Abstracts

The origin of the kink phenomenon of transistor scattering parameter S/sub 22/

S.-S. Lu, T.-W. Chen, H.-C. Chen and C. Meng. "The origin of the kink phenomenon of transistor scattering parameter S/sub 22/." 2001 Transactions on Microwave Theory and Techniques 49.2 (Feb. 2001 [T-MTT]): 333-340.

A novel theory based on dual-feedback circuit methodology is proposed to explain the kink phenomenon of transistor scattering parameter S/sub 22/. Our results show that the output impedance of all transistors intrinsically shows a series RC circuit at low frequencies and a parallel RC circuit at high frequencies. It is this inherent ambivalent characteristic of the output impedance that causes the appearance of kink phenomenon of S/sub 22/ in a Smith chart. It was found that an increase of transistor transconductance enhances the kink effect while an increase of drain-to-source (or collector-to-emitter) capacitance obscures it. This explains why it is much easier to see the kink phenomenon in bipolar transistors, especially heterojunction bipolar transistors, rather than in field-effect transistors (FETs). It also explains why the kink phenomenon is seen in larger size FETs and not in smaller size FETs. Our model not only can predict the behavior of S/sub 22/, but also calculate all S-parameters accurately. Experimental data of submicrometer gate Si MOSFETs and GaAs FETs are used to verify our theory. A simple method for extracting transistor equivalent-circuit parameters from measured S-parameters is also proposed based on our theory. Compared with traditional Z- or Y-parameter methods, our theory shows another advantage of giving deep insight into the physical meaning of S-parameters.

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