IEEE Professional Technical Group on NEWSLETTER ELECTROMAGNETIC COMPATIBILITY

Number 33 May 1964

Notes on Annual Meeting March 24, 1964:

The following officers were elected for the 1964-65 fiscal year:

Chairman:	Zigmund V. Grobowski, President Frederick Research Corp. 801 Gaither Road Gaithersburg, Md.
Vice-Chairman:	Fred Nichols, President Genistron, Inc. 6320 West Arizona Circle Los Angeles 45, Calif.
Secretary:	James S. Hill Jansky & Bailey, Inc. Shirley Highway & Edsall Road Alexandria, Va.
Treasurer:	John J. Egli U.S. Army Signal Research and Development Lab. Fort Monmouth, N.J.

The following were elected to the Administrative Committee for 3 years:

Ralph M. Showers
Moore School of E.E.
200 S. 33 Street
Philadelphia, Penna.

Zigmund V. Grobowski
Frederick Research Corporation
801 Gaither Road
Gaithersburg, Maryland

John J. Egli
U.S. Army Signal Research and Development Laboratory
Fort Monmouth, New Jersey

Fred Nichols
Genistron, Inc.
6320 W. Arizona Circle
Los Angeles 45, California

Henry Randall
Office of Director of Defense Research and Engineering
The Pentagon
Washington 25, D. C.

Membership as of March 24, 1964 is 1377. There are 14 Chapters. As of December 31, 1963, there was an uncommitted balance of $9,179.27.

Details of the 6th Symposium to be held in Los Angeles June 9-11, 1964 were discussed. An attempt was made to change the date back to the original planning required, the new dates of June 9-11 were continued. Abstracts of all papers will be published and available to the Symposium. A substantial number of, if not most, complete papers will be published later in the PTG-EMC Transactions.

CHAPTER ACTIVITIES

Boston:

A meeting of the PTG-MIL/EMC was held on February 12, 1964. The speaker of the meeting was J.S. Burgess of Rome Air Development Center and the title of his paper was "Exploratory Development for System Development".

Dayton:

Two meetings have been held: One on September 17, 1963 at which time Norman Griswold of Aeronautical Systems Division, Wright-Patterson Air Force Base, Ohio, gave a paper on "Tour of Dynamic Analyzer-Advanced Reconnaissance Systems Facility"; another one was held on November 12, 1963 and Juan J. de la Cierva, Dyna Science Corp., Fort Washington, Pa., gave a paper on "Control of Electrostatic Environment of Helicopter and Fixed Wing Propeller Aircraft".

Los Angeles:

There have been two meetings. One was held on November 21, 1963 and Fred J. Nichols, Genistron, Inc., Los Angeles, Calif. gave a paper on "Background Requirements and Electromagnetic Compatibility". Another meeting was held on March 19, 1964 at which time there was a panel discussion on "The Scope and Implications of MIL-STD-826". The panelists were Ed Kavanaugh, Director of Systems Engineering, Filtron Co., Don Radmacher, Chief Engineer, Stoddard Aircraft Radio Co., and Joseph Robinson, III, Engineering Supervisor, North American Aviation, Inc.

New York Met.

A meeting was held on December 12, 1963 at which time Richard McClure, ITT Federal Labs., 500 Washington Ave., Nutley, New Jersey, gave a paper on "Space Communications and RFI".

New Orleans:

On January 29, 1964 a meeting was held at which time W.J.C. Klamm, Jr., The Boeing Company, 225 Baronne St., New Orleans, La., gave a paper titled "Establishing Sensible Interference Control Programs".

Philadelphia:

A meeting was held on December 3, 1963 and Carter Cook, HRB Singer, State College, Pa., gave a paper titled "Spectrum Signature Measurement Program".

San Francisco:

There was a meeting held on January 23, 1964, at which time Ben Weinbaum, General Dynamics Astronautics, San Diego, Calif., gave a paper on "Large Weapon and Space System Electromagnetic Compatibility".

Seattle:

A meeting was held on November 20, 1963 and Robert Dietsche, District 14, FCC, Seattle, Washington, gave a paper titled "The FCC Position with Respect to Industrial RFI".

Interference at Saturn 1 Launching:

The Associated Press carried an article on January 29, 1964 relating to the delay in launching of the Saturn 1 rocket due to radio interference. The part of the AP despatch which mentioned this is as follows:

"The shot was delayed more than an hour by radio interference which affected a tracking radar and the radio frequency on which the range safety officer would send a signal to destroy the rocket in case it strayed off course.

"The radar trouble was traced to a ship off shore which turned off its signal when it was advised, and the other interference was cleared up soon afterward.

"When the trouble arose the countdown had reached 13 minutes, but one system aboard the rocket had to be turned off during the wait, so the count was set back to 25 minutes when it was resumed.

"The massive vehicle was intended to propel into orbit a 37,700-pound satellite, nearly three times as heavy as any previous man-made satellite."

Electromagnetic Interference:

Missiles and Rockets, March 30, 1964, in its Annual Military Systems Issue, mentions EMI as follows:

"Electromagnetic interference - Not a large national effort, but nevertheless an extremely important one is the tri-service effort directed by the Electromagnetic Compatibility Analysis Center at Annapolis, Md., for DOD. The radio frequency interference problem is steadily worsening, says one official, and the end is not even in sight. ECAC is concerned chiefly with the problem of self or 'friendly' interference.

"The other side of the problem is unfriendly interference - electronic warfare.

"DDR&E is attempting to establish a broad base over the entire EW field to improve weapon systems capability, to assure non-interruption of the National Command and Control System and to strengthen tactical C&C.

"It is hoped that the first problem, electromagnetic compatibility, will be on its way toward solution when sufficient data are collected, analyzed and understood concerning the effects of densely populated emitters. In the meantime, DOD will continue to stress to industry the need for black box-by-black box RFI isolation.

"Considerably more information, however, is needed concerning the variables of operating environment power, propagation modes and solar influences.

"The problems of intentional RFI are equally demanding. Their effect on both tactical and strategic communications could be disastrous. Similarly, all radio-controlled weapons, whether active or passive, are more subject to misdirection by properly transmitted radio signals, general jamming or by pulse-type radiations resulting from local nuclear bursts.

"One key problem with MMRBM guidance requirements has been that of developing a star tracker system capable of continuous track through the period of highest pulse intensity following a nuclear detonation. Reportedly, this problem remains unsolved.

"Anti-radiation missiles may also be subject to misdirection by manipulation of propagation from the target radar. This is an area of research not yet seriously investigated, but it is expected that DDR&E will agree to such a study in the future (probably under Air Force sponsorship)."

Two Documents Will Assist ECAC in Solving Military RFI Problems:

Missiles and Rockets, March 9, 1964 carries a 2-page article under the above title by Michael Getler, associate editor. The first few paragraphs of the article are as follows:

"Annapolis, Md. - Two documents now undergoing Dept. of Defense and Air Force review will play a major part in enabling the tri-service Electromagnetic Compatibility Analysis Center (ECAC) to deal with the growing cost and complexity of military radio frequency interference (RFI) problems.

"One of the documents, just handed to the AF's Electronic Systems Div., currently managing the center for DOD, is ECAC's new five-year plan. This fully details the projected requirements - and funds - to cope both with problems already at hand that will still need solving and with those associated with extension of RFI solutions into other locales and advanced equipments. Specifically, the plan is known to outline the need for the same kind of environmental and spectrum signature data for European, Canadian, and Alaskan RFI profiles as is now available for the U.S. interior zone.

"The center, which has been budgeted at about $3 million per year for each of the past three fiscal years, has asked for an increase in the Fiscal Year 1965 request.

"The second document, currently being reviewed by the office of the Director of Defense Research and Engineering (DDR&E) and the J-6 office of the Joint Chiefs of Staff (JCS), is an ECAC 'output catalog,' which should be of major value for the services and their electronics contractors. The catalog will be the first one released, although an earlier attempt was made at putting one out. It will be a periodically up-dated compilation of the types of information available from ECAC and the format.

"The catalog, expected to be released in about a month, will be distributed to the services; presumably their funded contractors will have access to it. Later, it is expected, firms not working under contract but who are developing or proposing new systems will also have access to ECAC data. This type of access has been inhibited to date so that a data base and RFI analysis and modeling schemes could be developed first. The extent of industry access to ECAC is one of the major items in the current DOD review. While no doubt helpful to both interests, unless properly handled it could swamp the ECAC."

Lens-Like Antenna: Low Noise, Less Space:

Electronics, February 28, 1964, carries a 3-page article, under the above title, by G. V. Robers, Chief, Data Transfer Section, FAA, Washington 25, D. C. A summary of the article and the sub-title are as follows:

"Wire-grid array improves signal-to-noise ratio and gives excellent gain in any direction. Erection space only 850 feet in diameter reduces cost.

Big Brother to the Luneburg Lens

"The antenna described in this article uses lens techniques based upon optical theory developed by the late R.K. Luneburg. While the Luneburg lens has been used extensively at microwave frequencies, this array is the first to extend lens principals to the 3-Mc to 30-Mc range. Moreover, the antenna described does the job formerly assigned to 1,100 acres worth of rhombics, yet requires only a fraction of the geographical area necessary for rhombics with equivalent coverage."

Radio Observation of the Electromagnetic Emission from Warm Clouds:

Science, February 28, 1964, published by the American Association for the Advancement of Science, carries a 2 1/2 page report by J. Doyne Sartar, National Center for Atmospheric Research, Boulder, Colorado under the above title. The abstract is as follows:

"Abstract. Microdischarges observable at 30 and 50 Mcy/sec appear from within cumulus clouds in an early stage of their development whether the temperatures within the clouds are above or below $0^{\circ}C$. Laboratory observations of radio emission from colliding drops may provide information on the physics of clouds in the atmospheres of this and other planets."

Effects of Static Electricity on Magnetic Recording:

The Magnetic Products Division of the 3M Company has brought out a 2-page discussion of the above subject in Instrumentation Bulletin No. 4. The first four and final paragraphs are as follows:

"The presence of static electricity in recording systems has long been a source of problems, but has become more prominent in computer and instrumentation recording due to the higher tape speeds and the use of polyester film in tape manufacture.

"Static pull or 'drag' can cause displacement of the time base to affect output in some types of recording and frequency misinterpretation in others. It can create tape skew to affect azimuthal alignment to cause reduced output. It attracts dust which contaminates the coating surface to contribute to drop-out errors. And generally, due to the sporadic tape motion created by static, it can promote excessive tape wear.

"In computer applications static often manifests as tape drag in vacuum chambers. In analog operations static can evolve as recorded 'noise' from electrostatic arcs between recording heads and ground, and as FM 'noise' resulting from speed variations.

"Of the above affects from static, the presence of dust is probably most detrimental to good recording results. Dust wound into a reel can cause 'picking' of the oxide from the base material to create non-magnetic areas resulting in signal omission. Dust between the oxide coating and the recording head, lifts the tape surface from the head to cause reduced output, especially in recording of high frequencies (or in high density pulse recording systems). . . . .

"Very notable benefits of this increased coating conductivity are the substantial reduction in tape drag resulting from static; less head-to-ground arcing; and, most important, less evidence of dust particles on coating surfaces."

A Method of Estimating The Extent of Interference To TV Broadcast Service Caused by Low-Power Transmitters Operating on VHF TV Channels

A Report No. R-6306 has been published by the FCC and authored by orge V. Waldo and William A. Daniel of the FCC. A summary of the port is as follows:

"Under very stringent conditions, low-power transmitters may be located within a few miles of a television station on either the upper or lower channel adjacent to the channel of this station, provided that co-channel interference is not caused in the areas served by TV stations operating on the channel being shared. The extent of interference which would result from this operation may be estimated by applying curves described in this report. In areas where neither co-channel nor adjacent-channel TV service is provided, mobile transmitters may be operated, but may not be needed."

IF-TV Interference Correction Postponed One Year:

Electronics, February 21, 1964 carries the following news item:

"FCC hopes makers of uhf tuners can come up with solutions to the problem of oscillator interference within a year. FCC's 500 microvolts per meter radiation limit for tv receivers clashed somewhat with the law requiring all sets being sold in interstate commerce to be equipped with uhf receivers after April 30, 1964. Rather than invoke its rule, the FCC climbed out of the box by agreeing to continue the 1,000-μv/m radiation limit until April 30, next year. In the meantime, it is calling for research on tuner design and radiation suppression.

"The commission's determination to back strongly uhf/tv broadcasting was evident in a decision last week denying a permit for a vhf translator to serve Asheville, N.C. FCC told Spartan Broadcasting Co. that it would look favorably on a uhf translator, or a second uhf station. Asheville already has a uhf station."

Noise in Potentiometers:

The Systems Designer's Handbook, as published by Electromechanical Design, January 1964, price $15.00, contains a section on precision potentiometers. The paragraphs devoted to noise are as follows:

"Two types of noise may be encountered in a wire-wound potentiometer; vibrational or microphonic noise, and residual noises from several sources. Vibrational noise, while in effect electrical, is purely mechanical in cause and is produced by the contact jumping away from the winding and thereby opening the contact circuit. Proper design of the contact arms, carefully calculated pressures, and close control of all structural resonances, will practically eliminate this class of noise. Avoidance of coarse winding will reduce 'bounce' and correspondingly raise the optimum operational velocity of a given pot without generating vibrational disturbances. Resolution noise is a stepping voltage variation introduced by the contact transit across discrete turns of resistance wire and is inversely proportional to the resolution figure of a given pot. There are, however, residual noise effects which consist of sharp random voltage peaks generated between the moving contact surface and winding.

"The principal cause of residual noise is foreign material; ie., dirty windings, wear products, etc., which intrude between contact surface and winding. Contact resistance fluctuations arising from such contamination are characteristically large, relatively stationary with respect to time, and independent of slider velocities.

"The foregoing noise effects, properly termed 'passive', is guarded against by foresighted design, scrupulously clean working conditions, and judicious use of long-wearing and electromechanically compatible wire and contact materials. Units should be carefully checked for contamination and assembled in dust-free, air-conditioned rooms.

"Sources of 'active' residual noise are not so simply analyzed. Fortunately, the resultant electrical disturbance in wirebound pots rarely exceeds, voltage-wise, a small fraction of a millivolt. Active noise is self-generated voltage under three principle sets of conditions; galvanic or chemical action at the point of contact between slider and wiper; thermoconjunctive effects, which depend on frictional or external heat; and triboelectrical phenomena, small voltages generated by abrasion of the contact upon the wire. Here again, noise is minimized by use of compatible materials, proven welding techniques, and optimum contact pressures.

"Noise tolerances are most commonly expressed as an equivalent resistance. Some users appraise noise voltage-wise. In either case, unless otherwise specifically noted, evaluations of noise are made with a constant current of one ma. This noise figure is in brief, a quantitative measurement of the total residual and microphonic noise, and is defined as the total residual noise peak voltage divided by the source current, the source current and actuator velocity always being specified. The several types of potentiometer noise discussed here are summarized by Helipot with regard to origin and possible modes of expression in Table I. Table II is a compact listing of possible causes of noise resulting from a variety of effects."

Table I classifies Noise Type as: Loading Noise; Shorting Noise, Resolution Noise (due to winding current); Resolution Noise (due to load current), Generated Noise and High Velocity Noise.

Table II gives Possible Causes under the following headings: Mechanical Design Effects; Metallurgical Effects; Chemical Effects; and Mechanical Operation Effects.

We Want Better Tape Recording, NASA Experts Say:

Electronics, February 21, 1964, carries an article excerpts of which are as follows:

"NASA is issuing to industry a tougher set of magnetic-tape tolerance requirements for spacecraft tape recorder applications....."

"Better lubrication and reduction of static electricity are also required. Studies indicate that electrostatic charge may contribute to flutter and other drive-speed errors normally attributed to friction alone."

EMP: Can It Short-Circuit Our Defenses?:

Electronic Design, March 2, 1964, has a staff article under above title. The sub-title and editorial box are as follows:

"Electromagnetic pulses from nuclear detonations worry government, industry; incompletely understood effects cause variety of damage; most data classified.

The Threat to ICBMs

"The potential danger of electromagnetic pulse to ICBMs in the air has not been explored in the open literature.

"After the last series of nuclear tests, however, the Russians claimed to have gained an anti-ICBM capability. Western specialists speculated that the Russians were referring to effects produced by multimegaton, high-altitude nuclear blasts. Such effects might incapacitate the guidance and arming systems of incoming missiles.

"Compton electrons, gamma rays and other fusion products would suffer little attenuation for long ranges at high altitudes. Since ballistic missiles must rise to high altitudes on the way to a distant target, they might be disabled if not designed properly.

"Thus an enemy might launch his offensive missiles, followed closely by a 'screen' of large explosions in the upper atmosphere, designed to act as a shield against retaliatory weapons. Timing would be important so that the pulse effect would hit the retaliatory missiles when they were above the lower atmosphere's protective cloak.

"Data in this area must remain speculative at this time, because of the lack of any open discussion of the problems."

Items of Interest from PROCEEDINGS of the IEEE, February 1964:

Considerations of Noise and Schemes for Its Reduction in Laser Amplifiers

H. Kogelnik, Bell Telephone Labs., Inc., Murray Hill, N.J., and A. Yariv, Watkins-Johnson Co., Palo Alto, Calif., formerly with Bell Tel. Labs., Inc., Murray Hill, N.J., have authored an 8-page article under the above title. The summary is as follows:

"Summary - Spontaneous emission adds noise to the signal in laser amplifiers. In this paper the radiation characteristics of this noise and structures to reduce it are discussed. The structures make use of the spatial directionality of coherent light, and consist of aperture stops in combination with lenses. Their ultimate performance is studied. Signal-beam configurations necessary for optimum signal-to-noise (SNR) are described."

Correspondence - Page 192:

Noise Performance of Photo Diodes in Parametric Amplifiers

There is a 3-column letter by K. Garbrecht and W. Heinlein, Siemens and Halske AG, Central Labs., Munich, Germany, which appears under the above title.

The Effect of Scanning Speed on the Signal/Noise Ratio of Camera Tubes

Page 217 has a letter by W.F. Schreiber, Dept. of EE, MIT on the above subject. Extracts from the first two paragraphs are as follows:

"The belief that scanning speed must have an important effect on the SNR of television cameras is so persistent that it seems worthwhile to discuss the matter specifically. The usual argument given is as follows: 'The signal amplitude from a camera tube is directly proportional to scanning velocity. The required bandwidth is also directly proportional to scanning speed. Since the noise power is uniformly distributed in frequency, the noise voltage must rise in proportion to the square root of the bandwidth and hence the square root of the scanning speed. Thus the SNR is proportional to the square root of scanning speed.'

"The argument as stated is incorrect because it fails to account for possible optimization of parameters....."

Determination of Error Rates for Narrow-Band Communication of Binary-Coded Messages in Atmospheric Radio Noise

On page 220 there is a full page letter by Arthur D. Spaulding, Central Radio Propagation Lab., National Bureau of Standards, Boulder, Colorado under the above title.

Noise Considerations in Resistance Bridges:

IEEE Transactions on Instrumentation and Measurement, June 1963, contained a paper under the above title by Joseph M. Diamond, Danish Atomic Energy Commission, Roskilde, Denmark. The summary is as follows:

"Summary - A signal-to-noise analysis is made of the Wheatstone bridge, where the unknown and standard resistors may be at different temperatures, a situation which occurs in resistance thermometry. The limiting condition is assumed to be dissipation in the unknown resistor. It is shown that the ratio arms should be low in resistance compared with the unknown resistor, while the standard resistor should be high. This is true to an extreme degree when the unknown resistor is at liquid helium temperatures, and the standard resistor at room temperature. This factor is much less important in high temperature thermometry, where the noise in the unknown resistor will predominate strongly. An impedance step-up device (transformer or tuned circuit) is valuable in raising the bridge signal and noise level above the noise of the first amplifier tube. However, as the step-up ratio is increased, two counterfactors appear, namely, noise in the loss resistance of the step-up device, and grid current noise. There is therefore an optimum step-up ratio, which has been found. The step-up device is permitted to have a different temperature from the unknown and standard resistors, to evaluate the advantage of cooling it. With certain assumptions about the noise and grid current of the first tube it is found that the equivalent temperature of a unity ratio (Mueller) bridge used for liquid helium measurements may be 400°K. If a high ratio (100/1) bridge is used, this figure is reduced to 43°K, and if the step-up device is cooled to liquid helium temperatures, this is further reduced to 12°K. An equation is found for the input power (into the unknown resistor) required to give unity signal-to-noise ratio, after filtering, for a given bridge unbalance."

Articles of Interest from ELECTRONIC DESIGN, March 16, 1964:

Tests of NEAR System A Success Despite Some RFI

The following are some pertinent paragraphs:

"The first series of tests of the National Emergency Alarm Repeater (NEAR) system have been successful, except for some interference to television sets.

"The system, which is intended to alert the nation to impending nuclear attack, consists of three elements: special-purpose signal-generating equipment, the power distribution system of the electric utilities, and special-purpose home receivers.....

"The NEAR system is still in its engineering test phase, which to continue through October, 1964. So far, prototype frequency-converter signal generators have been tested in seven areas, including Phoenix, Ariz.; Columbia, Mo.; Colorado Springs and Grand Rapids, Mich. The converters used in these range from 1 to 200 Kva. They generate signals of 210, 240, 255 or 270 cps for transmission over 60-cps lines.....

"The performance of some television sets in areas in which test have been conducted was degraded by interference from NEAR signa The Office of Civilian Defense theorizes that the NEAR audio signals disturb TV interlace by changing, in time, the trigger point of the vertical sweep circuit by introducting a 30-cps ripple in the low-voltage dc power supply. The amount of disturbance is a function of the power-supply filter, the design of the vertical output circuit and the amplitude of the NEAR signal.....

"According to the defense agency, sets using a power transform are most susceptible to the NEAR signals. The NEAR system canno be changed to eliminate the interference caused by its signals, the agency says."

RFI Instruments Now Semi-Automated

A 2 1/2 column article, under the above title, starts on page 15 The first paragraph states:

"Two of the three major trends in radio-frequency interference equipment at the show - spectrum display and speedup of data collecting - reflect military emphasis on spectral-signature data. The third trend is the move to higher frequencies, which also results from military needs."

Interference Control in Receiver Design:

Electrical Design News, March 1964, contains an article under the above title by Robert L. Collard, Design Engineer, Sparton Electronics, Jackson, Michigan. The sub-title states:

"In recent years the advancement of electronics has made it necessary to utilize more of the electromagnetic spectrum. Complex systems in use today have brought about a need for additional electronic equipment. Thus, it is common to find numerous types of electronic equipment together. Many occurences that have jeopardized lives and many millions of dollars worth of equipment have been attributed to radio-frequency interference. With the increased use of the spectrum, interference control must be emphasized. It becomes of utmost importance as the complexity and density of a system are increased. The magnitude of importance can be seen when the many sources of interference and susceptibilities to interference within a system are realized."

How to Calculate Carrier-to-Noise Ratio in Tropo Scatter Systems:

Microwaves, March, 1964, carries a 6 1/2 page article by Belton-Nord Alper, Microwave Systems Specialist, Military Electronics Div., Motorola Inc., Chicago, Illinois. The sub-title states:

"The designer's job is made easier by inclusion of the necessary design equations, curves, nomograms and charts."

Do Sunspots Affect Storage Battery Capacity?:

NATURE, August 18, 1962 carried an article by D. R. Barber, formerly Superintendent, Norman Lockyer Observatory, University of Exeter, England, under the title "Apparent Solar Control of the Effective Capacity of a 110-V. 170 AH Lead-Acid Storage Battery in an 11-year Cycle". The article describes how the recharging of a Tudor storage battery of 60 cells, over a period of 40 years, varied with the 11-year cycle of sunspot activity. Pertinent passages are as follows:

"As is clearly shown in Table 3, the fact that in years of high solar activity an appreciable excess of electricity is required at each charge to restore the cells to a fully charged condition implies a loss of effective capacity that appears to be controlled by some unknown and intermediary factor. . . .

"These detailed results thus confirm the general conclusion derived from the earlier examination of the charge frequency data, namely, that in years of high solar activity the battery loses - 30 per cent of its electrical capacity. . . . .

"Clearly much more experimental work is necessary to elucidate this novel problem. But it is felt that publication of the facts already available is justified, for the following reasons.

"First, a search of the likely literature, coupled with numerous inquiries, has failed to bring to light a prior publication of results similar to those described here; and secondly, it is hoped that publication at this stage may encourage other workers - perhaps more familiar with the complex physico-chemical reactions of the lead-acid cell - to pursue the problem to a satisfying conclusion."

ELF and VLF Shielding Effectiveness of High-Permeability Materials:

A mimeographed copy of the above paper delivered as Session 16 of the New York IEEE Show by R. B. Schulz is available from him by writing care of The Boeing Co., Airplane Division, Renton, Wash. The summary is as follows:

"Summary - This paper describes research conducted to determine the low-frequency shielding effectiveness of magnetic materials. Both analytical and experimental approaches were used. This work is unique in that it provides a technique for experimental separation of the various terms in the shielding expression. Expressions of shielding effectiveness of flat sheets for very low frequencies are derived and the results of experiments with the following are given:

"a. Sheet materials, including AMPB-65, HyMu 80, Conetic AA, MuMetal, copper-plated AMPB-65, and galvannealed steel.

"b. AMPB-65 sheets perforated with various size holes and various numbers of 0.125 inch diameter holes.

"c. An overlap junction of two AMPB-65 sheets with (a) various numbers of fastening screws and (b) various depths of overlap.

"d. Overlap junctions of copper-plated AMPB-65 sheets.

"e. AMPB-65 sheets clamped in Lindsay structure.

"f. Honeycomb-core stainless steel sandwiches."

Two Papers Available from White Electromagnetics, Inc.:

The following two papers are available from the White Electromagnetics, Inc. 670 Lofstrand Lane, Rockville, Maryland:

"Trends in Radio Frequency Interference Measurement"
by Hanley W. Ervin and D.R.J. White

The Abstract is as follows:

"This paper illustrates some fundamental instrumentation and measurement terms and the vague or misleading manner in which they are frequently used. For example, the subject of accuracy is shown in four different common uses and interpretations. Misuse of the accuracy term is also illustrated in describing the performance of receiver linearity and dynamic range, and the development of uncertainties of results through an error analysis of instrumentation and measurement systems. The damage results in either incorrect or poor decisions based on erroneous data, or wanton waste of dollars and effort by developing the wrong data, or both. Several examples are set forth on how a better technological communication can be affected.

"By way of illustration of both present and proposed instrumentation and measurement techniques, three substantially different examples are chosen from a vast repertoire of many, viz: (1) shielded enclosure performance tests; (2) radiated interference testing within shielded enclosures; and (3) electromagnetic spectrum searches and site surveys. The first example depicts misleading measurement practices and offers one of a number of possible solutions. The second example illustrates some naive and erroneous practices being used from time-to-time to conduct radiated transient interference measurements on test specimen, and outlines one practical approach for an orderly and meaningful conduct radiated transient tests. The third example, chosen to emphasize the far-field electromagnetic situation, depicts the naivete of random or arbitrary spectrum search site survey methods in current use, and outlines one logical method to increase probability of intercept and give equivalent results at a fraction of the cost."

"Techniques for Electromagnetic Compatibility" - by
Walter J. Blumberg and John E. McShulskis

The Abstract is as follows:

"This paper discusses the changing requirements in electromagnetic compatibility (EMC) Specifications and the increase in testing costs for complex weapon systems. New Specification requirements for peak detection and Automatic Scanning and X-Y recording are discussed. A new method of instrumentation is described (Automatic Scanning and Recording) which will reduce test costs almost in half."

Technical Bulletin, Volume 4, Number 1 - "Automating RFI Measurements" - February 1964, and Technical Bulletin, Volume 4, Number 2 - "Electromagnetic Spectrum Searches and Site Surveys" - March 1964 are also available from White Electromagnetics, Inc.

Sees Laminated Tape As Better Wire Shielding:

Electronic Evaluation & Procurement, January 1964, carried a 2-page article under the above heading for the use of aluminum-backed Mylar tape. The sub-title and first paragraphs are as follows:

"Many solutions are offered to the problem of how best to keep random noise from entering a signal-carrying cable. The case for aluminum-backed Mylar tape is made here.

"Increased shield effectiveness, higher reliability, reduced size, easier termination, and lower costs are the advantages claimed by Belden Manufacturing for its recently introduced Beldfoil shielding concept. The shielding, a laminate of rolled aluminum foil bonded to a film of DuPont Mylar polyester (Fig. 1), is applied spirally around the conductor or group of conductors to be shielded. An uninsulated conductor in intimate electrical contact with the aluminum side of the tape throughout the length of the cable provides for terminating the shield. The excess tape is ripped off at the termination and the ground wire (commonly called the drain wire) is connected.

"R.E. Sharp of Belden details the five benefits of this shielding method as:

"Increased shield effectiveness - The 100 percent coverage metal foil shield produces 20 to 30 db more rejection of interference than can be obtained with typical braided or spiral wrapped wire shields. The patented fold which short-circuits the spiral of tape maintains effectiveness of the shield into the radio frequency range."

See Newsletter No. 29, page 3, for further information.

Anti-Static Coating:

Electronic Production, November-December, 1963, issue carries the following description of an anti-static coating made by Evaporated Coatings Inc., 798 Welsh Road, Huntingdon Valley, Pa., as follows:

"Highly transparent thin film metal coating provides a combination of high visible light transmission and permanent anti-static properties. Permanency of the anti-static coating remains unaffected by changes in temperature, humidity, or other atmospheric conditions. Electrical surface resistivity can be between 0.1 and 10 meghoms/square. In the 10 meghom range, the new film provides 90% visible light transmission, only 2% less than for plain, uncoated glass. The anti-static coating can be applied to glass, ceramic, or plastics. It is especially suitable for transparent plastic or glass instrument windows where static buildup may cause false or erratic meter readings. Windows up to 40" can be processed. The coating can be applied alone or in combination with other films to impart additional reflection transmission, or absorption characteristics."

Further technical data may be obtained by writing the company for ECI Technical Bulletin 1258.

Device Speeds RFI Measurements:

Electronic News, February 17, 1964, carries a page article under the above title. The article contains 1 chart and 1 block diagram. The first paragraphs by Paul Hersch are as follows:

"New York. - Capehart Corp., here, has developed a device that has trimmed up to 40 minutes from each hour normally required to accomplish certain sets of radio frequency interference (RFI) measurements.

"Joseph H. Vogelman, vice-president, described the device as an automating attachment, designed to be used in conjunction with existing radio-frequency interference equipment.

"RFI, of course, can be a 'bugaboo' in military equipment. The Minuteman missile undergoes hundreds of checkouts, which take up to three months to complete via manual techniques.

"Dr. Vogelman said that the Capehart Spectrum-Amplitude Recording set reduces test and data collation time, and permits a lower competence level on the part of the tester. He added, that in contrast to present manual procedures, the automated method increases accuracy and reduces the possibility of conflicting results by different testers.

"It achieves this by eliminating the repeated calibrations and data transferals required of the manual procedure.

Has Two Functions

"The Capehart device essentially performs two functions. It motorizes the field-intensity meter dial while generating a saw tooth wave, in synchronism, for X drive control of the recording unit. It also contains the electronics - a detector and logarithmic amplifier - for a Y recording of the radio frequency interference."

Stewart Nellis Heads Technical Wire Products:

Stewart Nellis has been named President of Technical Wire Products, Inc., Cranford, N.J., replacing Ralf L. Hartwell who is now Chairman of Technit's Board of Directors. Otmar P. Schreil has been appointed Vice President of Marketing.

Technical Wire has reprinted the paper originally presented a the Fourth National Symposium by O. P. Schreiber titled "Reliable Electrical Contact Theory Applied To RFI Control". Copies may obtained by writing for RF-21 at 129 Dermody St., Cranford, N. J.

Notes From FCC Field Engineering and Monitoring Reports:

The following are selected incidences of interference from Ge Information Bulletin G 45596 - January 7, 1964:

Radioastronomers Chafe Under Chaff

The Philadelphia FCC monitoring unit, in investigating interference to sensitive radiotelescope receivers at Ohio State Univer found that the annoying signals were arriving from a source well a the horizon. This led to determination that sideband frequencies g erated by radar operation were being reflected back to earth by ch dropped by Air Force bombers to disrupt radar tracking during tr missions. This resulted in ink-line recordings of the radioastron observations being driven completely off the chart. As a result, t Air Force is endeavoring to protect the university's observations future chaff-dropping exercises.

FCC Monitoring Aids In Marine Emergency

The U.S. Coast Guard asked the FCC monitoring network to h decipher an emergency radiotelegraph message from a then unider fied vessel. By expertly straining their ears and reflexes to sift t of the repeatedly transmitted message amid other transmissions, listener puzzled out that is was a call for medical aid for a crewm with acute appendicitis. It enabled help to be sent on an oceanogra ship operated by the University of Rhode Island.

Concrete Interference to Air Safety

It took longer to trace interference to an aviation instrument landing system at Oakland, Calif. An engineer from the FCC San I cisco office was unable to hear the offending signal at the airport. flights confirmed that severe interference did exist and indicated i came from a nearby concrete supply company plant. Mobile equip and further checks led to auxiliary gasoline engines used to rotate mixing drums on trucks transporting concrete. The cooperative fi eliminated the difficulty by changing ignition cables.

Horns Aplenty

In another case, radio interference in a Pacific coast locality determined by an FCC marine office engineer to come from 30 hor mounted on 17 power poles, , used to signal key employees workin a nearby oil field. A switchboard operator could transmit a serie blasts in coded sequence to indicate the particular employee wante Radio frequency interference resulted from arcing of the relay co tacts vibrating in unison with the sounding horns. The manufactur of the horns promptly installed filters which eliminated the trouble

Citizens Stations Interfere With Aircraft (Model)

Class C citizens radio stations are authorized for the remote control of objects or devices, generally model aircraft. A model

aircraft club in the Midwest, which used radio for model flight control, complained that a thousand dollars worth of its planes were lost in crashes caused by interfering signals from Class D Citizens stations. The club claims that the jamming was deliberate. The FCC Chicago office is investigating.

Complaints Boomerang

A complainant, irate because of interference to her radio and TV reception, telephone the FCC New Orleans office that her entire neighborhood was affected and threatened to originate a petition for action. An investigative engineer quickly traced the trouble to the complainant's own refrigerator. He made a minor adjustment, and the trouble ceased. The embarrassed women, devoid of petition-filing intent, expressed her gratitude.

Blanket Interference

Complaint to the FCC San Francisco office that radio and TV reception was blacked out in Oakland prompted like on-the-scene action. A faulty electric blanket was discovered -- in the apartment building occupied by the complainant. A defective control caused it to transmit radiation over the block. The complainant agreed to sleep under an extra blanket (non-electric).

Interference Knows No Geographic Borders

The FCC Seattle office received an urgent request from the U.S. Border Patrol for assistance in tracing interference to the latter's radio communication link across norther Montana. The errant signal was being picked up by the patrol's repeater station atop a 7,000-foot mountain. It was of sufficient strength to open squelch circuits and activate the transmitter, completely disrupting communication between the patrol's mobile units and base stations.

Although the investigative trip required approximately five days travel-time, and winter conditions made access to the repeater station difficult, the undertaking was essential because of the nature of the communication service affected. After many bearings and observations, the source was found to be across the border in Canada, and a fix indicated the transmitter responsible. The investigative engineer obtained the name of the licensee and arranged with the Border Patrol to cooperate with the Canadian authorities in whatever efforts might be necessary to remedy the matter. A letter of appreciation was subsequently received from the Border Patrol.

FCC Aids Russia Eliminate Interference

A troublesome signal in an amateur radio band was found to occur whenever two particular Russian shortwave broadcast stations transmitted the same program simultaneously on channels close to one another. This caused a phantom signal that plagued U.S. "hams". Russia was notified and a radiogram was later received from Moscow stating that steps had been taken to prevent a recurrance.

Rock-and-Roll Unacceptable to German Station

Another case with a foreign aspect resulted from interference to military transatlantic radio circuits between Washington and Germany. Complaint was that rock-'n-roll music from a US. broadcast station was invading the traffic destined for Germany. The FCC Laurel, Md., monitoring station detected no such signal. But at the receiving end, the operators reported hearing the music and, to prove it, piped it back to Washington. In the face of such evidence, the signal was identified definitely as originating from a broadcast station in the Washington area. Shortly afterward, however, FCC monitoring control received an apologetic call from the German complainant, who explained that a switchboard operator on the landline feeding the Washington terminal was listening to the program on a broadcast receiver and had somehow plugged an audio line into the multiplexing circuits. The line was unplugged and so was the "interference".

German Hazard to U.S. Air Safety.

The tables were turned when the FCC monitoring network, when called upon to intervene in a case involving interference to aircraft communication at New York, identified the spurious emission as coming from a German broadcast station where a transmitter had developed a split personality.

NEW PRODUCTS:

The following new products were exhibited at the New York EEE Show:

RF Interference Analysis Console - by Electro International, Inc. Box 391, Annapolis, Maryland. The description is as follows:

"The primary function of the system is to provide a means of displaying and measuring repetitive RF interference in the presence of non-coincident, synchronized and/or random RFI signals. The detected signals may be displayed on a dual-beam oscilloscope with a long-persistence CRT. One beam is intensity modulated to display the raster presentation, the second beam displays a monitor signal from the suspected source. The interfering source is then identified when a correlation is noted between these displays.

"The system consists of: (3) RF preamplifiers, (5) RF tuning units (not supplied), (1) 500 cps to 6 mc wideband amplifier, (1) basic noise measuring unit, (1) interference raster generator, (1) power line impedance stabilization network, (1) sub audio amplifier. All units contain their own internal regulated power supply."

Empire PANADAPTER Model PA-210 is described as follows:

"The Empire PANADAPTER Model PA-210 is intended for use with noise and field intensity meters such as the Empire Models NF-105 and NF-112. It provides a panoramic cathode ray tube display of a band of frequencies centered around the frequency to which the noise meter is tuned. This mode of operation is extremely useful in scanning the range, since the nature of activity can be identified. Furthermore, the panadapter mode is now required by military specification.

"Since several IF frequencies are used to cover the range 14 kc/s to 22 Gc/s in the Empire noise meter line, the PANADAPTER is provided with the necessary circuits which ensure compatibility. Further circuits are provided to make the PANADAPTER also compatible with other types of noise meter, so that the unit is extremely flexible and covers all foreseeable applications. A front panel switch is used to select the mode compatible with a given noise meter."

Conductive Surface Coating in Aerosol Cans

Emerson & Cuming, Inc. of Canton, Mass. and Gardena, Calif. have brought out their Eccoshield ES, a highly conductive surface coating for RF shielding, in 6 oz. aerosol cans. The spray will drive conductive particles into minute cracks and crevices. In some enclosures, improvements as high as 30 db have been achieved. A 6 oz. can of Eccoshield ES will cover over 30 sq. feet to produce a surface resistance below o. 1 ohms per square.

New Interference Analyzer

Electro-Metrics Corporation, 88 Church St., Amsterdam, N. Y. has brought out a new Interference Analyzer as follows:

"A new Interference Analyzer designated Model EMC-10 has been developed by Electro-Metrics to meet the need for accelerated EMC data acquisition in the 20 CPS-50 KC range. Use of a voltage-tuned local oscillator in this completely solid-state instrument permits remote tuning without mechanical drive linkage and makes the instrument readily adaptable as a spectrum analyzer. A wide range of detector functions and outputs facilitates graphic or magnetic tape recording. Details are available from W. S. Lambdin, Electro-Metrics, Amsterday, N. Y., 518-843-2600."

New Auto-Plot Controller

White Electromagnetics, Inc. has developed a new Auto-Plot Controller, X-Y Plotter and RI-FI Receiver. The description is as follows:

"The Auto-Plot Controller (APC) motor drive is connected via a flexible shaft to Empire, Stoddart, Polarad or other field intensity and interference receivers. Its motor drive mechanism rotates the receiver tuning dial over its complete frequency range. This automatic band scanning is accomplished nominally in 60 seconds. The drive motor is also coupled to a multiturn

potentiometer which provides an analog voltage representing receiver frequency. This voltage is used to drive the X-axis of the X-Y plotter.

"The receiver tuning shaft is controlled by electronic limiting to automatically stop the rotation at the frequency limits of the band. When the receiver has been tuned throughout its frequency range it is automatically returned to the lowest frequency of the band.

"Calibration controls are provided for the X and Y channels of the APC to adjust for variations between receivers. Calibration and zero controls are also provided for the X and Y axis of the plotter."

Test Set Checks Noise Power Ratio

Electronics, March 13, 1964, page 84, has an article under the above heading. The first paragraph is as follows:

"All-Transistor noise-loading test set, model 2090, allows noise power ratio checks to be made on communications systems designed for up to 2,700 telephone channels or complex modulation systems having an equivalent bandwidth, such as television or telemetry."

The equipment is made by Marconi Instruments, 111 Cedar Lane, Englewood, New Jersey.

Edge-Mounted RFI Gasketing Available

Technical Wire Products, Inc. 129 Demody St., Cranford, N. J., has developed edge-mounting on radio interference gaskets. It is a combination of knitted wire gasketing on an extruded aluminum mounting strip with design to conserve space and to provide direct compression between the equipment edge and its mating surface without registry problems.

EDITORIAL NOTE:

There is an increasing demand for examples of the side-effects of RF energy on all kinds of matter. Your editor would greatly appreciate receiving any and all information, which members of PTG-EMC come upon, as to the effects of RF energy, static, magnetic storms, etc. upon matter. The reference to the storage battery phenomenon, as quoted from NATURE, is an example of odd bits of information which, one day, may fit together.

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