



PROFESSIONAL
GROUP ON
RADIO
FREQUENCY
INTERFERENCE

NEWSLETTER

NUMBER 9

MARCH, 1960

QUESTION NO. 190 (VIII)*

C. C. I. R. Ask for Help:

"Federal Communications Commission
Washington 25, D. C.

February 2, 1960

Editor - PGRFI Newsletter
Monument Street
Concord, Mass.

Dear Sir:

A new question for study by Study Group VIII, International Radio Consultative Committee (C. C. I. R.), on the subject - IDENTIFICATION OF SOURCES OF INTERFERENCE TO RADIO RECEPTION - was adopted at the IXth Plenary Assembly last April at Los Angeles. A copy of the Question is enclosed for your information in the event you do not have Volume II of the IXth Plenary published documents.

Study of this Question seems to fit in closely with the work of the IRE Professional Group for Radio Frequency Interference. You will note from the text of the Question that a reference manual or book, possibly augmented by aural recordings, is envisioned to help in identifying sources of radio interference.

It appears to me that the answer to that part of the Question concerning desirability is obvious, i. e., that such a reference is certainly desirable if it is possible to enlist enough interest to compile such information. It would be useful to everyone concerned with radio, including radio and monitoring station personnel, manufacturers of radio equipment, and even segments of the listening and viewing public.

It would not be necessary to finish completely such a manual of interference in order to answer the question initially. But a start should be made to include, for possibly two or three dozen prevalent types of interference, written descriptions showing characteristics (see paragraph (d) of the Considerings), oscilloscope pictures or sketches of interference patterns and tape recordings of the aural sounds. Also, a proposed format should be developed for presenting the study as a U. S. response to the C. C. I. R. Question.

Would you be so kind as to present this problem to the PGRFI to enlist their help? I would be pleased if you would coordinate the information developed by studies of this Question. If you cannot do so personally, could you please suggest to me someone else who will undertake the assignment? As you know, there are, in all, nine different Questions and Study Programs for which CCIR Study Group VIII is responsible. This makes it necessary to enlist volunteers to coordinate different studies. I know of no one or no group more qualified than members of the PGRFI to contribute to this particular Question on RF interference.

Sincerely yours,

George S. Turner
Chairman, U. S. Study Group VIII, CCIR

Encl. - 1

Geo. S. Turner
Chief, Field Engineering and Monitoring Bureau
Federal Communications Commission
Washington 25, D. C.

IDENTIFICATION OF SOURCES OF INTERFERENCE TO RADIO RECEPTION

The C. C. I. R.,

(Los Angeles, 1959)

CONSIDERING

- (a) that a list of all electrical and electronic equipment which might at time cause radio interference would include practically every device that uses electricity;
- (b) that interference-causing radiations have individual characteristics which, when observed aurally or visually, sometimes enable an experienced monitoring observer to identify the type of equipment producing the radiations;
- (c) that it would be helpful in solution of interference problems for both monitoring observers and radio station operators to compare interfering signals with a ready reference of all types of such signals which permit of cataloging individual signal characteristics;
- (d) that individual characteristics mentioned in (c) might include, but not be limited to, frequency range, distance range, on-off cycle, times of day the equipment source most generally used, characteristic note or tone, degree of frequency stability, usual bandwidth, type of signal as viewed on oscilloscope or panoramic presentation, type of equipment source and cause of radiations;

UNANIMOUSLY DECIDES that the following study should be carried out:

the possibility and desirability of listing by written description, aural recording and pictorial presentation, as appropriate, the individual characteristics of all observed types of interfering radiations, from either radio stations or electrical and electronic sources, where such references would assist in identifying a particular interfering signal.

* Account to be taken of the work of the C. I. S. P. R., in connection with this subject.

EDITORIAL COMMENT

Your editor will be glad to start coordinating the information requested by the Chairman of the U. S. Study Group (VIII) C. C. I. R. if he can count on a great deal of help from the other members of PGRFI. He would also like volunteers, from among those who have had some experience along these lines, to assist him in the different fields of electrical and electronic interference such as public utilities, rotating machinery, radar, medical and scientific equipment, home appliances, etc.

He would also like samples of suggested formats in which would be included all the technical information which would be required by all possible users of this data; a glossary to describe the sounds which would appear on the aural recordings; any drawings or oscilloscope pictures which have already been taken, and any suggestions which will help get out the material for this Handbook in the shortest possible time.

This is a project in which every member of PGRFI can take a part, no matter how small. This also includes our foreign members who, I am sure, must already have something on this order. Due to the one-month timelag in getting out Newsletters, please have everything in by one month from the time you receive this issue. Please send all material to: Rexford Daniels, Editor, Monument Street, Concord, Massachusetts, U. S. A.

Headquarters

WRIGHT AIR DEVELOPMENT DIVISION
Air Research and Development Command
United States Air Force
Wright Patterson Air Force Base, Ohio

Reply to
Attn. of: WCLNTI/Mr. Seth/23246

Subject: MIL-I-6181D

15 January 1960

To: Institute of Radio Engineers
ATTN: PGRFI
72 West 4th Street
New York 36, New York

1. The January 1960 Newsletter of the Professional Group on Radio Frequency Interference contains several errors. These errors will cause unnecessary correspondence, create serious misunderstanding, and delay in obtaining essential information. Please correct these errors as soon as possible. These errors are:

a. MIL-I-6181D supersedes MIL-I-2600 only on equipment intended for manned aircraft. MIL-I-26600 will continue to be used by the USAF for most other applications.

b. MIL-I-6181D is not a USAF specification. It has been fully coordinated and will be used by all three services.

c. Copies of MIL-I-6181D are not available now and will not be for 90-120 days. When they are available, they will not be available from Mr. N. D. Flinn, or any other individual at the Wright Air Development Division.

d. MIL-I-6181D is not a study document. It has been fully coordinated by the three services, and represents the maximum coordination possible at this time. It was officially issued, and will be dated, 25 November 1959.

e. This Division can supply copies of MIL-I-6181D only to USAF contractors. Copies should be ordered from:

Administrative Services
AF Publications and Engineering Data Division
ATTN: EWB FED
Wright-Patterson AFB, Ohio

2. Please ask the PGRFI to coordinate all future statements of this type to ensure that the information is correct.

Saul Weissman
Chief, Weapon System Intergration Br.
Comm & Nav Laboratory

We are very pleased to have the above corrections to the following paragraph from Excerpts of the Meeting of the Administrative Committee, June 15, 1959, as published in the January 1960 issue of the Newsletter:

"Chairman Schwenk suggested that an appropriate activity for this committee would be a technical advisory study of the new Air Force specification on interference, MIL-I-6181D. Mr. Milton suggested that official copies of this specification could be obtained by writing Mr. N. D. Flinn at Wright ADC."

ELECTRONIC DESIGN GETS OUT SPECIAL REPORT ON RFI:

The February 3, 1960 issue of ELECTRONIC DESIGN has published a Special Report on RFI. The issue contains an editorial "U.S. Must Demand Radio-Frequency Interference Control." The Special Report contains the following articles:

"Radio Frequency Interference - An Electronic Design Staff Report."..... 24

"Radio frequency interference, RFI, poses a serious threat to equipment and system reliability. Major steps are being taken to control RFI by consideration during initial design."

"RFI - An Up-To-Date Survey"..... 26

"A thorough coverage of RFI developments in communication and radar systems, measurement techniques and components - R. B. Schulz, H. M. Sachs, G. C. Vallender."

"RFI Check-List"..... 38

"Over 50 points to remember to reduce RFI where it does the most good - in the early design stage - L. W. Thomas."

"Interference Trouble-Shooting With Clamp-On Devices".... 44

"How to trouble-shoot wire-coupled interference in complex electronic installations conveniently, without cutting cables, by using clamp-on ammeters and injectors - T. H. Herring."

"Optimum Shielding Of Equipments Enclosures"..... 48

"How to select shielding materials and determine their effectiveness - A. L. Albin."

Additional articles on RFI, to appear in future issues, are:

"FCC Control of RFI", J. Deitz, Federal Communications Commission.

"RFI in Space Vehicles", J. Lee, Melpar, Inc.

"Methodology of Interference Prediction", W. Floyd of Melpar, Inc.

"Prediction of Transmitter Intermodulation", R. N. Bailey, Georgia Institute of Technology

"Prediction of Receiver Intermodulation", C. E. Blakeley, Georgia Institute of Technology

"RFI Gasketing", O. P. Schreiber, Technical Wire Prod., Inc.

"Dissipative Filters for Switching Contacts", R. Schulz, Armour Research Foundation.

"Generation of High-Power \sin^2 Video Pulses", A. F. Standing, Avco Corporation

"Government Specifications and Measurement Techniques", A. R. Kall, Ark Engineering Company

"Calibration of Radio Noise Interference Meters", M. J. Rodriguez, Polarad Electronics Corporation

ELECTRONIC INDUSTRIES to Run Series of Articles on RFI:

On page 69 of the February 1960 issue of ELECTRONIC INDUSTRIES is the following notice:

"Coming Soon:

Radio Frequency Interference Studies

A new series of articles discussing extremely important areas of this most timely subject. Our editors have arranged with more than ten of the most prominent engineers and scientists for this exclusiv

series. Study areas in this series include: Transmitters, Antennas, Transmission Lines, Receivers, Propagation, Instrumentation, Man Made RFI, Satellite Interference, The Role of Management, etc. This series running in Electronic Industries throughout 1960 will provide valuable and important reference data..."

IRE STANDARDS ON METHODS OF MEASURING NOISE IN LINEAR TWOPORTS, 1959

In the Proceedings of the IRE, January 1960, page 60, is the following on the above Standard:

"Approved by the IRE Standards Committee, June 11, 1959, Reprints of this Standard, 59 IRE 20, S1, together with the tutorial paper, 'Representation of Noise in Linear Twoports,' which immediately follows the Standard in this issue, may be purchased while available from the Institute of Radio Engineers, 1 East 79th Street, New York, N. Y. at \$0.75 per copy. A 20 per cent discount will be allowed for 100 or more copies mailed to one address."

REPRESENTATION OF NOISE IN LINEAR TWOPORTS:

The Proceedings of the IRE, January 1960, page 69, contained in article with the above title. The summary is as follows:

"This is a tutorial paper, written by the Subcommittee on Noise, RE 7.9., to provide the theoretical background for some of the IRE Standards on Methods of Measuring Noise in Electron Tubes. The general-circuit-parameter representation of a linear twoport with internal sources and the Fourier representations of stationary noise sources are reviewed. The relationship between spectral densities and mean-square fluctuations is given and the noise factor of the linear twoport is expressed in terms of the mean-square fluctuations of the source current and the internal noise sources. The noise current is then split into two components, one perfectly correlated and one uncorrelated with the noise voltage. Expressed in terms of the noise voltage and these components of the noise current, the noise factor is then shown to be a function of four parameters which are independent of the circuit external to the twoport."

OTHER ITEMS OF INTEREST IN PROCEEDINGS OF THE IRE, 1/60:

Page 107 - "THE OPTIMUM NOISE PERFORMANCE OF TUNNEL-DIODE AMPLIFIERS"

"The noise in a tunnel diode has been found to be essentially of the shot-effect type."

Page 111 - "FREQUENCY DEPENDENCE OF THE NOISE AND THE CURRENT AMPLIFICATION FACTOR OF SILICON TRANSISTORS"

"The theory of noise in junction transistors has been well verified experimentally in the case of germanium transistors at ordinary operating temperatures and low injection levels. There have been reports of discrepancies between theory and experiment, however, in the case of germanium transistors at low temperatures (say that of liquid nitrogen) and in the case of silicon transistors. The purpose of this paper is to present some recent experimental evidence concerning these discrepancies."

Page 114 - "SHOT NOISE IN TRANSISTORS"

"The theory of shot noise in transistors presented in an earlier paper has to be modified for silicon transistors to take account of trapping effects in the emitter space-charge region. It is the aim of this paper to discuss this modification."

HAZARDS OF ELECTROMAGNETIC RADIATION:

Naval Research Reviews, January 1960, contained the following article with the above title:

Check with liaison officer

"Several scientists and engineers at the U.S. Naval Ordnance Laboratory, White Oak, Md., are participating in a research program, RAD HAZ - for Radiation Hazards - now being actively pursued by all military services and also private industry. The 'problem in search of a solution' is that of radio-frequency energy from radio and radar transmitters which has caused a number of accidental rocket firings; high-intensity in ship structures and carrier aircraft; and burns suffered by personnel.

NOL is engaged in studying one aspect of the problem under the HERO project - Hazards of Electromagnetic Radiation to Ordnance. This aspect of the problem is complicated by the many different types of weapons and electrically initiated explosive components placed in operation. In addition to laboratory research at NOL, White Oak, representatives of NOL have taken part in field tests at the Naval Ordnance Test Station, China Lake, Calif., and on board aircraft carriers.

NOL research is presently centered on establishing the sensitivities of various initiating devices to radio-frequency energy. The primary vulnerability of a weapon to radio-frequency initiation is usually found in the electro-explosive device, the normal means of initiating the weapon. Since World War II, radio and radar transmitting equipment have become progressively more powerful. During the same period, electroexplosive devices have been designed for ever greater sensitivity to ensure reliable performance. The work at NOL is essentially part of a long-range program which will eventually result in the establishment of radio-frequency tolerance limits for all weapons and components. Present work of the HERO project at NOL is devoted largely to determining the sensitivities of various electroexplosive devices to electromagnetic radiation.

The earliest experiences with radio-frequency hazards to explosives were in private industry. A report published in 1953 by the Institute of Makers of Explosives stated: 'When they are in operation, all transmitters of radio and related radio-frequency services, such as television and radar, create a field of electrical energy in the air surrounding their antennas. It has been found that ... electrical blasting caps may pick up enough of this energy to cause them to explode.' Tables included in this report covered minimum safe distances from transmitters for electric blasting operations and operating characteristics for most types of radio-frequency transmitters.

In the over-all HERO test program, involving every branch of the military and naval services as well as private industry, all types of ordnance have been exposed to all sorts of electromagnetic radiations. Each weapon or component poses an individual problem. An early finding was that rockets in certain types of launchers were highly susceptible to accidental premature ignition from radio-frequency energy emanating from deck-edge whip antennas. As a result, restrictions were placed on the use of these particular launchers until they could be modified to eliminate the hazard.

The Bureau of Ships has over-all responsibility for coordinating the RAD HAZ program for the military services. Contributing to the program are HERO, undertaken by BuOrd and BuAer, and SPARKS, related to hazards to fuels and other volatile materials, under BuShips. A third aspect, under the Office of Naval Research, is BIO, related to personnel and health hazards encountered from radio-frequency energy.

ITEMS OF INTEREST IN ELECTRONIC DIGESTS, JANUARY, 1960:

"BIG DISH MEETS HUGE INTERFERENCE PROBLEMS" - abstracted from the article, "The Big Dish", by R. Adm. E. J. Peltier, Chief of USN Bureau of Yards and Docks, and G. W. Higgs, Jr.

"A sixty-foot radio telescope will be merely an adjunct to the 'Big Dish', the world's largest radio telescope (600 feet in diameter), being constructed by the Navy for research purposes at Sugar Grove, W. Va. Sensitivity of the Big Dish will be so great that the 60-foot-diameter radio telescope is needed to find terrestrial sources of radio noise that might interfere with radio wave reception.

The gigantic instrument being protected in this way 'is designed to detect radio-emitting galaxies billions of light years away, at many times the range of the best optical telescopes', according to the latest issue of The Military Engineer. 'The high sensitivity of the instrument',

the magazine continues in an article entitled The Big Dish, 'is a two-way problem. Not only is the sensitivity difficult to achieve, but also it is difficult to protect... The problem of avoiding radio interference has been paramount throughout the project'.

Among factors serving to protect the research instrument from interference are its location, existing radio-interference-suppression, zoning ordinances, and road traffic control.

The antenna is located on a ridge spur of the Shenandoah Mountain, where it is shielded by other mountain ranges in all directions. A West Virginia zoning ordinance prohibits the generation of radio noise above certain levels within a 10-mile zone around radio astronomical observatories.

'It is equally important', the article points out, '... that the antenna itself or the auxiliary and supporting facilities do not create radio interference'. The problem is being met, it continues, in the many motors for elevating and training the reflector. The motors must not emit electrical noises that might be received by the reflector and confused with celestial signals.

Other electronic and electrical equipment necessary to operate the radio telescope are also possible sources of interference. Operating control panels, command-data computers, data processors, and other equipment is required. To avoid their interfering with the antenna's reception, complete shielding is needed.

'It is now intended', the report concludes, 'to place the operations building underground, completely surrounded by 2 feet of chemically neutralized, granulated beehive oven coke. Entrances will be through tunnels which also will be shielded by coke, and equipped with conventionally shielded doors.'

News Briefs About

"SPACE AND SATELLITES"

"Reservation of certain radio frequency ranges for sole use of radio astronomers was called for at a recent Washington meeting of the National Academy of Sciences, National Research Council. Astronomers claim complete radio silence is needed to study information from outer space and they are asking for international cooperation."

"THE STATE OF THE ART"

"Electronic eavesdropping on private conversations is common practice throughout the nation by police and private enterprises, claims Samuel Dash, former district attorney of Philadelphia. In his recent book, 'The Eavesdroppers', Dash states legislation to ban use of eavesdropping equipment has 'failed completely'.

"DETECTING SIGNALS BY POLARITY COINCIDENCE":

The above titled paper by Bernard M. Rosenbeck of Columbia University, Hudson Laboratories, Dobbs Ferry, N. Y. appears in Electronics, January 29, 1960. The sub-head states:

"Weak low-frequency signals in a high noise background can be detected by this polarity coincidence multiplier. Output indicates presence and phase shift of signals received at dual inputs."

IRE STUDENT QUARTERLY Runs Article on RFI:

On page 35 of the IRE STUDENT QUARTERLY for December 1959 starts a three-page article on RFI titled: "Trouble with a Capital I" by Rexford Daniels.

The closing paragraph sums up the article as follows:

"The problem of interference, therefore, is one which may soon have to emerge from its anonymity and take its place, as a threat to our civilization, alongside nuclear radiation. For, if it is not properly controlled, it can make many of our future electronic developments inoperable."

INTERFERENCE PREDICTION:

Electronic Industries, January 1960, carries a one-page discussion of the National Bureau of Standards Boulder Laboratories finding a solution to this problem in an empirical graphical method. The opening paragraph states:

"As noise, particularly atmospheric noise, is the limiting factor in radio reception, it is very important to be able to predict its characteristics under various conditions throughout the radio frequency range. Such a prediction, including an estimation of the possible interference to a given communications system, can be derived from an amplitude-probability distribution. In this, voltage levels are plotted against the percentage of time these levels are exceeded.

However, although the amplitude-probability distribution is a particularly useful tool, its direct determination necessitates detailed measurements at all frequencies and at many locations. The complex equipment and the large number of personnel required to carry out the observations make continuous routine measurements virtually impossible."

MISSILE INTERFERENCE: CAUSE AND CURE

Electronics, January 8, 1960, carries a two-page article by G. W. Soderquist, Manager, Special Engineering, RCA Service Company Patrick AFB, Florida on constant monitoring of the radio spectrum to keep alien signals from spoiling missile tests. The problem is stated as follows:

"Every missile launched over the AFMTC contains equipment which operates over wide areas of the radio spectrum. The exact number of channels, and the precise frequencies used, are classified. Furthermore, they vary from test to test. But the office of the Area Frequency Coordinator at Canaveral must control and monitor the frequencies being used whatever they are, and suppress interfering electromagnetic radiation."

RADC SEEKING INTERFERENCE LAB:

Electronic News, January 25, 1960, carries the following article on above:

"Rome, N. Y. - The Rome Air Development Center at Griffis Air Force Base, has been asked for an appropriation of \$2,653,000 to build an electronic interference laboratory at nearby Stockbridge in Madison County.

The laboratory will be a ball-and-cylinder type building. The ball 150 feet in diameter, atop a cylinder 75 feet tall, will have a surface made up of flat triangular pieces on non-conductive and non-reflective metal.

Inside the ball, will be two floors for research."

OTHER ITEMS OF INTEREST IN ELECTRONIC INDUSTRIES, Feb. 19:

Page 125 - INTERFERENCES BETWEEN RADIO LINKS AT FREQUENCY MODULATION, M. Federici. "Alta Freq." August 1959, 11 pps.

"The author examines theoretically the interference produced on a FM receiver by a modulated or unmodulated carrier frequency of small amplitude and shows that the interference depends only on the relative amplitude of the wanted and unwanted signals and is not reduced by reference to an amplitude modulated receiver. The results of experiments carried out are related. (Italy).

Choice of the Working Frequency in Radio Links, G. Pivetta. "Alta Freq." Aug. 1959. 13 pps. The various frequency bands devoted to the radio links and the corresponding properties of the propagation are mentioned. The factors affecting the choice of working frequencies are the examined, namely: locations to be linked, band-width required by the desired number of channels, fading probability, local level of parasitic features of the various equipments, aerial size, interfering signals. (Italy).

"Measurement of atmospheric noise in the frequency range 2.5-9.5 MC/s has been in progress at the Research Dept. of all India Radio New Delhi, since November 1955. The measured data have been compared with the predicted ones for Delhi from C.C.I.R. Report No. 65. It is observed that the predicted values are invariably low and the difference between the two has, at times, exceeded 40 db. It is concluded that the noise grades predicted in the C.C.I.R. report do not represent condition prevailing in India and there are sufficient justifications to warrant their revision. (India in English.)"

NOTE:

From the announced editorial plans of many technical publications, it would appear that electromagnetic interference is, at last, coming into the importance which it deserves. Don't forget to tell your friends that they can participate in the expansion of this field in electronics by joining PGRFI.

Rexford Daniels
Editor, PGRFI Newsletter
Monument Street
Concord, Massachusetts
