addressing.

Further, I believe this organization is the proper one to take on the following related goals and challenges:

1. Achieving EMC is *not* enough. Achieving EM *intended performance* through the application of a full spectrum of engineering disciplines both current and new, is the goal.
2. Having our academic institutions do research in EMC is *not* enough. The curriculum for all engineering disciplines should include how EM environment impacts their considerations for system engineering solutions.

3. Managing the spectrum and other similar type efforts *after* equipments are built is *not* enough. Specific EM environment design requirements should be prerequisites before equipments are approved for development even if, for instance, the frequency allocation is "legal."

Within these goals and challenges lie the solutions to not only our current EMC problems but also those future ones of greater complexity just around the corner.

In conclusion, let me say:

a. There is a *significant* and *growing* EM problem of *global* proportions in the ability to continue to employ new technology *without* paying *undue* performance *penalties*.

b. You are attacking the *right problem* and your efforts need to continue.

c. *EM environment considerations* need to be *organized and systemized* into an *engineering discipline*, taught in our engineering curricula and *applied* in design and production to help reduce the unexpected performance penalties.

Lastly, let me recommend that the focus of this fine EMC group be expanded to include achieving EM system performance within a specified EM environment and that the theme for the next EMC symposium be "Advancing the State of *Engineering* for Electromagnetic Compatibility." It has been my pleasure to be with you today. Thank you for inviting me.

SEATTLE



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IEEE 1988 INTERNATIONAL SYMPOSIUM ON ELECTROMAGNETIC COMPATIBILITY

P.O. Box 68157 • Seattle, WA • 98168

August 2, 3, 4, 1988 • Westin Hotel • Seattle, WA



The 1988 IEEE International Symposium on EMC will be held at the Westin Hotel in Seattle, WA on August 2-4, 1988.

The EMC Society is seeking original, unpublished papers on spurious electrical interactions in five categories: antenna-to-antenna, wiring-to-wiring, radio noise, strong field pickup and metrology and control. Topics of interest for this symposium include:

- Communicating through impulse noise
- Circuit hardening for transportation and aerospace systems
- Automotive EMC
- Military use of available commercial equipment
- Shielding of structures and small enclosure testing
- Transients in factory, hospital, vehicle and home
- Statistics, emission limits and measurement techniques

The deadlines for submissions are:

Abstract and Summary (three copies): December 1, 1987

Notification of acceptance: February 1, 1988

Floppy disk for printing test: February 15, 1988

Camera-ready copy or disk: April 1, 1988

Prospective authors should submit a 50 to 75-word abstract and a 500 to 750-word summary with up to five illustrations explaining the contribution, its originality and relevance to EMC. Upon acceptance, authors will receive a manuscript preparation kit. If only a poster presentation is desired, please so indicate. Send abstracts and summaries to Tom Herring, Papers Chairman, P.O. Box 68157, Seattle, WA 98166 or telephone (206) 463-3567. For registration information, contact Dave Dennis, The Boeing Company, 4220 NE 95th Street, Seattle, WA 98115 or telephone (206) 525-9336.

EMC 88 A PULSE FOR PROGRESS

THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

BOD ACTIVITIES

BOARD OF DIRECTORS' MEETING AT THE ATLANTA SYMPOSIUM

The third Board meeting of 1987 was convened on August 24, 1987 at the Radisson Hotel in Atlanta in conjunction with the 1987 International Symposium on EMC. All but one member of the Board were present. President Carlson announced the untimely deaths of Board members Mel Johnson and Alfred E. Ekersley, both long time members of the EMC community. A moment of silent prayer was observed. Several EMC Society members were present and were introduced along with the Board members. For this meeting Don Clark, Vice President, agreed to take the minutes in the absence of Secretary Gilda Haskins. Gilda has forwarded her resignation as Secretary from the Board for personal reasons. President Carlson appointed Joe J. Fisher to fill Mel Johnson's unexpired term ending December 31, 1988. President Carlson then presented the minutes of the May 7 meeting for Board approval. The Board later in the meeting approved the minutes with minor editorial changes.

The major items discussed are now summarized:

1. Treasurer Ford presented an expanded report showing not only the net worth but a complete analysis of our long and short-term investment progress, our 1986 income in various categories and our 1986 expenses. The current net worth (as of 6/30/87) was \$327.6K, which is within the IEEE guideline of maintaining a balance of at least equal to, but not more than twice, our annual operating budget of about \$280K. The Treasurer's report was accepted and a special thanks from the Board was given to Dick for his especially complete report.

2. Next, Director Bob Haislmaier, Communications Services, presented the EMCS Newsletter report from Bob Goldblum. Bob's report again urged that there be increased inputs to his Associate Editors to bring before our members more articles of a controversial nature, as well as application notes and short technical papers. Book reviews, local Chapter activities and other IEEE Society news articles were further encouraged. A motion was made and the Board approved that there be a policy that the EMC Newsletter list future meetings and events of interest to our members, even though they are not sponsored by the IEEE. It was left to the discretion of the Newsletter Editor on implementation procedures. Should the members have such items which are candidates for announcements, please forward them to Bob Goldblum.

Bob also noted the death of Mel Johnson, Associate Editor for EMC abstracts. That work is being picked up by Dan Williams and Bill McGinnis of Southwest Research Institute. Dick Schulz presented his report on



by Donald N. Heirman

the EMC Transactions. There was particular furor over the publication of the Harmuth papers in the November 1986 Transactions suggesting the need for modifying Maxwell's equations. The Board approved the publication of these papers with the reviewers' opposing opinions and a special notice of the controversial nature of the material. This approval was done prior to publication. The Board further supported this approach at the meeting. Dick offered a solution to manuscript processing delays to answer questions raised by the IEEE publications organization concerning late delivery of our quarterly material. Finally, Dick has been making a concerted effort to make known that he is now retired and that he can be reached directly at his home on (214) 492-0137.

Next, Gene Cory presented his report on future EMC Symposia. Gene introduced Hugh Denny, Chairman of the Atlanta Symposium, who indicated that there were 85 papers, 19 technical sessions and a conference record with 544 pages. There were 80 exhibitors using 115 booths. An estimated 600 full registrations and 450 exhibitors were expected to attend. Don Weber, 1988 Symposium Chairman, indicated that all was on track for the 2-4 August 1988 dates. An additional \$2K advance was approved for mailings. Professor Akao, 1989 International Symposium Chairman, handed out the first call for papers for the Nagoya, Japan meeting. Jim Hill reported that the History Committee work is on hold for the moment. Anyone who is interested in searching their files for historical EMCS details (Newsletters, Transactions, old minutes of meetings, etc.) should contact Jim at his new telephone number (216) 650-6230. Jim also mentioned the upcoming EMC Conferences in Wroclaw, Poland (June 28-30, 1988), and in York, England (September 12-15, 1988). If you are interested in attending or presenting a paper, give Jim a call.

3. Ed Bronaugh, Director for Technical Services, introduced his Committee Chairmen, who further reported their work. Don Heirman presented a brief review of his complete report. There are 17 standards and standards projects under review or being written. A list of the key work is contained in the article on EMCS Standards elsewhere in this Newsletter. Don reported that IEEE STD 263 on Vehicular Noise Emission Measurements was withdrawn and that the VT Society was considering a project on the same topic. Working groups for several of these

standards were meeting at the Symposium. Contact Don at (201) 834-1801 for more information.

Next, Hank Ott, Education Committee Chairman, presented a draft criteria prepared by Dave Hanttula, for the selection of a Distinguished EMC Lecturer. The goal is to have two lectures selected by February 1988 and the remaining two by June 1988. Those interested should contact Hank at (201) 386-6660. Lecturers on the topics of EMC modeling and prediction, EMC measurements (including open area test site calibrations), antenna design, EMP and RADHAZ are being sought. Hank also indicated that this Committee is preparing an EMC bibliography list and an article on EMC for the IEEE student magazine POTENTIALS.

Ed Bronaugh reported on the Technical Advisory Committee (TAC) activities for Wil Lauber. The TAC Annual Report is out which lists the accomplishments and future plans of the seven Technical Committees (TC). For a copy, contact Wil at (613) 998-2377. Wil also met with each of his TC Chairmen at the symposium to help rewrite the scopes and charters of the TCs.

4. Bob Hofmann, Director for Member Services, introduced Charlotte Tyson, who presented the Cumming Award to Professor Sato for his outstanding role in the 1984 Tokyo Symposium. Bill Duff was also presented with his President's pin for his 1982-83 term of office. Charlotte also indicated that 81 new members were signed up at the San Diego Symposium. She also reported a 7.2 percent growth in EMC Society membership in 1986. Bill Duff announced that six Fellows candidates were processed by his EMCS Fellow Evaluation Committee. The prospects for two strong candidates being elected were considered good. Chet Smith indicated that he will be putting together a slate of officer candidates for the 1988 term and present it to the Board for elections at its November 19th meeting. Bob Hofmann indicated that there was available a video tape from IEEE Headquarters on "Coordinating Chapter Meetings." For more information, contact Bob at (312) 979-3627. He also indicated that there is a push for a new chapter in the Cleveland area. Jim Hill is coordinating that effort. Those members in the Cleveland area who are interested should call Jim at (216) 650-6230.

5. Walt McKerchar, Director for Professional Services, indicated that there were 300 questionnaires on EMC employment being distributed at the Atlanta Symposium. Bob Goldblum will process the returns and announce the results in the EMC Newsletter. Walt then introduced Herb Zajac, Chairman of the Public Relations Committee, who presented several ideas on how to make the public aware of what EMC engineers are doing for them! For a list of his ideas and to present your own, call Herb at (503) 627-4759. Walt indicated and received Board approval to sponsor a technical session on "RF Environments for Aircraft" at an upcoming Air Electrical Working Party meeting in Canada. For more information, call Walt at (206) 779-7069.

6. Herb Mertel, Chairman of the Transnational Committee, presented his report. One of his main goals is to promote new international EMC chapters, symposia/conferences, membership and awards. His report showed that Australia, Canada, France, England, Italy, Spain, Sweden, Switzerland and West Germany all had sufficient EMC membership to establish a chapter (Canada a second one). The problem may be in that the memberships are scattered throughout the country and not centrally located in one city, making meeting attendance a problem. For more information, contact Herb at (619) 578-1480.

7. President Carlson discussed several issues raised at the IEEE Technical Activities Board meetings. They are too numerous to list. Len would be happy to discuss any TAB issues our members may have been exposed to. Call Len at (206) 773-6297. Len announced the newly-elected members of the Board who will take office January 1, 1988 and serve through December 31, 1990. They were:

Ed Bronaugh
Bob Haislmaier
Don Heirman
Gene Knowles
Charlotte Tyson
Herb Mertel

8. President Carlson adjourned the meeting at 5 pm. The next Board meeting will be at 10 am on November 19th at the Walt Disney World Hilton in Orlando, Florida. The EMC-Society Standards Committee will meet at 8:30 am in the same room for 75 minutes, immediately preceding the Board meeting. For further information, contact Don Clark at (404) 894-3535 or Len Carlson at (206) 773-6297.

Respectfully submitted,
Donald N. Heirman
Associate Editor
Board of Directors' Activities

BOARD OF DIRECTORS ELECTION RESULTS

Ballots for the election of six members to the IEEE Electromagnetic Compatibility Society Board of Directors were mailed on June 12, 1987. The ballots that were returned have been counted and the winners of that election are:

Edwin L. Bronaugh
Robert J. Haislmaier
Donald N. Heirman
Eugene D. Knowles
Herbert K. Mertel
Charlotte R. Tyson

The new Directors will serve for a three-year term starting January 1, 1988. We thank those who took the time to participate in the election as candidates and voters and wish success to the new members of the Board.



by Walt McKerchar

INTER-SOCIETY ACTIVITIES

SAE

In the previous article I advised that the SAE AE-4 Committee on Electromagnetic Compatibility was to meet during the 1987 International IEEE Symposium in Atlanta. At "press time" this has not yet occurred. I will report on AE-4's activities in the next EMC-S Newsletter.

The dB Society

The only news to tell you of at this writing is that Mr. John Merrell, the dB Society Secretary since the Society was chartered in 1975, resigned. This was due to his starting a new business venture in Texas. His new business will require a lot of his attention and he felt that as Secretary he could not devote the time required to do both. Dr. Al Martin has been appointed as the new Secretary. As the dB Society has not yet met at this writing, I shall report their "happenings" in the next EMC-S Newsletter.

RTCA/FAA/RF Vulnerability Project

The FAA, the United Kingdom Civil Aviation Authority (CAA) and the French Service Technique des Constructions Aeronautiques have been working together to review the protection required of avionic systems from high energy ground/airborne RF emitters. These three agencies are in the process of developing proposed requirements and standards concerning the effects of transmitted energy on critical flight control and avionic systems aboard modern aircraft. This problem has been intensified by the trend towards increased power levels from high energy ground radiation systems, increased utilization of sensitive microelectronic critical flight control systems and the reduced electromagnetic protection provided by advanced technology airframe materials.

Existing FAA and International Civil Aviation Organization RF susceptibility standards appear inadequate (re. RTCA DO-160) to assure avionic system immunity from this RF threat. Since aircraft are required to fly throughout the world, an international RF susceptibility standard is most desirable. In an effort to scope the problem and define the radiation level in the United States, the FAA, in cooperation with the Electromagnetic Compatibility

Analysis Center (ECAC), surveyed all civil and military ground and airborne high energy RF sources. The FAA developed a worst-case flight scenario for transport category aircraft, and ECAC developed guidance material to standardize the analysis process to ensure that a standard could be developed.

A series of meetings with airframe and avionic manufacturers have been conducted to discuss and refine the criteria and guidance materials. Additional information received from the United Kingdom and France has expanded the data base. At a September 22-23, 1987 meeting in Washington, DC (invitation only) these data, criteria and guidance materials will be presented and discussed in an effort to define the protection requirements and establish a draft of an international susceptibility RF envelope.

This writer and several other experienced EMCers have strongly suggested to the civil aviation community at several recent meetings that an already in-place standard, which is recognized, "do-able" and subjects equipment to a 200 v/m field, be imposed without delay for future production "fly-by-wire" flight systems and flight critical avionic equipment. We also suggested that current fly-by-wire aircraft be qualified to these susceptibility requirements.

Should the readers have comments, suggestions or questions, inquiries may be directed to Mr. William Larsen, FAA Field Office, P.O. Box 25, Moffett Field, Mountain View, CA 94035-0025 or phone Mr. Larsen at (405) 694-6380 or 5051.

NATO/Air Electrical Working Party/Special Meeting on RF Environments

The next Air Electrical Working Party (AEWP) (which includes EMC) of the North Atlantic Treaty Organization (NATO) will be hosted by Canada in Ottawa in April of 1988. This meeting will include on the agenda a continuance of the AEWP Project 2001 that was started in 1985. This particular meeting will consider the RF environments presently under study by the civil aviation authorities. The interest of the NATO/AEWP is, of course, NATO operations out of civil airports throughout the world. A tentative agenda is shaping up like this:

- Environment for Civil Aircraft in the U.S., Canada and Europe
- Requirements for Fly-By-Wire Aircraft
- RF Hardening of NATO Aircraft
- Naval Ships RF Environments

- Army Battlefield RF Environments
- Testing of Aircraft RF Environments
- Design of Aircraft Avionic/Electrical Equipment
- State-of-the-Art Testing Facilities

Inquiries and questions relative to this NATO meeting may be directed to:

Canadian Delegate and
Chairman: Mr. Joseph Belanger
Attn. DASP 6-2-5-
Phone: (613) 993-1905 National Defense
Autovon: 843-1905 Headquarters
Ottawa, Ontario K1A 0X2
Canada

U.S.A. Delegate: Mr. Charles E. Seth
Phone: (513) 255-7275 ASD/ENACE USAF
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IEEE EMPLOYMENT GUIDES AVAILABLE

Both the *Employment Guide for Engineers and Scientists*, Second Edition, and the *Employment Guide for Engineers and Scientists*, Student Edition, have been reprinted by the IEEE United States Activities Board's Employment Assistance Committee in order to meet the continued high demand for these practical guidance publications. Employed engineers may purchase the Second Edition from the IEEE Service Center for \$7.50 (member) or \$15.00 (non-member). Please specify IEEE Catalog Number UH0157-8. Unemployed members may request a complimentary copy of the Second Edition by writing to the Washington Office and including their IEEE membership number.

Students may purchase the Student Edition through the IEEE Service Center for \$8.95 (member) and \$11.95 (non-member). Please specify IEEE Catalog Number UH0174-3. All sales are subject to tax, billing and/or shipment charges. Sales orders may be placed directly with the Service Center by calling (201) 981-1393.

REPORT OF DIVISION IV DIRECTOR

The Board of Directors of the IEEE held its second meeting of the year in Los Angeles on June 22 and 23. As is normal, the Board of Directors' meetings were preceded by the TAB meeting on June 19 and by the TABopCom meeting on June 18. The TAB meeting members consist of all the Society Presidents as well as some of the Vice-Presidents and the TAB Committee Chairmen. There are over 50 people present for the TAB meeting. The TABopCom, or TAB Operating Committee, consists of the ten Division Directors, the TAB Vice-President and the Chairmen of three TAB committees. From just this short description you can easily see that the IEEE is a large organization, not just in terms of the number of its members, but also in terms of its administrative structure.

I'd like to report on two of the larger issues that arose at the Los Angeles meetings. First, in the Board of Directors meeting considerable time was devoted to the budget of the Institute and, in particular, areas of operation where revenues have not matched earlier expectations. One of these is continuing education. It was clear that this is perceived by the Board as an important activity for the Institute to undertake. Yet, there is concern that the revenues are falling short of both expectations and expenses.

The second major issue arose in the TAB meeting and was brought before the Board by the TAB Vice-President and the Division Directors. This issue was the operation of the



by Gary A. Thiele

IEEE, the efficiency of its structure and the responsiveness of that structure. The Board asked the IEEE President to draft a plan for correcting any deficiencies that might exist and to present that plan to the Board at its November meeting with an interim report to be presented at the August meeting. In my opinion, the IEEE staff, as well as the volunteers, are just as dedicated as ever, but it may be that the moderate but steady growth of the past ten years has reached a point where the structure of the Institute, including the number of staff, has fallen behind the demands placed upon it. I'll keep you informed of progress on this issue in a future newsletter article.

EMC STANDARDS ACTIVITIES



by Herbert K. Mertei

ACTIVITIES OF THE IEEE EMC SOCIETY STANDARDS COMMITTEE

The following article was prepared by Guest Editor Don Heirman, Chairman of the EMC Society's Standards Committee:

The IEEE EMC Society's Standards Committee is updating all IEEE EMC standards. The Committees need additional help. Please volunteer by calling me, Don Heirman, at (201) 834-1801 or Steve Berger, Committee Secretary, at (512) 835-4684.

The current status of various standards is as follows:

P139-1952: Recommended Practice for the Measurement of Radio Frequency Emissions from Industrial, Scientific, and Medical (ISM) Equipment on User's Premises.

Status: 12/10/86 ballot was 85.7% returned and 100% affirmative. Revision sent for coordination and to NESCOM* on 8/87.

P140-1950: Minimization of Interference from Radio Frequency Heating Equipment.

Status: Ballot on Draft 2, 6/15/87, 85.7% returned. One negative vote and several editorial comments are being resolved by the W/G Chairman, Jim Maw.

P187-1951: Standard on Radio Receivers Open Field Method of Measurement of Spurious Radiation from Frequency Modulation and Television Broadcast Receivers.

Status: Ballot on Draft 4, 1/29/87, 71.4% returned. Awaiting 75% before future action. "Soft" dimension conversions on figures have been issued.

P213-1961: Procedure for Measuring Conducted Emissions in the Range of 300 KHz to 25 MHz from FM and Television Broadcast Receivers to Power Lines.

Status: Coordination with other standards organizations complete. C63 comments dated 6/2/86 need resolution. New review copy

P214-1961: To be incorporated into Standard 213 per IEEE Standards Board.

P263-1965: Measurement of Radio Noise Generated by Motor Vehicles and Affecting Mobile Communications Receivers in the Frequency Range 25-1000 MHz.

Status: Ballot to withdraw has passed EMC and VT Society Standards Committees. VT Society to redo on their own. Results of ballot to withdraw sent to IEEE Standards office 7/87.

P478/482: Recommended Practice for Cable and Connector Shielding Characterization.

Status: PAR approved at 6/19/86 Standards Board meeting; additional coordination added.

P509: Recommended Practice for Gasketing Material Shielding Effectiveness Measurement.

Status: First draft to EMC Society Standards Committee by 8/87 for review and comment.

P626: Recommended Practices for Signal Grounding.

Status: PAR Approved at 6/19/86 Standards Board meeting; additional coordination added.

P1128: Recommended Practices for RF Absorber Evaluation in the Range 30-1000 MHz.

Status: PAR approval by IEEE Standards Board 9/18/86. Letters requesting W/G members sent 2/87 to prospective users and manufacturers.

*NESCOM = New Standards Committee of the IEEE Standards Board.

- P1140: Standard for Near-Field Testing Procedures for Electric and Magnetic Field Radiation.
- Status: PAR approval by IEEE Standards Board 3/12/87. Letters requesting W/G members sent 7/87 to prospective users and manufacturers.
- Standard 299: The purpose of revising Standard 299 is to make it more usable for those who use shielded enclosures, especially large rooms. The standard provides test procedures for measuring shielding between 14 kHz and 18 GHz, with guidance for measurements up to 95 GHz and down to 100 Hz.
- Status: A second draft is under preparation. Responses by industry and government as well as the military have been favorable to the extent that Standard 299 may be a suitable replacement for MIL-STD-285.

ASME/IEEE JOINT RAILROAD CONFERENCE

The ASME/IEEE Joint Railroad Conference will be held April 12-14, 1988 in Pittsburgh, PA at the William Penn Hotel. This meeting is co-sponsored by the Vehicular Technology Society's Land Transportation Group. Papers will cover the following subjects:

- Electromagnetic compatibility
- Traction electrification system alternatives
- Signal and communication system innovations
- Energy efficiency of locomotives or transit vehicles
- AC and DC propulsion
- Automation and microprocessor control
- Monitoring, fault detection and maintenance of equipment
- High speed rail operations
- New transit system starts, planning design, construction and start-up
- People mover technology

For additional information, contact:

Dr. Tristan Kneschke
Meeting Chairman,
VTS Land Transportation Division
Traction Electrification Systems Department
Parsons Brinckerhoff/De Leuw Cather
1701 North Market Street
Dallas, TX 75202

or telephone (214) 573-8944.

NATIONAL RADIO SCIENCE MEETING

The National Radio Science Meeting, sponsored by the U.S. National Committee of the International Union of Radio Science (URSI), will be held January 5-8, 1988 at the University of Colorado, Boulder, CO 80309.

The following USNC/URSI Commissions will participate: A (Electromagnetic Metrology), B (Fields and Waves), C (Signals and Systems), D (Electronics and Optical Devices and Applications), E (Electromagnetic Noise and Interference), F (Remote Sensing and Wave Propagation-Neutral Atmosphere, Oceans, Land, Ice), G (Ionospheric Radio and Propagation), H (Waves and Plasmas) and J (Radio Astronomy).

The Meeting is being held in cooperation with the following IEEE Societies: Antennas and Propagation Society, Circuits and Systems Society, Electromagnetic Compatibility Society, Geoscience and Remote Sensing Society, Information Theory Society, Instrumentation and Measurement Society, Microwave Theory and Techniques Society, Nuclear and Plasma Sciences Society and the IEEE Wave Propagation Standards Committee.

For further information contact the Steering Committee Chairman, Professor S.W. Maley, at the Department of Electrical Engineering, University of Colorado, Boulder, CO 80309.

URSI SYMPOSIUM AND EIGHTH MICROWAVE COLLOQUIUM PROCEEDINGS AVAILABLE

The *Proceedings* of the URSI International Symposium on Electromagnetic Theory and the Eighth Colloquium on Microwave Communication, both held in Budapest, Hungary on August 25-29, 1986, are now available.

The *Proceedings of the URSI International Symposium* (two volumes, 850 pp., ISBN 0-444-98986-2) is available for \$275.50 in United States currency or Dfl. 620.00. The *Proceedings of the Eighth Colloquium* (one volume, 524 pp., ISBN 0-444-98989-7) is available for \$173.25 in United States currency or Dfl. 390.00. Both can be ordered from Elsevier Science Publishers, P.O. Box 1663, Grand Central Station, New York, NY 10163 or from P.O. Box 211, 1000 AE Amsterdam, The Netherlands.

PCs FOR EMC

Hello from California, again! That's right, California, where I have re-located to the Rockwell Science Center, P.O. Box 1085, 1049 Camino dos Rios, Thousand Oaks, CA 91360, telephone (805) 373-4102. If you have been following this column, you might remember that in late 1985 I moved to The University of Kansas. It's a longer story than I have space to tell, or you would want to hear about, how I happened to move again. Suffice it to say that after living there for 18 years, my wife and I missed California more than we had expected. My position at Rockwell will continue my involvement in computational electromagnetics, as well as offer the opportunity of interfacing with modeling work in other areas such as fluid dynamics and information processing. I'm looking forward to settling down for a longer spell this time.

With the recent introductions of the MAC II and the IBM System2 computers, it seems fair to say that a new era of personal computing is at hand. These new "PCs," based on the 32-bit Motorola 68020 and Intel 80386 microprocessors respectively, offer quantitatively new capabilities in performance. Not only do they run faster at 16 MHz and 20 MHz, but they offer memory addressing of up to 4GB! This increased speed and storage will make feasible an expanding variety of serious number crunching as well as graphics that until now have been the province of minis and mainframes. As one reference point, we observe that the IBM 7094, a mainframe of the mid-1960s, offered 144KB, a factor of $\sim 3 \times 10^4$ less than these new "personal computers."

In this column we review briefly how PC computing has matured over the past 10 or so years. Information presented here is excerpted from an article titled "Evolving Directions of PC Applications in Electromagnetic Analysis and Design" written by Fred Deadrick of LLNL and me for a meeting in April, 1986 of the Armed Forces Communications and Electronics Association. It seemed especially appropriate at this time since it traces the development of PC technology up to the anticipated introduction of these 32-bit microprocessor machines. Most of the material is new except for the *Creative Computing* benchmark which was mentioned in an earlier column (August 1984) and is included for the sake of completeness.

Early PCs

The past 10+ years have seen a dramatic evolution in the capabilities of the PC. This evolution has occurred over essentially three distinct generations. The first personal computers circa 1975, as exemplified by the Altair 8800 and the IMSAI 8080, were largely the domain of the technically capable electronic hobbyist. These early computers, which were only available in kit form, had to be



by Edmund K. Miller

assembled and de-bugged by the user (An EE degree was a definite advantage!). Input/output terminals were typically slow teletypes and program storage was usually on punched paper tape. Memory chips were also very expensive at the time, and they restricted the typical home computer to a few kbytes (4 to 16) of memory. The user was also largely on his own in terms of both hardware and software support, since assembly language and Basic were the only available computer languages during this time period, and very few hardware and software developers were in business. However, from this modest beginning many individuals with the vision to see the need and utility of the PC promoted rapid development of a flourishing personal-computer industry.

It was not until the later arrival of a second generation of ready-to-run computers such as the Commodore PET, the Apple II and the Radio Shack TRS-80 (about 1977) that personal computers became readily available to a much wider audience. The 2nd-generation PCs also led the way to increased convenience and user support through a burgeoning new hardware and software industry. Available memory increased significantly during this generation from typically 4K to 64K or more, and teletype output was replaced by the video screen and dot-matrix printer. Mass storage also evolved during this period from the plodding cassette tape to the speed provided by the floppy diskette. Software improvements were also made to the Basic language, and languages such as FORTRAN, C and Pascal became readily available to the scientific and engineering community. While these 8-bit micros may in general have lacked some of the compute power of today's PCs, they clearly showed the utility of the PC in engineering.

The Microprocessor Revolution

The present third generation of personal computers began with introduction of the IBM PC (1981), and continued with such recent PCs as Apple's Macintosh, Commodore's Amiga and the IBM PC-AT. They offer computing capabilities which make PCs truly productive tools for engineering design and analysis. This evolution of the PC

into a useful engineering tool is the result of many parallel developments in both hardware and software. Advances in microprocessor design and large-scale-integration technologies have led to faster clock speeds, larger word sizes and greater addressable memory. The original Altair used an Intel 8008 microprocessor operating a 8-bit words at a clock speed of 2 MHz, while today the Amiga utilizes the Motorola 68000 32/16 microprocessor operating at clock speeds of 7.16 MHz, and the IBM PC-AT uses an Intel 286 processor operating on 16-bit words with a clock speed of 6 MHz. The progression of the microprocessors used in some of the more popular PCs is illustrated in Table 1. The table gives a good clue as to what the future holds in terms of raw compute power of the PC.

Random-Access Storage

Dramatic advancements have also occurred in the development of the memory chip. As a rule of thumb, the size of memory chips has increased by a factor of four every 2 to 2½ years. The Altair started out with 256 words of memory! Today it is now common for a personal computer to have a megabyte or more of memory. Along with the increases in memory-chip size, the cost of memory has decreased dramatically. Figure 1 shows how the retail cost of the 256K dynamic memory chips dropped during 1984 and 1985.

YR	Microprocessor	Bits	Clock MHz	Mem Bytes	Typical Computer
1975	Intel 8008/8080	8	2	64K	Altair, IMSAI, SOL-20
1975	Motorola 6800	8	1	64K	Altair 680, SWTP 6800
1977	Zilog Z80	8	2/4	64K	TRS-80, Morrow, Osborne, Comemco, Northstar
1977	MOS Tech 6502	8	1	64K	PET, Apple II, Vic 20, Commodore 64, Atari 800
1981	Intel 8088/8086	8/16	4.77	640K	IBM PC & Compatibles
1983-6	Motorola 68000	16/32	8	16M	HP200, Macintosh, Amiga, Atari ST
1984	Intel 80286	16	6	16M	IBM PC-AT & Clones
1985	Nat'l NS32032	32	10	4G	—
1985	Motorola 68010	16/32	10	4G	AT&T Unix PC
1985-6	Motorola 68020	32	16	4G	HP320, Macintosh?
1986-7	Intel 80386	32	20	4G	AT&T, Compaq, IBM?

Table 1. PC Microprocessor Evolution. The question marks in the last two rows indicate the status existing in early 1986. Several of these 32-bit systems are now available.

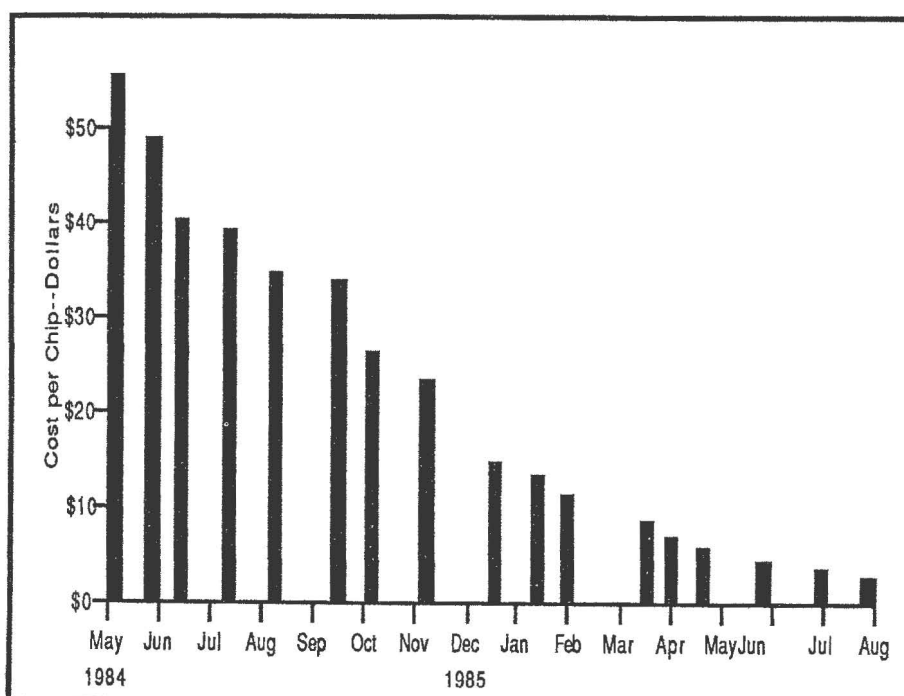


Figure 1. Cost Decrease with Time of 256K Dynamic Memory.

These savings are reflected in the overall packaged cost in dollars per kilobyte figures as shown in Figure 2. The 1-Megabyte dynamic memory chip is just now becoming available, and should begin to follow a cost curve similar to that shown in Figure 1 by the end of 1986.

Mass-Storage Technology

Substantial enhancements have also taken place in digital storage media during this time of development of the PC. The PET computer was equipped with a simple cassette tape recorder for program and data storage which oper-

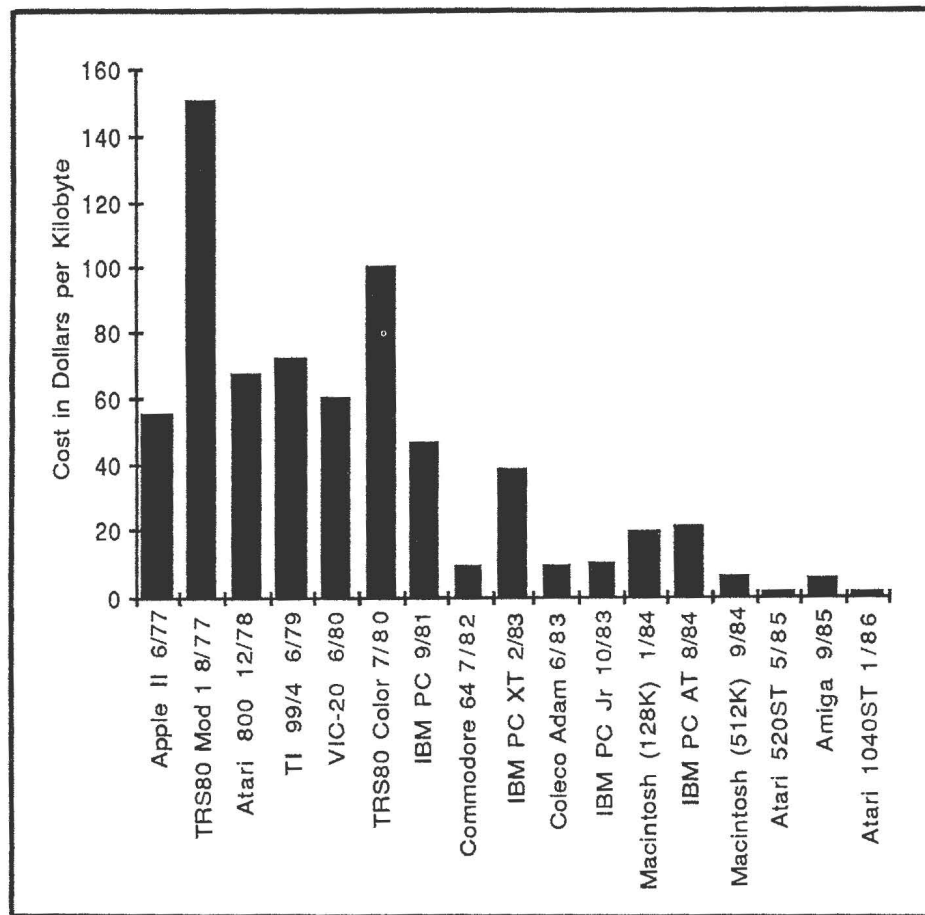


Figure 2. Memory Costs in \$/Kilobyte for Various PCs.

ated at data rates on the order of 10 bytes per second. The slow and unreliable cassette was soon replaced by first the 8-inch floppy diskette, then the 5 1/4-inch floppy and now the 3.5-inch floppy, the new standard. Storage capacity has increased from 80K to more than 800K bytes per floppy. During this same time improvements also occurred in Winchester hard-disk technology to the point where one can purchase a 20-Megabyte hard disk for less than \$500.

The Compact Disk ROM (Read Only Memory) is now making an entry into the personal computer arena with prestored databases such as dictionaries and encyclopedia, and even more exciting is the development of the gigabyte optical WORM (Write Once Read Manytimes) disk. These technologies will become commonplace with PC users in the next few years, just as the Winchester disk drive has revolutionized mass storage today.

Software Evolution

Turning to the software area, we find similar kinds of ad-

vances occurring there also. We observe that there is a close relationship between the performance capabilities of the software and the hardware available on which to run it. The first PCs were severely limited in available memory, which forced software to be written in a memory-efficient manner, sometimes at the expense of execution speed for large programs. Similarly, processor word size is an important factor in scientific computations, particularly if numerical accuracy is of concern. Larger word sizes naturally result in more efficient code when performing numerical calculations, largely because double-precision operation is then not always required.

Compiled languages like FORTRAN, Pascal, C and compiled Basic are now available for most PC computer systems. Compiled code can decrease execution times by factors of 5 to 10 times or even more. Table 2 shows the results of two different benchmark programs run on many of the popular PCs available to engineers. The

"Speed Benchmark" is an actual engineering code used to evaluate thermal equilibrium conditions. It is a multiplication-intensive finite-difference program written by F.J. Deadrick of Lawrence Livermore National Laboratory, Livermore, CA. The benchmark results show quite dramatically how solution times have decreased with the evolution of PC technology and software advances, and indicate the speed improvements which can be realized if compiled programs are used.

The second benchmark, "Accuracy," demonstrates the advantages of having a microprocessor with a large word size when evaluating a number of transcendental expressions. The test consists of a repetitive FOR-NEXT loop of the following form:

```
A = 1
FOR I = 1 TO 2499
    A = TAN (ATN(EXP(LOG(SQR(A*A)))))) + 1
NEXT I
PRINT A
```

COMPUTER TYPE	COMPUTER LANGUAGE	SPEED BENCHMARK	ACCURACY BENCHMARK		
		Minutes	Minutes	Result	Rel. Error
TI 99/4A	Basic	240.00	22.00	2500.0010	4.0e-7
Atari 800	Basic	210.00	29.15	2463.8409	-1.4e-2
Commodore 64	Basic	144.00	8.40	2508.9930	3.6e-3
IBM PC	Basica*	—	15.00	2499.9999	-1.2e-11
Commodore 128	Basic	—	4.25	2500.0000	3.6e-8
Apple IIE	Basic	138.00	—	—	—
S100-Z80	Basic	84.00	3.68	2304.8600	-7.8e-2
IBM PC	Basic	45.00	3.00	2715.2036	8.6e-2
IBM PC	QuickBasic*	—	2.92	2499.9999	-1.2e-11
Apple Z80 Card	FORTTRAN	36.00	—	—	—
HP150	Basic	33.96	—	—	—
Macintosh	Basic*	—	1.43	2499.9999	-1.3e-10
Macintosh	FORTTRAN*	—	1.43	2499.9999	-7.2e-11
Macintosh	Basic	29.00	0.72	2769.8530	1.1e-1
HP9836	Basic	18.42	0.80	2499.9999	3.5e-12
IBM PC-AT	Basic	17.30	1.12	2715.2036	8.6e-2
HP9816	Basic	16.80	0.78	2499.9999	3.5e-12
IBM PC	QuickBasic	9.63	0.82	2403.3180	-3.9e-2
HP9816	FORTTRAN	4.56	—	—	—
Macintosh	FORTTRAN	2.10	0.45	2107.8300	-1.6e-1
HP9920U	Basic	—	0.17	2499.9999	3.5e-12
HP320	Basic	1.27	0.02	2499.9999	3.5e-12
HP520	Basic	0.38	0.055	2499.9999	3.5e-12

Table 2. Microcomputer Speed and Accuracy Benchmarks. *Denotes double-precision arithmetic; FORTRAN and QuickBasic are compiled languages. The correct answer in the accuracy benchmark is 2500.0000.

At the end of the test the value of A should be 2500.0000. However, not that most of the 8 and 16-bit micros do not produce the correct result unless double-precision arithmetic is used with a consequent increase in execution time. The computational advantage of the new 32-bit processors are clearly evident from these benchmark results. Note that relative speed and accuracy can be problem dependent, so that the results of such benchmark comparisons should be regarded only as broad indicators and not quantitatively accurate for a specific application.

In spite of their limitations, simple benchmark programs can provide useful data for comparing a wide variety of computers, from mainframe to PCs. Another widely used benchmark was published in the February 1984 issue of *Creative Computing*. Results are presented there for computers ranging the Cray 1 to the Sharp PC-1211. The *Creative Computing* benchmark is especially interesting

in that it tests for time, accuracy and the performance of the random-number generator, and is included below:

```
FOR N = 1 TO 100
    A = N
    FOR I = 1 TO 10
        A = SQR(A)
        R = R + RND(1)
    NEXT I
    FOR I = 1 TO 10
        A = A^2
        R = R + RND(1)
    NEXT I
    S = S + A
NEXT N
PRINT ABS (1010-S/5)
PRINT ABS (1000-R)
END
```

Note that for the accuracy measure, a smaller number is better, as is also the case for the randomness measure. For comparison purposes, a DEC VAX 11/780 in single precision has time, accuracy and randomness measures of 1 second, 0.0113525 and 5.3 respectively. In double precision, the corresponding values are 1.5, 0.000000000163283 and 5.3.

Future Directions for the PC

The steady evolution of the PC toward faster microprocessors with larger word sizes, more and more memory at ever decreasing costs and the availability of fast mass storage devices clearly place the PC into the realm of a useful and productive engineering tool. The availability of computer languages, such as the fully ANSI Standard FORTRAN for the Macintosh, make conversion and adaptation of software developed for mainframes to PCs very easy. This makes the down-loading of mainframe scientific and engineering codes and packages more easily achievable, making the PC an even more productive engineering tool.

NEM 1988

The 1988 Nuclear EMP Meeting (NEM 1988) will be held at SRI International, 333 Ravenswood Avenue, Menlo Park, CA 94025 on May 16-20, 1988. The symposium will focus on EMP effects technology and its interrelationship with all other electromagnetic protection disciplines, including EMC, EMI and lightning.

Papers submitted should address broad subject areas, such as:

- EM Environments and Coupling Phenomenology
- Simulation and Measurement Techniques
- Numerical and Statistical Analysis Techniques
- EM Hardness Assurance and Maintenance
- Integrated EM Protection
- Related Lightning, EMC, EMI Studies
- Consistent EM Standards and Specifications
- Related Education and Training.

Special sessions are being organized to address selected topics, such as EMP and lightning environments, specifications and standards, pulse power for transient electromagnetics, EMP and high-power microwaves and civil power systems.

Each abstract submitted must be accompanied by a cover letter from the authors specifically stating that the abstract and content of the proposed presentation have been appropriately reviewed by the cognizant sponsoring agency and have been subsequently approved for public dissemination.

Authors are requested to submit a one-page abstract (original plus five copies) by December 7, 1987 to: K.F. Casey, NEM '88 Technical Program Committee,

JAYCOR, 39650 Liberty Street, Suite 320, Fremont, CA 94538. Abstracts with related information should be typed single-spaced on a single 21.5 cm x 28 cm page (8.5 x 11 inches) with the typed portion not to exceed 15 cm x 23 cm. The title of the paper and the author's name(s) and affiliation, including complete address, should begin 2 cm from the top of the page. The left margin should be 4 cm. This single page shall include all references and other material the author deems appropriate in camera-ready form. Notice of acceptance or rejection, along with information related to the paper presentation, will be mailed to the principal author by February 8, 1988.

NEM 1988 will be held in cooperation with the Electromagnetics Society, the U.S. Air Force Weapons Laboratory and the U.S. Defense Nuclear Agency.

EMP NOTE SERIES

The following EMP-related notes have been published and distributed recently:

LPN 19 "Return-Stroke-Initiation," Carl E. Baum, Air Force Weapons Laboratory, October 22, 1986.

IN 457 "Methods for Calculating the Shielding Effect of Solid-Shell Enclosures Against EMP," P.A.A. Sevat, Physics Laboratory of the National Defense Research Organization TNO, The Hague, The Netherlands, May 1981.

SSN 295 "Optimization of the Asymptotic Conical Dipole EMP Sensors," G.D. Sower, EG&G WASC, Inc., Albuquerque, NM 87119, October 30, 1986.

SSN 296 "Radiated Fields from a Vertically-Polarized Dipole Antenna using an Improved Pulser/Antenna Model," Gary D. Sower, EG&G WASC, Inc., Albuquerque, NM 87119, January 5, 1987.

SSN 297 "A Wide-Bandwidth Electric-Field Sensor for Lossy Media," T.M. Flanagan, C.E. Mallon, R. Denson and R. Leadon, JAYCOR, San Diego, CA, and Carl E. Baum, Air Force Weapons Laboratory, Albuquerque, NM, January 30, 1987.

Copies of these notes may be obtained directly from the author, from the Defense Documentation Center, Cameron Station, Alexandria, Virginia 22134 or from the note series editor, Dr. Carl Baum, Air Force Weapons Laboratory (EL), Kirtland AFB, NM 87117-6008. Non-U.S. citizens desiring the most recently published notes should request copies directly from the authors or through their embassies. In addition, these notes are available at many universities and companies doing research in EMP and electromagnetic theory. The EMP note series actively solicits contributed papers in this area for publication. For such contributions, contact Dr. Baum.

EMC PERSONALITY PROFILE



by William G. Duff



MARK MA

M.T. Ma was born in China in 1933. He received his B.S. degree from the National Taiwan University, Taipei, in 1954; his M.S. from the University of Illinois (Urbana) in 1957 and his Ph.D. from Syracuse University, Syracuse, NY in 1961, all in electrical engineering.

He was a lecturer at the National Taiwan University from 1955 to 1956, instructing undergraduate laboratories in power systems. He was employed by IBM Laboratories, Poughkeepsie, NY from 1957 to 1958, designing computer component circuitry. He was on the faculty of Syracuse University during 1958-61 as an instructor and research associate. After obtaining his Ph.D. he joined the Electronic Laboratories of General Electric Company at Syracuse in 1961, working on antenna systems for military and commercial applications, and remained there until 1964, when he was invited to become a senior research staff member with the National Bureau of Standards (NBS), Boulder, CO. Concurrently, he has also been a Professor Adjoint of Electrical Engineering with the University of Colorado since 1965, teaching graduate courses on antenna arrays and network synthesis and assisting in supervising Ph.D. student thesis research.

During the 19 years with the Federal Government Laboratories in Boulder, he was first associated with the Antenna Section doing research work on antenna arrays and modeling of practical arrays above a lossy ground. He also served as an Associate Editor for *Radio Science* when that journal was published by NBS. He then was transferred administratively to the Environmental Science and Service Administration (ESSA), and the Institute for Telecommunication Sciences (ITS), investigating problems such as broadband arrays, sea scattering, over-the-horizon radars, electrically small antennas, propagation theory, interacting cable networks and telecommunica-

tions technology. While with ITS, he was awarded a U.S. Commerce Science and Technology Fellowship in 1971-72 for a special assignment to the Assistant Secretary Office of the U.S. Department of Transportation in Washington, DC, to help assess the feasibility of establishing a magnetically-levitated high-speed train system for the northeastern corridor. During the 1974 energy crisis, he was privileged to be assigned to the Office of Telecommunications preparing a special position document entitled *United States Response to the Organization of Economic Cooperation and Development Questionnaire on Telecommunication Programs Related to Energy Conservation*.

Since 1978 he has been back at NBS working on various EMI-related problems and testing facilities, such as TEM cells, reverberating chambers, shielding effectiveness of materials, correlation between radiated and conducted EMI and ESD. He has also been heavily involved in conducting, teaching and directing the NBS/EMI Metrology Short Course. For this particular activity he edited a textbook, *Electromagnetic Compatibility and Interference Metrology*, published in 1986 as NBS Technical Note 1099. He is now Group Leader of the Interference Characterization Group, Electromagnetic Fields Division of NBS, managing and directing EMI-oriented metrology research and disseminating technical information for public usage.

He has published about 80 papers and reports in the fields of antenna theory and modeling, wave propagation, telecommunications technology and electromagnetic interference. He is the author of *Theory and Application of Antenna Arrays* (John Wiley Interscience, New York, 1974) as well as Chapter 9, "Synthesis of Broadband Antenna Arrays as Possible Over-The-Horizon Radars," of *Research Topics in Electromagnetic Wave Theory* (John Wiley Interscience, New York, 1981) and Chapter 3, "Arrays of Discrete Elements," of *Antenna Engineering Handbook*, Second Edition (McGraw-Hill, New York, 1984). His very first formal paper, "A New Mathematical Approach for Linear Array Analysis," co-authored with his professor, Dr. D. Cheng of Syracuse University, was presented at the 1959 National Electronics Conference (NEC) in Chicago. In that paper, the conventional z-transforms with infinite terms used for dealing with discrete sampled-data control systems were modified to become a finite z-transform and applied, with many advantages, to the analysis of antenna arrays. This paper

won him NEC's 1960 Annual Best Original Paper Award and the 1961 IRE Syracuse Section Award. He has also received many U.S. Department of Commerce awards.

Dr. Ma has been a technical reviewer for IEEE Transactions on Antennas and Propagation, IEEE Transactions on Electromagnetic Compatibility and *Radio Science*. He is a member of URSI Commissions A, B and E. He is also a member of ASTM Committee D09.12.14 (EMI), IEEE PES/SPD Working Group 3.6.8 (radiated fields from ESD events) and the IEEE EMC Working Group on Shielding. He has been an IEEE Fellow since 1982.

His family consists of a wife, a daughter and a son. His wife holds a M.S. in Library Science and is currently a librarian with the National Center for Atmospheric Research. Their daughter, who earned her B.A. from Yale University and a J.D. law degree from the University of Colorado, is working in California. Their son, after obtaining a B.S. from the University of Colorado, is now a second-year medical student with George Washington University. Dr. Ma's non-professional interests include swimming, world-wide traveling, comparing different cultural backgrounds in-depth and enjoying reading classical Chinese literature and calligraphies.

FOURTH INTERNATIONAL CONFERENCE ON SATELLITE SYSTEMS

The Fourth International Conference on Satellite Systems for Mobile Communications and Navigation will be held on October 17-19, 1988 at the Institution of Electrical Engineers, Savoy Place, London. Cooperating organizations include INMARSAT, the IEEE's Microwave Theory and Techniques Society and Vehicular Technology Society, the IERE and the Royal Aeronautical Society, Royal Institute of Navigation and the Royal Institute of Naval Architects.

Papers on the following relevant topics are invited:

- (a) **User requirements: Present and potential demand for mobile communication and navigation services**
- (b) **Maritime mobile satellite service: Space segment, technical description of systems and services. Future developments (ship earth station technology)**
- (c) **Aeronautical mobile satellite service: Operational requirements: air traffic control, aircraft fleet management and public correspondence. Implementation of systems: space segments, technical description of systems, experiments, trials and services**
- (d) **Land mobile satellite service: Synergy with cellular services; personal communications and paging**
- (e) **Integration of satellite systems with terrestrial networks**
- (f) **Multi-service satellites**

- (g) **The use of satellites in distress and safety systems**
- (h) **Radiodetermination satellite services: Integration of navigation with communication systems**
- (i) **User considerations including reliability, integrity, availability and privacy**
- (j) **Orbit configuration**
- (k) **Coding and modulation techniques**
- (l) **Frequency spectrum considerations including frequency availability, co-ordination and re-use**
- (m) **Satellite technology including antennas, high power amplifiers, spacecraft reliability and on-board processing**
- (n) **Mobile terminal equipment**
- (o) **Institutional and economic considerations**
- (p) **Current and projected systems, experiments, trials and demonstrations**
- (q) **Propagation and EMC**
- (r) **Techniques for multiplexing, signaling and multiple access**

Potential authors should note the following deadline dates:

Receipt of synopses: October 26, 1987

Notification of provisional acceptance of synopses:
late November 1987

Receipt of full text for final review: April 15, 1988

Those wishing to offer a paper should submit a synopsis of not more than 1000 words to the Secretariat on or before October 26, 1987. The synopsis should include the main points of the paper and, where possible, indicate where the emphasis will be placed. Authors whose synopses are selected will be requested to provide full type-scripts of not more than 4000 words of text (or less if illustrations are included) for assessment by April 15, 1988. **The synopsis should be marked with the appropriate letter indicating to which subject area of the scope the synopsis applies. If it is appropriate to more than one topic, all relevant designations should be marked.**

The working language of the Conference is English, which will be used in all printed matter, presentations and discussions. Simultaneous interpretation will not be provided. For more information on registration and a possible exhibit, contact:

SSMCN 88
Secretariat, Conference Services
The Institution of Electrical Engineers
Savoy Place
London WC2R 0BL United Kingdom

or telephone 01-240 1871, ext. 222, Telex 261176 IEE LDN G, or Fax 01-240 7735.

BOOK REVIEWS

We are back with the book review column. The interruption in the last issue of the Newsletter was the first since the start of this column many years ago. It was due to some very unfortunate circumstances. First my wife Betty passed away recently, a victim of cancer. Before her death, we had decided to move back to our old home in Hudson, OH and had sold our home in Springfield, VA. So I was faced with packing up and moving our 25-year collection of assorted household items, workshop tools and so forth, as well as all the EMI/EMC hardware and software collected over a 40-year period. The move has taken me to:

263 North Main Street
Hudson, OH 44236
Telephone: (216) 650-6230

where the EMXX Corporation and I are doing business now, but are not really settled yet. There are still over 200 boxes to be opened. It will be months before we find some of the important things we are still looking for. We realize now that we should have thrown away more things and moved much less of the collection.

Our book reviewer for this issue is Dr. Bob Haislmaier, Navy Program Coordinator for Electromagnetic Compatibility for the Chief of Naval Operations. We are indebted to Bob for fitting this review into his busy schedule. Because of his interest in EMC education and text books for EMC courses, we felt he would be the ideal reviewer for this Third Edition of Dr. Keiser's *Principles of Electromagnetic Compatibility*.

PRINCIPLES OF ELECTROMAGNETIC COMPATIBILITY (THIRD EDITION)

by Bernard Keiser, D.Sc., E.E.
Artech House, 685 Canton Street,
Norwood, MA 02062, 1987
1987 \$60.00

The Third Edition is an update of a reference first published in 1979 and well known to many in the EMC field. It encapsulates the author's short course, "Electromagnetic Compatibility," which he has been teaching since 1975 in the Continuing Education program at George Washington University, Washington, DC. The preface states that the purpose of the book "is to provide the practicing engineer a working knowledge of electromagnetic interference and compatibility, along with illustrations portraying actual interference situations and their solutions without the extensive use of mathematics." The reason for this Third Edition, then, seems to be the author's desire to make sure that the practicing engineer's working knowledge is indeed current.

Following the layout of prior editions, the book begins with a discussion of EMI sources and coupling media (Chapters One through Four), continues with information on how to prevent and remedy EMI (Chapters Five through 10) and then explains how to predict and analyze EMI (Chapters 11 through 13). Specifications and test

plans are discussed in Chapters 14 through 16 and test methods and equipment form the subject matter of Chapters 17 through 20.

Those who are familiar with earlier editions of this fine introduction to EMC engineering should note the following significant additions:

Section 3.3	Possible Future Interference Sources
Section 5.8	Facility Grounds
Section 5.9	Earth Grounds
Section 5.10	Ground Resistance Measurement
Chapter 7	Barrier Shields and Wave Diffraction
Section 9.3.5	Conductive Plastics
Section 10.9	Integrated Circuit Susceptibilities
Section 15.3	European EMC Requirements
Section 19.3	Open Field Test Sites
Chapter 20	Testing Computing Devices to FCC and VDE Requirements

The Third Edition also includes two appendices. Appendix A lists useful units in the International System of Units (SI) without definition and Appendix B lists frequency bands.

Those not familiar with Dr. Keiser's course or book will find this one a useful display of considerations one deals with in engineering EMC into equipment, systems and facilities. References at the end of each chapter can then be used to delve deeper into the theoretical and experimental details required to practice EMC engineering.

Reviewed by
Dr. Robert J. Haislmaier



by Jim Hill, The EMXX Corp.

A REPORT ON THE URSI INTERNATIONAL SYMPOSIUM ON ELECTROMAGNETIC THEORY AND THE EIGHTH COLLOQUIUM ON MICROWAVE COMMUNICATION

An URSI International Symposium and a Colloquium on Microwave Communication were held at the same time in the same location for the first time to the mutual benefit of both meetings. Held August 25-29, 1986 in Budapest, Hungary, the meetings were organized by the Hungarian National Committee of URSI, the Scientific Society for Telecommunication and the Research Institute for Telecommunication (TKI). The conferences were sponsored by the International Union of Radio Science (URSI) and the Hungarian Academy of Sciences. Every participant could attend the presentations of both conferences on the basis of a common registration.

Topics of the URSI Symposium were:

1. Field analysis and numerical methods
2. Scattering and diffraction
3. Antennas
4. Guided waves, waveguides, open structures, etc.
5. Transient phenomena
6. Random media
7. Inverse scattering
8. Fields in biological media

The Eighth Microwave Colloquium main topics were:

- I. Trends in communication systems
- II. Information and signal processing
- III. Network theory and computer-aided design
- IV. Microwave circuits and devices

A total of 532 papers were accepted by the International Organizing Committees. The large number of papers necessitated organizing some poster sessions to avoid an inconveniently tight time schedule in the oral program. Six parallel oral sections were arranged. The division of accepted papers was as follows:

Common Plenary Session: 4 invited papers

URSI Symposium: 6 invited, 179 oral and 109 poster papers

Colloquium: 14 invited; 140 oral 80 poster papers

Most of the papers were presented on topics 1-4 at the URSI Symposium and on topics III-IV at the Colloquium. All the papers of the conference were published in the conference proceedings by the publishing house of the Hungarian Academy of Sciences, Budapest. There were 533 participants at the conferences from 41 countries, most of them from the URSI member countries. There were 29 papers which represented the results of international teamwork.

On the 26th of August, the URSI Commission B held a meeting to discuss the problems of the Electromagnetic Symposium to be held in 1989 and the tasks of the URSI General Assembly in 1987. On the 27th of August, the International Organizing Committee of the Colloquium

held a meeting on applying the experience of the present European Microwave Conference in Budapest to the occasion of the next Microcoll in 1990.

After the conference programs, some technical visits were arranged at three research sites: The Research Institute of Telecommunication, the Research Institute of the Hungarian Post and the Technical University of Budapest.

A few cultural programs were organized in order to help participants get acquainted with Hungary. Some of these were a visit to the National Gallery and the Parliament, a sight-seeing tour and an organ concert in Matthias Church. However, the boat trip to Szentendre on the last afternoon and sight-seeing in this picturesque little town succeeded most of all. The collection of the "Margit Kovacs Museum" made a great impression on all. This pleasant excursion was a good opportunity for discussing the conference events and for strengthening friendships.

(From a report by Professor T. Bercell, Research Institute for Telecommunication, Budapest, Hungary in the June, 1987 issue of the IEEE Antennas and Propagation Society Newsletter)

38th ELECTRONIC COMPONENTS CONFERENCE

Jointly sponsored by the IEEE Components, Hybrids and Manufacturing Technology Society and the Electronic Industries Association, the 38th Electronic Components Conference will be held at the Biltmore Hotel in Los Angeles, CA on May 9-11, 1988. Papers are being sought covering the following topics:

- **Connectors:** New or improved designs of connectors with emphasis on filtered and/or surface mount. Also new or improved contacts, materials, plating or designs.
- **Manufacturing Technology**
- **Materials**
- **Discrete Components**
- **Packaging**
- **Interconnections**
- **Optics**
- **Reliability**
- **Hybrid Microcircuits**

Besides papers on superconductivity and GaAs, the Program Committee is seeking papers on switch mode power supplies and high temperature (above 125°C) electronics for under-hood automotive, down-hole and aircraft engine applications. A selection of the best papers will be published in the IEEE CHMT Society Transactions and the author of the best paper will receive \$500. Students who submit papers that are accepted in the regular review process and who present their papers at the Conference may apply to the General Chairman, Ronald W. Gedney, IBM Corporation, Department U50, Building 032-2, 1701 North Street, Endicott, NY 13760, for reimbursement of reasonable travel and living expenses.

A 500-word abstract and an extended outline which clearly describe the nature, scope, content, organization and key points of the proposed paper are required for paper selection and session assignment. The paper must consist of work not published or presented previously. Mail 10 copies of the abstract and outline with your phone number by October 26, 1987, to:

Edmund A. Bolton
AVX Corporation
100 Copeland Drive, Suite 5
Mansfield, MA 02048

Authors will be notified of paper acceptance with instructions for publication by December 4, 1987. Manuscripts are due in final form by February 5, 1988.

For additional information, write Edmund A. Bolton at the above address.

INSTRUMENTATION/ MEASUREMENT TECHNOLOGY CONFERENCE

The IEEE Instrumentation/Measurement Technology Conference will be held in San Diego, CA on April 19-22, 1988. The theme of the conference is "Intelligence In Instrumentation."

Subjects of the conference will include, but will not be restricted to:

- EMI and EMC
- Acoustics and Noise Measurements
- Advances in Robotic Technology
- Artificial Intelligence
- Antenna and EM Field Measurements
- Automatic Testing/ATE
- CAD/CAM/CAE
- DC and Low Frequencies
- Fiber Optics, Optoelectronics and Lasers
- Medical Electronic Technology
- Metrology, Standards and Calibration
- Oceanographic Technology
- PCs in Instrumentation
- Pulses and Transients
- RF/Microwave and MM Wave
- Sensors and Transducers
- Software Testing
- Testability and Self-Testing
- Waveform Measurements

For more information contact Robert Myers, Conference Coordinator, 1700 Westwood Boulevard, Suite 101, Los Angeles, CA 90024 or telephone (213) 475-4571.

SIXTH INTERNATIONAL CONFERENCE ON ELECTROMAGNETIC COMPATIBILITY

The Sixth International Conference on Electromagnetic Compatibility, organized by The Institution of Electronic and Radio Engineers, will be held September 12-15, 1988 at the University of York, York, England. The Conference will be preceded by a Tutorial Day and will include an exhibition. Papers on all aspects of EMC, including electromagnetic pulse (EMP), lightning, systems security and electrostatics, are invited. For guidance, a non-inclusive list of topics includes:

- Case studies
- Education and training
- Immunity
- Equipment protection, installation and operation
- Screening (shielding)
- Medical equipment
- Electromagnetic environment
- Coupling
- Components and materials
- High density circuit technology
- Instrumentation and measurement
- Low frequency and power systems
- Processor-based systems
- Biological and other hazards
- Regulations, standards and specifications
- Spectrum use and management
- Electronics in transport
- Impact of new technology

A synopsis of not more than 300 words highlighting the novel aspects of the paper should be sent to the Conference Committee for assessment. Synopses should be submitted not later than October 27, 1987. Where appropriate the necessary military or commercial clearances must be gained by authors prior to submission. Final papers, which will be published in a conference document, should not exceed 8 sides of 248 mm x 343 mm sheet including diagrams. A typical page of typed text is approximately 700 words. Papers will be required in their final form by February 29, 1988.

Authors will be invited to make oral presentations of their papers and it is the Committee's intention that these presentations should be used to update the work which their papers describe and to give detailed explanations of selected features of their contribution. Therefore, authors will be specifically requested not to read their written papers in full. The conference will be conducted in English and no translation facilities will be available.

Synopses of papers for review and requests for registration information should be sent to:

The Conference Secretariat
Institution of Electronic and Radio Engineers
99 Gower Street, London WC1E 6AZ ENGLAND
Telephone: 01-388 3071

REPORT ON THE EIGHTH WROCLAW SYMPOSIUM ON ELECTROMAGNETIC COMPATIBILITY

The Eighth International Wroclaw Symposium on Electromagnetic Compatibility was held June 24-26, 1986. The symposium was cosponsored by URSI, CCIR, CCITT and four other international organizations as well as national associations of electrical engineers from 14 countries. About 220 participants from 20 countries attended the symposium (20 from non-European countries). A total of 98 papers were presented in English or Russian with simultaneous translation (79 oral presentations, 19 posters). A three-volume, 1192-page proceedings containing 129 papers accepted for presentation was available during the symposium.

Professor A. Smolinski, Chairman of the National URSI Committee, chaired the Symposium Council and Professor F.L. Stumpers, Chairman of URSI Commission E, chaired the Scientific Program Committee. Professor D.J. Bem, Chairman of Commission B of the National Committee, (who served as the Symposium Chairman) was supported by Co-chairman Mr. J. Rutkowski and Organizing Chairman Mr. W. Moron.

Seventeen sessions covered the majority of EMC fields. The core of the symposium were invited sessions organized by Professor T. Yoshino, Japan (EM emissions related to earthquakes); Dr. H. Lorke, GDR/CCITT (EMC in wire communications); Professor K. Bullough, UK (Terrestrial EM environment); Professor H. Mikolajczyk, Poland (EMC and biological risk); Professor L.E. Varakin, USSR (Cellular systems); Professor H. Kikuchi, Japan (Lightning EMP); Professor N.B. Chimitdorziev, USSR (Propagation). Other sessions concerned spectrum management and utilization, EM fields and antennas, interference control, EMP threat, EMI/EMC in devices and systems and measurement and monitoring. For the first time the Young Scientists Participation Pro-

gram was organized with substantial financial support from URSI. Four young scientists (from China, UK, Malaysia and Spain) were invited to present their works in fields connected with EMC. Great interest was awakened by the round table discussion on "General Background and Experience in Automation of National Spectrum Management," co-organized by the URSI Commission E V-chairman Professor R.G. Struzak and the CCIR IWP 1/2 Chairman Mr. R. Mayher. The discussion was followed by the demonstration of the microcomputer application in spectrum management by the IWP 1/2 members.

The symposium took place on the premises of the Wroclaw Technical University. The get-together cocktail party and picnic in the countryside gave a good opportunity for informal contacts. On the last day there was a common meeting of the Symposium Council, the Program Committee and the Organizing Committee with all session Chairmen. The symposium results and organization were evaluated and possible future improvements were discussed. A general opinion was that the Eighth International Wroclaw Symposium on EMC created a good forum for presentation of works and gave an opportunity to review the activity in the field of electromagnetic compatibility on an international scale. Copies of the Symposium Proceedings (papers in English or Russian as submitted by authors with the summary in the second language) are still available from:

EMC Symposium
Box 2141
51-645 Wroclaw 12, Poland

The next Ninth International Wroclaw Symposium on Electromagnetic Compatibility is planned for June 28-30, 1988. Papers are invited.

1988 INTERNATIONAL CONFERENCE ON LIGHTNING AND STATIC ELECTRICITY

The National Interagency Coordination Group (NICG) of the National Atmospheric Electricity Hazards Protection Program, in concert with Florida Institute of Technology, is sponsoring the International Conference on Lightning and Static Electricity to be held at the Sheraton Century Center Hotel, Oklahoma City, OK, April 19-21, 1988.

The NICG consists of research experts from the National Oceanic and Atmospheric Administration, National Aeronautics and Space Administration, Federal Aviation Administration, U.S. Air Force, U.S. Navy, and the U.S. Army. This conference will also be in cooperation with the Royal Aircraft Establishment, Farnborough, Culham

Laboratory and the International Commission on Atmospheric Electricity.

Conference sessions will be based on (but not limited to) the following subject categories: lightning phenomenology (measurements, modeling and meteorological relationships), aerospace vehicles, helicopters, aircraft (protection of fuel systems, hardening of equipment, effects on electronic systems, modeling and coupling analysis, test criteria and techniques, structures and materials and grounding and bonding), electrostatics and "p-static," lightning mapping systems, ground operations and facilities (personnel hazards, effects upon electronic systems, protection, ordnance and explosives, electrical power

transmission and distribution and management responsibility), shipboard installations (personnel hazards, effects upon electronic systems, ordnance and hardening and protection) and specifications and standards. For further conference information or to change a mailing address contact either Donald R. MacGorman, Confer-

ence Chairman, NOAA/ERL/National Severe Storms Laboratory, 1313 Halley Circle, Norman, OK 73069, U.S.A. (phone: (405) 366-0405), or G.A.M. Odam, European Coordinator, Royal Aircraft Establishment, Farnborough, Hants, United Kingdom GU14 6TD or phone 252 24461, ext. 2662.

CALENDAR 1987

September 29–October 1

9th EOS/ESD Symposium
Peabody Orlando
Orlando, FL

Contact: EOS/ESD Symposium
Box 14
Gillette, NJ 07933
Telephone: (201) 522-4770

September 29–October 1

9th Antenna Measurement Techniques Association
Meeting/Symposium
Stouffer Madison
Seattle, WA

Contact: James R. Otey
1987 AMTA Symposium
6632 South 191st Place
Suite E-105
Kent, WA 98032

October 19–21

20th Annual Electronic Connector Study Group
Symposium
Franklin Plaza Hotel
Philadelphia, PA

Contact: 20th Annual ECSG Symposium
P.O. Box 167
Fort Washington, PA 19034-0167
Telephone: (215) 825-3840

Late November

National Symposium on Electromagnetic Compatibility
Shen Zhen, People's Republic of China

Contact: An Zhi Yuan
EMC-87 Symposium Committee
Res. Inst. of Communications,
Telemetry and Telecontrol,
Ministry of Electronics Industry
P.O. Box 174-216,
Shi Jia Zhuang, He Bei
People's Republic of China

EMCABS

In this issue we are publishing 28 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, Ford Aerospace Textron
E.L. Bronaugh, Electro-Metrics/Penril Corporation
R.N. Hokkanen, Harris Corporation
R. Jacobson, Sperry Flight System
S. Kuniyoshi, Naval Sea Systems Command
D.R. Kerns, Southwest Research Institute
R.B. Schulz, Consultant
R.M. Showers, University of Pennsylvania



by William H. McGinnis

“HOW CAN I GET A COPY OF AN ABSTRACTED ARTICLE?” The answer to this frequently asked question follows.

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.

<p>Two-Level Simulation for the Evaluation of Frequency Assignment Strategies Attila Illes VIDEOTONElektronics, Radio Factory 8000 Szekesfehervar, Berenyi ut Pf. 104., HUNGARY Eighth International Wroclaw Symposium on Electromagnetic Compatibility Part 3, 1986, pp. 1133-1140</p> <p>ABSTRACT: A two-level simulation algorithm is described by which an effective computer-aided frequency assignment method can be developed for temporarily deployed radio systems which are organized in a hierarchical structure. The first level of the simulation is for evaluating the spectrum utilization of the candidate assignment methods, while the second one is a complete EMC analysis. The simulation was run for two strategies, which were found as the potentially best ones according to other publications.</p> <p>INDEX TERMS: Frequency assignment strategies, two-level simulation algorithm, radio systems, spectrum utilization, EMC analysis</p>	<p>EMCABS: 01-07-87</p>	<p>Magnetic Effects from Lightning Transients in Shielding Telecommunication Cables *Prakash U. Bakhrui, Kenneth E. Bow and David E. Fischer *Dow Chemical, Midland, MI 1986 IEEE International Symposium on Electromagnetic Compatibility CH2294-7/86/000-0507, September 16-18, 1986, pp. 507-518</p> <p>ABSTRACT: Metallic shielded telecommunications cables have been damaged by magnetic fields characteristic of lightning discharge. Varying degrees of damage occur from "magnetic crush" as a function of cable design, shield/armor materials and geometry and transient magnitude and duration. Results show that shields or armor with circumferential conductivity are subject to severe damage, while those without such conductivity are effectively immune. Magnetic crush involves no direct electrical arc or discharge to the cable, yet damage created can have all the apparent effects of the direct arc condition. The longitudinal transient current capacity of present shields and armors used in such cables is sufficient. Little, if any, damage occurs to cables passing or carrying such currents.</p> <p>INDEX TERMS: Shielded telecommunications cables, magnetic fields, lightning discharge, magnetic crush, cable design, shields, armors, immune, conductivity, electrical arc, longitudinal transient current, cables</p>	<p>EMCABS: 04-07-87</p>
<p>The Fast Synchronization in a Direct Sequence of Spread Spectrum Systems A. Mencil Communication Research Institute, Warsaw, POLAND Eighth International Wroclaw Symposium on Electromagnetic Compatibility Part 3, 1986, pp. 1162-1171</p> <p>ABSTRACT: The time synchronization method is presented in a direct sequence of spread spectrum systems for low signal-to-noise ratios and noncoherent reception. Using the method, the synchronization time decreasing, the comparison to the other methods, has been assured. The method is based on a suitable choice of the cross-correlation functions set between both synchronization and reference signals. If a choice of such a set is done optimally, the mean synchronization time is in proportion to $\lg_2 N/N$-code length of signals, but not to N as in other methods.</p> <p>INDEX TERMS: Time synchronization method, direct sequence, spread spectrum systems, signal-to-noise ratios, noncoherent reception, cross-correlation functions set, synchronization, reference signals</p>	<p>EMCABS: 02-07-87</p>	<p>Survey of the State of the Art of Electrical Transient Upset in Digital Circuits Joanne M. Stellato and Robert V. Garver U.S. Army Laboratory Command Harry Diamond Laboratories, 2800 Powder Mill Road, Adelphi, MD 20783-1197 1986 IEEE International Symposium on Electromagnetic Compatibility U.S. Government work not protected by U.S. copyright, September 16-18, 1986, pp. 505-506</p> <p>ABSTRACT: Electrical transients can cause nonpermanent undesirable logic states in digital circuits which show up in the output as errors. As integrated circuits are being made more dense, their susceptibility to upset, which may be induced at far lower levels than damage, is increasing. Although this survey concentrates on upset due to the electromagnetic pulse (EMP) type of transients, it covers other types of upset. The survey results increase the need for a basic upset test which should lead to a systematic characterization of upset due to EMP. The test results should be fundamental building blocks in the computer modeling of circuit response to transients, in addition to aiding prediction of the stochastic response of systems to known transients.</p> <p>INDEX TERMS: Malfunction, interference, digital circuits, transients, integrated circuits, susceptibility, electromagnetic pulse, EMP, computer modeling, stochastic</p>	<p>EMCABS: 05-07-87</p>
<p>On High Spectral Efficiency Coding of Frequency-Hopped Channels Nguyen Quang A Technical University of Budapest, 1111 Budapest Stoczek u. 2, HUNGARY Eighth International Wroclaw Symposium on Electromagnetic Compatibility Part 3, 1986, pp. 1172-1181</p> <p>ABSTRACT: Signature coding problem for multiple user communication systems is formulated. Signature codes for a frequency-hopped channel are presented. It is shown how to use signature codes to get high spectral efficiency in the frequency-hopped system.</p> <p>INDEX TERMS: Signature coding, frequency-hopped channel, spectral efficiency, frequency-hopped system</p>	<p>EMCABS: 03-07-87</p>	<p>Surveillance Testing Ensures EMP Hardness of Military Systems Thomas W. Buckman, James L. Knighten, Richard W. Stewart and Anthony P. Trippe IRT Corporation P.O. Box 85317, San Diego, California 92138 1986 IEEE International Symposium on Electromagnetic Compatibility CH2294-7/86/000-0495, September 16-18, 1986, pp 495-504</p> <p>ABSTRACT: The MIDAS-700 is a self-contained, mobile, integrated data, acquisition system which advances the EMP hardness surveillance (HS) technology. It was specifically developed as a flexible measurement set which can evaluate all types of EMP protection measures, rapidly, at low cost and with a minimum of downtime on the system under test. A MIDAS-700 is currently deployed in Europe in support of a NATO test program to perform verification testing, and to establish hardness maintenance baselines on key NATO groundbased C³ facilities. This presentation includes an account of the operational characteristics of MIDAS-700 during this extensive set of surveillance tests.</p> <p>INDEX TERMS: Nuclear detonations, EMC field, coupling, EMP, hardness surveillance, HS, testing programs, MIDAS-700, NATO, C³, surveillance tests</p>	<p>EMCABS: 06-07-87</p>

<p>Frequency Tuneable Ring Wave Pulser Charles M. Hewison and Vincent Mancuso General Electric Company Aerospace Electronic Systems Department, Utica, NY 13503 1986 IEEE International Symposium on Electromagnetic Compatibility CH2294-7/86/000-0493, September 16-18, 1986, pp. 493-494</p> <p>ABSTRACT: A method of generating the classical damped sinusoid (ring wave) tuneable to all frequencies from 10 kHz to 100 MHz has been developed. Peak amplitudes for current and voltage are merely functions of final stage power amplification.</p> <p>INDEX TERMS: Ring wave pulser, ring wave, peak amplitudes, current, voltage power amplification</p>	<p>EMCABS: 07-07-87</p>	<p>The Influence of Multipath and its Suppressing Circuit in Global Positioning System Kiyofumi Suzuki and Tetsuo Ikeda Nagoya Institute of Technology, JAPAN EMC-S Tokyo Chapter, EMCJ86-97</p> <p>ABSTRACT: This report describes an effect caused by multipath waves and its suppressing circuit in non-coherent Delay Lock Loop (DLL). We measured the characteristics of DLL and multipath suppressing circuit in the presence of a multipath wave.</p> <p>INDEX TERMS: Multipath wave, GPS, DLL</p>	<p>EMCABS: 10-07-87</p>
<p>Elimination of the Effect of Interference Due to the Other Users on the Tracking Performance in SSMA Shinji Suzuki, Masashi Sato and Norihiko Morinaga Faculty of Engineering, Osaka University, JAPAN EMC-S Tokyo Chapter, EMCJ86-95</p> <p>ABSTRACT: In this paper the effect of the interference due to the other users on the performance of the tracking systems (especially, Delay Lock Loop) in SSMA is investigated. Analytic expression for the interference on the timing error of DLL is derived. Two methods for the elimination of the effect of the interference due to the other users are proposed.</p> <p>INDEX TERMS: Spread spectrum, tracking performance, interference, dual DLL</p>	<p>EMCABS: 08-07-87</p>	<p>A Tentative Model of Digital Apparatus as Radiative Electromagnetic Noise Sources II Ryuji Koga*, Megumi Kosaka*, Hiroyuki Fukuda* and Hiroya Sano** School of Engineering, Okayama University*, Faculty of Engineering, Fukuyama University**, JAPAN EMC-S Tokyo Chapter, EMCJ86-100</p> <p>ABSTRACT: This paper describes results of experiments which prove the mathematical model that the authors have proposed in a preceding paper. Distribution of magnetic flux was measured with a small bore shielded loop antenna and a squarer for the electric signal from it as well. In the result of the matched distribution, the characteristic length which represents the complexity of the flux distribution in the computer casing was about 15 mm. Extension of the validity of the mathematical model outside the casing is left open.</p> <p>INDEX TERMS: Impulsive electromagnetic noise, radiation, corpuscular-model</p>	<p>EMCABS: 11-07-87</p>
<p>An Experimental Consideration on Optimum Receiver for Impulsive Radio Noise (4) Anohtai Sethapanee*, Hiroji Kobayashi*, Naoki Sutoh*, Kenji Yamauchi*, Muneco Maeda*, Norihiko Morinaga** and Toshihiko Namekawa*** Himeji Institute of Technology*, Faculty of Engineering, Osaka University**, Faculty of Engineering, Setsunan University***, JAPAN EMC-S Tokyo Chapter, EMCJ86-96</p> <p>ABSTRACT: From simulation it was clearly known that the performance of this optimum receiver for impulsive noise surpasses that of ordinary receivers. Accordingly, this study is devoted to an experiment on this kind of receiver using the powerline as the channel. Some parts of the structure of this optimum receiver that was used in simulation are changed. Here, noise is considered as Class A impulsive noise and with the data rate of 1200 baud, the bit error rate is examined for various carrier-to-noise ratios and compared with theoretical BER. Cases of error are shown.</p> <p>INDEX TERMS: Impulsive noise, power line noise, optimum receiver, bit error rate</p>	<p>EMCABS: 09-07-87</p>	<p>Improvements in Picture Quality in Urban Mobile Visual Communication—Using an Antenna Pattern Diversity Reception Deock-ho Ha, Tstomu Tackeuchi, Fumio Ikegami and Susumu Yoshida Faculty of Engineering, Kyoto University, JAPAN EMC-S Tokyo Chapter, EMCJ86-87</p> <p>ABSTRACT: This paper describes an evaluation of the picture quality improvement in urban mobile TV reception gained by the use of an antenna pattern diversity system. The fluttering-ghost curves and indices for an antenna pattern diversity reception by using a four-direction antenna and an omni-directional antenna reception are calculated and compared. The antenna pattern diversity reception can significantly improve picture quality in mobile TV reception by reducing the effects of multipath interference fading.</p> <p>INDEX TERMS: Mobile TV reception, antenna pattern diversity, fluttering-ghost curves and indices, picture quality improvement, multipath interference fading, omni-directional antenna</p>	<p>EMCABS: 12-07-87</p>

<p>Measurement of HF Radio Wave Noise Caused By Running Bullet Train and Estimation of Breakdown Current Zen-Ichiro Kawasaki, Taketosi Nakai, Masahiro Nagatani and Hiroshi Nakada Research Institute of Atmospherics, Nagoya University, JAPAN EMC-S Tokyo Chapter, EMCJ86-88</p> <p>ABSTRACT: Electric field changes caused by a running bullet train are measured using a circular flat antenna (0.07m²) and a high speed transient recorder (10⁸/sec). Measured data can be classified into two different types, one of which is a damping oscillation type (such as an electric field observed at the Experiment of Hertz) and the other is a continuous-pulse-train type. Averaged dynamic Fourier spectra are obtained for both types of electric field changes. Breakdown currents are also estimated for the damping oscillation type electric field changes.</p> <p>INDEX TERMS: Electromagnetic impulse noise, dynamic Fourier spectrum, Breakdown current</p>	<p>EMCABS: 13-07-87</p>	<p>ESD Characteristics and Their Effects on a Computer (5) Masamitsu Honda Nippon Univac Kaisha, Ltd., JAPAN EMC-S Tokyo Chapter, EMCJ86-91</p> <p>ABSTRACT: The purpose of this report is to discuss the indirect ESD event which is caused by contact/collision between metal objects such as a steel pipe chair, a cart or the like. The EMI effect will produce indirect ESD which is not always proportional to the electrostatic energy of the charged object, but governed by the speed of contact just before the time of discharge.</p> <p>INDEX TERMS: Indirect ESD, EMI effect, electrostatic energy, contact speed</p>	<p>EMCABS: 16-07-87</p>
<p>An Experimental Study on Radiated Magnetic Field Strength Of Metallic Pair Cable Katsuhiko Kataoka and Hideo Kishimoto NTT Electrical Communications Laboratories, JAPAN EMC-S Tokyo Chapter, EMCJ86-89</p> <p>ABSTRACT: By systematizing electronic devices, they can be connected with cable and transmit data to each other. Not only the device itself, but also the cable radiates an electromagnetic wave. Therefore, the study of EMI from the cable is important. In this paper, radiated magnetic field strength of metallic pair cable is measured. Cable length is 3 to 15 m; frequency is under 30 MHz; and distance is 0.25 to 3.0 m. Radiated magnetic field distribution of the cable is cleared.</p> <p>INDEX TERMS: EMI, metallic pair cable, radiation, magnetic field strength, experiment</p>	<p>EMCABS: 14-07-87</p>	<p>Numerical Analyses of Magnetic Shielding in Superconductive Magnetic Energy Storage Yasunori Kanamaru* and Yoshifumi Amemiya** Kanazawa Institute of Technology*, Chiba Institute of Technology**, JAPAN EMC-S Tokyo Chapter, EMCJ86-92</p> <p>ABSTRACT: Superconductive magnetic energy storage (SMES) system is more useful than other systems by reason of high efficiency. But the SMES produces strong magnetic fields in living environment. The research gives the same suitable designs of magnetic shielding for the reduction of magnetic field in living environment. The results of numerical analyses of magnetic fields are shown in the case of using the shielding coil and shielding plate in this report.</p> <p>INDEX TERMS: Superconductive magnetic energy storage, magnetic shielding</p>	<p>EMCABS: 17-07-87</p>
<p>Relative Field Strength of VHF/UHF Vertically and Horizontally Polarized Waves in 3 to 25-Meter Range of Propagation on a Metal Plane Ground Tatsuichi Kawana and Kunimasa Koike Radio Research Laboratory, M.P.T., JAPAN EMC-S Tokyo Chapter, EMCJ86-90</p> <p>ABSTRACT: The relative field strength of VHF/UHF (27-900 MHz) vertically and horizontally polarized waves is measured in the 3 to 25-meter range of propagation between two half-wave dipole antennas on a metal plane ground which was installed on a natural earth ground of a test site. The experimental values are compared with the theoretical values calculated by the Moment Method and the EMF Method assuming the reflection coefficient of the plane is +1 (vertical polarization) and -1 (horizontal polarization). The difference between the calculated values and the measured values are within 2 dB in the case of vertical polarization and 1 dB in the case of horizontal polarization.</p> <p>INDEX TERMS: Vertical polarization, horizontal polarization, Moment Method, EMF Method</p>	<p>EMCABS: 15-07-87</p>	<p>Near-Field Absorption in Prolate Spheroidal Models of Humans Exposed to the Radiation of Small Apertures in a Transmitter Housing Yoshitsugu Kamimura Radio Research Laboratory, M.P.T., JAPAN EMC-S Tokyo Chapter, EMCJ86-93</p> <p>ABSTRACT: Irradiation of a prolate spheroidal model of man by the near-field of a small aperture of the radio transmitter is analyzed. The aperture source is replaced by an equivalent configuration of electric and magnetic dipoles. The specific absorption rate in the irradiated object is obtained by block model calculation using method of moment.</p> <p>INDEX TERMS: Radiation hazard, near-field, radio transmitter, block model, method of moment</p>	<p>EMCABS: 18-07-87</p>

<p>Temperature Distribution in Human Body During RF Hyperthermia Shiro Tsutsumi Osaka City University, JAPAN EMC-S Tokyo Chapter</p> <p>ABSTRACT: The temperature distribution in a human body during hyperthermia treatment using RF heating is discussed. A general survey of the subject, including the behavior of cancer cells under thermal dosing in living bodies and methods for heating tumors seated in the body, is given. The discussion focused on RF capacitive heating by 8 MHz radio waves, as this type of hyperthermia apparatus is widely used. An attempt to derive both the SAR (Specific Absorption Rate) distribution and the temperature pattern in a human body has been made by solving the electromagnetic equations and the thermal balance equation numerically using two-dimensional FEM (Finite Element Method). Also, experiments to simulate the human body using an agar phantom with relatively simple geometry have been performed to check the utility of the computer method. The computer results have been successfully compared to real measurements and proven clinically useful. The results of the study of a patient with a large abdominal tumor by both methods is given and remaining engineering problems and future topics for research are discussed.</p> <p>INDEX TERMS: Hyperthermia therapy, RF capacitive heating, temperature distribution, Finite Element Method, SAR distribution</p>	<p>EMCABS: 19-07-87</p>	<p>RF Noises in Machines Connected to Mains Cable Discussion Papers of Cable for Artificial Mains Network (2) Tsuruo, Shimayama EMC-S Tokyo Chapter, EMCJ86-99</p> <p>ABSTRACT: After discussing RF noise generation mechanisms of the machines connected to vinyl cable, it can be said that the cable can be used for artificial mains network. To decide noise power in cable, their terminal voltage and line current must be measured all over the radio frequencies. There are many problems about measurement of damped oscillation by spectrum analyzer.</p> <p>INDEX TERMS: Artificial mains network, terminal voltage, line current, radio frequencies, damped oscillation</p>	<p>EMCABS: 22-07-87</p>
<p>Analysis of ESD Immunity of Electronic Equipments Based on Ground Potential Variations T. Mori, O. Ibaragi, T. Kon and K. Shinozaki NTT Electrical Communications Laboratories, JAPAN EMC-S Tokyo Chapter, EMCJ86-101</p> <p>ABSTRACT: The relationship of physical configurations in an equipment grounding system to ESD immunity was analyzed using a new coupling model. The noise voltage caused by ground potential variations in circuit boards is comparable to that caused by electromagnetic coupling between ESD current and circuit loops. The noise voltage and immunity depends remarkably on the unbalance in internal ground cable lengths and on the interface cable ground impedance.</p> <p>INDEX TERMS: ESD, immunity, coupling model, grounding, ground potential</p>	<p>EMCABS: 20-07-87</p>	<p>Development of a Calibration System for Magnetic Field Standard by Feederless Loop Antennas Tatsuichi Kawana*, Yasunobu Maeda** Teruo Teshima* Radio Research Laboratory, M.P.T.*, Ministry of Construction**, JAPAN EMC-S Tokyo Chapter, EMCJ86-102</p> <p>ABSTRACT: A calibration system for magnetic field standard is developed using two feederless loop antennas (transmitting and receiving) in which signal source, diode detector, amplifiers and batteries are included. The current of the transmitting antenna and EMF induced on the receiving loop antenna are measured through non-metallic optical fibers, V-F and F-V converters. Magnetic field strength H_1 is evaluated based on the transmitting loop current and H_2 based on EMF induced on the receiving loop antenna showed agreement within 1.0-0dB at a distance between 65 cm and 75 cm.</p> <p>INDEX TERMS: Calibration system, magnetic field standard</p>	<p>EMCABS: 23-07-87</p>
<p>Radio Frequency Characteristics of Three Lines Flat Type Vinyl Cable Discussion Papers for Cable for Artificial Mains Network (1) Tsuruo, Shimayama EMC-S Tokyo Chapter</p> <p>ABSTRACT: To measure the induced noises in mains coming from machines, it is common to use the CISPR's artificial mains network made of resistance instead of mains. In such a case, the induced noise level will be down from the actual condition, as the resistance produces a good noise suppressor. To check whether flat-type vinyl cable can be used for artificial mains network or not, measure its RF characteristics.</p> <p>INDEX TERMS: Induced noise, noise suppressor, flat type vinyl cable, artificial mains network, RF characteristics</p>	<p>EMCABS: 21-07-87</p>	<p>Power Line Wide Band Noise Filter For Customer Equipment Kusuo Takagi NTT Electrical Communications Laboratories, JAPAN EMC-S Tokyo Chapter, EMCJ87-1</p> <p>ABSTRACT: Many ac power line noise filters consisting of a circular toroidal coil and earth bypass capacitors are used. Few effects appear for noise suppression if they are used in bad or non-earth condition. In this report, a new filter constructed with non-circular common mode choke coil and its effects are shown.</p> <p>INDEX TERMS: EMI, EMC, immunity, noise filter, power line, customer equipment</p>	<p>EMCABS: 24-07-87</p>

<p>Experimental Study on Shielding Effect for Shielding Cable in Metallic Duct Hiroshi Yamane, Tamio Motomitsu, Hisaaki Kanamori and Tsuyoshi Ideguchi NTT Electrical Communications Laboratories, JAPAN EMC-S Tokyo Chapter, EMCJ87-2</p> <p>ABSTRACT: This paper describes the shielding effects for the induced overvoltage from a high power transmission line using electromagnetic shielding cable laid in metallic ducts. A new measurement circuit of the shielding effects using a small-scale model is proposed. It is clarified that the shielding characteristics are affected with induced longitudinal voltage, distributed ground resistance, etc., and also that this countermeasure is effective for high induced longitudinal voltage area.</p> <p>INDEX TERMS: Shielding, metallic ducts, induced overvoltage, shielding cable</p>	<p>EMCABS: 25-07-87</p>	<p>Numerical Calculation for Characteristics of an Electromagnetic Anechoic Chamber Shimizu Yasutaka and Nishimura Kohsuke Tokyo Institute of Technology, JAPAN EMC-S Tokyo Chapter, EMCJ87-4</p> <p>ABSTRACT: Microwaves are absorbed but slightly reflected by the absorbers on the floor, ceiling or walls of an electromagnetic anechoic chamber because the absorbers cannot absorb the waves perfectly. The influence of reflected waves from absorbers was calculated by considering the image of the transmitting antenna and comparing it with an experiment. The decision of the positions of the equivalent reflection planes in the absorbers has much influence for the calculated results, and when it is decided adequately, the simulated results show good coincidence with the experimental results.</p> <p>INDEX TERMS: Microwaves, electromagnetic anechoic chamber, absorbers, reflected waves image, antenna, reflection planes</p>	<p>EMCABS: 27-07-87</p>
<p>Characteristic of Spherical Dipole Antenna Using Optical Fiber Kazuo Murakawa, Nobuo Kuwabara and Tsuyosi Ideguchi NTT Electrical Communications Laboratories, JAPAN EMC-S Tokyo Chapter, EMCJ87-3</p> <p>ABSTRACT: A spherical dipole antenna was proposed for a standard emitting source. This paper presents a developed spherical dipole antenna. In this antenna, the emitting field can be evaluated theoretically and the emitting frequency can be controlled from an outside signal generator through an optical fiber. The emitting field is calculated by the Mode-Matching Method. The numerical results agreed with measured data. The analysis shows that the antenna factor is constant for a wide frequency range.</p> <p>INDEX TERMS: Spherical dipole antenna, optical fiber, emitting field, antenna factor</p>	<p>EMCABS: 26-07-87</p>	<p>Effect of Ground Conductivity on 100 kHz to 1 MHz Fourier Spectrum of Lightning Electric and Magnetic Fields Zen-Ichiro Kawasaki, Minoru Nakano, Tosio Takeuti and Taketosi Nakai Research Institute of Atmospherics, Nagoya University, Nagoya, JAPAN EMC-S Tokyo Chapter, EMCJ87-5</p> <p>ABSTRACT: Electric and magnetic fields due to lightning were observed during the summer of 1985 at Fujioka, Gumma. More than two hundred data were recorded. Out of 200 lightning strokes, nine were extremely near (within 3.3 km) and nine were of middle distance (around 30 km). Averaged Fourier spectrum were estimated for these near and middle distance lightning strokes. Theoretical Fourier spectrum, which are calculated using Norton's Formulation, were compared with the experimental results and the ground conductivity was estimated.</p> <p>INDEX TERMS: Fourier spectrum, lightning electric and magnetic fields</p>	<p>EMCABS: 28-07-87</p>

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