Abstracts

Embedding Impedance Approximations in the Analysis of SIS Mixers

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Tucker's quantum theory of mixers is the basis for almost all analysis and design of SIS (Superconductor-Insulator-Superconductor) mixers. This paper examines the adequacy of three approximations to Tucker's theory: (i) the usual three-frequency approximation which assumes a sinusoidal LO voltage at the junction, and a short-circuit at all frequencies above the upper sideband, (ii) a five-frequency approximation which allows two LO voltage harmonics and five small-signal sidebands, and (iii) a quasi five-frequency approximation in which five small-signal sidebands are allowed, but the LO voltage is assumed sinusoidal. These are compared with a full harmonic-Newton solution of Tucker's equations, including eight LO harmonics and their corresponding sidebands, for realistic SIS mixer circuits. It is shown that the accuracy of the three approximations depends strongly on the value of omegaR/sub N/C for the SIS junctions used. For large omegaR/sub N/C, all three approximations approach the eight-harmonic solution. For omegaR/sub N/C values in the range 0.5 to 10, the range of most practical interest, the quasi five-frequency approximation is a considerable improvement over the three-frequency approximation, and should be suitable for much design work. For the realistic SIS mixers considered here, the five-frequency approximation gives results very close to those of the eight-harmonic solution.

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