**Analog and Mixed-Signal Design and Test Techniques for Improved Reliability**

by

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The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this dissertation. The Graduate College will ensure this dissertation is globally accessible and will not permit alterations after a degree is conferred.

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## ABSTRACT

The relentless evolution of semiconductor technology has led to a pervasive reliance on integrated circuits (ICs) across an array of applications, from consumer electronics to safety-critical systems in automotive and medical devices. Ensuring the reliability and robustness of these ICs has become paramount. This dissertation addresses the growing need for defect-oriented testing in analog and mixed-signal (AMS) circuits, introducing a novel digital-like methodology. It emphasizes breaking down complex AMS circuits into smaller, manageable subcircuits, which are rigorously examined using purely digital monitors and injectors. The methodology is resource-efficient, optimizing existing circuit resources to minimize area overhead and power consumption. A significant achievement lies in the development of a Built-In Self-Test (BIST) for a 12-bit Successive Approximation Register (SAR) Analog-to-Digital Converter (ADC), showcasing the approach's effectiveness and flexibility.

Additionally, this dissertation pioneers a smart sensor design approach that reduces dependence on intricate device models, thereby ensuring high performance across a broad range of operating conditions. A case study on a temperature-to-digital converter (TDC) design demonstrates its capability to function reliably over an extensive temperature range. The methodology optimizes parameters, allowing energy-efficient sensor designs that meet industry standards while minimizing silicon area and power consumption.

These works signify a dedicated commitment to advancing the reliability and functional safety of analog and mixed-signal circuits, contributing to the evolving landscape of IC design.