Abstracts

General oscillator characterization using linear open-loop S-parameters

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From a practical standpoint, oscillator design using linear open-loop S-parameters is attractive to designers due to the ease of use and widespread availability of linear S-parameter-based analysis software. However, the easiest and, therefore, most common approach is based on intuition and rules of thumb. The intent of this paper is to obtain quantitative expressions that characterize oscillator performance in terms of the linear open-loop S-parameters. A characteristic equation is derived that determines oscillator stability. The Nyquist stability criteria can be applied to this equation directly from the open-loop Bode plot. A closed-loop gain parameter is derived, which describes how the open-loop circuit self-connects. From this parameter, the startup time, oscillation frequency, and loaded Q can be predicted. A prediction of actual oscillation frequency can be made based on a simple oscillator model with known saturation characteristics. It will be shown under what conditions these expressions simplify to more readily applicable forms. In many cases, the designer can adjust analysis parameters to allow the use of the simplified expressions.

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