Abstracts

Noise Parameters of SIS Mixers

L.R. D'Addario. "Noise Parameters of SIS Mixers." 1988 Transactions on Microwave Theory and Techniques 36.7 (Jul. 1988 [T-MTT]): 1196-1206.

It has been shown that very low noise receivers can be constructed at millimeter wavelengths by using mixers containing super-conducting tunnel junctions as the nonlinear elements. This is possible because of both the low intrinsic noise of these devices and their potential for high conversion gain. In this paper the quantum theory of mixing is used to derive the full noise parameters and small-signal parameters of sinusoidally pumped SIS junctions. These are then put into a form that allows the extensive theory of two-port linear networks to be brought to bear, allowing calculation of such useful parameters as minimum noise temperature, optimum source impedance, available (or exchangeable) gain at minimum noise, and stability factor. These quantities are properties of the pumped junction that do not depend on the source or load impedance, but do depend on the terminations at the image and harmonic sideband frequencies. The harmonic sidebands are taken to be shorted, and the image termination dependence is studied in detail. Numerical results are presented for both ideal (BCS theory) and practical (measured current-voltage characteristic) junctions. The noise parameters of the cascade connection of an SIS mixer and a (noisy) IF amplifier are considered, leading to a specification of the optimum coupling network between the two. Finally, it is noted that the SIS mixer is usually not unconditionally stable, but that oscillation can be avoided by careful design of the IF coupling network.

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