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Scanning the Issue

Theory of Intermodulation and Harmonic Generation in Traveling-Wave Masers (Schulz-DuBois, p. 644)—The traveling-wave maser (TWM) is one of the older and better established members of the family of quantum-electronics devices available today. Its particular advantage—and a very practical one it is indeed—is that it can provide microwave amplification with the lowest noise power per unit bandwidth. In some applications, it is mandatory that intermodulation levels be substantially below noise to preclude signal degradation. In contrast to other amplifiers, the maser does not produce intermodulation distortion when the gain goes into compression; in fact, gain compression and intermodulation are the result of two separate physical processes. The quantitative theory for TWM intermodulation is developed in this paper using two approaches. The coupling of the nonlinearities to the maser circuit is considered, and a computation of the power outputs at intermodulation and second-harmonic frequencies reveals these levels to be well below noise under most conceivable conditions for masers used as low-noise receiver preamplifiers.

Measurement of Intermodulation and a Discussion of Dynamic Range in a Ruby Traveling-Wave Maser (Tabor, Chen, and Schulz-DuBois, p. 656)—This paper, a companion to the one above, reports measurements made of intermodulation in a ruby TWM similar to the one developed for project Telstar. The power level at frequency $2f_2-f_1$ was measured when strong signals at f_1 and f_2 were applied to the maser. As predicted by the theoretical treatment in the companion paper, the intermodulation level was found to be extremely low. In a concluding section the authors discuss the dynamic range of a typical TWM. These two papers are of special interest because of the implications of this work for other quantum-electronics devices, including lasers.

Insertion Loss Concepts (Beatty, p. 663)—A rose by any other name might smell as sweet, but when discussing roses it's exceedingly helpful if everyone calls them by the same name. Likewise with insertion loss. This term is used, misused, and abused in so many ways that it is fast gathering an aura of uncertainty about it. Also, certain other related concepts, such as attenuation and mismatch loss, are in need of clarification. This paper presents a set of definitions and equations which the author suggests as an approach to more precise terminology. As such, it will be read with interest by a variety of workers, such as microwave, antenna, transmitter, receiver, and systems engineers.

Effects of Arctic Nuclear Explosions on Satellite Radio Communication (Arendt and Soicher, p. 672)—Two recent mileposts on man's scientific and technological journey are his achievements with nuclear energy and artificial earth satellites. The present paper is concerned with aspects of both, specifically with the anomalous effects of nuclear tests on the reception of signals from various orbiting satellites. Observing on frequencies from 20 to 400 Mc, the authors recorded radio blackouts and reception from far beyond the geometric horizon, made comparisons with normal propagation periods, and correlated the observed anomalies with ionospheric disturbances attributable to nuclear explosions.

Charge Carrier Inertia in Semiconductors (Champlin, Armstrong, and Gunderson, p. 677)—Concomitant with the trend toward using semiconductor devices at ever higher frequencies comes the need for a better understanding of the microwave characteristics of semiconductors. For example, significant changes in conductivity and permittivity of germanium and silicon can be observed at millimeter, and even centimeter wavelengths due to carrier inertial effects, and this must be considered when ultra-microwave semiconductor devices are designed. The present paper derives equivalent circuits which illustrate inertial effects and discusses their temperature dependence. A highly accurate reflection-bridge technique for measuring conductivity and permittivity was used to perform measurements on silicon and germanium, and the results are compared with theory. This study will be of particular interest to those working in microwaves and solid state or who use semiconductor devices at high frequencies.

A Study of Electrodynamics of Moving Media (Tai, p. 685)—Three years after Einstein announced the special theory of relativity, Minkowski rose to the challenge that had faced physics for many years and presented the theory of the electrodynamics of moving media. This elegant theory is sufficiently abstruse that many people are at best only vaguely familiar with it and remain unaware of its power and beauty. The author of this paper restates the theory using a language familiar to readers who know the electrodynamics of stationary media. This lucid presentation, concerned as it is with the very keystone of electrical science—electromagnetic theory—should be welcome to all members of the profession.

The Laser Interferometer: Application to Plasma Diagnostics (Gerardo and Verdeyen, p. 690)—The evolution of the laser from an object of research to a device useful in a variety of applications continues and accelerates. A laser interferometer has been shown to be a valuable tool in experimental plasma physics. In this application, the output from one end of a gaseous laser is propagated through the medium to be studied and is then reflected back onto itself. The laser acts as both the source and the detector. The interferometer sensitivity can be significantly increased by employing curved mirrors in the reference arm, and this paper discusses the optimum geometrical conditions and gives some experimental measurements of electron densities in gaseous plasmas. This valuable contribution is another example that the electromagnetic spectrum of concern to electrical engineers knows no upper bound.

Fundamental Limitations in RF Switching and Phase Shifting Using Semiconductor Diodes (Hines, p. 697)—For many years semiconductor diodes have found important applications in RF switching. The maximum power and minimum attenuation depend upon the characteristics of the diodes and the exact function being performed. In this paper the author derives equations and theorems which define these limits for quantized RF control networks used in on-off control switches, selection switches, and phase-shift devices. This contribution will be found to be of value in such diverse fields as communications, antennas, computers, control, and measurements.