Abstracts

Circuits for High-Efficiency Avalanche-Diode Oscillators (Dec. 1969 [T-MTT])

W.J. Evans. "Circuits for High-Efficiency Avalanche-Diode Oscillators (Dec. 1969 [T-MTT])." 1969 Transactions on Microwave Theory and Techniques 17.12 (Dec. 1969 [T-MTT]): 1060-1067.

This paper describes and analyzes the circuits which have been used successfully for TRAPATT oscillator studies. The results lead to a better understanding of the TRAPATT oscillator and yield a simple model of the oscillator which is useful for circuit design. The circuit characteristics of an experimental TRAPATT oscillator are determined from measurements on the circuits and from equivalent circuit model calculations. The following conclusions can be drawn from the analysis. First, the avalanche diode requires sufficient capacitance near the diode to sustain the high-current state required for TRAPATT operation. Secondly, at a distance from the diode corresponding to approximately one half-wavelength at the TRAPATT frequency the transmission line containing the diode should be terminated by a low-pass filter. The function of the filter is to pass the TRAPATT frequency and to provide a shorting plane for the harmonics of that frequency. Finally, on the load side of the filter, tuning for the TRAPATT frequency is required. The model of the circuit described above suggests a simple explanation of the diode-circuit interaction in a TRAPATT oscillator. Simplified waveforms suggested by the model have been used to calculate power out-put, efficiency, dc voltage change, and RF impedance for the oscillator. The results agree within a few percent with those obtained for an experimental oscillator. An important conclusion of the analysis is that the high-efficiency operation of avalanche diodes at frequencies in the UHF range can be explained by the TRAPATT theory, even though the trapped-plasma or low-voltage state may last only 1/20th of the oscillation period.

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