Abstracts

Circuit Model Simulation of Gunn Effect Devices

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A circuit model of the Gunn device that retains both the time dependent and nonlinear device properties is presented. The model is based on the physical properties of a high-field domain in a uniformly doped sample and represents this domain and the remainder of the device by appropriate circuit elements. A computer program has been written that allows the device to be connected to any combination of RLC elements up to and including two parallel RLC circuits in series. Computer calculations have been made with a low resistance series circuit to simulate the Gunn mode of operation. The variation of Gunn frequency with bias voltage has been calculated and is in qualitative agreement with experiments. An inductance of 1 nH in series with 1 ohm is found to significantly alter results in comparison with the pure resistive case. The effect of this series inductance has also been observed experimentally as a lack of harmonics in resistive device mounts with stray inductance. Results obtained with a parallel RLC circuit point out the importance of circuit voltage control on the domain behavior. The LSA diode is treated as a bulk conductance following the drift velocity-electric field curve for GaAs. The bulk velocity and differential mobility are approximated by polynomials of electric field from which the device equivalent circuit is obtained. A physical insight into the operation of the LSA device is gained through a plot of time-integrated differential mobility with time. It is shown that an RF load for which this integral does not change appreciably over an RF period results in maximum efficiency. Results of efficiency and negative resistance of the device obtained for a bias field of 10 kV/cm are presented and are in good agreement with calculations of other workers.

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