Chapter 8

OSCILLATION-BASED TEST STRATEGIES

G. Huertas, G. Leger, D. Vazquez, A. Rueda and J.L. Huertas
IMSE, CNM, CSIC / University of Sevilla

Abstract: This chapter aims to present a structural test methodology using the so-called OBT technique. The conceptual bases of the OBT approach are presented as well as many practical details on its application to practical integrated circuits.

Key words: Structural testing, Oscillation-based test, Test of analog and mixed-signal ICs

1. INTRODUCTION: MOVING FROM FUNCTIONAL TO STRUCTURAL TEST

Analog circuits are difficult to test because there is a wide variety of analog building blocks, their specifications are very broad, and there is a strong dependency of circuit parameters on component variations. For mixed-signal ICs, where analog circuits must coexist with digital components, testing difficulties increase substantially because the access to both analog and digital blocks is severely restricted. The consequences are a reduced fault coverage, a higher test application time and a longer test development time.

In mixed-signal IC’s, the most difficult components to test are the analog cores, since analog test is based on checking functional specifications, what can be conflicting when test time has to be kept small, the number of available pins is reduced and full access to input/output core terminals can not be granted. Furthermore, functional test techniques greatly differ depending on the involved analog components and/or their application field,
turning almost impossible to define a general (functional) test methodology applicable to any analog block.

Experience forged from the test of digital circuits encourages researchers to try structural or fault-driven test methods for analog components and explore Built-In Self-Test (BIST) alternatives as well. This has to be done in a manner that increases accessibility to provide core isolation and test resources access, but it might have a high cost in terms of area overhead, power wasting, performance degradation and/or noise and parasitic penalties. But neither moving from functional to structural testing nor incorporating BIST are trivial issues in what analog circuitry is concerned, and are still far from a wide acceptance by the designer community. This acceptance will depend on several factors like compatibility with functional test approaches, test efficiency, test confidentiality and additional design effort.

In order to get an efficient, yet economically feasible test procedure for a complex mixed-signal ASIC, several factors have to be considered:

1.- **stimuli generation.** A single signal should be preferred, specially a signal that can be easily supplied to a selected input or can be generated on-chip.

2.- **access to several/many internal nodes** that can be read either sequentially or in parallel, allowing us to select convenient test points.

3.- **a single test output** containing all the information required for performing an interpretation of the test signals. It should be preferred to have such an information coded in digital, since it would reduce the tester requirements.

4.- **a simple measurement set** giving enough information about the operational status of the Circuit Under Test (CUT)

5.- **a system-level strategy** to decompose the ASIC into meaningful parts that can be tested in a common way.

Among the emerging structural test solutions, the so-called Oscillation-Based Test (OBT) technique is very appealing. It is conceptually simple, does not demand strong circuit modifications during testing and can handle BIST without the penalty of dedicated, additional on-chip signal generation hardware. In broad terms, when OBT is employed no external test stimuli are required, some few simple measurements are used, and can be combined with a multiplexing scheme to probe internal nodes, thus complying with some of the factors above.

In this Chapter, the basic concepts underlying OBT are presented, as well as the principles for applying this test methodology to complex integrated circuits. Our aim is to provide the reader with an overview of the lights and shadows this test technique offers nowadays. Section 2 reviews the existing knowledge on this topic. Section 3 deals with the principles supporting the