Introduction

ACTIVE microwave effects in bulk semiconductor have been discovered and extensively developed in the past four years. A previous special issue (January, 1966) was devoted to transit-time effects such as the domain mode of the transferred-electron effect, which was discovered by J. B. Gunn of IBM; the avalanche, transit-time diode, was predicted by W. T. Read of Bell Telephone Laboratories in 1958, and reported by R. L. Johnston, B. C. Deloach, and B. G. Cohen of Bell Telephone Laboratories in 1965; and solid-state plasma effects. This special issue covers recent work on these effects and a true bulk negative-resistance effect, named limited space-charge accumulation (LSA), which was discovered by J. A. Copeland of Bell Telephone Laboratories.

A wide range of devices for oscillation, amplification, control of oscillation, and function generation have followed these initial discoveries.

The use of these new devices as laboratory oscillators, communication and radar transmitters, including phased-array types, and receiver local oscillators can be envisioned. Many new applications of these microwave devices will be possible because of the small size and weight of the devices and their rugged simplicity, as well as their low ultimate cost. One such application may be, for example, radar for automobiles, with the obvious advantage during times of poor visibility and with potential as a sensor for electronically operated vehicles.

Representative state-of-the-art oscillator power levels at present are approximately 150 watts in pulsed operation at 2 GHz and 350 mW in continuous operation at 12 GHz for the domain mode of transferred-electron effect in GaAs. In the LSA mode of transferred-electron effect in GaAs 350 watts in pulsed operation at 8 GHz and early results in continuous operation have yielded several milliwatts at 90 GHz. In the avalanche diode, pulsed operation has yielded 30 watts at 10 GHz and several watts at the same frequency in continuous operation. All of these power levels can apparently be raised in the next few years, especially in the LSA mode, where a half a megawatt can be predicted for pulsed operation at 10 GHz.

This second special issue on semiconductor bulk effect and transit-time devices covers recent work up to mid-1967 and includes the contents of key papers presented at a conference in February, 1967, and at two conferences in June, 1967, along with other material.

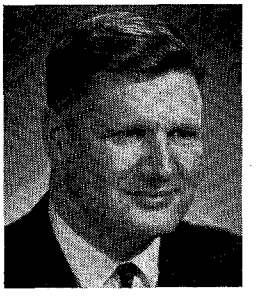
In the area of transferred-electron effect, the first paper was solicited to present a perspective of the various aspects of domain and LSA modes. More detailed papers on several theoretical and computational aspects of different modes appear next. Several papers on experimental achievements follow, which include fundamental measurements on GaAs with and without domains, operation of domain mode in CdTe, and recent LSA and domain mode device results, including a means of signal amplification.

In the area of avalanche and transit-time effect, small-signal theory, including noise, is presented, and recent results as well as future device design are reported.

Microwave radiation from indium antimonide and other solid-state plasma effects, in addition to oscillations due to acoustic domain transit, are also reported in a few papers.

Finally, several short contributions are included as correspondence on the same research areas.

—LESTER F. EASTMAN, *Guest Editor*



Lester F. Eastman (A'53–M'58–SM'65) was born in Utica, N. Y., on May 21, 1928. He received the B.S.E.E., M.S., and Ph.D. degrees from Cornell University, Ithaca, N. Y., in 1953, 1955, and 1957, respectively.

From 1957 to the present time he has been on the faculty at Cornell University where he now is a Professor of Electrical Engineering. In this ten-year period he and his associates have developed a graduate research program in physical electronics and microwave electron devices. Presently this research group has fifty people, including twenty-five graduate students, and has solid-state bulk and transit-time devices as its major emphasis. He conceived and organized the informal Conference on Active Microwave Effects in Bulk Semiconductors, held first February, 1965 and annually since that time. He also is serving as Chairman of the Technical Program Committee of the First Biannual Cornell Conference on Engineering Applications of Electronic Phenomena, held in August, 1967. During 1960 and 1961, he was on leave at Chalmers Technical University, Gothenburg, Sweden; and during 1964 and 1965 he was on leave at RCA Research Laboratories, Princeton, N. J., where he did research on microwave effects in bulk semiconductors. At present he and his students are doing research on Gunn effect including high pulsed power LSA operation, avalanche and transit-time diodes, and high-field effects in indium antimonide.

Dr. Eastman is a member of Eta Kappa Nu, Tau Beta Pi, Sigma Xi, and Phi Kappa Phi.