Abstracts

Nonlinear dynamics of microwave synthesizers-stability and noise

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The nonlinear dynamics of microwave synthesizers based on type-II third-order loops is analyzed in this paper. Instead of using standard simplified models, realistic models are considered for the loop filter, phase detector (PD), and voltage-controlled oscillator based on experimental characterization. The new models enable the simulation of incidental frequency modulation and the accurate prediction of the synthesizer operation ranges, including possible hysteresis phenomena. The stability of phase-locked solutions is analyzed, enabling the prediction of possible chaotic behavior. For an accurate determination of the output spectrum, a phase-noise simulation is also carried out, considering the noise contributions from the loop elements. The sidebands inherent to the synthesizer solution are taken into account for this analysis. The analysis strategy has been applied to a microwave synthesizer, operating in the 2-3 GHz band, with very good results. Two types of PDs are considered: the JK flip-flop PD and frequency mixer, comparing the resulting loop performance in terms of stability and phase noise.

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