ABSTRACT

On-Chip Spectrum/Vector Analyzer for Built-In Testing of Analog Integrated Circuits.
(December 2002)

Marcia Gisela Mendez Rivera, B.E., University of Guanajuato, Guanajuato, Mexico;
M.S., Instituto Nacional de Astrofisica, Optica y Electronica, Puebla, Mexico
Chair of Committee: Dr. Jose Silva-Martinez

The number of functions that can be integrated on a single chip has increased during the last years, making the functional testing of circuits a challenging task. Even though the digital testing has reached certain maturity and well-defined techniques have been developed, we cannot use the same techniques for analog and mixed-signal circuits due to the different nature of digital and analog circuits. In the case of analog circuits, the number of possible values is unlimited and there is not a specific value that tells us if the circuit is working properly. The complexity and sensitivity of the time and voltage nature in analog circuits makes the testing task even more difficult. Even more, the analog circuits have to be tested under different conditions; e.g., sweeping frequency and amplitude. Due to the fact that there are not specific and efficient techniques for testing analog circuits, every analog circuit requires a particular design in order to be tested. As a result of this, the test cost is the dominant issue in many products and the investment made in this stage is not recovered.

This work deals with some of the fundamental problems faced in analog testing. New techniques to characterize and test analog circuits using an external digital tester rather than an analog tester have been developed. The architecture used is a built-in self-test circuit. The test is made in an automatic way, obtaining information that tells us if the circuit works or not based on certain error margin. In our case, the parameters that concern us are transfer function (magnitude and phase response) and harmonic distortion components.

The techniques proposed to measure the frequency response of the DUT rely on the capability of the circuit to generate a low distortion and accurate sinusoidal signal to be used as stimuli. The switched-capacitor based circuit techniques used ensure the synchronization between the blocks involved. The use of the same digital signal for controlling these blocks assures that the tracking error could be within 0.5% if switched-capacitor techniques are used.