



ELECTROMAGNETIC COMPATIBILITY GROUP

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NEXT MEETING OF AD COM

CHAPTER ACTIVITIES

Boston

Communication Technology/Electromagnetic Compatibility/Antennas and Propagation/Microwave Theory and Techniques Groups held a joint meeting on October 14, 1965. Prof. Robert P. Rafuse, Massachusetts Institute of Technology, gave a talk on "Electromagnetic Compatibility in R&D Organizations."

Los Angeles

A meeting was held on Sept. 16, 1965 and Mr. F. H. Knowlden, North American Aviation, Downey, Calif., gave a talk on "The Era of Man's Journey to the Moon."

Another meeting was held by this Chapter on Nov. 18, 1965 and there was a Panel Discussion of EMC Specifications. The panel members were: Mr. Eldon Hughes, NAA Autonetics, Mr. William Lash, Douglas, Mr. Ben Weinbaum, GD/Convair, Mr. Fred Nichols, Genis-tron, Inc., and Carl Pearlston, Aerospace.

Mohawk Valley

There was a meeting held on Sept. 21, 1965 and Dr. F. J. Morris, EMCO, Austin, Texas, spoke on "Low Frequency Electromagnetic Field Measurements."

Philadelphia

This Chapter held a meeting on Oct. 12, 1965 and Messrs. R. F. Wood and R. H. Thompson, Franklin Institute Research Lab., Phila., Pa., gave a talk on "Radio Frequency Hazards to Electro-Explosive Devices."

Washington, D. C.

The following meetings have been held by this Chapter:

1/14/65 - Mr. Chas. K. Fendley, Marshall Space Flight Center, Huntsville, Ala., spoke on "NASA's Electromagnetic Interference Specification, MAFC-Spec-279."

3/11/65 - Mr. Leonard Thomas read a paper written by Lt. Col. James Wishart, Chief of Plans and Programs, ECAC, titled "Present and Future Capabilities of Electromagnetic Compatibility Analysis Ctr."

5/13/65 - Mr. Curtis B. Plummer, Executive Director, FCC, Washington, D. C., spoke on "The Role of National Frequency Allocation Policy in Interference and Spectrum Utilization."

9/16/65 - Mr. Ralph L. Clark, Special Assistant to the Director of Telecommunications Management, Executive Office of the President, gave a talk on "Electromagnetic Compatibility - A National Problem."

11/18/65 - Mr. Paul Billick, R&D Directorate, U. S. Electronic Command, gave a talk on "Radio Interference Measuring Set AN/URM-100 (XE-1)."

EMC SESSION AT IEEE INTERNATIONAL MEETING

The Electromagnetic Compatibility Session at the IEEE International meeting will be held on Friday, 25 March from 9:00 to 11:00 a. m. Organizer for this Session is Mr. Herman Garlan, c/o FCC, Washington, D. C. Proposed papers may be forwarded directly to him. This is Session #65.

The next meeting of the National Administrative Committee of the G-EMC will be held on Thursday, March 24, 1966, at 2:00 p. m., Room 504, Hilton Hotel, New York City. All members of the NAC and other committees of the G-EMC, as well as all Group Chapter Chairmen, should plan to attend if at all possible.

INFORMATION FOR IEEE AUTHORS

The August 1965 issue of the IEEE SPECTRUM, page 111, carries "Information for IEEE Authors." Additional copies may be obtained from Elwood K. Gannett, c/o The SPECTRUM, IEEE, 345 East 47th Street, New York, 17, N. Y.

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The following announcement has been published by the Clearinghouse for Federal Scientific and Technical Information:

"A very broad two-volume guide to interference reduction is now available to science and industry from the U. S. Dept. of Commerce through the Clearinghouse. Prepared by the Army Electronic Labs., the work attempts to provide the engineer with the necessary background and techniques to enable him to minimize the interference generation and interference susceptibility of communication-electronic equipment that he designs. It is intended for the use of design engineers with little or no interference reduction experience. The various types of interference are defined and illustrated with text, their generation in equipment is discussed, and interference transfer media are also looked into. Electromagnetic compatibility control and tests plans, and grounding, bonding, and shielding design theory and practice are also extensively reviewed.

"The work groups interference signals into narrowband and broadband types. The broadband type is further divided into random and impulse interference. Random types consist of closely spaced electromagnetic impulses that are not clearly distinguishable from one another. The impulses are frequent and overlap, with sharp peaks exceeding the average level. Impulse interference is characterized by sharp pulses that are relatively infrequent and clearly separated, as for example the thermal agitation and atmospheric interferences. Impulse interference may be generated by an internal combustion engine ignition system, powerline discharges, motor brush sparking, electronic equipment, or other electrical or electromechanical devices.

"The authors of the work note that interference reduction is often left out of the initial design in the expectation that if trouble is encountered later, field fixes will take care of the problem. Many engineers believe that filtering and shielding alone do an adequate job. Also, there is a tendency to believe that interference specifications are needlessly harsh or cannot be complied with even when the requirements are recognized as legitimate. Lastly, time and money pressures sometimes lead to the erroneous belief that interference reduction at the design state is too expensive.

"Two approaches to the reduction of interference are cited by the authors: initial design for optimum interference reduction and application of remedial interference control measures after equipment has become operational. Of these approaches, the authors prefer the former. The initial design approach entails early determination of interference generation and susceptibility characteristics of a particular piece of equipment in its operational environment, based upon equipment function, configuration, and performance and upon interference specifications. The equipment is then designed to meet both these performance and interference requirements.

"The primary method of control cited in the work is efficient circuit design, maximizing the energy in the intelligence-bearing signals and minimizing spurious energy. All technical characteristics of the device must be considered. Shielding, filtering, bonding, and isolation of the interference-producing unit are means useful in circuit design. To maintain shielding integrity, lines entering or leaving enclosures must be decoupled by suitable filters.

"Induction and radiation fields can be contained within equipment enclosures by having equipment cases of adequate thickness (with joints welded or otherwise continuous) and by having spring-contact fingers or conducting gaskets on the periphery of removable covers or doors. In the presence of strong radiation at a fixed frequency, such as microwave energy from a radar transmitter, tuned filters in the receiver antenna circuit are often quite effective. Interference control at the source is achieved by confining and dissipating interference energy being generated so that it cannot reach susceptible circuits or equipment by conduction, induction, or radiation. . . . Army Electronic Labs., Ft. Monmouth, Aug. 1964, 793 pp. in two vols. . . . Order AD 619 666D, Vol. 1, and AD 619 667D, Vol. 2 INTERFERENCE REDUCTION GUIDE from Clearinghouse, U. S. Dept. of Commerce, Springfield, Va. 22151. Price for Vol. 1 is \$7.00 and for Vol. 2 \$7.50"

In the Dec. 27, 1965 issue of Electronic News, an article by Ja Robertson appeared under the above title. Paragraphs of interest are as follows:

"White Sands Missile Range, N.M. - The same bacteria and micro-organisms that bring colds and illness to man also may be causing untold damage to missile components and systems.

"A unique microbiology lab here is putting missile parts and materials under the microscope, to identify possible damage.

"Over a period of time, micro-organisms similar to those that decompose fruits and vegetables can destroy materials used in missiles, said officials of the Missile Range Microbiology Lab. Particularly susceptible are neoprene and Teflon components used extensively in missiles. Also, some kinds of solid propellant can be attacked by the organisms.

"The organisms can live on a wide variety of missile materials: cellulose, canvas, silicon rubber, and paints.

"The organisms have been known to produce living bridges across electronic circuits, thus causing short circuits in missile electronics."

RELATIVE MERITS OF HONEYCOMB MATERIALS FOR EFFECTIVE SHIELDING

The above paper given at the 7th National Symposium on EMC Herbert G. Bostrom, Metex Electronics, Walnut Ave., Clark, N. J. now available to those who will write to the author. The paper shows some of the considerations that should be given before choosing the proper honeycomb material together with some of the basic formula so that you can determine the cutoff frequency and the attenuation. It also illustrates curves showing static pressure versus volume in CFM, attenuation versus frequency, and also charts that will be helpful.

SIGNALS AND NOISE IN COMMUNICATION SYSTEMS

The above is a new title in the Bell Telephone Labs. Series by H. E. Rowe, BTL, Holmdel, N. J. It is available through D. Van Nostrand, Inc., 120 Alexander St., Princeton, N. J. 09540 at \$10.00. A description of the material in the book is as follows:

"This outstanding book constitutes a modern and superior treatment of conventional modulation theory and related topics. It should have great utility as a reference work, and for courses in communication theory at the high undergraduate and graduate level.

"Amplitude modulation, angle modulation (i.e., frequency and phase modulation), and various pulse modulation systems (pulse amplitude, pulse position, pulse duration, and pulse code modulation) are treated extensively, and major attention is given to showing the ways in which mathematical analysis is helpful in studying these communication systems.

"Certain material not heretofore readily available appears in this text. The behavior of signals, noise, distortion, interference spectra, and multiplex systems are treated in a fundamental way the various modulation techniques. The use of Hilbert transform emphasized, resulting in a much more concise and understandable presentation of certain topics, such as noise and distortion in amplitude modulation. Particular stress is upon the more useful methods for computing the spectra of various modulated waves, example, the spectra of angle-modulated waves, phase or frequency modulated by a gaussian random process. An extensive problem set of 145 problems has been included."

GREMLIN-PROOFING: SOME ANSWERS TO NATURE'S SNEAKIEST TRICKS

George H. Hill, U. S. Ordnance Test Station, China Lake, Cal. has a 4-page article in Electronic Design, Nov. 22, 1965, under the above title. It discusses power surges, thermoelectric effects, static electricity, triboelectricity, chemoelectricity, hot whiskers, Cur points and other gremlins.

TELEVISION INTERFERENCE FROM LIGHTLY-LOADED TRANSMISSION LINE INSULATORS

N. A. Hoglund and H. W. Sullivan, New England Electric System, have a 4-page article under the above title in the Nov. 1965 issue of 'Transmission & Distribution'. The first two paragraphs are as follows:

"Since the late 1940's, when television burst on a welcoming public, power utilities have found that sparks occurring between metal components of insulators can cause disturbance to broadcast reception. The sparks occur not only from faulty insulators but basically from objection of the metal connections of insulators to low conductor weights. This article will report the causes of such sparks and describe the experience of the New England Electric System (NEES) in eliminating them. NEES construction designs described herein and found susceptible to creating television interference (TVI) are now obsolete.

"Investigations have shown that metal-to-metal sparks cause practically all TVI originating from transmission lines. Self-sustaining sparks may occur at insulators, pole hardware, or any place where potential exceeds 500 volts and corresponding air gaps exceed 5×10^{-5} inches. The associated spark current is normally less than a milliamper (10⁻³ ampere) and usually consists of the charging and leakage currents associated with insulators. The following treatise assumes electrically normal and well-maintained equipment and restricts discussion to sparks at insulator metal parts."

NASA PUBLICATION ON SPACE COMMUNICATION

"Space Communications, . . . in theory and application are treated in a four-volume bibliography prepared by NASA. The bibliography covers modulation and channels, coding and detection, information processing and advanced techniques, and satellite and deep space applications. The compilers endeavor to provide maximum coverage of the literature from 1958 through 1963, with annotated references. All frequency ranges from VLF to microwaves and optical wave applications in space missions. This also applies to practically every known modulation method. Controlled communications embrace any combinations of modulations, coding, multiplexing, and detection methods which can be controlled, usually automatically. Feedback communications systems, also called loop systems, are an important class of such controlled arrangements. Novel modulation methods are emerging which are likely to permit the operation of communication links with extremely weak signals. The first impressive results of deep space probes are due to newly developed communications and ranging systems which have the ability to operate with signals virtually buried in noise when picked up by the most sensitive antennas and receivers. Complex analog and digital signal processing systems can extract these extremely weak signals from the noise and disturbance . . . NASA, June - July 1965, . . . Order companion volumes N-65-27821 SPACE COMMUNICATIONS: THEORY AND APPLICATIONS, VOL. 1, MODULATION AND CHANNELS, 473 pages, price \$2.50; N-65-29846, same title, VOL. 2, CODING AND DETECTION THEORY, 412 pages, price \$2.25; N-65-31136, same title, VOL. 3, INFORMATION PROCESSING AND ADVANCED TECHNIQUES, 447 pages, price \$2.50; and N-65-32187, same title, VOL. 4, SATELLITE AND DEEP SPACE APPLICATIONS, 290 pages, price \$1.75 from Clearinghouse, U.S. Department of Commerce, Springfield, Va. 22151."

NEW LOW-NOISE FLUORESCENT-TUBE LAMPS

EBU (European Broadcasting Union) Review #91-A Technical, June 1965, page 117, describes a new Japanese low-noise fluorescent-tube lamp as follows:

"One of the most serious sources of electrical interference with broadcast reception is the fluorescent-tube lamp, and the statistics of interference complaints indicate that for sound broadcasting it is the most common cause of complaint in Japan, accounting for some 45% of the cases, and the second most common in Europe, with 26%. Its effect on television reception, too, is far from negligible, corresponding to about 6% of the cases investigated in Europe. The disturbance is caused by complex phenomena in the vicinity of the electrodes, the interference being both radiated directly and also transmitted along the mains wiring.

"To overcome this disadvantage, the N.H.K. (Japan Broadcasting Corp., Tokyo) Research Laboratories designed a fluorescent-tube lamp with modified electrodes, and, in collaboration with one of the Japanese electric-lamp manufacturers, developed in 1964 a fluorescent tube which caused very little radio interference - in the neighborhood of one-twentieth and one-thirtieth of that caused by ordinary fluorescent lamps. Its life appears to be approximately 6000 hours and the relative light output is claimed to be even greater than that of ordinary fluorescent lamps."

AUTOMATIC RFI TESTING: TOO FAST TOO SOON?

Microwaves, June 1965, carried a 6-page article under the above title by J. B. Brinton, Jr., News Editor. The first paragraphs of interest are as follows:

"A fast-growing need for microwave interference and spectrum signature data is forcing development of automated RFI-measurement systems. (See Outline of EMC Activity, p. 13) But while the movement toward automation becomes pronounced, a minority decries 'automated inaccuracy' as fathoming 'mountains of unreliable data'.

"Several new automatic testing systems will be reported at the National Electromagnetic Compatibility Symposium, June 28, 29 and 30, at New York's Waldorf-Astoria. Among these are:

"The AN/URM-100, developed by Watkins-Johnson, Palo Alto, Calif., for the Army. The system uses YIG tuners that sweep electronically over a 1- to 12-Gc range. It incorporates self-calibration, low-spurious receiver circuitry, digital data printout, automatic x-y plot, and the potential for computer control.

"ISEMI (Instrumentation System for Electromagnetic Interference). General Dynamics-Convair, San Diego, Calif., is the contractor for this Air Force study. The system would span 20 cps - 40 Gc with capabilities similar to those of the URM-100, and modular design.

"Compatibility Analyzer, also under Air Force-sponsored development at General Dynamics-Convair. The system uses an analog computer to perform Fourier analysis of pulse signals. With a sampling scope, the system spots potential interference at up to 1 Gc.

"Not on the symposium program, but typical of industry trends are:

"EMC-25, scheduled for late-1965 delivery by Fairchild Electrometrics, Amsterdam, N. J., which will offer a 25-Kc to 1-Gc range, solid-state construction and -117-dbm sensitivity at 1 Gc.

"LF-SHF-2T, a portable field intensity meter from Stoddart Electro Systems, Gardena, Calif., with solid-state design, modular construction, and a 10-Kc to 10-Gc range."

ITEMS OF INTEREST FROM PROCEEDINGS OF THE IEEE - DECEMBER 1965

A Radio Problem That May Have a Ten-Billion-Year-Old Solution

Bell Telephone Labs., page 7A, has an advertisement under the above title. The first paragraph states:

"Activities in technology sometimes have surprising implications. For example, recent antenna tests conducted by Bell Telephone Laboratories at Holmdel, New Jersey, have apparently produced evidence about the early history of the universe."

Nuclear Explosion Phenomena and Their Bearing on Radio Detection of the Explosives

E. T. Pierce, Stanford Research Institute, Menlo Park, Calif., has authored a 15-page article under the above title. The abstract is as follows:

"Abstract - The characteristics of nuclear explosions are first discussed. It is shown that nuclear events can create radio noise signals, change the height distribution of existing ionospheric ionization, and produce fresh ionization; the last effect is the most important in radio detection. The influence of X-rays, γ -rays, neutrons, and radioactive debris in augmenting ionospheric ionization are considered in turn. The most significant increases are at altitudes of 60-100 km, and the consequent modifications to VLF propagation and to the absorption and phase of HF signals traversing the region of enhanced ionization are examined.

"The general level of the paper is elementary, approximate and tutorial."

Effects of Propagation on the High-Frequency Electromagnetic Radiation from Low-Altitude Nuclear Explosives

William Sollfrey, The Rand Corp., Santa Monica, Calif., has authored an 8-page article under the above title. The Abstract is as follows:

"Abstract - The high-frequency electromagnetic pulse radiation from nuclear explosions presents a possible detection mechanism. This paper first considers the selective attenuation of the higher-frequency components of the pulse when it travels via ground wave, and shows how the waveform is modified with distance. Effects of the height of the source are included. Propagation via sky wave is investigated, and it is demonstrated that ionospheric dispersion considerably stretches the pulse for reasonable propagation distances. The receiver bandwidth should be selected to match the ionospheric dispersion at the receiver frequency."

Propagation of the Ground Wave Electromagnetic Signal, with Particular Reference to a Pulse of Nuclear Origin

J. R. Johler, Ionospheric Telecommunications Lab., Boulder, Colo., and J. C. Morgenstern, The Mitre Corp., Bedford, Mass., have authored a 10-page article under the above title. The Abstract is as follows:

"The physical phenomena of the theory of propagation of an electromagnetic pulse at low radiofrequencies are scrutinized from the viewpoint of detection systems. Methods for tagging a point in time on the pulse are described theoretically. The filter action of the propagation medium together with various select receiver filters are considered in the analysis.

"A particular electromagnetic pulse observed and recorded at a short distance from the source (44.6 km) is propagated theoretically to a great distance (>2000 km) as a ground wave. The behavior of the tagged point in time on the pulse is studied both as a function of distance and as a function of the conductivity of the ground. The computer method is also used to determine the attenuation vs. distance function of the pulse. This study provides information of general interest on the subject of low radiofrequency pulse propagation. In addition, the results of this study form a basis for the determination of the effects of ground conductivity on location finding systems, based on the theory of propagation of an electromagnetic pulse."

ITEMS OF INTEREST FROM ELECTRONIC INDUSTRIES - Jan. 1966

Two-Way Radios

"Two-way radios may soon be standard equipment for London 'Bobbies'. As a trial, the British Home Office has purchased 300 walkie-talkies from Cossor Communications Co., a subsidiary of Raytheon. Eventually all 30,000 patrolmen in Britain could have direct communications with fellow officers and headquarters."

Editor's Note: The equipping of security officers with two-way radios has been found to have some interesting side-effects, such as: 1) Citizens, knowing the local officer can be reached directly, are equipping themselves with transceivers on the same frequency for emergency purposes; 2) criminals are making jamming transmitters, for those frequencies, which are expendable and can be placed in locations as decoys, and, 3) these units are another factor in raising ambients.

"Vagrant radiation brought FCC to the aid of FAA in the Los Angeles district to clear interference from around Los Alamitos airfield. Trouble was traced to a nearby housing tract and pinpointed to a garage door opener, which the owner volunteered to stop using. But, FCC men found that the development builder had installed openers with each house, and the manufacturer was then out of business. So, FCC had to take 41 of the devices off the air."

USING FET OPERATIONAL AMPLIFIERS WITH TRANSDUCERS

Electronic Products, Nov. 1965 has a 3-page article by William O. Hamlin, Zeltex Inc., Concord, Calif., with circuit diagrams describing how FET can be used in operational amplifiers. A paragraph of interest is as follows:

"Noise pickup

"High impedance levels and low output introduces a serious noise problem when the transducer is physically separated from the amplifier. Coaxial cable coupling must be used, yet the effect of cable capacitance can considerably reduce frequency response. The degraded response cannot be compensated for at the amplifier. The circuit configuration is shown in Fig. 2 and the equivalent circuit showing capacitance effect and response curve is shown in Fig. 3."

WELDING AND FLAME CUTTING OF WROUGHT IRON

A. M. Byers Co., P. O. Box 269, Ambridge, Pa. 15003, has prepared a 24-page Service Bulletin under the above heading. The Bulletin is useful for those contemplating using wrought iron plate for the construction of shielded rooms. Copies may be obtained by writing the above address.

NOISE PROBLEMS WITH INTEGRATED CIRCUITRY

N. G. Alexakis, Consultant, Los Angeles, Calif., has written page article under the above title in the Dec. 1965 issue of EDN. T subtitle and first two paragraphs are as follows:

"This article points to the culprit causing system noise problems, discusses how to predict when noise problems will occur and elaborates on the system concept of preventing these problems.

"Digital integrated circuitry is characterized by its unique voltage-current relationships as compared to discrete components. Although the voltage levels are quite small, the current levels are about the same as in nonintegrated circuitry. A unit requiring 30 mw at 3v, for example, has an operating current level of 10 r. This relatively high current-to-voltage ratio, coupled with higher operating speeds, is the basic cause of system noise problems.

"The purpose of this article is to pinpoint the factors that control and determine noise levels in integrated-circuit systems. Assuming a given circuit element, the absence or magnitude of noise can be predicted if the determining factors are understood. It will be shown that the critical factor is wiring inductance, which is somewhat under the control of the designer and can be minimized. The relative effects of resistance, capacitance and inductance will be considered. It will be shown that noise levels can be predicted. On the basis of this analysis, it will become clear that certain system techniques are superior to others."

The Relay Conference Proceedings of the 2nd International Conference on Electromagnetic Relays, co-sponsored by The National Association of Relay Mfrs. and Oklahoma State University, April 1965, are available from Mr. James V. Roughan, Executive Director, NARM, P. O. Box 7765, Phoenix, Ariz. 85011 at \$5.00.

The following paper of 15 pages is reprinted in this publication: "Miniaturized Suppression Components for Relay Interference Reduction" - by A. L. Albin and E. Busch, Fairchild Space & Defense Systems Syosset, L. I., New York. The introduction is as follows:

"Multiple contact relays find wide use in command and control systems because of their simplicity and inherent reliability. Designers employ relays of the 'crystal can' type extensively in cameras and satellite programmer applications, where the relay is actuated by a cam-operated switch or a time-interval command. The discharge of the inductive energy of the relay coil during switching, and arcing at the contacts of the relay, which may interrupt power to many circuits, can produce high levels of electromagnetic interference. Hence considerable emphasis has been placed at Fairchild on methods for suppressing relay interference. Particular attention has been paid to circuitry compatible with the increasing use of solid-state, compactly packaged equipment, where there is little room for the conventional inductive-capacitance filters.

"An investigation was conducted to determine the feasibility of utilizing miniature components for suppression of relay contact interference, and to determine the most effective means of energizing the relay coil with minimum interference. A postage stamp-sized miniature resistance-capacitance (RC) filter was developed, useable in low current applications, which provides high attenuation to conducted and radiated interference. Transistor drivers were found to be highly effective as a means of energizing relay coils and solenoids drawing currents up to 1 ampere."

INTERFERENCE TO IONOSPHERIC EXPLORER XX

The following paragraphs have been extracted from the article titled "The Ionospheric Explorer XX Communications System: Description and Performance," by Gerald Halpern and Frederick G. Zimmer, Airborne Instruments Lab., in the Nov. 1965 issue of the Microwave Journal:

"The spacecraft has experienced a number of spurious commands. Attempts have been made to determine the time and origin of the commands, but they have been hampered by the delay in ground communications and insufficient housekeeping data. Spurious commands generally seem to be a function of geography, with the majority occurring over the United States. Since the command frequency is used for various ground-to-air communications purposes, there is a great deal of emission at this frequency throughout the country. With this in mind, a number of tests were performed to determine if spurious commands could be generated, and under what conditions.

"The tests were conducted by using the prototype system with the exception of the TM antennas and baluns, which were simulated by 50 ohm power splitters. Spurious signals were generated by signal generators connected to the spacecraft by cables. When two spurious signals were required, they were combined linearly at a power splitter. Normal command tests of the system, under the same conditions, indicated a sensitivity of -108 dBm. Since the prototype does not have an address command system, it requires only one tone to generate a command. With the spacecraft set up in bus 1 (tone 6) and the beacon on, any spurious 2, 4 or 5 tones would result in an indication on a monitoring receiver.

"It was found that the spacecraft is susceptible to spurious commands that are generated by two signals which heterodyne within the command receivers. The results were repeatable when both signals were 20 dB over the normal signal requirement. Since the minimum theoretical power required to command from the ground stations is about 1 watt the two signals must be at least 100 watts each. The minimum theoretical power requirement in this situation is obtained by using the 18 dB margin calculated and adding the 6 dB that was previously used as a fading allowance. With a minimum of 170 watts radiated, about 1 watt was obtained.

"There are many possible sources from which the spurious commands could originate. However, for illustrative purposes, consider whether spurious commands could be caused by STADAN stations. The command frequency-stability requirement of STADAN stations is ± 0.001 per cent. Therefore, if two stations are on the air at the same time, the difference between their carrier frequencies can range between 0 and 2.5 kc, which completely covers the frequency range of the tones. Since the stations radiate about 175 watts, this situation could be a cause of spurious commands if both are tracking the spacecraft.

"The known frequency of spurious readout commands to date is small, and although they are a cause of annoyance they do not jeopardize the operation of Explorer XX."

A NEW CLASS OF FILTERS FOR PULSE APPLICATIONS

The Clearinghouse for Federal Scientific and Technical Information Bulletin PA 65-381, Electronics, contained the following item under the above heading:

"A New Class of Filters for Pulse Applications . . . developed by New York University for the Air Force yields better performance characteristics when rise time, overshoot, and 3 db frequency of the magnitude response are all considered to be important. The natural frequencies of the proposed filters all lie in catenary contours, and the transmission zeros are all at infinity. They overcome some of the difficulties encountered when working with Thomson, Butterworth-Thomson, and Mullick filters. The NYU investigators note that filter design plays an important role in network theory. If the filter networks are required for pulse applications, the transient response must be fast with little or no overshoot. Butterworth filters, which have maximally flat magnitude response, have fast transient response; but for the higher order filters the response to a step input has undesirable overshoot. Furthermore, the overshoot increases with the increase in the order of the filter. . . NYU's Laboratory for Electroscience Research, Bronx, N. Y., for the Air Force, Sept. 1965, 44 pages. . . Order AD-623 586 A New Class of Filters for Pulse Applications from Clearinghouse, U.S. Department of Commerce, Springfield, Va. 22151, price \$2.00.

LASER BEAM TO BE USED IN TESTING

Electronic Science Preview, Nov. 1965, carried the following item:

"Beams of invisible light some day may replace the thousands of wires that now carry checkout signals into a space launch vehicle before lift-off. IBM scientists are exploring the use of laser beams that can be modified like a radio wave to carry information. The modified laser beams do not interfere with other communications channels like radio. Theoretically a laser beam can transmit more information than a radio wave because it generates a higher frequency. Harnessing laser beams to send off space vessels would eliminate much of the complicated equipment presently needed to disconnect a launch vessel's thick umbilical at the moment of firing."

SHIELDING AND GROUNDING FOR INSTRUMENTATION SYSTEMS

Ralph Morrison, Vice President, Chief Engineer, Dynamics Instrumentation Co., 583 Monterey Pass Rd., Monterey Park, Calif. has written an 8-page booklet under the title "Basic Considerations - Shielding and Grounding for Instrumentations Systems." The Summary and first three paragraphs are as follows:

"SUMMARY. This paper discusses best shielding and grounding practices in instrumentation. Simple yet important rules are developed which give insight into the correct use and application of single-ended and differential amplifiers. Multi-signal systems with their complex grounding and ac power requirements are discussed in terms of these rules.

"Shields and grounds are subjects usually not taught in school. The subject material is quite elementary but because it is not often presented in simple logical form, it can be a source of difficulty to engineers and systems people. The purpose of this paper is to provide a general understanding of these grounding and shielding problems.

"Occasionally noise pickup processes are complex, but most often they are simple. The simple ones must be taken care of first before the sophisticated ones can be separated out and treated. The following list indicates a few of the common problem sources:

1. The resistances of long cables can not be neglected.
2. Long lines and ground returns are inductive as well as resistive.
3. Unsuspected capacitances permit reactive currents to flow in signal lines.
4. Transformers are sources of emf's which will 'pump' reactive current into the shields and signal lines of a system.
5. Ground points are rarely at the same ac potential.

"This list represents physical fact. The system designer should design so that these facts do not cause him a problem. This paper describes rules and processes that permit operation in a real system; i.e., where many ground points exist, where signal lines are long, and where many power transformers are used. The discussion starts out by considering a simple instrument amplifier. Operating rules are developed that pertain to the general system problem."

CURING INTERFERENCE IN RELAY SYSTEMS: LOOK TO THE SOURCE, THEN SUPPRESS

Sam J. Burruano, Consultant, Burruano Associates, Inc. Harrington Park, N. J., had a 7-page article in the Nov. 29, 1965 issue of Electronic Design titled "Curing Interference in Relay Systems: Look to the Source, Then Suppress." The subtitle and first four paragraphs are as follows:

"The erratic, broadband nature of switching transients and RFI makes them tough to handle. But a review of suppression methods shows that the problem is solved through design compromises.

"The performance of electronic systems is ever inhibited by transient and radio-frequency-interference (RFI) signals generated by switching circuits. These play havoc with the operation of the system and may even damage the components. Although many techniques are available to suppress the unwanted signals, each remedy involves a trade-off in some aspect of performance and a consideration of the size, weight and cost involved.

"One type of suppression may mitigate the RFI, (which is sometimes referred to as electromagnetic interference, EMI) and do very little to retard the transients. Another suppressor may perform in the exact opposite manner. A third may reduce both RFI and transients, but with an accompanying decrease in switching speed.

"When confronted with a suppression problem then, the designer must, of necessity, choose a suppression network. His selection criteria should consider these features:

- The voltage and current levels involved.
- The suppressor's reliability.
- How well it attenuates RFI.
- How it affects noise levels.
- The suppressor's size and weight.
- How well it handles arcs and surges.
- Its influence on the switching functions, such as operate or release time.

"Let's examine the source of the troublesome signals and then see how they can be suppressed successfully."

REDUCE GROUND NOISE IN ANTENNAS

Electronic Design, Nov. 22, 1965 has a column and a half article under the above title on getting rid of noise picked up by a Cassegrain microwave antenna when energy, radiated from the ground around the antenna, enters the horn feed. For further information contact: Technology Utilization Officer, Jet Propulsion Lab., 4800 Oak Grove Drive, Pasadena, Calif. 91103, Reference: B63-10229.

CAPACITOR CUTS NUISANCE RFI IN A POWER SUPPLY

William J. Mattox, Supervisory Engineer, Electro International, Inc., Annapolis, Md., has written a 2-page article with five drawings under the above title, in Electronic Design, Dec. 20, 1965. The subtitle and first two paragraphs are as follows:

"Conducted interference through a power supply's transformer can be reduced with an inexpensive capacitor across the secondary.

"An inexpensive capacitor, placed across the secondary terminals of a power supply's transformer, gets rid of interference caused by a ringing oscillation in the secondary.

"The usual methods of dealing with interference caused by power supplies include the use of filters in the ac main line or a capacitor across the primary terminals. However, neither of these techniques is as effective as a capacitor across the secondary. The reason for its effectiveness becomes clear when we examine the origin of this noise."

ELECTRONIC DEVICE MAY REPLACE DRUGS AS PAIN KILLER

The following news item appeared in the Nov. 22, 1965 issue of Electronic Design:

"Narcotics such as morphine and Demerol may become old hat with the development of an electronic pain-killer.

"Doctors at Massachusetts General Hospital have been applying 9-volt pulses directly to the brains of cancer patients to cut off pain for about eight hours.

"As described by Dr. Frank Ervin, standard stereotactic techniques (xyz plot and CRT display of known signal patterns) are used to implant the probe in the thalamus. This portion of the brain acts as a switchboard in channeling signals from the body to the brain. The effect of the 9-volt, 30 cps, low-current pulse is that of confusing the pain-sensing part of the brain.

"Researchers at the hospital are looking into an inductive-coupling method that would eliminate connecting wires."

WHAT'S NEW IN SOLDERING

Electronic Products, Dec. 1965, has a series of articles by Ralph Powell, Contributing Editor, under the above title. Titles of subjects covered are:

- Advances in Solder
- Solders for Microelectronics
- Soldering Microcircuits
- Solderable Conductive Paint
- Wave-Soldering Machines
- Soldering Tools
- Competitive Methods
- 12 Questions and Answers about Resistance Soldering
- Selection Check List for Soldering Irons

GOT A 'BEEP' IN YOUR POTS AND PANS?

Roy Thompson, Staff Reporter of the Winston-Salem Journal, had the following article in the Dec. 20, 1965 issue:

"Ladies, do your pots and pans sometimes talk to you?

"Do they say 'beep'?

(If they say something else, you may stop reading this story. Turn to the comics page. . . take an aspirin. . . call your family psychiatrist.)

"But, if what your pots and pans are saying is 'beep' then get a watch with a second hand and time the 'beeps'.

"If your getting a 'beep' every hour or so. . . every 15 minutes. . . or every nine seconds, you may stop reading this.

"But if your pots and pans go 'beep' every 12 seconds, read on. . .

"Your pots and pans are all right.

"And, no matter what your husbands and neighbors may say, you are all right.

"South of town at Air Force Radar Station there's a big search radar outfit, it swings around 24 hours a day looking for enemy planes that may come to attack Union Cross, Rural Hall, Clemmons or some other military target whereabouts.

Searching for Enemy

"This big gadget, according to M. Sgt. A. J. Morabito, sends out 'bursts' of radio frequency energy in an eternal search for enemy planes.

"Sometimes this radio frequency energy encounters a pot or pan under just the right conditions, and the pot or pan will, as Morabito explained, 'resonate.'

"(Meaning 'beep').

"The big screen makes a full turn every 12 seconds, so your pot or pan will 'beep' every 12 seconds. . . five 'beeps' a minute. . . 300 'beeps' an hour.

"The sergeant wouldn't say just how far the radar can make things 'beep.'

"If the Russians knew, they could figure out how powerful our radars are. And, as worrisome as the 'beeps' may be, they're necessary to the national defense.

"If you have a 'beep,' just move the pot or pan. That often 'de-beeps' things.

"Or cook a good supper in it.

"The Air Force has had no complaints involving pots and pans that 'beeped' while busy.

"If you have something else 'beeping,' you may have a bigger problem.

"Radios and record players sometimes do it. Also electronic church organs.

"Just moving the 'beeper' or facing it in a different direction will often help.

"If it doesn't, trade it in on a cheaper model. Morabito explained that the higher the fi, the 'beeper' the 'beep.'

"If this doesn't work, call a repairman.

"Do not call the Air Force station. The government is responsible for keeping enemy planes out of our hair, but accepts no responsibility for any 'beeping' that may result.

"Morabito asked that we stress that 'beeping' is the only thing their radar can do to the civilian population.

"It has nothing to do with the fact that your chickens have stopped laying or the roof over the living room keeps leaking.

"Once you realize that our whole future may be involved, a little 'beep' every 12 seconds doesn't bug you much.

"Morabito, for instance, has a 'beep' in his radio. And something in his bathroom 'beeps'. The pipes, probably.

"He just calls the 'beeps' another sacrifice he's making for his country."

SURGE PROTECTIVE DEVICE

Electromechanical Design, Dec. 1965, has a 2-column news report under the above title. The subtitle and first three paragraphs are as follows:

"Diverting High Currents from Electronic Gear

"Triggered vacuum gap (TVG) device, invented by Dr. J. M. Lafferty of General Electric's Research and Development Center, protects utility power lines and complex electronic equipment from sudden surges of electricity.

"The General Electric devices - the modern equivalent of the old-fashioned lightning rod that intercepted bolts of electricity from the sky - take advantage of an electrically charged 'cloud' that appears and disappears in a few millionths of a second. They will not ordinarily conduct electricity, since their circuit contains two electrodes separated in a vacuum - a non-conductor.

"The range of voltages over which the devices will function is unusually wide, from 500 volts to 30,000 volts; a conventional protective device designed for operation at 500 v. might be effective only from 400 to 700 v."

NEW PRODUCTS

Automatic RFE Tester Sweeps to 40 GC

Microwaves, Oct. 1965, carries a half-page description of a new automatic RFI tester. The text is as follows:

"A second-generation automated RFI/EMC system is just off the breadboard. The URM-110 is now in test at Frequency Engineering Labs, Farmingdale, N. J. Built for the Army Electronics Command, Ft. Monmouth, N. J., the system will detect and record interference over a 12- to 40-GC range. One of its unusual features is a frequency-synthesizer second LO.

"The URM-110 is one of a new series of high-speed systems with which the Department of Defense hopes to fill its growing need for spectrum-signature and interference data (See MicroWaves, June'65).

"Similar to the URM-100, already announced but operating at higher frequencies, the FEL system measures power density and signal characteristics in slit bandwidths of 0.1, 1.0, 10.0, and 50.0 Mc. These bands are swept in 0.2 sec each, enabling fast spectrum surveillance. The full 28-Gc range could be covered in 2 minutes and 40 seconds using the 50-Mc slit bandwidth.

"YIG preselectors and phase-locked first-IF BWOs enable this fast-sweeping coverage. The second-IF oscillator is a phase-locked, crystal-referenced, frequency synthesizer. It is digitally programmed, spanning 1.75 - 2.75 Gc in 100 Kc steps.

"The resulting data is stored in a magnetic-core memory for later readout. When directed, the all-integrated-circuit computer spills this data into an X-Y plotter, digital printer or scope.

"Rather than presenting the operator with a wastebasket-full of needless paper, the computer can be programmed to read out necessary data only. Thus, readout would occur only when power density rose above a certain level, or with a band-to-band change greater than a preset amount, say 2 db."

New Two Stage NPN-PNP Complementary Transistor Amplifier

A document may be purchased on the above transistor amplifier. The description of the document and its place of purchase is as follows:

"Transistor Amplifier . . . A new two state NPN-PNP complementary transistor amplifier with great versatility over a broad frequency range has been developed by the Naval Ordnance Test Station. The use of complementary transistors allows negative voltage feedback to maximize the performance of the amplifier. This configuration provides a very stable gain over a broad frequency range coupled with high input impedance and low output impedance. Good DC has stability and low noise are also characteristic of the circuit. Because of the wide applications of the amplifier a general analysis was made by the researchers to determine optimum parameter configurations. This was done to gain information for the designer's use in optimizing the design reliability and stability of the circuit as applied to a number of devices. Particular areas of investigation included a derivation of

approximate gain and impedance equations; an exact computer analysis to determine the effect of all the component parameters on circuit performance; and the plotting of trade-off curves showing the relationships of gain, impedances and stability to feedback and transistor operating points. A Federal evaluator says of the Navy work, 'It is an exhaustive treatment of a very useful circuit. The depth of the presentation is beyond that usually available.' . . . Naval Ordnance Test Station, China Lake, Calif., July 1965, 34 pages. . . Order AD-619 650 A BROAD-BAND COMPLEMENTARY TRANSISTOR AMPLIFIER from Clearinghouse, U.S. Dept. of Commerce, Springfield, Va. 22151, price \$2.00."

YIG Resonators Yielding Practical Low-Noise Devices

Electronic Design, Dec. 20, 1965 has a column and a half description under the above title. The first two paragraphs are as follows:

"A group of four new solid-state devices built around the low-noise, high-Q properties of YIG (yttrium-iron-garnet) resonators has shown extremely promising results in recent laboratory developmental tests.

"In designing the devices - an oscillator, filter, paramp and harmonic generator - the Watkins-Johnson Co., Palo Alto, Calif., has taken advantage of the small size of the YIG resonator and the fact that it is the only resonator with a Q-factor that increases in proportion to the frequency. Because of the small size of the devices, the company has hopes that they will find wide application in future miniature microwave circuitry."

Editor's Note: The last Newsletter was supposed to have gone out first class mail, in order to give the required time interval for the submission of nominations, but it was sent out bulk rate and some were received after the closing date. It is hoped that this Newsletter will go out first class mail so that it will not overlap with the next issue which will soon follow.

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