PROFESSIONAL GROUP ON RADIO FREQUENCY INTERFERENCE

NEWSLETTER

Number 15 March, 1961

RFI Program, IRE CONVENTION on Radio Frequency Interference, Waldorf-Astoria, Sert Room, March 20, 1961:

Radiation Characteristics of Antenna at Other Than Design Frequencies, J. C. Pullara and J. P. Jones, Melpar, Inc., Falls Church, Virginia.

The Relationship Between Broadband Interference Measurements (DBMC) and Pulsed-CW Signals, L. R. Pangburn, G. E. Co., Utica, New York.

Shielding Enclosure Performance Utilizing New Techniques, R. B. Schulz, Armour Research Foundation of Illinois Inst. Tech., Chicago, Ill., and D. P. Kanellakos, Stanford Univ., Stanford, California.

Graphical-Numerical Prediction of Tuned RF Amplifier Output Spectrum, W. G. Duff, Jansky & Bailey, Inc., Washington, D. C.

Radar Mutual Interference Problem, C. Gager, A. Ruvin, and C. Fowler, Airborne Instruments Lab., Deer Park, L. I., N.Y.

This program is scheduled for 2:30 P.M.

SAN FRANCISCO CHAPTER FORMED:

The following letter was received by your editor:

"We are happy to announce that a San Francisco Chapter of the Professional Group on Radio Frequency Interference has been organized. An initial meeting was held in mid-November to nominate officers and make plans. The officers who have since been elected are:

Chairman	Peter Spencer, Filtron
Vice-Chairman	Robert Lathrop, Cook Eng.
Secretary-Treasurer	Richard Davis, Lockheed MSD

"Attendance at the initial meeting numbered sixteen, and expressions of interest have been received from some twenty-five persons in the Bay Area. At the first technical meeting scheduled for early March, Mr. Fred Roe, of the Northern California Electrical Bureau, and Mr. Richard Lake of Pacific Gas and Electric will speak on the subject of 'Interference in Power Systems.' Mr. Roe is the author of the book, 'How to Locate and Eliminate Radio Frequency Interference'."

UTICA-ROME CHAPTER HOLDS TWO MEETINGS:

"Two official meetings have been held to date. The first was strictly a chapter meeting to acquaint the local membership with behind the scenes activity and plans of the several committees of the chapter. This was a non-dinner meeting held at the Rome VFW on 2 November 1960. Twenty members attended and Mr. Miller, as chairman reviewed the correspondence to date. He emphasized the recommendations made by the Washington, D. C. Chapter as we are following their guide lines in our future plans.

"These plans were specifically to program for a historical review of interference for our first technical meeting, which was a Utica-Rome IRE Section, by the member of the National PGRFI Committee. Mr. Leonard Milton, of Filtron Co., Inc., and vice-chairman of the national committee was contacted and subsequently agreed to provide a presentation on 12 December. At this meeting we sponsored the regular Section Meeting on the grand new Mohawk Valley Technical Institute campus. A calamitous weather situation prevented Mr. Milton from ever getting out of his own driveway on Long Island. We were most fortunate to have available Dr. Carl Frederick of the Frederick Research Corporation to act as a substitute speaker. He provided a similar review on the same subject. Mr. Benjamin Linderman, Chief of the RADC Interference and Anti-Jam Analysis and Control Branch, provided an excellent and interesting summary of some of the plans for implementing the new DOD Interference Program. A break was made for light refreshments, after which an informal discussion period was held for approximately one hour. Because of the many parties during the Christmas season, various illnesses, and a very miserable cold evening, the attendance was only thirty."

RF Interference Measurement Techniques Panel Discussion at New York Section Meeting:

The monthly meeting of the New York Section held on November 2, 1960 at the Engineering Societies Building Auditorium was devoted to a panel discussion on "Measurement Techniques in Radio Frequency Interference." The Panel Members were Mr. J. F. Chappell, of the U. S. Army Signal Research and Development Laboratories, Mr. S. J. Burruano, of the Filtron Co. and Mr. A. R. Kall, of Ark Electronics Co. with Mr. B. Rosen, of Polarad Electronics Corp. as the Moderator.

Mr. Kall led off the panel presentation with a summary of the interference measurement requirements contained in the military specifications emphasising the problem areas such as reproducing near field measurements, giving limits interms of received microvolts or microvolts per meter, requirement for impedance stabilization networks, the measurement of broadband interference and the elusive impulse bandwidth figure and the use of sine wave or impulse calibration of interference meters.

Mr. Chappell then spoke on the competition for the RF spectrum and how it is complicated by unintentional radiation. He then gave a short history of the developments that led up to the present RF interference instrumentation from the Signal Corps viewpoint. This covered the reasons why they use peak measuring instruments with impulsive calibration to measure broadband interference in terms of microvolts per unit bandwidth and the use of antenna injection methods for radiated measurements. He concluded with a discussion of the Spectrum Signature requirements of MIL-STD-449 and the uses that will be made of this information.

Mr. Burruano then discussed some of the problem areas in the

military specifications including the difference between the limits of 1000mc using a dipole antenna or a horn antenna and the new limits in effect and the difficulties in obtaining meaningful measurements above 1000mc.

The question and answer period after the panel presentations was very wide-ranged and lively. Mr. Rosen started with questions on the need and desirability of using automatic equipment for RF interference measurements. The panel agreed that this was needed in view of the time now required to make measurements. Some possible means of combining sweep or panoramic measurements with point-by-point measurements was also pestulated. Sweep signal generators for susceptibility measurements were also discussed.

Further questions from the audience of about 50 persons were on the philosophy for making RF interference measurements, the definition of Spectrum Signature, the FCC requirements for interference control and measurements, the merits of using antenna conducted or radiated measurements, that is using waveguide measurements or free space measurements for a Spectrum Signature and whether the time function of an equipment was considered as part of the Spectrum Signature.

ILLUMINATING ENGINEERING SOCIETY APPROVED FOR AFFILIATION:

The IRE Executive Committee has approved the Illuminating Engineering Society for affiliation of its members with the Professional Group on Radio Frequency Interference.

EIA FORMS RFI SUBCOMMITTEE:

The Electronic Industries Association has formed EIA M-5.8 Subcommittee for the purpose of aiding industry in designing electronics equipment and systems for compatibility with themselves and with their environment. The broad scope for this Subcommittee is described as follows:

"Radio Frequency Interference Task Group

"1. Study and develop technical criteria and procedures which will guide, insofar as practical, electronic systems designers to insure *radio frequency compatibility of new systems. Two interference control problems will be considered.

a. Conducted and radiated interference from non-radiating type systems.

b. Spectrum clutter due to harmonic and spurious outputs from radiating type systems.

"2. Study and coordinate comments on existing and proposed Military Specifications and documents concerned with radio frequency interference reduction and control. Prepare and propose RFI specifications and documents to the Military where deemed required.

"*Radio frequency compatibility is defined as the capability of electronic components or systems to be operated in the intended operational environment at designed levels of efficiency without degradation due to unintentional interference. The scope of this definition encompasses the utilization of the full flexibility of equipment, as well as the factors involved in the ability of operators to cope with interference".

Mr. Beryl L. McArdle is chairman of the Subcommittee and D. L. Sullivan, Staff Engineer, Department 539, International Business Machines Corp., Military Products Division, Owego, New York, is chairman of an M5.8 ad hoc committee to produce a so-called "Systems Designer's Guidebook on RFI".

AN INSURANCE POLICY COVERING RFI

BY GEORGE S. TURNER, CHIEF,
Field Engineering & Monitoring Bureau
Federal Communications Commission

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EDITOR'S NOTE:

Recognizing the necessity of controlling radio frequency interference (RFI), AFCEA has been interested in supporting means which further this end. It is our conviction that any assistance which can be given to further the Federal Communications Commission and its field division representatives, to aid them in their work to successfully minimize interference, would be highly commendable. Today there are thirty-four local Cooperative Interference Committees which perform a most valuable service in locating sources of interference.

AFCEA members have been active in the CIC Program and we hope that more members will participate in these committees. Ray Meyers and Al Parker, AFCEA members, were instrumental in getting the first CIC organized in California. Another AFCEA member, George S. Turner, has urged that our Association Chapters seriously consider supporting the functions of a committee in their locale. The following article by Mr. Turner, Chief, Field Engineering and Monitoring Bureau, Federal Communications Commission, explains how the various CIC's assist the FCC and perform a national service. In a subsequent article, Mr. Meyers, Chairman of the Southern California CIC, will discuss ways to organize a committee. Also he will describe typical problems which have arisen and how these problems on interference have been solved.

The April 1957 issue of SIGNAL contains guide lines on individual and collective CIC voluntary participation.

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The Alphabetical Abbreviation RFI -- for Radio Frequency Interference -- is well known to both Government and Industry users of the crowded radio spectrum. While the problem of RFI is becoming increasingly serious, fortunately something can and is being done about it. For one approach, equipment specifications designed to reduce unwanted radiations are continually under review and extensive programs are underway for advance prediction and later identification of interference sources and levels, considering the total environment of electronic installations. "Spectrum signatures" of electronic equipments are being determined and cataloged for use in electronic computers for prediction and subsequent identification of interfering radiations. In the internationa picture, the International Special Committee on Radio Interference (CISPR) and the International Radio Consultative Committee (CCIR) are studying various aspects of RFI leading to improved techniques of detection, identification, measurement and prevention. But in spite of all these worthwhile studies and actions, a person or organization experiencing RFI is in need of an immediate remedy. As in all human endeavor, organized groups are more effective in solving RFI than are individuals working alone. The following discussion relates to one very important organization -- the Cooperative Interference Committee (CIC) -- which may be likened to an insurance policy covering anyone in the radio communications industry against the RFI hazard. This certainly includes AFCEA members who, therefore, should be interested in participating and in accruing the benefits.

CIC Organization

The Cooperative Interference Committee is an industry-wide composite group representing all classes of communication services within a particular geographical region. Generally represented also are manufacturers of electronic equipment, power companies, county and municipal governments and specific communication organizations, such that someone on the committee is generally in a position to take or suggest the proper corrective action to solve an interference case.

Much has been learned in the six years since the start of the CIC program. One of the most important facts observed is that a clear separation of responsibility should exist between the CIC's and the Television Interference Committees (TVI). Over 500 of the latter, comprising mainly radio amateur operators, are doing excellent work to reduce interference to television reception by the public. They in turn do not handle

line. Installation of a low-pass filter with a 150 kc cutoff reduced this noise by more than 50 db to meet the specifications in MIL-I-16910A."

BUDOCKS TO PRODUCE FILM ON ELECTROMAGNETIC INTERFERENCE

"The Navy's Bureau of Yards and Docks will produce a film, "Electromagnetic Interference Ashore", at the Naval Civil Engineering Laboratory at Port Hueneme, California.

"The film, the first of its kind, is being made to further educate Bureau personnel in Washington, D. C. and in BuDocks field activities in the fundamentals of interference control in the advancing age of outer space communication.

"The movie contractor, McNamara Production, Inc., 8230 Beverly Blvd., Los Angeles, California, is producing the film for the Navy under the supervision of the Naval Photographic Center in Washington, D. C.

"Stanton A. Bennett, the Bureau of Yards and Docks Consultant on Electromagnetic Control, has been designated as the technical advisor for the Bureau contract."

SELF-ADAPTIVE FILTER FINDS UNKNOWN SIGNAL IN NOISE

Under the above title, in the February 17, 1961 issue of "Electronics", was an article by C. V. Jakowatz and G. M. White, of the Research Lab., G. E., Schenectady, N.Y. The sub-title stated:

> "After several occurrances of a random signal, the automatic system forms a memory of the signal. As the shape of the signal changes, the System alters its memory accordingly and creates an optimum filter."

ELECTROSTATIC COUPLING AND ELECTROMAGNETIC COUPLING DESCRIBED IN SAFETY GROUNDING FOR LINE WORK:

Electric Light and Power, January 15, 1961, carries a 4 1/2 page article titled "Problems in Safety Grounding for Line Work", by J. G. Cassan of The Hydro-Electric Power Commission of Ontario, Canada.

The sub-head states: "Established procedures for safety grounding and bonding in power-system maintenance and operation still leave room for considerable improvement."

Where safety grounds are being used as a path for RF energy to earth ground, some of the problems discussed in this article and the solutions to the problems should be of interest to those having grounding problems.

RADIO FREQUENCY CONTROL THROUGH INITIAL DESIGN:

A paper with the above title was delivered by R. K. Hothem, Welex Electronics Corp., Washington, D. C. at the Northeast Research and Engineering (NEREM) meeting November 1960. A summary of the paper, as contained in the NEREM RECORD, is as follows:

"Interference control through initial design can be a savings, rather than a costly practice. Care in the selection of circuitry and components often eliminates the necessity of taking suppression measures after production. We know that too many activities depend on brute-force suppression methods, applied after production is complete, to meet their interference specifications. We should also recognize that Christmas tree or brute force approach of hanging capacitors and chokes on equipment which was previously designed with no regard for interference characteristics, is expensive, creates additional size, weight and maintenance problems and, because of the frenzied haste in which it is usually applied, is very conducive to inefficiences.

"For many years engineers engaged in interference control have been urging that designers and manufacturers of electrical and electronics equipment incorporate interference control in the early planning and design stages. This approach has, in general, had little success for several reasons:

(1) Manufacturers have not taken advantage of the interference control concept.

(2) Many design engineers are uninformed of the proper design methods for the control of interference.

(3) Frequently, the inter-action between adjacent equipments is ignored.

"The art of interference control has not yet developed to a point where all black-box type suppression devices may be eliminated. However, great progress has been made in this area. Examples of these, are semiconductor switching circuits in lieu of electromechanical relays and newly-developed techniques for the design and manufacture of power absorption-type wave guide filters instead of the reflected power-type wave-guide filter."

Copies of the NEREM RECORD may be obtained for $7.50 by writing to the IRE, New York.

INSTRUMENT SOCIETY OF AMERICA INVITES TECHNICAL PROGRAMS:

In a letter, dated January 11, 1961, to Mr. Ronald L. McFarlan, President of the IRE, the Instrument Society of America extends an invitation to the IRE to present a technical program as part of the 16th Annual ISA Conference and Exhibit to be held in Los Angeles, September 11-15, 1961.

The Technical Secretary of the IRE has forwarded the invitation to all Professional Groups. Prof. R. M. Showers, Chairman, PGRFI, has appointed Herman Garlan, Chief, Experimental Branch of the FCC to coordinate all requests by members of PGRFI to participate. Dr. Showers believes that members of PGRFI, who are manufacturers of interference measuring equipment, as well as those who would be concerned with instrument requirements and specifications, might be interested. All inquiries should be sent directly to Herman Garlan.

The Procedures Governing Presentation of Technical Programs by Invited Societies at Conferences of the Instrument Society of America are as follows:

1. Invited societies are offered the opportunity to present technical sessions under the regulations governing ISA programing units. Specifically, ISA will print and distribute preprints of all papers submitted on schedule to ISA Headquarters at no cost or income to the cooperating society. If cooperating societies wish to furnish copies of each preprint for distribution at the function, in accordance with ISA practice, they may do so at their own expense and without remuneration provided adequate copies are supplied prior to established deadlines.

2. Invited societies retain all publication rights to papers presented at sessions which they program. However, ISA reserves the right to incorporate such papers into the bound "Proceedings" of the function if such Proceedings are prepared.

3. The program chairman for each invited society is expected to coordinate program plans with ISA's Meetings Manager at Headquarters in order to avoid simultaneous sessions on closely related subjects and to insure program consistency. Sufficient prior information must be furnished to satisfy established schedules for publicity

the type of communications RFI case with which the CIC's can cope.

Another point learned is that a committee does not have to hold regular meetings or be constantly involved in tracking down radio interference to accomplish worthwhile results. The directory listing of names, addresses, telephone numbers and company or agency affiliation published by each CIC is an equally important means of holding a group together. If the directory is kept current, any member needing assistance or advice in an RFI problem, affecting his company or organization can usually find the right person with the knowledge of what is causing the interference. Other CIC's may choose to hold regular meetings and be relatively more active, even to participating in domestic and international studies relating to interference and commenting on Federal Communications Commission proposed rule making. The choice as to the amount of extra activity rests entirely with the committee. The point is, however, that the so-called "stand-by" committee with an up-to-date directory is an effective CIC organization even if it only handles a small number of RFI problems per year. It provides an insurance policy which can at any time prove of real value to one or more members and to the community. Looking ahead to possible future increased radio spectrum congestion and to the communications satellite era, the added insurance of a CIC organization for quick personal and company reference in an RFI case seems more and more important. Thus rather than wait for the government engineer, who may be tied up on priority work elsewhere, the local CIC organization can make an immediate check (frequently by telephone) by having appropriate members of the operating staffs compare operating schedules, frequencies activated, and on-the-air observations. Off and on checks can go far in pinpointing a defective transmitter; similarly, when the source of the interference is in doubt, over-the-air observations by others should be helpful in identifying the "RFI signature" of the interference and, in verifying whether the interference is local or distant. Experience during the past six-year period has demonstrated that a well organized and integrated CIC is thus able to make a quick investigation and in many instances solve the interference through the use of its own facilities and "self help" action.

In those cases which do not lend themselves to local and reasonably prompt detection and treatment, the FCC is always ready and anxious to step in. However, as has already been indicated, if the personal services of an FCC engineer are required, some delay is usually inevitable. Here again the CIC organization can be effective. In a case of continuing interference, other than local, rather than call the nearest FCC district office for a field investigation, it would no doubt save time to place the call to the nearest FCC monitoring station--the CIC Directory would contain a listing with telephone numbers of FCC offices and stations. The call should be made by a member of the Committee who has personal knowledge of the nature, frequency and related characteristics of the interfering signal. By notifying the FCC monitoring station at a time when the interference is active, the monitoring station should be able to check the signal over the air and if needed get aid in solving the problem from the entire FCC network.

As the number of licensed radio stations and industrial, scientific and medical RF units continues to increase each year, so do the interference complaints received by the Federal Communications Commission. The FCC does not shirk its responsibility to resolve interference between its licensees. Field engineers of the FCC Field Engineering and Monitoring Bureau at radio monitoring stations and in mobile investigative units are constantly at work digging out the facts needed to solve interference cases. But the FCC Field staff is not now and never will be large enough to do the job alone. "Self-help" by radio user groups is expected. It is, therefore, natural that the CIC idea was born to obtain the benefit of group action over individual effort. AFCEA members are interested in the CIC program as their association membership represents a true cross section of the communications industry to which RFI is becoming more of a serious problem as the art advances.

CIC Idea -- Past and Present

Two AFCEA Southern California Chapter members, Ray Meyers and Al Parker, with the sponsorship and help of Bernard Linden, FCC Engineer in Charge, Los Angeles, developed the CIC idea and formed the first committee. Ray is the present chairman of the Southern California CIC. The idea spread with the help of the originators and other FCC Engineers in Charge. There are now 34 active committees throughout the country, including Alaska, Hawaii and Puerto Rico. AFCEA members are the chairmen of committees in Honolulu (Robert Britton); St. Louis, Missouri (H. G. Wise) and San Juan, Puerto Rico (Jorge Velez). AFCEA is, of course, not the only national organization helping with the CIC program. The Institute of Radio Engineers and the Joint Technical Advisory Committee groups and others have publicized it and worked for its success.

CIC Idea -- Future

For those committees finding it possible and desirable in the interest of better interference control to do more than maintain a current directory of members and corrective action on RFI cases coming to their attention, the following additional activities are suggested:

1. Together with the directory, maintain and publish a manual of successful technical solutions to particular interference problems.
2. To the extent possible, without involving a conflict of interest among members who represent the various communication services, participate as a committee in international studies relative to RFI conducted by the CISPR and CCIR study groups. Information regarding these studies can be obtained from the Telecommunications Division of the Department of State. Also, submit comments on FCC proposed rule making wherever it has a bearing on RFI, e.g., Parts 15 and 18 of FCC Rules governing Incidental and Restricted Radiation Devices, and Industrial, Scientific and Medical Services, respectively.

FCC Support

I have given instructions for the FCC Engineers in Charge and their staffs at the district offices to help in any way possible to further the CIC program. They are not members of CIC's but are available to help form the committees and to assist in resolving interference cases. The Engineers in Charge help to interest well known persons in the communications field to undertake the formation of a committee and are pleased to meet with a group at any time to explain the program. After a committee is organized, the FCC Engineer in Charge works closely with its members. He refers interference complaints to the committee if, in his opinion, they are of the type that the committee can handle. Of course, the committee gets industry-type interference complaints directly, when its existence becomes well known. If a difficult interference case cannot or should not be resolved by the committee, it is referred to the FCC for investigation.

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From: "SIGNAL", January, 1961

In SIGNAL, February 1961, under the title "AFCEA's Role in the CIC" an article has been written by Ray E. Meyers, Chairman, Southern California CIC and AFCEA Regional Vice President on how CIC works and some of the experiences which it encounters.

Military Oscilloscopes Pass Rigid Tests for Radio Interference

Under the above title an article appeared in SIGNAL, February 1961, by John Tatum, Engineering Group Leader, Oscilloscope Div., Hewlett-Packard Company. The article describes some of the techniques which were employed to reduce both conducted and radiated noise. The following are some interesting statements under "Conducted Noise":

"Conducted interference is interference that appears on the power conductors of electronic equipment. Some unusual conducted noise below 150 kc originated in solid state diodes and transistors in the power supply of the 170A. Rectifying and regulating action of the diodes and transistors caused broadband noise generation that the noise receiver detected. Adequate capacitive filtering was installed in the power supply to reduce this interference to an acceptable level. Small (.02 to .1 mf) capacitors were placed across each separate ac secondary transformer winding to attenuate switching noise from the semiconductors used in the power supply.

"Another source of conducted noise was discovered at fast sweep speeds when signals from the sweep generator and amplifier were conducted back into the power supply and finally into the power

releases, program printing and press conferences.

4. Invited societies are expected to publicize the event by announcement in their publications and by distribution of publicity materials and advance programs to their potentially interested members.

5. Members of invited societies are admitted to the ISA function and are entitled to all privileges at the reduced registration rates and fees prevailing for ISA members.

6. Invited societies will be shown as a cooperating society on the program and publicity for the event.

ITEMS OF INTEREST IN ELECTRONIC DESIGN, OCTOBER 26, 1960:

Broad-Band Communications Systems Sends, Receives, 'Intelligent Noise' - page 25

"A new broad-band military-communications system, known as 'Phantom' system, will receive and transmit 'intelligent noise or static' without interrupting or causing static on local radios.

"It represents a different approach from the conventional narrow-band military communications technique in which each transmitter and receiver is allocated a specific narrow bandwidth to avoid interference and to crowd as many channels as possible into the electro-magnetic spectrum.

"In broad-band communications the transmission bandwidth is many times larger than the intelligence bandwidth, or signal being relayed. For military communications broad-band techniques provide three types of security: security against jamming because of the tremendous amounts of power required to interfere with the transmitted signal; transmission security since the average power is spread over a wide bandwidth making the signal extremely difficult to detect; and message security in that even if the signal is detected, it can be made very difficult for an unauthorized listener to understand what is being transmitted.

"The system is under development at General Electric's Military Electronics Department of Syracuse, N.Y."

RF Filters: Eight New Types Added to MIL-F-15733 page 147

"The most significant change to MIL-F-15733 has been the deletion of all six types of filters listed in MIL-F-15733C and the addition of eight new styles. Two of the new styles are tubular; the other six are bathtub type. The tubular types have current ranges from 1 to 30 amp at 100 v dc, and 1 to 50 amp at 400 v dc (125 v ac). The bathtub types have ranges from 1 to 50 amp at 100 v dc, 400 v dc (125 v ac), and 600 v dc (250 v ac). The type designation has been expanded to include symbols for current rating, insertion loss characteristic, terminal identification, operating temperature range, and vibration grade. This spec also supersedes MIL-F-18344A (SHIPS). Radio Interference Filter, MIL-F-15733D."

ITEMS OF INTEREST IN PROCEEDINGS OF THE IRE, NOVEMBER, 1960:
Abstracts and References - pages 1945-46

"The External Noise of Commercial Aerial Installations - W. Kronjager and K. Vogt. (Nachrichtentech. Z., vol. 12, pp. 371-373; July, 1960) Measurements were made of frequency distribution in the range 2-30 Mc of the external noise received by the rhombic antennas at the receiving stations Eschborn (1634 of 1958 (Kronjaer, et al)) and Luchow. Pronounced differences in noise reception at frequencies below about 8 Mc are caused by the proximity of sources of man-made noise to the Eschborn station."

"Extraterrestrial Radio Noise as a Source of Interference in the Frequency Range 30-1000 Mc - F. Horner. (Proc. IEE, vol. 107, pt. B, pp. 373-376; July, 1960). 'Published information on the intensity of noise from the galaxy, the sun, and from other extraterrestrial sources is presented in a form which shows their importance relative to the internal noise of typical receiving installations. Particular attention is paid to a half-wave horizontal dipole antenna and to an antenna with a 20° pencil beam directed horizontally.'"

"A New Method for the Suppression of Low-Frequency Noise on Television Cables - R. Rasch. (Nachrichtentech. Z., vol. 12, pp. 416-418; August 1959.) Description of a specially developed unit for reducing the mains hum on coaxial-cable links and for improving the signal-to-noise ratio at low frequencies for crosstalk on parallel video transmission lines.

ITEMS OF INTEREST IN ELECTRONIC INDUSTRIES, NOVEMBER 1960:

On page 216 - "Certain Aspects in Bearing Determination of Interfering Waves, Y. A. Yeruchimovitch. 'Radiotek' 15, No. 6, 1960. 5 pp. In this article processes are analyzed of finding directions of two interfering radio waves using amplitude sensitive direction finders with direct reading. Laws, governing the elliptic form and errors of bearings, are established, as well as their relationship with other parameters of the incident waves. Attention is called upon the important function of the lateral inclination of waves from the circle of their propagation along the earth's surface. The following phenomena are explained: 'parallelogramming', 'wandering bearings' and 'circular reception'. A number of practical recommendations are also given. (U.S.S.R.)"

On page 208 - "A Method of Reducing the Image and Combination Interference in a Superheterodyne Receiver - by B. N. Mityashef. 'Radiotek' 15, Nov. 7, 1960. 2 pp. A brief description of a new method to eliminate image and combination interferences produced in superheterodyne reception. This method permits more advanced and perfected design of receivers. Results of an experiment are included. (U.S.S.R.)"

On page 214 - "Analysis of Noises in Power Lines of o.4/6 KV." L. B. Venchkovskii. 'Avto i Tel.' Aug. 1960, 9 pp. The results of analysis of noises in the power line of the oil lease of 0.4/6 kv in the range from 150 c to 100 kc are given. (U.S.S.R.)"

ELECTRON BEAM WELDING TO BE STUDIED:

As soldering of electrical connections is becoming less and less popular as a means of making low ohmic paths for R. F. energy, new techniques of welding are becoming of increasing interest. Electromechanical Design, December 1960, carries the following news item:

"Electron beam welding of electrical connections for micro-assemblies will be studied at Hamilton Standard's Electronics Dept., Windsor Locks, Conn., under a contract from the Signal Corps. The contract covers the development of welding techniques for the interconnection of micro-assembly wafers or substrates, each containing tiny electronic circuits. A micro-assembly is formed by stacking the substrates, which vary in thickness from 0.010 to 0.30 inches thick, one over the other and interconnecting them with vertical wires. In normal manufacturing, solder is used to make the multiple inter-connections between the wavers. However, as the parts density increases, smaller connections are needed on the edges than are possible with conventional soldering methods. The electron beam study will explore methods of welding the interconnections at densities of 1,600 per square inch. To illustrate the minuteness of the work, Dept. Mgr. Walter R. Bush noted that a period on a typewriter is 100 times larger than one of the welds that will be made. The Hamilton-Zeiss electron beam welding machine can be focused to a spot size less than 0.010 in diameter and achieve depth to width ratios in weldments as great as 20.1."

ALL SPACE EXPERIMENTS TO TRANSMIT DATA ON 136-137 MC:

Electronics, December 16, 1960, contained the following item on page 14. It is of interest because of the interference angle:

"All space experiments from now on will use 136-137 Mc to transmit data back to earth. National Aeronautics and Space Administration has added the necessary antennas and electronic equipment at eight of its Minitrack stations. Dual capability - on both 108 Mc

and 136-137 Mc - is being retained to accommodate space experiments still transmitting on 108 Mc.

"Reason for the shift is that the 108 Mc is too close to existing television channels and interference has been a nuisance. Space use of 108 Mc was approved by Federal Communications Commission only as a temporary measure for the International Geophysical Year.

"NASA expects to have all of its 13 Minitrack stations converted to the new frequency by next May. Cost to change the Minitrack stations is about $250,000 apiece".

AMPLITUDE-PROBABILITY DISTRIBUTIONS FOR ATMOSPHERIC RADIO NOISE:

Under the above title is NBS Monograph 23 issued November 4, 1960 by the U. S. Department of Commerce, National Bureau of Standards, by W. Q. Crichlow, A. D. Spaulding, C. J. Roubique, and R. T. Disney. The introduction states, in part:

"A knowledge of the detailed characteristics of atmospheric radio noise is essential to the design of radio communication systems operating at frequencies up to about 30 Mc/s. These characteristics can conveniently be expressed in terms of an amplitude-probability distribution which has been found to be an extremely useful tool in the analysis of the expected interference to a communication system. However, since the measurement of the complete amplitude-probability distribution on a continuous basis for many frequencies and locations is prohibitive in both manpower and equipment needs, a method of obtaining this distribution from three easily measured statistical moments has been developed at the National Bureau of Standards. The three moments are the average power, the average envelope voltage, and the average logarithm of the envelope voltage...."

This report may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. - Price 20 cents.

ADAPTIVE WAVEFORM RECOGNITION:

Under the above title General Electric Research Laboratory has prepared an information study by C. V. Jakowatz, R. L. Shuey, and G. M. White and is issued as Report No. 60-RL-2353 E (revised). A copy of the Report may be obtained by writing to Research Information, Room 1A66, Research Laboratory, P. O. Box 1088, Schenectady, New York. The abstract states:

"The work reported grew out of a study of systems capable of selecting 'significant' events from an environment. The system described 'learns' to recognize the individual members of a set of randomly occurring unknown, but fixed, waveforms buried in additive noise. The system consists of a set of adaptive filters and is best described in terms of one of those filters.

"With experience a specific adaptive filter alters its characteristics so that it contains in its memory one of the unknown waveforms. When this occurs, a portion of the system converges to the matched filter for that waveform. The conditions required to initiate convergence are more severe than those required for detection of a known waveform by a predesigned filter. The utility of the adaptive filter is in circumstances where a priori information concerning the waveform to be detected is only partially available, or the waveform is slowly changing. By learning, the filter obtains and then utilizes the information required for the design of an optimum filter. In addition, at any instant the system can provide an estimate of the unknown waveform and its confidence in that estimate.

"The adaptive filter continuously correlates the input with a waveform in memory, i.e., the waveform for which it is a matched filter. When the correlation is sufficiently great: (a) it modifies its memory so that the stored waveform is a weighted average of the previous contents of memory and the input; and (b) it increases the value of correlation required to modify the memory. Both the information in memory, and the degree of correlation required, decay with time.

"In the absence of a signal, the filter reaches an equilibrium state in which the contents of memory continuously change in a random fashion. In the presence of a randomly occurring fixed waveform, if the memory contains a sufficiently large component of the signal, the filter in a statistical sense preferentially accepts samples containing that waveform. When this occurs, convergence is initiated. The accuracy of the concept of the waveform in memory and the degree of correlation required for the acceptance of an input simultaneously rise.

"A waveform recognition system has been constructed that utilizes a ten-tap delay line of 500 cps bandwidth. Adaptation to two input waveforms has been demonstrated. Experimental performance curves will be shown. In the experiments performed, the system detected and converged to signals, the presence of which could not be detected by a human, given the input in acoustical and visual form.

"Adaptive waveform recognition, as a classifying and association system, will be briefly discussed."

C.C.I.R. PREPARES PRELIMINARY DRAFT OF RESPONSE TO QUESTION NO. 190:

The U.S. CCIR Study Group VIII has prepared a Preliminary Draft of Proposed Response to Question No. 190 - "Identification of Sources of Interference to Radio Reception". This is the Question to which members of PGRFI were asked to contribute through a letter from George Turner, of the FCC, which appeared in the PGRFI Newsletter No. 9, March 1960.

The Preliminary Draft disucsses the material assembled to date and the manner in which it might be presented to those in government and industry and requests suggestions from all those interested in the control of electromagnetic energy. Copies of the Draft have been kindly made available to members of PGRFI, on request, by writing to George S. Turner, Chairman, U. S. Study Group VIII, Federal Communications Commission, Washington 25, D. C.

THE FCC CONTROLS MAN-MADE RFI:

Under the above title, Electronic Industries, October 1960, carries an article by Edward W. Allen and Herman Garlan, of the FCC. The sub-head of the article states:

> "The FCC is the official U. S. agency responsible for controlling RFI that disturbs the reception of desired transmissions. How this is accomplished, their enforcement procedures, and what they actually regulate are given in detail with some of their problems".

ARTICLES ON RFI PLANS AT FORT HUACHUCA:

For those who wish to check on what is going on at Fort Huachuca, Arizona, in regard to RFI, the following articles have appeared:

> Fort Huachuca: Arbiter of Army Electronics, Electronics, November 11, 1960.
>
> Signal Snarl, Army's Increasing Use of Electronic Gadgets Brings Static Problem: Wall Street Journal, Nov. 11, 1960

NEW BOOKLET ON TVI CAUSES, EFFECTS AND SOLUTIONS:

An 18 page booklet has been prepared for the Washington, D. C. Television Interference Committee, titled "A General Review of TVI Causes, Effects and Solutions", by the Babcock Electronics Corp., and Cannon & Sullivan Technical Publications of California. Other literature on TVI is also available from the WTVIC. Single copies may be obtained by sending a self-addressed, 9 x 12 envelope with either 6 cents for third class or 16 cents for first class attached, to Harold R. Richman, Editor, Washington TVI Committee TVI Aids, 1110 Lake Blvd., Annandale, Virginia. Multiple copy quotations may be obtained by writing Ferris N. Smith, Babcock Electronics Corp., 1640 Monrovia Avenue, Costa Mesa, California.

LOWER LINE FREQUENCIES INTERFERE WITH HEARTBEAT RADIO:

In Electronics, December 23, 1960, is an article titled "Radio

Transmitter for Remote Heartbeat Measurements" by G. A. Harten, Philips Research Laboratory, Eindhoven, Netherlands. A paragraph of interest is as follows:

"To reduce interference, the pulse amplifier passes frequencies between 1 and 3 cps, that is, 60 to 180 heartbeats a minute. Chief causes of interference were a-c power lines (hum) and unduly sharp movements by the subject, which have a frequency on the order of 10 cps. The ear must be screened if a powerful infrared source is near, since the ear is transparent to infrared and the phototransistor will respond to radiation up to 1.5 μ."

ELECTRONICS PUBLISHES BIBLIOGRAPHY ON INTERFERENCE:

On Page 78 of Electronics, December 23, 1960, is a bibliography of material which has appeared in Electronics in the past 6 months:

Army Proving Ground, testing for	BF 38	Nov. 11
Grounding, shielding and design to reduce interference	TF 84	Sept. 9
Metal-filled silicone shielding	CM119	July 29
Probe r-f interference at satellite altitudes	EN 11	Oct. 14
Standard adopted by services	BF 37	July 1
Wire mesh makes flexible r-f shields	PT90	Oct. 21
Interferometer measures projectile acceleration	TF68	Sept. 16
Interferometer system to track missiles	GF 38	July 29

FOREIGN ITEMS OF INTEREST IN ELECTRONIC INDUSTRIES:

In the December, 1960, issue of Electronic Industries on page 152 are the following foreign items of interest:

"Recording Atmospheric Radio Noise, Use of Magnetic Tape, C. Clarke, 'El Tech.', Sept. 1960. 1 p. A comparison of noise structure on 24 kc/s obtained from direct measurement and via the medium of tape recording shows that the results are statistically indistinguishable. (England)."

"Input Impedance of Interference Meters for the Broadcast Frequency Band. I. M. Fourmanhoc. 'Radiotek' 15, No. 6, 1960. 4 pp. Equations are derived for calculations of the input impedance of interference meters for the broadcast band of frequencies (0.15-20.00 Mgcs). The input impedance is determined for the typical model -12-2M interference meter. Offered is the input circuit of the meter with a matched divider for measurements of radio interference. Circuit is in the equivalent circuit form. (U.S.S.R.)."

INSTANCES OF RADIO INTERFERENCE:

Electronic Industries, December 1960, on page 40, mentions the following instances of radio interference:

"RFI-ODDITY: An airline at Chicago reported interference to its airground radio communication. The Allegan and Chillicothe monitoring stations of FCC 'fixed' the area of its source and local investigators traced it to a Michigan piano factory. There a radio frequency heater was doing a good job of drying wood glue, but it was also putting out a hefty radio emission that could be heard hundreds of miles away.

"Radar used for air traffic control at Oakland, Calif., experienced interference of long duration before FCC assitance was asked. An FCC engineer with a mobile unit speedily determined that the disrupting signal was coming from a radar installation on Mount Tamalpais. The bearings were accurate enough to show which of the three radar units there was responsible. The Air Force took immediate steps to eliminate its trouble.

"One Ohio monitoring station received complaints by an electronics firm about interruptions of its communication in the citizens band. The wayward transmissions were deciphered to be taxicab dispatching messages. However, they were accompanied by no call signals or other identification. Direction finders fixed their origin in Bermuda. Inasmuch as citizen frequencies are used on a shared basis without interference protection, there was no justification for complaining to the British authorities.

"When an international telegraph carrier complained of multiple interference on its circuit to Saudi Arabia, the FCC net found that it was caused by 10 different radio stations scattered throughout the world."

PROPAGATION CONSIDERATIONS IN RFI:

In the December 1960, issue of Electronic Industries is an article with the above title by L. Valcik and R. B. Schulz, Armour Research Foundation, Illinois Institute of Tech., 10 West 35th Street, Chicago 16, Illinois. The subhead states:

"The electromagnetic field generated by a radiating antenna is quite complex. This complex field is the result of the simultaneous propagation of the energy by several modes. These modes are used for desired transmissions and, unfortunately are also available for undesired signals. The characteristics of these modes are described

ELECTRONIC INDUSTRIES PUBLISHES BIBLIOGRAPHY ON RFI:

In Electronic Industries, December, 1960, page 225, is a biblic graphy of material on radio frequency interference which has appeare in this publication in the past 12 months:

Consider Interference in Systems Design	Rocco F. Ficcki	3-142
Controlling RFI Susceptibility in Receivers	H. M. Sacks & J. J. Krstansky	9-92
Detecting Interference to Missiles	H. Kilberg	4-170
The FCC Controls Man-Made RFI	Edward W. Allen & Herman Garlan	10-86
Guide to RFI Filters		6-124
Making Transmitters RFI-Free	C. E. Blakely & R. N. Bailey	3-133
New System Defeats Multipath Effect	George A. Scheer	5-150
Predicting the Antenna's Role in RFI	Ernest Jacobs	5-96
Propagation Considerations in RFI	L. Valcik & R. B. Schulz	12-80
RFI in Satellite Communications Systems	O. M. Salati	4-92
RFI is Everybody's Business	John E. Hickey, Jr.	3-131

ELECTRONIC DESIGN PUBLISHES BIBLIOGRAPHY ON RFI:

In the December 21, 1960 issue of Electronic Design, page 148, is the following bibliography of material on radio frequency interference which has appeared in this publication in the past 6 months:

Interference key to space frequency controversy	EDN p4 Aug 3
RFI compatibility plan set up by DOD	EDN p4 July 6
RFI measurement tool - the impulse generator	ART p68 July 2
RFI - natural interference in space systems	ART p90 Aug 3
RFI test equipment	ART p74 Sept 1
Radar interference with microwave communications	DIG p160 July 2

COMPLETE STORY ON VEHICULAR INTERFERENCE TO BE PRESENTED:

D. H. Short of Delco-Remy, Anderson, Indiana, plans to presen a paper at the Society of Automotive Engineers' meeting in March 196 This paper will cover the complete story on vehicular interference from the automobile standpoint. The title and cost of obtaining an official copy from the SAE will be mentioned in a forthcoming issue of the Newsletter.

NEW BOOK ON INTERFERENCE CONTROL:

"Eliminating Man-Made Interference" by Jack Darr of Mena, Arkansas, has been published by Howard W. Sams & Company, Inc. It is 160 pages and costs $2.95. The chapter headings are as follows:

Introduction ..... Chapter 1
Definitions - Noise Versus Interference - Spectral Distribution of Random-Noise Energy - Signal-to-Noise Ratio and the Bandwidth of a Receiver.

Noise and Its Elimination ..... Chapter 2
Causes of Man-Made Noise - Transmission of

Electrical Noise - Transmission Characteristics of Noise - Noise-Reducing Components - Suppression-Shielding

Noise Filter Design.....Chapter 3
The Basic Filter Circuits - Filter Efficiency - Filter Configurations - Basic Filter Types - Filter Design Formulas - Tuned Filters - Building Your own Filters - Commercial Filters

Locating Interference.....Chapter 4
Noise Detectors - Noise Indications - Using an Auto Radio to Narrow Down Noise - Intermittent Noises - Very High-Level Noises - Tracing High-Level TVI Sources

Small AC Motors.....Chapter 5
Motor Types - Servicing and Repairing Small Motors

Case Histories..... Chapter 6
Random Noise from Motors - Random Noise from Gas Discharges - Miscellaneous Random Noises - Intermittent Random Noise - RF Interference in Audio Systems - RF Interference in Radio Receivers - RF Interference in Television Receivers - Interference from Amateur Transmitters

Automobile Radios..... Chapter 7
Noise Sources in a Car - The Automobile Electrical System - The Ignition System - Generator Noise - Front-Wheel Noise - Instrument Noise - Noise from Other Electrical Equipment - Shielding, Bonding, and Body Noises - Corona - Antenna Troubles - False Noises - Alternators - Imported Cars and U. S. Compacts

Two-Way Mobile-Radio Systems..... .Chapter 8
General Description - Testing FM Receivers for Noise - Shielded Ignition Systems - Receiver Adjustments - Noise in Base-Station Receiver

Aircraft Radio..... Chapter 9
Aircraft Engines - DC Voltage Supply System - Aircraft Radio Equipment - Electrical Noise in Aircraft Radio

Marine Radio.....Chapter 10
Marine Engines - Lighting Generators - Other Electrical Equipment - RF Interference: Distress and Communication Channels

Unusual Noise and Interference..... Chapter 11
Interference from Inductive Controls - Electronic Medical Apparatus - Geophysical Equipment - The Shielded Room

The FCC and Its Role in Interference Complaints.....Chapter 12
FCC Monitoring Stations - How to Report a Complaint of Interference - Unusual Cases of Interference

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NEW BOOK

Electrical Noise - by W. R. Bennett, Data Communications Consultant, Bell Telephone Labs., 288 pages, 6 x 9, 106 illustrations. McGraw-Hill, $10.00.

"How noise originates in electrical circuits, the terms in which it is described, how it is measured, and how circuits may be designed to minimize undesirable effects from noise are presented in this newly published book. It describes in qualitative and quantitative terms the physical nature of various important noise sources, including thermal agitation or resistance noise, shot noise in vacuum tubes and semiconductor junctions, noise from spontaneous emission of electromagnetic radiation, and noise in gas discharges. Fundamentals needed for analyzing basic sources of noise are covered, and methods of measurement and design are stressed. A discussion of the relation of signal and noise in communication systems of various types is included

"Coverage of recent advances includes a treatment of noise in transistors, masers, and parametric amplifiers. Among the subjects of special interest are the properties of thermal noise and its relation to black body radiation, and an introduction to elementary mechanics which is woven into the discussion of the maser and of noise in semiconductors. Fundamental facts about such devices as junction diodes, transistors, gas discharge tubes, klystrons, traveling wave amplifiers, and nonlinear reactive amplifiers are given as an adjunct to thei noise properties. In addition to the standard theory of noise figure and its significance, a treatment is given of the more comprehensive Haus-Adler theory of noise measure. The book also presents a comprehensi review of noise in the various methods of signal transmission such as amplitude modulation, frequency modulation, and the different kinds of pulse modulation".

NEW PRODUCTS:

Electronic Design, September 28, 1960, page 83, carried the following news item:

"Radar Interference Eliminator - No modification of present systems needed - This beacon interference eliminator may be used wit any standard radar having a beacon capability of IFF or ATC Identifica tion. The device is connected into the video lines connecting the radar beacon receivers with the display, requiring no modification of present systems. The instrument eliminates spurious signals from radar displays through a passive operation, and the output is proportional to the input. Lockheed Electronics Co., Dept. ED, Plainfield, N. J., Booth 529 B."

Radio Frequency Interference Calculator: - Stoddart Aircraft Radio Co., Inc., 6644 Santa Monica Blvd., Hollywood, Cal., has developed a slide-chart for use with its NM-52A, 375 - 1000 mc. Detail are as follows:

The Radio Frequency Interference Calculator supplied with the NM-52A RFI Meter replaces the normally used chart set. With one setting of the calculator slide the RFI meter indication in μv or db is transcribed into all the standard terms or units in general use in military specifications on RF interference. This one setting also corrects for the antenna factor when taking radiated measurements.

For radiated CW or Narrowband measurements, four NB scale are provided. These give direct and simultaneous answers in the following terms:

(1) μv antenna induced voltage (or antenna open circuit voltage)
(2) Db above 1 μv antenna induced.
(3) Microvolts/meter.
(4) Db above 1 μv/meter.

For Broadband measurements, both conducted and radiated, eight BB scales are provided. These give direct and simultaneous answers in the following terms:

(1) μv/mc.
(2) Db above 1 μv/mc.
(3) μv/kc.
(4) Db above 1 μv/kc.
(5) μv/kc antenna induced.
(6) Db above 1 μv/mc antenna induced.
(7) μv/meter/kc.
(8) Db above 1 μv/meter/kc.

The RFI calculator may also be used to transcribe the above listed radiated limit terms from one to another or the conducted limit terms from one to another (e.g.) μv/kc to db above one μv/mc or μv/meter/kc to μv/kc antenna induced.

In addition to the scales, the back of the calculator provides information on measurements, instructions in the use of the calculator procedure for standardizing equipment gain, and instrument bandwidth data.

Additional Calculators are to be developed for their other instruments. The price of the above Calculator is $12.50.

Electromagnetic Interference Test Console: - The Northrop Corporation, Norair Division, 1001 East Broadway, Hawthorne, Calif. has announced the new EMI Electromagnetic Interference Test Console Model 101. It is mobile and can be used for rapid interference testing of complex electronic and electro-mechanical systems and compatibili testing of power and control functions. Inquiries should be addressed

to the Marketing Department of the company.

NEW SERVICES:

"INTERDICT" by Capehart Corporation:

On Page 15 of the February 24, 1961 issue of Electronics, appears an advertisement of the Capehart Corporation announcing the formation of a new service called INTERDICT - Interference Detection and Interdiction by Countermeasures Team - to handle site problems involving r-f interference for the military or industry. Dr. Joseph H. Vogelman, who authored the article which appeared in Electronics, February 3, 1961, titled "Graphical Method Predicts Radio Interference", heads up this new service.

Electromagnetic Compatibility Analysis:

On page 19 of Electronic News, February 27, 1961, appears an advertisement of the Armour Research Foundation, Chicago, Ill., announcing the expansion of its facilities in the area of Electromagnetic Compatibility Analysis and immediate openings in the Chicago and Washington, D. C. areas.

EDITOR'S NOTE:

Another issue of the Newsletter is planned to appear after the IRE International Convention as permission to publish certain news items could not be obtained in time to meet the dead-line on this issue.

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