Abstracts

DC Instability of the Series Connection of Tunneling Diodes

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An oscillator with a series connection of tunneling diodes produces significantly higher power than a single diode oscillator. However, a circuit with series-connected tunneling diodes biased simultaneously in the negative differential resistance (NDR) region of the I-V curve is dc unstable. This dc instability makes the series connection oscillator fundamentally different from a single diode oscillator. Associated with the dc instability are the phenomena of minimum oscillation amplitude and frequency. Due to the minimum oscillation amplitude, it is critical to provide the impedance match between the oscillator circuit and the series connection at the desired oscillation amplitude level. An in depth, comprehensive analysis of the dc instability is given here. Based on this analysis, a numerical procedure is developed to accurately predict the minimum oscillation amplitude and frequency. Time domain simulations which give further insight into series-connection oscillator behavior are discussed. The effect of increasing the number of diodes on the oscillator performance is explored as well. Based on numerical and simulation results, oscillators with several tunnel diodes connected in series were designed and tested. Experimental results that confirm the existence of the minimum oscillation amplitude are presented for oscillators with two, three, and four tunnel diodes.

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