

October through December, 1957

IBM Technical Papers Published in Other Journals

A Back-Window Cathode-Ray Tube, M. B. Diegert, *Electronics*, **30**, 202-204 (November, 1957).

A 10-inch cathode-ray tube with which electronic and pictorial data are displayed on a common screen is described. The pictorial data, contained on a 35-mm film strip, is optically projected through a window in the rear of the tube and superimposed onto the phosphor viewing screen for comparison with the electronic display.

The Economics of Component Parts Selection, E. F. Fuegel, *Electrical Engineering*, **76**, No. 11, 958-962 (November, 1957).

A prerequisite for the best equipment to suit a particular requirement is a thorough knowledge of the economics, selection, application, and performance of component parts. Other factors that affect equipment reliability—engineering costs, rating of component parts, customer losses—are discussed along with a working formula for determining the cost of a part.

Evaluation of Transistor Life Data, J. D. Johnson and B. Van Swearingen, *IRE Transactions on Reliability and Quality Control*, **PGRQC-11**, 15 (August, 1957).†

The purpose of evaluating transistor life data is to make possible proper application, specification and design of transistors. The many methods of testing and analyzing life characteristics are reviewed and discussed from the standpoint of the user, with emphasis on a particular statistical approach.

Life tests are conducted at various temperature and power levels. As a control feature, shelf-life tests are usually performed simultaneously. Data collected from life tests are recorded on punched cards. Each card contains all the data for a given transistor at a particular time during the life test. This information is used as the input for an electronic calculator, by means of which statistical summaries can be computed. This method permits either individual or group evaluation procedures. Results are presented on curves and charts.

The IBM Standards Program, J. J. O'Farrell, Jr., *Industrial Standardization—Company Programs and Practices: Studies in Business Policy*, No. 85 (National Industrial Conference Board, Inc.), 45-47 (December, 1957).

This article is one of the case studies selected for the NICB's broad look at industrial standardization. It describes the growth of the standards program in IBM, the objectives of the program, and the company-wide organization of the various groups that set up and maintain standards. The report discusses in detail how standards are developed and implemented. Special emphasis is placed on IBM's coded parts program and data classification system, and on the use of electronic data processing equipment in maintaining standards. Approval procedures and distribution techniques are

discussed. An important point is how acceptance of standards is obtained by a continuing program of publicity and well-organized assistance. This standards program has enough controls to discourage random independent effort but is flexible enough to encourage real progress.

Magnetic Annealing Effect in Cobalt-Substituted Magnetite Single Crystals, R. F. Penoyer and L. R. Bickford, Jr., *Physical Review*, **108**, No. 2, 271-277 (October 15, 1957).

The effect of magnetic annealing at 375°K on the room-temperature anisotropy of a series of six single crystals in the composition series $\text{Co}_x\text{Fe}_{3-x}\text{O}_4$, in the range of x values between 0.0 and 0.15 is investigated. The anneal-induced anisotropy is shown to be represented by the equation

$$W_U = -F \sum_i \alpha_i^2 \beta_i^2 - G \sum_{i,j} \alpha_i \alpha_j \beta_i \beta_j,$$

where α_i and β_i are direction cosines of the magnetization during measurement and during the annealing process, respectively. The values F and G are shown to vary with x in a regular fashion: $F \approx 10.1 \times 10^6 x^2$ erg/cc and $G \approx 9.25 \times 10^6 x$ erg/cc. These results cannot be explained by the Néel orientation-ordering model or by the precipitate model of magnetic annealing. A new model, involving cobalt ions individually rather than in pairs or larger agglomerates, is introduced.

Millimicrosecond Transistor Current Switching Circuits, H. S. Yourke, *IRE Transactions on Circuit Theory*, **CT-4** No. 3, 236-240 (September, 1957).†

It becomes necessary to avoid operation in saturation if transistor switching circuits are to be developed with response times limited by the bandwidths of the transistors operating as amplifiers, and by diffusion or transit-time delay. Since a low collector-to-base voltage, or operation near saturation, has a detrimental effect on transistor bandwidth, it is desirable to avoid this operating region as well.

Where non-saturating circuits are used with transistors having cutoff frequencies of several hundred megacycles, transistor and circuit capacitances become the primary limitation on speed. To minimize the delays due to capacitance it is desirable to operate with voltage swings as small as reliability considerations will permit.

A new mode of operation has been developed whereby well specified currents can be switched reliably with small voltage swings. The complementary current-switching technique described provides a means of constructing relatively simple logical circuits in which transistors are operated well out of saturation in a region of maximum bandwidth. This technique offers several advantages as well as high-speed switching. The resulting logical circuits have complemented outputs and reset their own levels. There is no requirement on the upper limit of α , dc stability factors are essentially unity, and the circuits are simple and relatively noise-free.

On the Design of Decimeter Broadband Antennae with High Directivity and Extremely Small Reflection Coefficient, H. P. Wolff, *Optik*, **14**, No. 10, 458-473 (October, 1957).

After a brief discussion of the relevant theoretical foundations, a method for the determination of the dimensions of radiating elements is described by means of two separate designs for such elements, which, working within a frequency range of 10% of the mean frequency of the range, have a reflection coefficient of less than 2½%.

The first design provides as radiating element a full-wave radiator inserted into a paraboloid reflector the reaction of which has been cancelled. The second design makes use of a half-wave radiator inserted into the same paraboloid. In this design, however, the reaction of the paraboloid is utilized to match the impedance of the radiator to that of the feeding line, although this reaction has a phase difference of more than 360° within the frequency band considered.

Photoetching Limited Amounts of Small Metal Parts, D. Huffman, *Industrial Photography*, **18** (October, 1957).

A fast method is described for preparing small metal parts or printed circuits with photo resist, and an easy way is shown for coating the resist onto metal. Multiplying images is done quickly by making diazo paper negatives and pasting up with cellophane tape. When a heat lamp and fan are used for drying, many etching jobs can be performed in less than an hour after artwork is prepared.

Quadrupole Coupling Constant and Molecular Structure of CO¹⁷, B. Rosenblum,* and A. H. Nethercot, Jr., *J. Chem. Phys.* **27**, 828 (September, 1957).† Letter to the Editor.

The hyperfine structure caused by the O¹⁷ nuclear quadrupole moment was observed in the rotational microwave spectrum of CO¹⁷ near 112,400 mc. The results are in strong disagreement with theoretical calculations of the electronic structure of CO. The value derived for eq (the gradient of the electric field at the oxygen nucleus) is -1.0×10^6 esu²/cm³. Recent molecular orbital calculations predict a value of $+1.6 \times 10^6$ esu²/cm³ as does also a simple valence bond model with 15% s - p hybridization. These results indicate a much larger concentration of electrons along the internuclear axis than had previously been expected.

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Simulation of Transistor Switching Circuits on the IBM 704, R. J. Domenico, *IRE Transactions on Electronic Computers*, **EC-6**, 242-247 (December, 1957).

When the configuration of a circuit and the equivalent representations of the transistors are known, a computer program can be written to yield the performance of the circuit and the mean values of the circuit parameters. Nonlinearity of the transistors is accounted for by piece-wise linearization of an

equivalent circuit. Rules of interconnection have been devised to combine this procedure efficiently with the manipulation of the matrix equations that define the linear external circuitry. The general method can be extended to combinations of basic circuits.

Studies on Some Infrared Stimulable Phosphors, S. P. Keller, J. E. Mapes, and G. Cheroff, *Physical Review*, **108**, Second Series, No. 3, 663-676 (November 1, 1957).

Physical properties of the two phosphor systems SrS:Ce, Sm and SrS:Eu, Sm, as well as the base material SrS, have been studied. The optical studies concern spectra of transmission, excitation, fluorescence, phosphorescence, stimulation, and stimulated emission. Relative storage efficiencies of the major exciting wavelengths have been measured. Time characteristics of the phosphorescence and the infrared exhaustion have been determined. The dc photoconductive response as a function of the wavelength of the incident light has been studied. A simplified band-theory model which correlates all of the experimental data in conjunction with the electronic structures of the activators is presented.

Using an Automatic Calculator, D. Mace and J. Alsop, *The Columbia Engineering Quarterly*, **11**, No. 1, 13-17, 50-54 (November, 1957).

The Watson Research Laboratory has set up for Columbia University students a short course in programming for the 650. The course consists of three one-hour sessions of formal discussion plus the solution of a problem by the student. A pamphlet entitled "A Simplified System for the Use of an Automatic Calculator" has been written for the student to read before coming to class. In addition to a description of the course, this article contains some of the material covered in the pamphlet: the sections of a calculator are described; the 650 instruction format and 13 operation codes are discussed; the idea of a program loop is introduced and illustrated.

Vibrations of a Monoclinic Crystal Plate, E. G. Newman and R. D. Mindlin, *The Journal of The Acoustical Society of America*, **29**, No. 11, 1206-1218 (November, 1957).

A detailed study of Ekstein's solution of the equations of elasticity is made for the case of the coupled vibrational modes of an infinite, monoclinic crystal plate with traction-free faces. It is shown how the spectrum of frequencies and the character of the modes may be deduced by tracing the development of coupling from a simple solution in which the modes are uncoupled and by taking into account the asymptotic behavior at long and short wavelengths and high and low frequencies. The results of computations are given for the AT cut of quartz. The purpose of the investigation is to obtain some of the qualitative and quantitative information which is needed for the formulation of approximate equations of motion which may be solved for plates of finite dimensions.

†From previous quarterly period, July-September 1957.