Abstracts

A Large Signal Analysis Leading to Intermodulation Distortion Prediction in Abrupt Junction Varactor Upconverters

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Even though the abrupt junction varactor parametric upconverter is a "square-law" device, it exhibits gain saturation. This nonlinearity of the transfer characteristic is responsible for the nonlinear distortion present at the output of the device. Of the several methods used to measure nonlinear distortion, the two tone test has been widely used. It is the accepted test method of both SMPTE and CCIR. This paper discusses the relationship between the nonlinear distortion measured by the two tone test and the nonlinear gain characteristic. It shows that if one is known the other is uniquely determined. The analysis is broken into two parts. The first is a large signal analysis of the "square-law" parametric frequency converter. The results show that the gain is a function of the input signal level. It is this nonlinear relationship that is responsible for gain saturation. The second part is a study of the series representation of this nonlinear equation with respect to the terms containing the intermodulation frequencies. The final result is an equation which predicts the amplitude of the intermodulation distortion at any of the intermodulation frequencies. The analysis presented is closely related to the circuit and diode parameters and therefore not only predicts the amount of intermodulation distortion but also shows how it may be reduced. Experimental verification of the theory is also included.

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