NEWSLETTER



ELECTROMAGNETIC COMPATIBILITY GROUP

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SOME 7th SYMPOSIUM HIGHLIGHTS

A new policy was tried out, as far as conducting a Symposium was concerned, and seemed to be most successful. Exhibitors had a panel discussion session where they could explain, in detail, their new products and instrumentation. This cut down the need for thinly disguised technical papers by suppliers and, at the same time, gave them an opportunity to answer questions without hesitation.

Many electromagnetic pulse problems were, for the first time, discussed in an unclassified open session.

Radiation hazards also came in for detailed discussion. The question was raised as to the potential results of extremely long-term effects of very low-level radiation. Were they being studied and, if so, what was being discovered?

"Man-rated" is a new term gradually creeping into EMC language. It applies mainly to material furnished for the man-in-space program and carries "Zero Defects" one step further. Man-rated means that life of an individual depends on the operation of that item.

Reflected power should be considered as it can give double the strength of a signal under certain circumstances.

A possible hazard exists just as soon as an electroexplosive device is placed in an EM environment. And EM environments are getting worse.

There is too much specification level testing instead of looking at broader problems. It should be the responsibility of the EMC engineer to keep ahead of the specifications and anticipate what may be required in future.

The 1966 8th Symposium will be held in San Francisco.

A more complete write-up of the 7th Symposium will appear in the next issue of the Newsletter.

CHAPTER ACTIVITIES

Boston:

Military Electronics/Electromagnetic Compatibility and Space Electronics & Telemetry/Aerospace & Navigational Electronics held a joint meeting on May 27, 1965. Dr. Lester C. Van Atta, NASA - ERC, gave a talk on "<u>Current Activities and Plans of NASA-ERC and Policies</u> and Plans of the Aerospace & Electronic Systems Group".

Chicago:

There were two meetings held by this Chapter: One on February 11, 1965 and F. W. Yazombek, ITT - Kellogg, gave a talk on "EMC -Worldwide"; another meeting was held on May 13, 1965 and Jack E. Moe, General Dynamic, Dallas, Texas, gave a talk on "EMC - Texas Style".

Dayton:

The following meetings have been held by this Chapter: Februar 18, 1965, paper given by James Senn, Genistron, on "<u>RF Hazards to</u> <u>Explosive Devices</u>"; April 21, 1965, paper by Robert Northwood, Commander, Defense Electronics Supply Center, Dayton, Ohio, on "<u>Trends in Use of Electronics in the United States Navy</u>", and April 2: 1965, paper by Gerald Desch, Technology Inc., Dayton, Ohio, on "Radio Frequency Susceptibility of Integrated Circuits".

Huntsville, Alabama:

A meeting was held on November 16, 1964 and the following wer the speakers and subjects: Andrew J. Nalbandian, EMI Group Supervisor JPL, "EMI Systems Effort at JPL"; William R. Johnson, Sr. Engineer, Northrop Space Labs., assigned to JPL as EMI Project Eng Ranger, "Electrostatic Charging & Discharging of Rocket Launched Vehicles"; Albert C. Whittlesey, Research Engineer, JPL, "Interference Measurement Techniques at High Gain Antenna Systems", and Albert A. Olbefer, Research Engineer, JPL, "Cape Simulation Susceptibility Test".

Two more meetings were held: One on March 22, 1965 and L. S. Boudreaux, Chrysler Corporation, New Orleans, gave a talk on "Susceptibility Testing Criteria & Techniques"; another meeting on May 17, 1965 wherein W. L. Cipperly, Filtron Company, Inc., Hunts ville, Alabama, gave a talk on "Terrestrial Grounding Systems".

Los Angeles:

A meeting was held on May 20, 1965 and R. H. Stone, General Electric Company, Palo Alto, California, gave a talk on "Microwave Interference - Problems and Solutions".

New Orleans:

The Electromagnetic Compatibility/Antennas and Propagation Group held a meeting on April 29, 1965 and J. W. Smollen, III, NASA New Orleans, Louisiana, spoke on "<u>Michoud and Michoud Space Pro-</u> grams".

Philadelphia:

A meeting was held on April 13, 1965 and Guy D. Johnson, Jr., U.S.A.E.L., Fort Monmouth, New Jersey, gave a talk on "<u>The Army</u> Current Program in EMC Instrumentation".

San Francisco:

The Electromagnetic Compatibility/Instrumentation and Measure ment Group held a joint meeting on February 24, 1965 and Arthur Fon Hewlett-Packard, Palo, Alto, California, gave a talk on "The Technique of Spectrum Analysis". Another meeting was held by the Electro magnetic Compatibility Group on April 22, 1965 and J. Fisher, Genistron, Inc., Los Angeles, California, gave a paper on "A Computer Study of the Insertion Loss of EMI Filters in Mismatched Systems".

Seattle:

Two meetings were held: One on March 17, 1965 and Richard Schulz, Boeing Company, Airplane Div., Renton, Washington, spoke on "Low Frequency Shielding Resonance"; another meeting was held on May 26, 1965 and C. D. Lunden, Boeing Company, Seattle, Washington, spoke on "Puget Sound Ambient Radio Noise Levels".

MORE SOURCES OF EDUCATIONAL MATERIAL

The following is a report submitted by C. W. North, Chairman of the Sub-Committee on Education, at the last G-EMC Administrative Committee Meeting:

1. NASA Educational Course:

NASA is coming out with an E. M. I. educational course sponsored by the Apollo Program. Basic test material is to be contained in a book by NASA, "NASA E. M. I. Awareness Course". The book, 20 chapters of some 671 pages, with foreword by General Phillips, is scheduled to be published by U.S. Government Printing Office in July. Eleven of the twenty chapters will also be published in pamphlet form primarily for design use.

Present reports are the General Electric of Daytona will initiate the training program for NASA Personnel only at G.E. Daytona. The first class is scheduled to convene August 15.

Suggestion: Have synopses of the 11 pamphlets above published in I.E.E.E. G-EMC Newsletter as soon as they become available.

2. Control Plans and Specifications:

For Space Systems Management and Engineering the report No. TDR-469 (5540-20)-2, prepared by Aerospace Corporation for the Air Force Systems Command, is top level educational material. The title of this report is, "Electromagnetic Compatibility Requirements for Space Systems, General Specifications for," published April 1965.

This report is illuminatory, clearly explained, concise and practical. If we follow it, we would eliminate the old common practice of doing no EMI testing until after the hardware is packaged. This has proven to be impractical and costly in schedule delays and last minute design changes. Adopting these recommendations would insure a minimum of acceptance and evaluation test time as well as assuring that the specification requirements were complied with across the board.

3. EMP (Electromagnetic Pulses) from Nuclear Explosions and Lightning:

Recent studies involving the design of equipment that may be operated after exposure to nuclear blasts, have stimulated the interest of design and development engineers. EMP are highly important special cases of EMC problems and must be given special consideration.

However, it must be remembered that EMP is only a part of an EMC program and other factors involved cannot be ignored or put off until after hardware has been designed.

As previously reported, EMC programs are frequently curtailed because top management does not get the correct information from the EMC specialists in time to plan a practical program.

Mr. J. M. Bridges, DOD, gave a paper, "The DOD Program on Electromagnetic Compatibility", at a joint meeting in Boston in early 1963. Copies were distributed to the Administrative Committee. Basically the paper stressed the need for backing of top management from both manufacturer and customer.

Since EMC is not a hardware product, it is often neglected. However, management should note that with our fixed priced, incentive bonus type of contract, failure to meet EMC specifications has and does cause delays in delivery schedules, redesign problems and could easily destroy an incentive bonus. Mr. Bridges called attention to the fact that Reliability is not a hardware product either and was not implemented until pushed by top management and that the same consideration must be given to EMC. The EMC specialists must get the word to the program people and see that adequate planning is accomplished. Program initiated without the advice of EMC specialists usually fail.

1966 COMMUNICATIONS CONFERENCE Seeks PAPERS on EMC

The IEEE Group on Communication Technology has invited mem bers of G-EMC to participate in the 1966 IEEE Communication Confer ence which will be held at the Hotel Sheraton in Philadelphia on June 1 17, 1966. This meeting is the successor to past conferences known a GLOBECOM. The first Communication Conference was held in Bould Colorado, in June 1965.

The 1966 Conference will stress topics of general interest such as commercial satellites, world wide government systems, speech processing, community antenna and educational TV, computers in cor munications. It is proposed to devote one session to RFI/EMC problems in these areas.

Papers will be reviewed through the Program Committee which comprises representatives of the CTG technical committees and parti cipating Groups. Reviewable 1000 word digests of proposed papers w be considered for inclusion in the program. The committee also wist to hear from members concerning timely topics for which papers migbe solicited. Papers not being solicited by the Program Committee, other suggestions for the program should be sent to the Technical Pre gram Chairman, A. E. Joel, Jr., Bell Telephone Laboratories, Inc. Room 2G-330, Homdel, New Jersey, by February 25, 1966. Dr. R. Showers, Moore School of Electrical Engineering, University of Penr sylvania, Philadelphia, Pa. 19104, has agreed to serve as liaison function between G-EMC and the Program Committee of GLOBECOM. Suggested paper titles may be addressed to him.

Printed digests of all papers will be available at the meeting.

The meeting will also include a Banquet and a Keynote session , general interest to broad segments of the membership.

RFI SOLUTION DUE BEFORE GEMINI 5

Electronic News, June 21st, 1965, carried the following news item under the above title. Excerpts are as follows:

"Cape Kennedy, Fla. - The problem of radio frequency inter ference between voice and telemetry is expected to be licked in a mis sile range aircraft before the Gemini 5 flight.

"The engineering modification program being undertaken wil also provide better quality and reliability in relaying voices of astronauts to ground stations on the Eastern Test Range, it was said.

"The communications modification for two C-130 aircraft is directed by the Air Force here with Electronic Communications, Inc St. Petersburg, as contractor...

"One of the most important advantages in solving the RFI pr lem, as being undertaken by ECI, is to combine both the voice relay and telemetry in one plane. Until now, two instrumentation aircraft have had to be used - one for telemetry and one for voice relay. . .

HIGH-VOLTAGE DC TRANSMISSION THROUGH THE EARTH: A STUDY OF EFFECTS

The AOR Research Review, March 1965, carried the following article under the above title:

Microwave Physics Laboratory, AFCRL

"What would be some of the effects of passing high-voltage currents in the 400-ampere range through the earth between electron separated by several hundred miles? Would the currents interfere v railway-track signaling circuits? - - would ground currents influenc aircraft compasses or radio aids to navigation? - - would there be d ger to animals or persons?

"Arnold Orange of AFCRL, together with representatives o the Bonneville Power Administration, Portland Oregon, and scientis from Geoscience, Inc., of Cambridge, Mass., have recently report on experiments designed to answer these questions. Orange was asl to participate in the study because of his unique knowledge of the ear crust as a signal-carrying medium. The study was an outgrowth of proposal for tying together the power networks of the Pacific Northwest and the Southwest, using high-voltage, direct-current transmission instead of alternating current.

"An advantage of direct current, not possessed by alternating current, is that one half the rated power of a line can be transmitted with one conductor out of service by allowing the current in the remaining conductor to return through the earth. Before adopting this scheme, however, it was necessary to bring to light any possible harmful effects of the ground current flow. A series of tests were conducted in the Columbia Basin for this purpose. In these tests, currents of from 90 to 400 amperes were passed through the earth between electrodes separated by 40 to 240 miles. Surface potential gradients were measured at varying distances from the current electrodes. Measurements of change in pipe to soil and railroad-track potentials were also made.

"As a result of these tests, it appears that high-voltage direct current will not interfere with railway-track signaling circuits, or with aircraft compasses or radio aids to navigation. By using proper electrode size, voltage gradients--even at the electrode itself--will be below levels of possible danger to persons or animals.

"Corrosion damage to buried metals, such as pipe lines, does present a problem. But if electrodes are bcated as far as practical from buried metal structures, or if the structures themselves are specially protected, the problem can be avoided. Direct-current leakage through metallic circuits of grounded a-c systems also appears to present no problems. The tests in the Columbia Basin are the first in a series of field tests that may be necessary before plans are made final.

"Orange's contributions to the Bonneville Power Administration study are a direct result of his research at AFCRL over the past several years (as reported in the 8 January 1965 issue of Science)concerned with signal propagation through the earth's crust. By such means, extremely hardened communications can be achieved for distances between 10 and 50 miles. NORAD has recently evidenced considerable enthusiasm for the potential operational capabilities of the technique."

PACEMAKER PROBLEMS

Time, June 25, 1965, carried the following news item under the above title:

"When nature devised the delicate, low-voltage electrical system that keeps a human heart beating at about 70 times a minute, it did not anticipate interference from doctors' diathermy machines, radio transmitters or neon signs. Thanks to the amazing vitality of natural tissues, there was no possibility of metal fatigue, either, regardless of what else might go wrong. But in some of the artificial pacemakers that have been implanted in the bodies of thousands of heart-disease patients in the past few years, interference and fatigue are proving to be troublesome. Difficulties may show up when the patient is still on the operating table, while the pacemaker is being inserted in a pocket of chest or abdominal muscle, or they may develop years later.

"New Zealand surgeons report in the British Medical Journal that they have had close calls with two patients. A man of 68 had been doing well in Dunedin Hospital after a week on an external pacemaker. The surgeons were installing an internal model that was designed to work indefinitely, but when they cut into the patient's heart sac to put an electrode in the heart muscle, the external pacemaker went wild, and the heart twitched ineffectively. The doctors traced the trouble to high-frequency interference from the diathermy machine that powered the electric scalpel they were using. This man and another who had a similar experience both recovered, but the surgeons were puzzled and worried, so they did a lot of experiments with animals.

"They discovered that some types of internal pacemakers are so designed that a diathermy machine operated within three feet of them causes interference; the pacemaker pulses so fast that the heart cannot keep up, and so it will stop or just twitch. The same interference occurs within six inches of a neon sign, or close to the frequency-regulating coils of radio transmitters. One form of diathermy is commonly used in doctors' offices for simple surgery such as removal of warts. Human tissues afford some shielding for a patient with an implanted pacemaker, but interference may still be dangerous.

"Fortunately, X rays apparently present no such hazard to a pacemaker; it is only from X rays that doctors can diagnose the trouble when the wires leading from the pacemaker to the heart break because of metal fatigue. The University of Kentucky's Dr. Harold D. Rosenbaum reports that this can easily happen, not only because of the incessant movement of the heart - which puts a strain on the wires - but also as a result of breathing and such everyday actions as tying shoe-laces. If the breaks are detected in time, the patient can get along well again after an operation to replace the wires.

CATS ARE CULPRITS

Derby, England (UPI) - Frederick Ward of Britain's General Post Office said television reception in weak-signal areas could be diturbed by static electricity generated by neighbors stroking their cats

A POTENTIAL HAZARD TO THE GEMINI CAPSULE

SIGNAL, July 1965, the monthly publication of AFCEA, had the following item:

"Could a dangerous electrostatic discharge ignite the Gemini Capsule and its Agena docking vehicle just as they begin to connect ar turn the nation's first space rendezvous into a disaster? The Nationa Aeronautics and Space Administration is trying to find the answer through the results of the recent Gemini-4 flight. NASA considers such danger to be possible, that high voltage electrostatic potentials unleashed between two vehicles in space docking maneuvers could dar age their skins or ignite their attitude control jets or retrorockets. solid-state instrument, an Electrostatic Potential Meter, was placed on board the GT-4, to determine whether the capsule actually stored up a static electrical charge of hazardous proportions. Designed and built by Electro-Optical Systems, Inc., the unit's sensor section extended through the spacecraft's skin, with the sensing head flush with the capsule's exterior to exactly measure the amount and type of surface charge accumulation. If heavy charges are discovered on Gemini and 5, and later on the Agena, it is possible that alternations will be made before a docking is attempted."

NEW WEI TECHNICAL BULLETIN

White Electromagnetics, Inc., 670 Lofstrand Lane, Rockville, Maryland, in its Technical Bulletin, Volume 5, Number 3, discusses Calibration Techniques for Automatic Spectrum Scanning and Plotting Instruments. It discusses both conducted and radiated signal calibration processing. Copies may be obtained by writing to the above address.

ENGLAND RESTRICTS USE OF 420 to 460 Mc/s BAND

Use of the Frequency Band 420 to 460 Mc/s

"Civil Aviation Information Circular No. 74/1960 (Tels 23/60) drew the attention of aircraft operators to the inadvisability, due to th possibility of interference from new services operating in the band 420-460 Mc/s, of using radio altimeters operating in this band when flying over densely populated areas. The circular further advised tha this frequency band was no longer allocated to the aeronautical radionavigation services, and that continued use of altimeters operating in the band could be authorised on a temporary basis only.

"2. In view of the time which has since elapsed and the current ready availability of radio altimeters operating in the approved bands 1600-1660 and 4200-4400 Mc/s, it has been decided, in consultation with the Air Registration Board, that as from 30th June 1965, United Kingdom type approval will be withdrawn from all radio altimeter equipment operating in the band 420-460 Mc/s.

"3. There may be isolated instances where the continued use of an equipment operating in the band 420-460 Mc/s is justified for the proper conduct of certain operations. In these circumstances consideration will be given to the issue by the Ministry of a special authorisation to carry the equipment. Application for such authorisation should be made through:

> The Air Registration Board, Brabazon House, Redhill, Surrey,

stating the operational purpose for which it is desired to use the equip ment.

ELECTRIC SHOCK FROM "DISCHARGED" CAPACITORS:

The United States Atomic Energy Commission Health and Safety Information Bulletin reproduced the following from the United Kingdom Atomic Energy Authority Accident Prevention Issue #57, June 1965:

"All high-grade capacitors and, in particular, large-energy storage capacitors, as used in pulsed capacitor banks, will recover a considerable proportion of the original charging energy if left on open circuit after discharge. Experience at Culham Laboratory has shown that recovery may be as much as ${}_{1}0\%$ of the original voltage, and a 30-kv capacitor may build up to 2 or 3 kv in 10 minutes. Further, dangerous voltages can build up on open-circuited high-voltage capacitors over a period of many months after they have been discharged.

"This phenomena is known either as the 'residual effect', 'dielectric hysteresis', or 'dielectric absorption' effect and a capacitor is said to have an 'absorptive capacity'. The mechanism of charge is complex.

"It has been found that a discharge of energy exceeding 10 joules into the human body can be hazardous to life, while 1/4 joule gives a heavy shock. 10 joules would be obtained by complete discharge of a capacitor charged as in the following table:

"CAPACITY (F)	0.002	0.2	20	80	320	2000
			an (an a).			1 - 1
"CHARGED TO (KV)	100	10	1	0.5	0.25	0.1

"It is essential that each spare or disconnected capacitor should be kept individually short-circuited by a robust connection when not in use.

"It should also be remembered that 'new'capacitors have already been energized for test purposes, and should also be kept short-circuited when stored. Capacitors built into equipment which is not in use must be similarly short-circuited individually; otherwise, hazard may exist when they are connected in series, or if there is a circuit fault on a bank of parallel connected capacitors.

"It is recommended that all such capacitors should carry a label adjacent to their terminals, e.g.:

WARNING

Keep short-circuited when not in use

RFI AND SPACE DISCUSSED BY HOUSTON AEROSPACE GROUP

The following news item appeared in Electronic News, June 28, 1965:

"Space Men Worry Over Gain In RFI From Radar Sources"

"Houston. - Electronic systems that produce potentially detrimental electromagnetic radiation - causing radio frequency interference at orbital altitudes - are increasing at an alarming rate, Larue A. Hoffman of Aerospace Corp., El Segundo, Calif., said here.

"Mr. Hoffman, associate head of the electromagnetic techniques department at Aerospace, spoke at an electromagnetic compatibility control technical session at the fourday Aerospace Technology Conference and Exhibit.

"The meeting was sponsored by the Aerospace Group and Houston Section of the Institute of Electrical and Electronics Engineers in the Shamrock-Hilton Hotel here last week.

"There is already suspicion that a number of missiles and payloads may have been prematurely activated by RFI, 'Mr. Hoffman said. 'Experienced pilots report increasing RFI with increasing altitude such that at times they are confused as to what stations they are monitoring.' "He said ground-based and aircraft equipment of concern include devices of purely peaceful nature and those for military use, but the threat due to spaceborne equipment is minimal at this time.

Ground Equipment

" It is with the ground-based equipment that RFI studies should be primarily concerned at present, 'Mr. Hoffman continued. 'These include intentional jammers, highpowered 'peaceful' radars, and other devices operating at frequencies, pointing angles and power levels that create potentially detrimental radiation levels.'

"An RFI program initiated by Aerospace Corp. includes both analytical studies and an experimental or exploratory effort, it was said. The purpose of the initial experiment is to obtain data on the more significant suspected sources of RFI with a low-cost, flight-qualified, spaceborne monitoring subsystem.

"The transmitters considered to be the most likely sources of RFI presently at orbital altitudes are the high power radars operating from 200 to 3000 mc, Mr. Hoffman said. 'Significant, but of lower power, are the radars operating from 3000 to 10,000 mc.'"

ITEMS OF INTEREST IN PROCEEDINGS OF THE IEEE, JULY 1965

Statistics of Thermal and Laser Radiation

Henry Hodara, National Engineering Science Co., Pasadena, Calif., has an 8-page article under the above title. The abstract is as follows:

"The random fluctuations of a signal constitute noise. Their magnitude which depends on the signal statistics may be significant in laser radiation. In this paper the statistics of thermal or incoherent radiation are briefly compared with those from an amplitude stabilized laser and the amplitude probability density of the uncoupled multimodal laser field is derived."

RF Noise Measurements of MIG Beam with Pinhole Collector

On page 728 starts a letter from W. R. Curtice, Raytheon Co., Waltham, Mass. and L. A. MacKenzie, Cornell University, Ithaca, N. Y., under the above title. The first paragraph is as follows:

"Electron beam analyzer equipment has been adapted to make refined RF noise measurements on the hollow beam produced by a scaled model of a magnetron injection gun. This gun is operated on a pulse basis with a beam voltage of 1000 to 4000 volts at a microperveance of 7 to 10, depending on the magnetic field. A sample of both the dc and RF noise current density in the beam is obtained by a collecting plate with a 0.010-inch hole. The plate is movable over the entire beam cross section as well as in the axial direction along the beam. Accurate dc current-density profiles are measured as a function of position in the transverse plane and plotted on an X-Y recorder. RF noise current profiles are obtained in a similar way by frequency analyzing the pinhole current. A small Faraday cage for collecting this pinhole current is built into the center conductor of the coaxial line that provides RF coupling to the current sample."

Orthogonal Detection to Reduce Common Channel Interference

On page 742 and 743 is correspondence on the paper by J. E. Bridges and R.A. Zalewski, IIT Research Institute, Chicago, Illinois, in Proceedings of IEEE Sept. 1964. T. H. Crystal, Dept. of Elec. F and Research Lab. of Electronics, M.I.T., have comments of the pr ious paper and J. E. Bridges and R. A. Zalewski have replied.

MAKING LIGHT OF THE NOISE PROBLEM

Electronics, July 26, 1965, carried a 5-page article under the above title by J. D. Merryman, Texas Instruments Inc., Dallas, Tex. The sub-head and first two paragraphs are as follows: 'Integrated circuit employs optical coupling to solve the 'interface problem' for computer subsystems, data transmission, and communications.

"One attractive property of optoelectronic devices is their potential for isolation; they can get rid of the noise that is generated when two subsystems are coupled. The noise problem is even tougher in integrated circuit systems, because the transformers used in traditional methods of isolation are too bulky.

"Thus, in a growing number of applications, the best way to obtain no noise at an interface is to couple signals optically. A new device that will do this is an integrated circuit with a gallium-arsenide light-emitting diode mounted on top. The light is collected by a silicon photodetector diode which is diffused, together with the other components of the integrated circuit, onto a single monolithic silicon structure."

INE NOISES IN RECORDING;

Under the above title appeared some correspondence in HiFi/ itereo Review, July 1965, as follows:

> "Q. Before I do any tape recording I go through the following procedure: I remove the fuses from the hotwater heater, turn down the furnace, unplug.the refrigerator, and caution (threaten) other family members to avoid turning lights or appliances on or off during the recording period. I do all of this to eliminate pops, buzzes, and hums from the tape. With all my precautions, however, noise still gets in, as it is impossible to see that all appliances are turned off, and kept off, while recording. Do you have any further suggestions that might be of help in obtaining tape recordings unmarred by noise?

> > Robert A. Ricketts Seattle, Wash.

"A. The electrical noise produced by appliances can get into a tape recording in several different ways. There may be direct radiation of radio-frequency noise caused by the sparking of faulty electrical contacts. This is picked up directly by the early high-gain stages of your tape recorder. The a.c. line may also be carrying and radiating r.f. noise (whose original source is the sparking contacts). It is also possible that the noise is not r.f. in nature at all. If the taperecorder circuits are sensitive to line-voltage surges, the sudden current drain caused by the turning on of an oil burner or refrigerator motor will cause the line voltage to drop, and the recorder amplifier will go into a momentary instability that will appear on the tape as noise.

"Obviously, the only way you are going to effect a cure is to attack the problem at its source. It should be possible to shield and suppress the arcing or sparking that causes the r.f. pickup. On the other hand, if line-voltage surges are your problem, the solution is to use a constant-voltage transformer with enough current capacity to handle the tape recorder.

"Two books on the subject of interference that may be helpful are: R.F. Interference Control Handbook,

published by Howard W. Sams & Co., Indianapolis, Indiana: and How to Locate and Eliminate Radio & TV Interference (#158), published by John F. Rider Publisher, New York, N. Y."

INTERFERENCE IN ANTENNA SYSTEM:

Radio-Electronics, July 1965, answers the following question in its Service Clinic:

Q. "We have an amplified signal distribution system in our showroom. We had some troubles with it, so we added an antenna-mounted preamplifier. We have a good all-channel antenna, aimed at a channel-12 station 85 miles in one direction. Channels 3, 10 and 13 are 27 miles in the other, all maximum-power transmitters.

"We have very bad windshield-wiper interference on10 and 13, sound interference on unused channel 9, and so on! Where is the defective part in this system? - A.S., Sacramento, Calif.

A. "You haven't got one. Just the opposite. Everything is working too well! You're using a very high-gain, deep fringe antenna, plus a high-gain antenna-booster, plus a high-gain broad-band amplifier. You are simply overloading the input of the broad-band amplifier!

"The 'interference' is actually what the CATV technicians call splatter, and is due to trying to get the signals through the amplifier at too high a level. Also, if any single channel in such a system is more than 6 db higher than the others, you'll get the same trouble. Such stations must be padded down to the same level as the rest.

"Get a good field-strength meter and check the rf signal level at the input of the broad-band amplifier. If this is more than about 1,200-1,500 uv per channel, it will have to be reduced. I believe I'd try this without the antenna booster; try reorienting the antenna to see if you can't improve the situation in that way: If you use the booster, I'd put it on a separate channel-12 antenna, to bring that station up."

ITEMS OF INTEREST FROM PROCEEDINGS OF THE IEEE - MAY 196

Optimum Detection of a Stochastic Signal In a Gaussian Noise of Unknown Strength

A 2-column letter by F. B. Tuteur, Dept. of Engineering and Applied Science, Yale University, New Haven, Conn., is on page 487. The first paragraph is as follows:

"Although the detection of stochastic signals has been considered in considerable detail by a number of authors, it is usually assumed that the statistics of the noise are known. In this correspondence we consider the problem of detection when the power level of the noise is unknown. The results can be extended to cover the case where several parameters of the noise statistics are unknown."

> *** *** Radar Interference by EM Emission from Charged Water-Drop Collisions

A 2-column letter by W. H. Andersen, Heliodyne Corp., Norton AFB, Calif., is on page 493. The first paragraph is as follows:

"The sensitivity of radar systems is often limited by unwanted radar echos (clutter), or by extraneous electromagnetic (EM) signals (interference). An excellent summary with bibliography is available by Skolnik. It is important that the various factors which contribute to clutter and interference be known in order to help design radars for various applications and to choose the proper frequencies for their use. This communication notes recent evidence showing that the EM radiation given off by the collision of electrically-charged water drops may be a previously-unrecognized source of interference for certain frequency radars under appropriate conditions."

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On the Phase Variations of a Narrow-Band Signal Plus Noise

M. L. Moe and D. L. McArtor, Dept. of Elec. Engrg. Denver Research Inst., University of Denver, Denver, Colo., have a 3column letter on page 506. The first paragraph is as follows:

"The purpose of this correspondence is to discuss some properties of the phase variations of a narrow-band signal plus narrow-band noise and to show that, contrary to some statements in the literature, the phase variations are not band limited."

Beam Noise Reduction in High Magnetic Fields

Bayrum Vural, RCA Laboratories, Princeton, N. J., has a 2column letter beginning on page 510. The first paragraph is as follows:

"A significant reduction in the noise figure of a TWT by application of very high magnetic fields in the helix region has been reported recently by Hammer and Thomas. In this correspondence a possible explanation of this effect is suggested in terms of a field-dependent contribution to the axial component of ac current." "The modern field-strength meter can do more than just measure RF field strengths. It can be used to measure, among others:

> Hum modulation. Differential gain in a TV modulator. Swept frequency impedances. Noise.

"A field-strength meter is essentially a tuned RF microvoltmeter with a 75-ohm coaxial input. When equipped with an antenna it will measure field strengths. But it is often used without the antenna to measure signal levels. For example, a TV-type field-strength meter is often used to directly measure the signal levels in TV distribution and community antenna systems.

"A knowledge of this versatility may help owners of field-strength meters to obtain more from these specialized instruments. All too often a company must make an investment in the meter for important, but admittedly infrequent, field measurements and then leave the instrument idle the rest of the time."

HOW TO REDUCE RFI BY GOOD DESIGN PRACTICE:.

EDN, in its May 1965 issue, carries a 6-column article under the above title by Jack Corsiglia, Anaheim, California. The sub-title and first paragraph are as follows:

"To minimize RFI, a basic design philosophy must be established at the initial stage of system design. By using the guidelines that are presented in this article, equipment will not only contain internally generated RFI, but also will withstand the influences caused by external interference.

"Equipment that satisfies RFI specifications results from proper electrical and physical design as well as good construction practices. However, this design and construction often can be simplified and made more effective if characteristics of the RF environment are known. If such information is not available, then an ambient noise survey should be performed, to determine which frequencies may possibly cause interference. After fabricating the equipment, the system's spectral distribution of radiated and conducted noise should be determined as well as the system's susceptibility to electromagnetic noise."

SUPPRESSING NOISE AT THE CONNECTOR:

Electronics, May 17, 1965, has a 3-page article by Edwin Rowlands and Michael P. Noonan, ITT Cannon Electric, a division of International Telephone and Telegraph Corp., Los Angeles, under the above title. The sub-title and a paragraph of interest are as follows:

"Tiny ceramic dielectric and ferrite filter, built around a connector contact pin, reduces interference. "Engineers have a number of ways of filtering out unwanted electrical impulses that come out of, or enter, the black box at the points of interconnection. But these methods usually involve additional components and labor. Now a small ceramic filter, built around a connector contact pin, will suppress rfi with no extra wiring and little additional weight."

FIELD STRENGTH METER CAN DOUBLE IN BRASS:

Electronic Design, May 3, 1965, carries a 6-page article under the above heading by Ken Simons, Chief Engineer, Jerrold Electronics Corp., Philadelphia, Pa. A list of field strength meter specifications covers a page and a half. The first three paragraphs are as follows:

AN EXPERIMENTAL EVALUATION OF A COMPUTER ANALYSIS OF SYSTEM ELECTROMAGNETIC COMPATIBILITY

Under the above title, J. E. Maynard, H. L. Rehkopf and B. L. Carlson, The Boeing Company, Seattle, Washington, presented a pape at the Aero-Space Conference on June 21, 1965. The abstract and intr duction are as follows:

"This paper describes a limited simulation of airborne or space system equipment assembled in the laboratory, on which interference tests were performed concurrently with an analysis of the compatibility using a general-purpose digital computer.

"Conclusions are presented concerning the needs for input data for a computer analysis of system electromagnetic compatibility, the adaptability of specification test data to these needs, and additional test data which could supply useful information for a computer analysis."

"Present methods of analyzing and determining the intra-system interference compatibility of a system often rely chiefly on the results of lengthy manual-analysis techniques and system electro-interference tests. The disadvantage of this approach is that the manual analysis is necessarily cursory due to time and schedule commitments, and the tests are performed on a production item after the engineering designs are frozen. Incompatibilities uncovered during the test require expensive fix and retrofit programs, and in many instances, fail to uncover incompatibilities which occur during the operational phase of the system. Thus, the ability to analyze and predict intra-system interference incompatibilities early in the design stages of a space or weapon system has strong economic value.

"This paper presents an experimental evaluation of a technique of predicting intra-system interference compatibility by means of a digital computer. The adequacy of the computer analysis is determined by the comparison of computer predicted results and laboratory measurements made on a controlled mock-up of a typical airborne system."

Copies of this paper may be obtained from J. E. Maynard, The Boeing Company, Aero-Space Division, Seattle, Washington.

R&D, PRODUCTION ACCELERATE IN BRUSHFIRE WAR ELECTRONICS

In Electronic Design, May 24, 1965, in its News Bulletins, the ollowing paragraph appeared under the above title:

"Wired telephones, useful between two entrenched command posts and over controlled terrain, have no place in counter-guerrilla warfare where CPs must be mobile. The basic radio problems in Southeast Asia long have been known: The Indochinese peninsula has a characteristic radio noise level at medium and high frequencies 100 times greater than in the Panama Canal region and higher than any other place on earth except the Congo Basin and the Amazon."

TRIAC OPTIMIZES STATIC CONTROL OF AC POWER:

F. W. Gutzwiller, Manager-Application Engineering, General Electric, Auburn, New York, under the above title, has explained GEs new Triac for its three-element static ac switch. The sub-title and maragraphs of interest are as follows:

"The bi-directional controlled rectifier (Triac) exhibits less switching to RFI and requires fewer auxilliary components in static ac switching applications than competing devices.

"Lower RFI Levels Result

"Switching circuits employing semiconductor devices like the Triac do not produce as much rådio frequency interference (RFI) effects as those which use conventional mechanical and electro-mechanical switching devices. The contacts of these latter components bounce upon closure and arc upon opening. The Triac does not generate highly noisy signals because it does not bounce when closing, and it opens at the instant when its current naturally passes through zero. At this point a minimum discontinuity in the current waveform exists; hence, interference is minimized. These advantages accrue even under random triggering operation.

"With suitable triggering, the Triac can close an ac circuit at the instant when minimum RFI occurs. The ideal point for closing occurs when the ac supply voltage passes through zero and is independent of load power factor.

AVAILABLE THROUGH THE SUPERINTENDENT OF DOCUMENTS

The following government reports are available through the Superntendent of Documents, Government Printing Office, Washington 25,). C.:

Bibliography of Fading on Microwave Line of Sight Tropospheric Propagation Paths and Associated Subjects

A collection of titles and abstracts is presented for articles dealing with microwave fading that has been observed on tropospheric line of sight paths. Selections are included for related subjects such as: measurement of meteorological factors; spatial frequency and time diversity reception; and attenuation due to trees and buildings. 1964. 113 il. Catalog No. C 13.46:302 60¢.

Bibliography on Tropospheric Propagation of Radio Waves

The subject matter of this annotated bibliography, containing over a thousand abstracts or titles, published between 1902 and 1964, is confined to the effects of the Earth's atmosphere on radio-frequency radiation from 10 cps to 100,000 Mc. 1965. 302 p. Gatalog No. C 13.46:304 \$2.00.

ERROR PROBABILITIES DUE TO ATMOSPHERIC NOISE AND FLAT FADING IN HF IONOSPHERIC COMMUNICATIONS

Under the above heading, a letter by P. A. Bello, ADCOM, Inc. Cambridge, Mass., was printed in the March 1965 issue of the Proceedings of the IEEE. The first two sentences stated:

"Atmospheric noise can be a major source of error in the transmission of digital data at HF via ionospheric reflection. This correspondence is a report on the results of a successful study (1) to predict the error rates of digital modems at HF due to atmospheric noise and flat fading with the aid of appropriate mathematical models of the noise and fading...."

EMC Today

Electronic Industries, July 1965, has an editorial under the abov title by Bernard F. Osbahr, editor, After reviewing the editorial history of Electronic Industries and RFI/EMC, the following suggestions are made:

"In addition, we should like to make the following constructive suggestions:

"1. EMC technology has advanced sufficiently to warrant training engineers in the field of RFI/EMC. They should receive information about how to detect, measure, and design devices and equipment to suppress unwanted radiations. It would be a good subject to include in all college engineering courses.

"3. There is a definite need for minimum specifications that would be applicable to all services - military, government, and civilian. Gritical problems could be covered by more stringent specifications.

"4. New EMC test equipment is coming on the market that has the desirable features of portability, automatic operation, and accuracy. This instrumentation is useful in the hands of trained specialists. However, there is still a need for equipment that can be used by technicians who do not have full knowledge of the field. This equipment should be rugged, portable, easy to operate, and less costly.

"5. Engineers need comprehensive EMC design handbooks. Such texts would also help them solve existing problems.

"6. Designers should more fully consider the electromagnetic environment in which equipment will operate. Some steps have been taken in this direction through ECAC (Electromagnetic Compatibility Analysis Center) for military equipment designers and users. A similar service, embracing the same methods, should be developed for civilian applications. Civilian and military equipment should be capable of living together.

"7. Electrical/electronic devices such as heating pads, motors, razors, radios, tape recorders, and SCRs for control devices, etc., are creating unwanted radiation. Steps have been taken with some TV receivers under the 'Good Neighbor' policy to reduce spurious radiation. All devices should be under some/effective control. The purchaser of electrical devices knows that he should look for the Underwriters Laboratories approval label. Perhaps the engineering department of EIA and NEMA could develop radiation reduction standards. Then it would become possible to tag or label equipment that has met these specifications.

"Let's look at electromagnetic radiation as a natural resource that should be nurtured and conserved in every possible way. Senate Bill S. 1015 now before Congress would grant broad power to the FCC to regulate unwanted radiation. We believe this is a constructive step in the right direction."

NEW PRODUCTS:

SHIELD MU - New Magnetic Shielding Products

SHIELD MU Tape and Foil and SHIELDFLEX Flexible Tubing have been developed by the Magnetic Metals Company, Camden, New Jersey 08101. It is available in three kinds of alloys: 80% nickel iron; 50% nickel iron; silicon-iron, and low carbon steel. Technical data may be obtained by writing to Russell Industries, Inc., 96 Station Plaza, Lynbrook, N. Y. 11563.

> ***** New Corrosion Preventative

Corrosion Reaction Consultants, Inc., Dresher, Pa. 19025, have brought out a spray to displace water, in the form of moisture and condensation on electrical and electronic equipment, and replaces it with a thin molecular film. The product is known as CRC 2.26. It is claimed to effectively prevent re-entry of moisture, protect metal surfaces from corrosion and eliminate chemical or electro-chemical action that corrodes.

***** Filter Developed To Sell by Foot

Lundy Electronics & Systems, Inc., Glen Head, N. Y., has developed a new flexible filter for electromagnetic interference. It is wire-like in form and is extruded around a conductor either as straight wire or in coil form. The material absorbs electromagnetic interference and dissipates it in the form of heat. It is designated LossyLine and it is possible to purchase it by the foot.

***** Antistatic Agent

An antistatic agent for use on both plastic and glass surfaces is available from the Relay-Instrument Div., Westinghouse Electric Corp., Pittsburgh, Pa. This transparent conducting agent considerably reduces error due to static charge by draining the static. It can be used either to re-treat old surfaces or as an initial treatment for new instruments. It also prevents attraction of dirt to the charged materials.

14 KC to 1 GC Tunable Rejection Filter Set

A set of five Tunable Rejection Filters to cover the frequency sange of 14 KC to 1 GC has been introduced by Fairchild-Electro-Metrics Corporation, 88 Church St., Amsterdam, New York 12011.

Each of the five units has a typical rejection capability of greater than 100 DB for a signal anywhere in its range. At 60 DB down the band rejection width is approximatly 0.2% of the notch center frequency while at 20 DB down the width is approximately 20%.

Converter Permits RFI Measurements to 40 GC

Stoddart Electro Systems Division of Tamar Electronics, Inc., 2045 West Rosecrans Ave., Gardena, California, has brought out a new Microwave Frequency Converter which extends the frequency range of RFI equipment to 40 GC. It is designated NMC-1040. Although the NMC-1040 was primarily designed to be operated with the advanced Model NM-62A and Model NM-62B RFI measuring instruments, it can also be used with similar instrumentation of other manufacturers.

New Shielding Cable/Connector Terminations for RFI

Glenair, Inc., 1211 Air Way, Glendale, California 91201, has developed a means of ferrous coating standard aluminum parts thus making it possible to furnish parts with the advantages of both nonferrous and ferrous materials for the accommodation of low and high frequencies. At the present time, the process is limited to certain circular and rectangular connectors but will be extended to others in the near future. Further technical information may be obtained from Mr. Larry Schwartz, Chief Engineer.

> **** New Anti -Static Product

Merix Chemical Company, 2234 E. 75th St., Chicago, Illinois 60649, has developed MERIX WIPE. This has been developed for su heat-exposed electrical and electronic surfaces as TV and radio cabi nets where normal anti-statics break down. Further information ma be obtained by writing Mr. Eric O. Sonneman, President, at the abov address.

New Shielding Equipment for Ignition

A new ELECTRO-SHIELD Filter and Cable has been announced by Estes Engineering Company, 1639 West 135th St., Gardena, Calif 90249. It is a waterproof 30 amp 100 vdc filter with optional lengths shielded cable to provide noise-free power cables for all electronic equipment such as Two-Way Radios, Depth Indicators, Direction Finders, and other DC electronic equipment.

Noise-Free Transducer

Sensonics, Inc., 3831 Plyers Mill Rd., Kensington, Md., annouces a patended Variducer which features high linearity, ultra sens tivity and virtually no noise. The Variducer's accuracy and low noise are attributed to its rigid mounting and to the method of electrical con tact which makes soldering and spring mounting obsolete. It is claim that Variducers can measure any pressure in the transducer field, whether it is the flutter of a fly's wings or a supersonic blast. *****

New Products of Solar Electronics

Solar Electronics Company, 5909 Melrose Ave., Hollywood 38, California, has prepared a new catalog of instruments and accessorie for the RFI/EMC engineer. The two newest items are Model 6254-5 RFI Transient Generator with adjustable pulse position feature, and Model 6550-1 Power Sweep Generator which provides 100 watts of sig nal with any of three wave shapes into less than two ohms. The Powe Sweep Generator is an accessory for making conducted susceptibility tests in accordance with MIL-STD-826 and earlier specifications.

> New Signal and Telephone Circuit Filters

RF Interonics, Inc., 15 Neil Court, Oceanside, L.I., New Yor has brought out a new line of signal and telephone circuit RFI/EMC filters known as series 222. These parts are designed for use in 600 ohm communications circuits, with a pass band up to 10 KCS, and insertion loss in the stop band as high as 100 db from 14 KCS to 1000 M Filters may be supplied as single circuit, cylindrical types; dual circuit-chassis mounted shielded packages; or pre-wired multi-circuit box assemblies.

New Heterodyne Mixer-Oscillator and Attenuator and Signal Calibrato

Weinschel Engineering, Gaithersburg, Maryland 20760, has brought out Model HO-1 Harmonic Mixer-Oscillator which provides a complete local oscillator-mixer package for the heterodyne conversion to 30 Mc of signals in the frequency range from 10 Mc to 12.4 Gc. Th Model HO-1, together with the Model HO-A Mixer package and the Model DS-109 Double Stub Tuner - supplied as accessories - were designed to be used with the Weinschel Model VM-3 Attenuator' and Signa ilibrator, the Weinschel Model VM-1 Standard Attenuator Comparator, d similar heterodyne receivers operating at 30 Mc. The Model HO-1 equally suited to general laboratory, standards laboratory and field plications where ruggedness, high sensitivity, broadband operation d accuracy are important.

Laminated and Molded Bus Bars

Eldre Components, Inc. 1239 University Ave., Rochester, N. Y. 607, has brought out its Technical Bulletin B-l describing its new minated and molded bus bars for power distribution. The following e the Introduction and first paragraph of the Technical Bulletin which ay be obtained from Mr. Jerome A. Kliman, Marketing Director of e above company:

"Introduction - In every electronic assembly power must be disibuted, from one point to another. Transistor operating voltages ust be provided at many points in the circuit. Until now, these were nnected by multiwire harnesses or by repetitive wiring, which were lky and time-consuming to install and verify, requiring extra comnents or tie points, and which contained the possibility of wiring ror.

"Now, in one compact unit, the ELDRE BUS, a multiplicity of ltages can be transferred to any part of the circuit and connected ere needed. Wiring time is greatly reduced, harness wiring and petitive wiring are eliminated, wiring is made easier. . . the benes are endless.

"It is the purpose of this booklet to acquaint the design engineer th the advantages of a bus in power distribution. An important propty of a distribution bus is its ability to reduce noise pick-up. Data Il also be given to enable the engineer to design or specify a bus for ; particular application.

"Description of the ELDRE BUS-The ELDRE BUS consists of flat nductors, insulated from each other and molded into a completely aled multi-conductor unit. Each conductor has terminations specid by the customer at points to suit each individual requirement. Any mber and type of terminations may be specified. Thus a voltage or ltages can be applied anywhere and everywhere necessary."

New RFI Shielded Packaging on "Off-the-Shelf" Availability

Signal Interference Control, Inc., 80 Winchester St., Newton Highlands, Mass. 02161, has made a patent application on a new RFI shielded package which can be made available, on an off-the-shelf basis, in all sizes. At the present time, it is available in aluminum and will be available in iron. Test results show 100 db from 200 Kc to 10 Gc. Special drawer, instrument and full size cabinet enclosures can be supplied without tooling charges. Technical information may be obtained by writing to Seymour L. Vincent, Engineering Associates, at the above address.

EDITOR'S NOTE:

This is the first Newsletter which has had to be finally typed for reproduction before being handed in to IEEE Headquarters. If it looks kind of strange, it is because of the lack of our experience in such matters and our apologies are extended herewith. We are very glad to acceed to Headquarter's request but question whether the added effort and time will allow us to continue. It is one thing to have the complete job to do, where we can fit the amount of copy to the available space, and another not to know what will be done with it or how it will look.

If IEEE Heacquarters is going to continue this practice, it should furnish editors with some guide-lines as to the form to be followed and the mechanics to be observed. We may have more to say about this when we see what happens to this Newsletter.

> Rexford Daniels, Editor IEEE G-EMC Newsletter Monument Street Concord, Mass. 01742