Abstracts

The Traveling-Wave IMPATT Mode

M. Franz and J.B. Beyer. "The Traveling-Wave IMPATT Mode." 1978 Transactions on Microwave Theory and Techniques 26.11 (Nov. 1978 [T-MTT]): 861-865.

The small-signal analysis of a distributed IMPATT diode ifdicates the existence of a traveling-wave mode. The severe power-frequency limitation as well as the associated low impedance level of the discrete diode appear avoidable. No external resonant circuitry is needed. It is shown that the TEM parallel-plate waveguide mode of the junction is modified by the injection of electrons at the p+ -n junction (or Schottky contact). The transverse electric field takes on a traveling-wave nature in the transverse direction tracking the injected electrons, and a small longitudinal electric field will also be present. In previous papers on IMPATT traveling-wave structures, the IMPATT effect was lumped into an effective complex permittivity in a composite layer model or into an effective shunt admittance in a transmission line model. The current work attempts to incorporate the IMPATT mechanism into the wave model and considers the actual carrier field interaction. The srnall-signal analysis yields an analytic field solution and a characteristic equation for the complex propagation constant. Solutions are found and documented for various frequencies and bias current densities. For the particular structure considered, at 12 GHz with a bias current density of 1000 A/cm² a gain of 72 dB/cm was found.

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