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NEWSLETTER
RADIO FREQUENCY INTERFERENCE



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**NOTES ON PTG-RFI ADMINISTRATIVE COMMITTEE
MEETING - MARCH 26, 1963:**

The new officers for 1963-64 are:

Chairman: Donald R. J. White, President
White Electromagnetics, Inc.
4903 Auburn Ave.
Bethesda, Maryland

Vice-Chairman: Zigmund V. Grobowski, Consulting
Jansky & Bailey, Inc. Engineer
1330 Wisconsin Ave. N.W.
Washington, D. C.

Secretary: Albert R. Kall, President.
Ark Electronics Corporation
624 Davisville Road
Willow Grove, Pa.

Treasurer: Samuel J. Burruano, President
Burruano Associates, Inc.
51 Sullivan Street
Westwood, N. J.

It was voted, subject to the approval of the IEEE, to change the name from PTG-RFI to PTG on Electromagnetic Compatibility in order to reflect the increased scope and also to more closely identify the work of the Group with the same terminology now being used in most government work.

Los Angeles has voted the location of the 1964 PTG-RFI Symposium subject to IEEE approval.

The Education Committee was asked to prepare and submit, at the June meeting, an educational report to management on the importance of EMC/RFI.

On the subject of education, it was suggested that members of PTG-RFI expose themselves to educating others and offer to give papers at other professional societies' meetings or symposia.

It was suggested that all Chapters should have a fixed time for meetings which could be published in the Newsletter and permit other members to attend when in the vicinity.

Because of the large number of Administrative Committee members being from the East, it was suggested that the Bylaws be changed to add Regional members. A committee was appointed to draft such a change.

There was quite a discussion over whether exhibits should be allowed at Symposia. It was decided to discuss this with IEEE.

A committee was appointed to look into the cross-indexing of EMC/RFI material so that it would be easy to cross-fertilize information with other similar activities, such as ECAC, ASTIA and IEEE.

CHAPTER NEWS

The Chicago Chapter had a meeting on December 14, 1962 at which J. C. Klouda, Elite Engineering Co., Chicago, gave a paper on "Various Aspects of Shielded Enclosures, Testing and Usage".

The Washington, D. C. Chapter held a meeting at the Electro-magnetic Compatibility Analysis Center, Annapolis, Md., on March 19, 1963. The subject was "The ECAC Mission" and those participating in the program were Colonel Charles C. Woolwine, Director, ECAC; J. Paul Georgi, Technical Director; S. I. Cohn, Director, Technical Operations; R. B. Wise, Manager, Information Processing Department; P. D. Newhouse, Manager, Analysis Department; and G. F. Paprotny, Supervisor, Computer Systems and Operations.

The Los Angeles Chapter reports on its schedule of meetings and invites all visitors to attend. The Chapter meets the third Thursday in every other month. The next meeting will be May 16th, then July 18th, September 19 and November 21. The place is the Engineers' Club, Room 3333, Biltmore Hotel, Los Angeles, Calif., and the time is 7:30 p. m.

5TH NATIONAL SYMPOSIUM Shaping Up:

Plans are shaping up for the 5th National PTG-RFI Symposium, which will be held on 4 and 5 June at the Bellevue-Stratford Hotel in Philadelphia. A total of seven technical sessions will be held with an average of about five papers each. The program will be opened with three invited papers on the following topics: Frequency Allocations; Submarine Interference Problems; General Space Interference Problems. The remaining sessions will include papers on Compatibility Analysis, Suppression, Shielding, Filtering, Instrumentation and RFI Management.

Finally, there will be a panel discussion on Specifications and Standardization Wednesday afternoon. The panel will also discuss the results of a special workshop session to be held on Monday evening prior to the official opening of the Symposium.

A new innovation this year is that of exhibits which will be set up in a room adjoining those for the technical sessions. Thus, there will be an opportunity to examine some of the latest hardware for RFI applications away from the hustle and bustle of the IEEE Show. The usual cocktail party on Tuesday evening will be held in the same room with the exhibits. Also, a banquet and luncheon are planned as in previous years.

NINTH ARMOUR CONFERENCE - October 15-17, 1963:

Notices have gone out stating that the Ninth Tri-Service Conference on Electromagnetic Compatibility will be conducted by Armour Research Foundation in Chicago on October 15-17, 1963, at the Museum of Science and Industry. A classified session, if there is enough interest, will be held on the Illinois Institute of Technology campus. 150 word abstracts should be submitted by 1 July 1963 to J. E. Bridges, Conference Chairman. Terry Jackson is program chairman.

ARMOUR RESEARCH FOUNDATION To CHANGE NAME:

The Armour Research Foundation has sent out a statement to the effect that, on June 1, 1963, it will become the IIT Research Institute.

AMERICAN STANDARDS ASSOCIATION REVISES RAD HAZ COMMITTEE:

A. L. Albin of the Fairchild Camera & Instrument Company, IEEE delegate to the American Standards Association Committee

C-95, reported informally on the most recent meeting. The original scope of the committee covered electromagnetic hazards to mankind, volatile materials, and explosive devices in the frequency range 10kc to 100 gc, and excluded infrared, x-rays and other ionizing radiations. Six sub-committees were established, including

1. Test Techniques, Procedures and Instruments
2. Terminology and Pertinent Equipment Nomenclatures
3. Units of Measurements
4. Safety Levels - Personnel
5. Safety Levels - Ordnance
6. Safety Levels - Volatile Materials

During the two years since inception of the committee (15 Feb. 1960), Subcommittee 2 and 3 were consolidated, and Subcommittees 5 and 6 were inactive. The latter have been deactivated for lack of data on which to establish adequate standards at this time.

The sub-committee on Test Techniques, Procedures and Instrumentation reported on measuring devices as follows:

"The desirable characteristics of a suitable rf intensity measuring device have divided into physical, electrical and psychological parameters. These parameters are of design objectives, and may not necessarily be attainable within the present state-of-the-art. Recommendations will not be made for specific instruments, but rather for the desirable characteristics for instruments to be used by industry and government. An evaluation of available instruments and those under development is in progress."

Subcommittee 2 and 3, Terminology and Units of Measurement, reported that an interim draft of some 700 terms had been compiled in the areas of instrumentation, measurement, and definition of hazards, and will be sent to the BuShips sponsor for reproduction and distribution. The next general meeting for ASA Sectional Committee C-95 will be held 25 June 1963 at ASA Headquarters, New York City.

RF NOISE AGAIN USED IN PRODUCTION TESTING:

Aviation Week & Space Technology, January 7, 1963, had a page article titled "Potential Failures Detected by RF Noise" by Philip J. Klass. The first four paragraphs are as follows:

"New technique for detecting incipient malfunctions and locating intermittent faults which are difficult to find in avionics equipment has been developed by Minneapolis-Honeywell's Aeronautical Division in Minneapolis.

"The technique is based on the discovery that imperfections in solder joints and minute breaks or discontinuities in internal component connections generate a radio frequency (RF) noise which is superimposed on the power supply voltage. The idea is credited to Frank Hagert, an M-H evaluation engineer.

"Recently the technique was used to discover 10 faulty components in a group of 140 amplifier-demodulators for the F-104 flight control system. These had successfully passed operational calibration tests and might otherwise have gone undetected until they failed under exposure to mechanical or thermal shock. The faulty components included diodes, transistors, capacitors, transformers and connections, according to Hagert.

"The new technique is being used on the assembly line of Honeywell's F-104 flight control system and is planned for use on the attitude-flight control system, which the company will supply for the Gemini and Apollo spacecraft. The technique is not useful in discovering short or open circuits or components which are drifting in value, but other techniques can serve this purpose."

In transmitting the above article to your editor, R. A. Schwarz, Supervisor, Sub-Contract Programs, Aeronautical Division, Minneapolis-Honeywell, stated in part:

".....Our work with this technique at Honeywell covers a time period of almost 5 years. Since the first identification of this phenomena, we have found increasing application for these techniques and are currently installing equipment on two production lines. We anticipate additional data over the next several months which will provide statistical background for the application of this technique on a variety of circuits, components, and systems.

"Our activities to date have been concentrated in two areas:

(1) Use of RF Testing to identify intermittent type failures on devices with reported intermittent type failures which have not been

identifiable by normal test methods, and (2) Evaluation of RF Testing on a sample large enough to demonstrate its feasibility for production purposes.

"At this point, we are convinced that this technique is a useful tool for identifying potential failures not discernable by ordinary test methods. We do not as yet, however, have sufficient statistical data on the field operational experience on equipments tested by this method to show a significant difference in operational reliability. A program is underway to gather this data. Honeywell is also investigating this technique as a means for reliability testing of individual parts."

REDUCING NOISE In SYNC PULSES:

Under the title "Unique Synchronizing Technique Increases Digital Transmission Rates" is a 3-page article by K. Roedl and R. Stoner, General Dynamics/Electronics, San Diego, Calif., in Electronics, March 15, 1963. The subtitle and parts of the first three paragraphs are as follows:

"A major problem in achieving faster and more accurate radio transmission of digital data to remote receiving stations is that of synchronizing the transmitting and receiving systems. With high-stability timing systems, an initial synchronization is usually adequate for the reception of short messages, but for longer messages it becomes necessary to resynchronize periodically on the transmitted data.

"Some of the methods developed use the leading or trailing edge of the received pulses for synchronization. In radio transmissions, however, these edges are affected by noise and may shift to such an extent that the timing obtained become inaccurate and unreliable. A received signal after demodulation may be narrowed or widened as a result of noise (Fig. 1A).

"Methods to diminish the detrimental effects of noise have been developed using the center of the received pulse instead of the edges. Since laboratory tests have shown that the center of a modulated signal shifts noticeably less than the edges when affected by noise, more accurate synchronization may be obtained this way. At any signal-to-noise ratio tolerable for reliable communications, the pulse center remains relatively stable....."

ARTICLES OF INTEREST IN IEEE PROCEEDINGS MARCH 1963

Description of the Noise Performance of Amplifiers and Receiving Systems:

An article of six and one-half pages Sponsored by IEEE Subcommittee 7.9 on Noise. The first two paragraphs of the introduction are as follows:

"IN GENERAL the output noise of a receiving system contains components contributed not only by the termination at the input of the receiving system but also by the receiving system itself. Furthermore, the output signal-to-noise ratio¹ of the system will depend not only on the output noise but also on the nature of the signal that is impressed upon the input of the receiver. Hence, any meaningful evaluation of the noise performance of a receiver when used in a particular system must include considerations of the sources that contribute to the output noise, the bandwidth and gain of the receiving system in all of its responses, the nature of the signal and the efficacy of the output utilization circuit. It is evident that no single number can describe completely how well a given receiver will perform in all kinds of systems.

"What, then, are the pertinent attributes of a receiver, and how are they measured and quoted? From the viewpoint of the designer of the receiver, the attributes must be readily measurable. From the viewpoint of the designer of the system, the numbers quoted by the receiver designer must be such that the output signal-to-noise-ratio (SNR) under operating conditions can be calculated."

Information Capacity of Fading Channels Under Conditions of Intense Interference:

Under the above title, is a 10-page article by J. P. Costas.

The summary states:

"The newer, more efficient data transmission systems which are designed to combat channel variations or interference, or both, require information concerning the channel variations for proper operation. Although it is seldom recognized, such systems must receive and process two distinct types of information. The first, and quite obvious, type of information concerns the intelligence signal which is provided as an output from the receiving terminal of the system. The second, and much less obvious, type of information concerns medium variations. This information is normally used internally at the receiver terminal in order that proper processing of the received signal may be obtained. As the channel SNR progressively worsens, the total information capacity of the channel must of necessity decrease. Eventually the total information capacity of the channel becomes so small that the receiver is denied the required information concerning medium variations and proper operation of systems of the above type is no longer possible.

"This paper is concerned with the limiting case of very small channel SNR's that are below the level required for analysis of the medium at the receiver. The channel capacity of an ideal or non-fading channel is derived for reference purposes and in order that an estimate of the information rate loss due to medium variations at low SNR's may be obtained. The problem of data transmission over a fading channel under conditions of intense interference is approached in an intuitive manner. A system for operation under such conditions is proposed which appears to offer the best performance possible. The performance of this proposed system is then analyzed to yield capacity formulas for the conditions specified. No proof is given that the system proposed is, in fact, ideal but the resulting capacity formulas are believed to be correct in form and sufficiently accurate in a quantitative sense for useful practical application.

"The mathematical approach used is sufficiently general to permit inclusion of random system variations (such as oscillator phase) as part of the medium variations and hence the results are believed to be applicable to a wide variety of communications situations including deep-space probe telemetry."

Gate Noise in Field Effect Transistors at Moderately High Frequencies:

Under the above title, A Van Der Ziel, Electrical Engineering Department, University of Minnesota, Minneapolis, Minn., has a 6-page article. The summary states in part:

"At higher frequencies the gate noise of a field effect transistor increases rapidly with increasing frequency. This effect is here attributed to the thermal noise of the conducting channel and is caused by the capacitive coupling between the channel and the gate."

Fluctuation Component of Atmospheric Noise Temperature:

Under the above title, Torleiv Orhaug, National Radio Astronomy Observatory, Green Bank, W. Va., has a letter with 3 figures. Parts of the first two paragraphs are as follows:

"During the period December 1961-June 1962 observations of 8-kmc atmospheric noise were conducted at the National Radio Astronomy Observatory in Green Bank, W. Va., using a TWT switched-load radiometer. A fixed 12-foot parabolic antenna was used as receiving antenna. The purpose of the observations was to investigate the fluctuation of atmospheric thermal noise, with particular regard to practical sensitivity of radio astronomical observations in the microwave region.

"Large variations in atmospheric brightness temperature were observed during rain conditions, and there is good correlation between observed and theoretical brightness temperatures [according to data giving the absorption coefficient of raindrops published by Gunn and East¹]. The variations of atmospheric brightness temperature are also in good agreement with similar observations made at 6 kmc by Hogg and Semplak.²⁻³ As they pointed out, appreciable increases in system noise temperature may be encountered during unfavorable meteorological conditions."

Measurements of Electrometer Tube Noise

Under the above title, Norton W. Bell, Bell & Howell Res. Center, Pasadena, Calif., has a column in correspondence with one figure. Part of the first paragraph is as follows:

"Electrometer tubes are widely used to measure small currents. Under certain conditions, the major source of noise in such measurements is the electrometer tube. The noise spectral density of nineteen type-5886 tubes has been measured between one and 1000 cps. The results are shown in Fig. 1 for the best, median, and worst tubes."

Noise Characteristics of Cold Cathodes

Under the above title, K. Ramanathan, R. Johannes, P. Cholet, Philco Corp., Blue Bell, Pa., have a 3-1/2 column letter with 2 figures. Part of the first paragraph is as follows:

"Considerable interest has been shown recently in developing cold cathodes capable of delivering high current densities at a relatively low noise level. These cathodes emit hot electrons. Hot electrons are electrons accelerated by high fields across a metal-insulator-metal sandwich which can achieve energies considerably in excess of those of electrons in thermal equilibrium with the lattice. These energetic electrons will be emitted into a vacuum if they do not lose their energy through dissipative processes during penetration of the surface barrier into vacuum."

ITEMS OF INTEREST IN ELECTRONIC DESIGN, MARCH 15, 1963:

Radar Echoes From Mars:

"S-band radar signals have been successfully bounced off Mars by Jet Propulsion Laboratory's Goldstone, Calif., station. The radar echoes indicate Mars' topography is much like that of earth. The signals are radiated at 2388 Mc from a 100-Kw transmitter; they are concentrated by an 85-foot parabolic antenna into an 0.3-degree-wide beam with an effective radiated power of 25 billion watts. About 1 watt of this is intercepted by Mars, and about 5 per cent is reflected back to the Goldstone antenna. The 125-million-mile round trip path of the signals is the longest known transmission of signals generated in the Western World."

Soviet Mars Probe May Support Theory On Magnetic Field:

"The Russians announced that the Mars vehicle had discovered a third radiation belt around the earth. The radiation is not expected to be strong enough to hamper manned space flight."

Spectrum Signature Measurements: Radar Systems:

Under the above title is a 4-page article by H. M. Sachs, Deputy Director of Technical Operations, Electromagnetic Compatibility Analysis Center, Armour Research Foundation, Annapolis, Md. The sub-title states:

"Limitations of test equipment and variability of data put practical limitations on forms of RFI data. Here are approximations that can be made to obtain data for interference prediction."

Simple Network Gives Sharp Frequency Rejection:

Adjustable Frequency Rejection Filter, Patent No. 3,009,121. William V. Loebenstein.

"A simple and inexpensive rejection filter can be built using a tunable RC network. For audio applications, needle scratch and 60-cps hum are eliminated with equal facility. Two or more such filters in series are capable of the simultaneous and independent rejection of separate frequencies.

"Superimposed dc is unaffected over the entire tunable range, since the network includes a dc path, comprising resistor 42 and 43, that offers constant attenuation to dc regardless of network tuning."

INTERACTION OF AEROSOLS And AIR IONS:

Under the above title is a report by Dr. Karl E. Schaefer and James H. Dougherty of the U. S. Naval Medical Research Laboratory, Submarine Base, New London, Connecticut. The Introduction is as follows:

"Under conditions of prolonged confinement in the closed space of a submarine or a space capsule microclimatic factors such as aerosols and ions might become important. We have observed a 10 - 20 fold increase in condensation nuclei and in the number of positive and negative ions in the air of conventional fleet-type submarines during submergence (1,2). It was also found that the concentration of aerosols is significantly elevated in submerged nuclear powered submarines and reached a steady state concentration of 0.4 ug/L in approximately 100 hours (3). The level of air ions in nuclear powered submarines is, ingeneral, not different from that of the natural atmosphere and averages less than 1000/ml for both positive and negative ions (3).

"The effects of electrically charged particles (ions) on man and animals have been studied quite extensively in the past, but have produced controversial results. The experimental conditions were not clearly defined; one investigator might be using small ions and another one medium or large ions. And furthermore, interaction of aerosols present in the air with ions was generally neglected.

"In preparation for studies of physiological effects of ions on man, we have attempted to clarify the interaction of aerosols and ions, and also to determine what amount of ions present in the atmosphere is inhaled through a respiratory mask and actually reaches the airways."

SOME INTERESTING STATEMENTS In "FAIL-SAFE":

The authors of the book "FAIL-SAFE" have brought out several of the problems which exist in electronics today and which are not usually mentioned in public. Add to these "interference" and one can see why the military is so concerned.

Page 157:

"He had in mind the public warning, several years previously, by Admiral L.D. Coates, the Chief of Naval Research, which admitted that insiders knew: electronic gear was becoming so complex that its was outstripping the ability of man to control it; complexity of new generations of machines was increasing the danger of accidents faster than safeguards could be devised. The statement had never been countered but simply ignored."

Page 159:

"But the whole system had one big flaw in it. Nobody could be certain that the black boxes would actually work properly in a showdown. The reason was simple. There had never been a showdown, and there never could be a sure test showdown - A showdown meant war..."

Page 187:

"The fact of the matter is that the machines move so fast, are capable of such subtle mistakes, are so intricate, that in a real war situation a man might not have the time to know whether a machine was in error or was telling the truth."

"R-F SHIELDING MATERIALS"

Under the above title Albert R. Kall and Fred Kugler, Ark Electronics Corporation, Willow Grove, Pennsylvania, have written a letter to the Editor of Electronic Industries, March 1963, which brings out some points of difference with an article entitled "A Comparison of R-F Shielding Materials" in the December 1962 issue of the same publication.

USING MAGNETIC SHIELDING MATERIALS

Under the above title, C.M. Jorgenson, Chief Engineer, Magnetic Shield Div., Perfection Mica Co., Chicago, Ill., has written a page article with 8 photographs and 2 charts in the March 1963 issue of Electrical Design News. The first 4 paragraphs are:

"In the past few years a family of shock-insensitive, relatively low-retentive magnetic shielding materials has been developed. They are ferrous alloys designed exclusively for shielding purposes. The use of nickel in the alloy greatly increases the magnetic conductivity (permeability) while decreasing its level of saturation. Whether a high- or low-permeability shield is used depends on the field intensity and the desired attenuation.

Problem and Solutions

"The basic problem is to find the smallest, least expensive shield that will do the job. A high-permeability material provides large attenuations in field strength but at the same time tends to saturate easily. Shielding a 40-gauss field by using a material that saturates at 30 gauss is equivalent to a 10-gauss field with no shield at all. If, however, low-permeability shielding is used exclusively for all high-intensity fields the shielding material becomes bulky and expensive.

"The best approach to shielding a high-intensity field is to use layers of low- and high-permeability materials. That is, a material with a low permeability and high saturation point is used to shunt most of the field. A second layer of high-permeability material then provides sensitive, low-level shielding for the field that is left. In many cases more than one layer of each type is used. This is best determined empirically.

"The low-permeability material is put on the high-field intensity side of the shield. This dual-layer shield will allow a wider range of field intensity to be accommodated without significant reduction in the effectiveness of the shielding. The low-permeability material provides the first line of defense against high-intensity fields while the second layer provides a high-magnetic conductivity for low-level fields."

A typical test set-up for calibration of magnetic probe is shown.

CORONA And TREEING BREAKDOWN OF INSULATION:

The April, 1963, issue of Insulation carries Part 3 of an article titled "Corona and Treeing Breakdown of Insulation Progress and Problems" by Murray Olyphant, Jr., Electrical Products Laboratory, 3M Company, St. Paul, Minnesota. The Sub-title states:

"The first two parts of this article in the February and March issues dealt with corona breakdown processes; erosion and breakdown in practice; corona starting and extinction (laminar voids, external conductors, effect of pressure and temperature, spherical voids, corona extinction voltage, and self-extinction, void conduction); methods of accelerating breakdown by voltage acceleration and frequency acceleration; and corona resistance test data for a large number of insulating materials. The final and concluding part discusses treeing breakdown tests at considerable length and provides an excellent summary along with a complete list of references."

There are 43 references.

SITE NOISE And Its CORRELATION With VEHICULAR TRAFFIC DENSITY:

Proceedings of the I.R.E. Australia, January, 1963, contained a 7-page article under the above title by A.G. Ellis, Postmaster-General's Department, Melbourne, Victoria. The summary states:

"In the VHF and UHF ranges, one of the major parameters associated with the prediction of radiotelephone system performance is the effective noise factor. This factor is a combination of the receiver's internal noise factor, a relatively small and constant component, and another noise factor, called the site noise factor, which assesses the intensity of the noise fields enveloping the receiver's antenna.

"Although this latter component has long been known to vary from site to site, its magnitude for planning purposes has hitherto been arbitrarily set at one of several discrete levels, the one chosen being determined solely by the size of the city in the vicinity of the site.

"This paper shows that predictions of greater accuracy are obtained when the site noise is related to the nearby traffic density, and as a result of measurements taken at various sites in Victoria and New South Wales, suggests the law between them.

"The measurement technique and the individual results and their anomalies are also discussed in detail."

Estimated Sky Temperatures Due to Rain for the Microwave Band

Under the above title, D. C. Hogg, R. A. Semplak, Bell Telephone Labs., Inc., Holmdel, N. J., have a 1-1/2 column in the correspondence section. Part of the first paragraph is as follows:

Measurements of sky noise due to rain at 6 Gc, reported previously (1), are used here to calculate that effect at other frequencies in the microwave band. The method of calculation is as follows. Since the attenuation coefficient of rain and especially its dependence in frequency is well established (2) one is able to derive the equivalent thickness of a homogeneous layer of rain above a vertically beamed receiving antenna for a given noise measurement, the rain rate at the receiving site being known."

Measurement of Microwave Interference at 4 Gc Due to Scatter by Rain

Under the above title, D. C. Hogg, R. A. Semplak, D. A. Gray, Bell, Telephone Labs., Inc., Holmdel, N. J., have a 2 column and one figure letter. First two paragraphs are as follows:

"The effect of noise emission by rain at 6 Gc has been discussed previously. From these data one is able to estimate the magnitude of this source of noise for the entire centimeter-wave band." However, during tests employing a low-noise receiving system operating at 4 Gc on Crawford Hill, Holmdel, N. J., the observed background level during rainstorms was much higher than could be attributed to noise emission alone.

"It was known that ground-based transmitters operating in the 4160 to 4180 Mc band of the receiver were located in the vicinity of Crawford Hill, and it was suspected that transmissions from these sources were being scattered into the receiving system. This communication discusses one such observation."

The FM Random-Noise Threshold:

In the March-April 1963 issue of Frequency, Elie J. Baghdady, Adcom, Inc., Cambridge, Mass., has a five-page article under the above title. The sub-title states:

"Despite long experience with the threshold phenomenon in FM systems, some rather basic questions about it have dragged along for years without satisfactory settlement. Dr. Baghdady's discussion clarifies some of the fundamental issues on this controversial subject."

PUZZLED About HUM-M?:

Radio-Electronics, April 1963, carries a 2-column article by Anthony Prasil with the above title. The first paragraph states:

"The article 'Puzzled About Hum' by Norman H. Crowhurst which appeared in the January 1961 issue is excellent. It especially interests me because for many years I have been designing and building very-low-noise preamplifiers, both vacuum-tube and transistor types. Since these are required to amplify signals as small as the Johnson noise of the input resistance (between 1 and 10 uv, depending on the system bandwidth), the slightest amount of hum pickup is very obvious and must be eradicated. Doing this sort of work, one soon learns the many pitfalls which may be encountered and the way to cure the trouble at hand. You also learn to avoid the same mistakes in future designs."

The STRANGE CASE Of The 60-CYCLE HUM :

General Electric, in the March 1st, 1963 issue of Electronic Design, ran an advertisement in which one column was devoted to a discussion under the title "The Strange Case of the 60-Cycle Hum". The text of the article, minus the wiring diagram, is as follows:

"Who would ever have thought that this simple, innocent looking circuit would be the cause of mysterious, sporadic

interference in AM radio receivers in certain locations, but not in others" RF measurements in laboratory showed absolutely nothing!

"Keith Howell, the Erie Stanley Gardner or our Application Engineers, relates this harrowing tale. Analysis of reports showed the trouble to be a 60-cycle hum that reared its ugly head only when the receiver was tuned to certain local stations (and considering the quality of the music some of them play it was a neat trick to identify a hum in the first place). Once identified, Keith relates the guilty party was summarily dealt with and the case solved. In the laboratory, and later in the field, careful detective work demonstrated that the circuit was essentially a diode modulator for an RF signal riding on the power line.

"Once the mystery was solved, of course, it was a cinch to eliminate the problem. The cure was simply to bypass the rectifier with a .005 mfd ceramic disc capacitor. (The same capacitor could also be connected across the line, but this removed the RF signal which the receiver was using and was not 100% effective in very-strong-signal areas). Case solved. Everybody happy. But an important moral should be drawn. Rectifiers don't generally produce radio interference, except by their effect on external circuitry, as in this case of the inadvertent diode modulator."

A GE in-house paper titled "Controlled Rectifiers and Radio Interference" by E. E. Von Zastrow, Application Engineering Center, Rectifier Components Department, General Electric Company, Auburn, New York, No. 200.33-61, can be obtained through Mr. E. K. Howell, Application Engineering Center, at the above address.

NUCLEAR RADIATION EFFECTS CONFERENCE:

Announcement has been made for the First Tentative Schedule of Technical Sessions Summer General Meeting and Nuclear Radiation Effects Conference to be held in the Royal York Hotel, Toronto, Ontario, June 16-21st, 1963. Additional information may be obtained from Edward C. Day, Assistant Staff Secretary, Technical Operations Committee, IEEE, Box A, Lenox Hill, Station, New York 21, N. Y.

LUNAR EXCURSION MODULE (LEM) CONTRACT:

Ground Support Equipment (GSE), February/March 1963 has this to say, on page 10, about the above:

"... The requirements for the electronics check-out of the Lunar Module will literally and figuratively be out of this world, as safe return from the surface of the moon to the Apollo Space Craft will rely on the functioning of the module electronics. The LEM electronics will have to have extremely high reliability and there apparently will have to be some sort of on-board test and check-out equipment. This on-board equipment will have to have extreme reliability and environmental requirements beyond any test equipment built to date. The solution of the problems posed by LEM should provide interesting advances in the art of electronics testing."

ASTIA CHANGES Its NAME:

ASTIA, the Armed Services Technical Information Agency, is now being reorganized and named as the Defense Documentation Center for Scientific and Technical Information (DDC). It will be a clearing house for defense research efforts and will absorb the functions of other military document centers. The aim is to get classified documents more quickly to eligible contractors, set up technical report quality standards, and press the military services to enforce contractor obligations to submit technical reports.

SPRAGUE ELECTRIC CONSOLIDATES RFI/EMC WORK:

A news item in Electronic News, Monday, April 15, 1963, states as follows:

"North Adams, Mass. - Sprague Electric Co., has consolidated its radio interference filter, wave filter and electro-magnetic interference control activities in a new Filter division, according to Robert C. Sprague, chairman of the board and chief executive officer.

"The new Filter division will have its headquarters at the company's Marshall Street plant here, and will be headed by Frederick S. Scarborough as division manager.

"The continued growth and increasing complexity of Sprague's interference control field service and filter operations have resulted in corporate decision to elevate them to a full divisional status, in view of their increasing importance in the company's over-all sales, engineering services, and production picture, it was said.

"The new division will be responsible for interference control and filter activities here and at the company's Vandalia, Ohio and Los Angeles, Calif. operations, with production support continuing from the company's general manufacturing operations in Visalia, Calif., and North Adams."

What You Must Know To USE FERRITES At LOW FREQUENCIES:

Under the above title, Donald Leibowitz, RCA Princeton, Princeton, N. J., has written a 4-page article in *Electronics*, March 1st, 1963. The first paragraph states:

"The purpose of this article is to give engineers a clear picture of what they can do with ferrites and what ferrites can do for them. This picture will be conveyed by (a) describing the elementary theory of ferromagnetism, (b) discussing the important design criteria in the use of ferrites, (c) listing the applications of ferrites to engineering and electronics problems, and (d) discussing the possibilities and limitations in the manufacture of ferrite materials."

COAXIAL CABLE SLIDE RULE:

A coaxial cable slide rule has been developed by Phelps Dodge to offer quick reference for calculation of performance data and physical specifications of Foamflex coaxial cable. The slide rule rapidly provides information on attenuation, including frequency and decibels; average power rating in frequency and kilowatts; physical dimensions of outer and inner conductors; plus weights, minimum bending radius, and other useful data. The slide rule may be obtained by writing to: Phelps Dodge Electronic Products Corp., P. O. Box 187, 60 Dodge Avenue, North Haven, Connecticut.

ARMY PROTECTS MISSILES AGAINST STRAY R-F:

Electronics, a McGraw-Hill Publication, has given permission to reprint the above titled article in their April 5, 1963 issue, by George V. Novotny, Associate Editor. The sub-title states: "Develops new techniques to keep warheads safe near strong transmitters." There are two schematics and two pictures.

"Dover, N. J. - AA2XV are the call letters assigned by FCC two weeks ago to a unique radio station authorized to operate on all frequencies from 100 Kc to 10 Gc.

"Its task is to protect our missiles and ordnance items from being blown up accidentally by a burst of radiated r-f from a radar, communication, or command transmitter that has just the right frequency and field strength to actuate the warhead squibs.

"Station AA2XV is part of a new installation being raised by Army's Munitions Command at Picatinny Arsenal, to study the effects of radiated r-f on nuclear and conventional warheads, projectiles and other electrically triggered ordnance items.

"The facility will base a continuing program to test all ordnance items as developed for susceptibility to r-f heating. Testing has started on warheads to develop standards for r-f environment tolerances at weapon sites.

"Picatinny is also developing protective filters to keep harmful r-f radiation out of explosive squibs in ordnance items, and studying skin shielding techniques. Other protective measures may include coded actuating devices not susceptible to ordinary r-f.

"Six Transmitters - The wide frequency range will be covered by six separate transmitters, with radiated power capability of 250 to 500 watts c-w and pulses over 1 Kw in the 350 Mc to 10 Gc range, and over 1 Kw in the lower ranges; there will be provisions for frequency sweep; modulation, and for vertical, horizontal or circular polarization. Field strengths at the site will range up to 100 volts/meter for the far-field tests.

"Power Sensors - Warhead tests are conducted on specimens wired with sensitive ambient-temperature-compensated vacuum-deposited thermocouples, installed within 0.003 in. of the squib bridge wires.

"Developed by the Naval Weapons Lab. in Dahlgren, Va., these

sensors can detect power levels of 200 microwatts in the bridge wires, without disturbing in any way the r-f integrity of the missile. Other r-f sensing devices are small crystal video detectors, which are more sensitive but have to be wired into the missile circuit.

"Army spokesmen said Picatinny will conduct further development of more sensitive sensing devices, and testing techniques such as the use of modulated r-f to eliminate effects of noise and temperature variations.

"Test Facilities - When completed, the Army facility will have a large r-f anechoic chamber where smaller items can be tested without outside radiation. For low r-f frequencies a cage is being developed in which low-frequency radiations will be simulated by generating alternate electric and magnetic fields perpendicular to each other at the correct intervals.

"Although the other two services, as well as the AEC, are doing work in this area, Army spokesmen indicated the Picatinny installation will be the largest and most complete of its kind. A conference on Hero (Hazards of Electromagnetic Radiation to Ordnance) techniques will be held in May at the Franklin Institute in Philadelphia."

An editorial comment on the general subject of radiation appeared as follows:

Radiation as a Weapon?

"Can r-f radiation be used to down enemy missiles, either as an offensive weapon or as a protective shield surrounding a large area?

"Army won't say, and Picatinny is not working on this aspect of the problem for the time being. It appears that a lot of power is required for such action - too much, with available power sources, for mobile r-f antimissile projector units. An r-f shield protecting a country would be a mammoth project using the power of many Niagaras, and probably could not guarantee any results.

"But all this may change as we learn more about what happens when r-f gets inside a missile, and as smaller and more powerful energy sources are developed."

RUSSIAN REVISION OF INTERFERENCE SPECIFICATION, 1954:

The following abstract was sent in to the PTG-RFI Newsletter by Herbert K. Mertel, EMC Engineer, United Control Corporation, Seattle 14, Washington, with the following comment in part: "Recently, I had the opportunity to review an industrial interference specification from the U. S. S. R. I found this document of considerable interest since the interference measurement approach is quite similar to the one described in our early military interference specifications. I abstracted the main points of this document for PTG-RFI membership information....."

Abstract

"NORMS FOR MAXIMUM ADMISSIBLE INDUSTRIAL RADIO INTERFERENCE". A. Zharov, Chief of State Inspection Committee for Electrical Communication of the U. S. S. R. Communications Ministry, Moscow 1961.

This document is a revision of the interference specification issued in 1954. The introduction starts with "Radio - the ingenious invention of the great Russian scientist A. S. Popov". Other highlights of the introduction are "the problem of combating industrial radio interference has acquired even greater urgency..... The struggle against industrial radio interference should be (executed) primarily by suppressing the interference at its sources through design and circuitry changes.... Readers remarks and preferences for possible incorporation in subsequent editions of the norms..... should be addressed to the (see source of document)".

The document gives the spec limits for every possible type of electrical/electronic industrial equipment that may exist, including: railway rolling stock, automobiles, motor cycles, telephones, fluorescent lights, aircraft electrical equipment, vending machines, etc.

The spec limits are in micro-volts for conducted and radiated measurements when measured with a standard interference receiver and test setup. The limits are given only for frequencies of .15 to 400 Mc/s even though the definition

states "Industrial interference is a term applied to the radio frequency components of the spectra of electromagnetic processes at frequencies of 10 Kc/s to 30 Gc/s.....".

The specifications for the standard receiver are given. The 3 db bandwidth is given for each frequency range: 12-150 Kc/s = $1.5 \text{ Kc/s} \pm 20\%$, 15-20 Mc/s = $9 \text{ Kc/s} \pm 10\%$, 20-150 Mc/s = $100 \text{ Kc/s} \pm 10\%$, 150-400 Mc/s = $200 \text{ Kc/s} \pm 10\%$. The image rejection is to be 20 to 40 db, the discharge time constant 600 m-sec., the frequency accuracy $\pm 5\%$ and the amplitude accuracy $\pm 25\%$.

The conducted interference is to be measured from .15 to 20 Mc/s and from 20 to 150 Mc/s with the help of a "Power-Line Equivalent" (similar to our L. I. S. N.) or direct attachment to power lines not exceeding 6 KV. Specifications for networks are given. Test setups are quite similar to ours.

The radiated interference is to be measured from .15 to 20 Mc/s with a one meter $\pm 20\%$ rod and from 20 to 400 Mc/s with tuned dipole. If necessary, a screen room shall be used. Power lines to screen room shall be filtered. Instructions for construction of screen room and filter are given. "The radio-interference-field level in it (screen room) due to sources located outside it (shall) not exceed 2 micro-volts.

The spec limits of the industrial equipment are given for the frequency ranges of .15 to .5 Mc/s, .5 to 2.5 Mc/s, 2.5 to 20 Mc/s, 20 to 150 Mc/s, 150 to 400 Mc/s and are constant for each range but vary from 10 to 1000 micro-volts for conducted interference and 2 to 250 micro-volts for radiated interference. The spec limits are a function of type of equipment, location (residential, industrial, city limits, urban, suburban, etc.) The distance between antenna and source varies from .25 to 50 meters. Allowances are made for short duration interference.

A sample of the required standard interference test report form is included in the document. The interference of equipment that are not designed to generate discrete high-frequency current is to be measured at 24 given frequencies between .15 and 400 Mc/s for standard test. The number of test points is reduced to 9 for control and acceptance tests. The last sentence of Part I is heavily underlined and states "A source of radio interference must satisfy the norms (spec limits) at all frequencies of the continuously normalized range".
Note: This report is available from ASTIA. AD 286596.

NEW PUBLICATIONS:

Monograph on Radio Noise of Terrestrial Origin:

Under the above title is a book edited by F. Horner, 202 pages, price \$8.75. It can be purchased from American Elsevier Publishing Co., Inc., 52 Vanderbilt Ave., New York 17, N. Y. A synopsis of the contents is as follows:

"During the XIIIth General Assembly of the International Scientific Radio Union (URSI) in London, during September 1960, Commission IV on Radio Noise of Terrestrial Origin held eight sessions on the following topics: Sources of noise in lightning; Properties of natural noise; IGY Whistler data; VLF Emissions and hydromagnetic waves; Whistler theory; The Exosphere; Man-made noise; and VLF Propagation. These are the papers presented in this book. The book also contains a survey and bibliography of recent research in the propagation of VLF radio waves."

Radiation Effects on Electronic Components:

The U.S. Department of Commerce, Office of Technical Services, has published "An Annotated Bibliography" under the above title. It has digests of 201 papers and was compiled by Lockheed Missiles & Space Company under an Air Force contract. Its OTS number is AD 277840 and the cost is \$2.25.

NEW PRODUCTS

New Crystal Filter for RFI Control:

A new crystal filter development by the Midland Manufacturing Company, 3155 Fiberglas Road, Kansas City 15, Kansas, may have new applications for the better control of RFI. It is claimed that they can be made more symmetrical than usual

image parameter designs; have only nominal insertion losses in narrow bands and with selectivity beginning 4 or 5 db lower than conventional designs. Very close approximations of Chebishev (flat bottom, square corner) characteristics are possible. The new filters are called ILo and a brochure may be obtained by writing to the Midland Company.

Magcentric Bearing and RFI:

In answer to an inquiry, by your editor, as to the electromagnetic compatibility of his new Magcentric bearing, Mr. Joseph Lyman, Cambridge Thermionic Corporation, 448 Concord Ave., Cambridge, Mass., has replied as follows:

"The Magcentric(r) bearing supports the floated element by two sets of fields. One field is fixed and is derived from permanent magnets, the other field varies with lengthwise position of the shaft and is electromagnetically derived. The electromagnetic field is supplied by about ten watts at 10kc and is confined by the ferrite cup cores and associated discs to a very small region around the periphery of the disc. In the standard version of the bearing no particular shielding is employed, however, complete shielding can be employed if virtual elimination of the external field is necessary in the application."

No/Noise/No-Bounce Switch:

Instruments & Control Systems, March 1963, page 125, carries a 3-page article by Edmund A. Bolton, Manager, Switch Department, Vitramon, Inc., Bridgeport, Conn., under the above title. Three paragraphs of the article are as follows:

"The absence of noise, lack of bounce, adjustability, close differential between make and break, and precise repeatability recommend many applications for the switch. At present, many designers feel it necessary to amplify each point prior to switching in order to obtain accuracy. This switch can commute low-level signals without amplification, with obvious savings in cost, weight and space.

"The fact that the switch injects no RF noise into the switched signal permits elimination of bulky and expensive hash filters.

"The switch can be used in punch-card sensing, where a number of circuits may carry low-level signals and extremely low contact resistance is required."

Mr. Bolton writes: "If any of your members are interested in investigating the no noise performance of the 'VG' switch further, we will be glad to supply samples if we are informed of the test results." Reprints are available on request.

NOTE:

In the last Newsletter, your editor asked for help to enable engineers, who are making RFI surveys for their companies for the first time, to obtain accurate information on the problems to be encountered in the RFI/EMC field. James C. Senn, of Genistron, Inc., has very kindly crashed through with three papers which, taken together, might be helpful in presenting a reasonably good picture of the RFI/EMC fields to the uninitiated and has offered to send them to anyone who requests them on his company letterhead. They are as follows:

Lecture Series, Engineering X 415PQR, Dynamic Environments, University of California
Lecture 12 by James C. Senn

Management Responsibility in Obtaining an Electrical/Electronic Compatible Weapon System - by Fred J. Nichols, 8th Armour Conf.


Electromagnetic Compatibility in Weapon Systems - F. J. Nichols & J. C. Senn, AIEE Summer General Meeting, Denver, Colo., 1962.

Mr. Senn writes that he will present a tutorial RFI paper before the Institute of Environmental Sciences, in Los Angeles, in April, 1963, which is written specifically for engineers who are not in the Electrical or electronics fields. The title is "Radio Frequency Interference as a Dynamic Environment" and will be available after presentation. His address is 6320 W. Arizona Circle, Los Angeles 45,

California.

Is there anybody else who would like to make a contribution to education in the RFI/EMC field - as suggested in the Administrative Committee meeting? Your editor will be very glad to pass it on.

Rexford Daniels, Editor
PTG-RFI Newsletter
Monument Street
Concord, Massachusetts


NEWSLETTER
IEEE Professional Technical Group on
RADIO FREQUENCY INTERFERENCE
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