Abstracts

Inherent Signal Losses in Resistive-Diode Mixers

A new time-domain method is presented for the characterization and analysis of resistive-diode mixers. The method has been found to be helpful in evaluating experimental models of new mixer designs. From an analytical viewpoint, this method has provided some new insights into mixer behavior and the fundamental limits to mixer performance. In analyzing equivalent mixer models, the method has been found to be in agreement with the classical frequency-domain approach. In using the time-domain method to determine the minimum available loss, theoretical studies were made using an "ideal-diode" model which is presumed to have zero forward-bias resistance and infinite reverse-bias impedance. Significant signal losses were found to occur, even in this "lossless" condition, when reactive filtering was used to suppress unwanted frequency responses. The lost signal power was not reflected and it did not appear at other signal-related frequencies. This result has also been found in a frequency-domain analysis using a new formulation suggested to the author in private correspondence. This loss is explained in two different ways, depending upon the model used and the method of analysis. In one example, using the time-domain approach, it was found that signal energy is converted into dc in the rectified current. In the frequency domain analysis, the loss is explained as the result of frequency conversions into a large number of high-order modulation products. The paper includes some newly formulated conjectures concerning the ultimate limits on conversion loss in single-diode mixers.

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