Analog Signal Generation for Built-in Self-Test of Mixed-Signal Integrated Circuits: A Comprehensive Guide

Analog signal generation is a crucial aspect of built-in self-test (BIST) for mixed-signal integrated circuits (ICs). BIST enables testing and debugging of ICs without the need for external test equipment, making it an essential technique for ensuring the reliability and quality of mixed-signal systems.

This article provides a comprehensive overview of analog signal generation for BIST of mixed-signal ICs. We will cover the different types of analog signal generators, their design and implementation, and the various techniques used for BIST pattern generation.

Analog Signal Generation for Built-In-Self-Test of Mixed-Signal Integrated Circuits (The Springer International Series in Engineering and Computer Science Book 312) by Gordon W. Roberts

★★★★★ 5 out of 5

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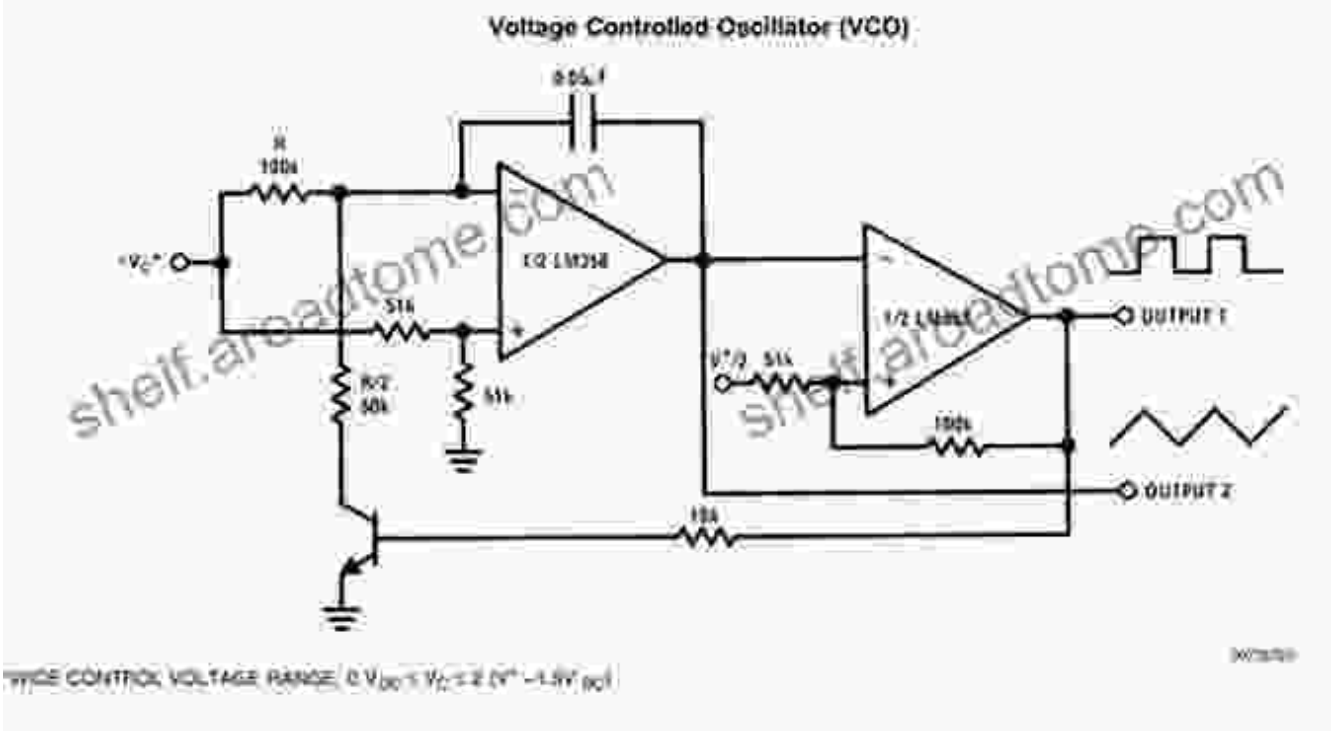
Types of Analog Signal Generators

There are several different types of analog signal generators used for BIST, each with its own advantages and disadvantages. Here are the most

common types:

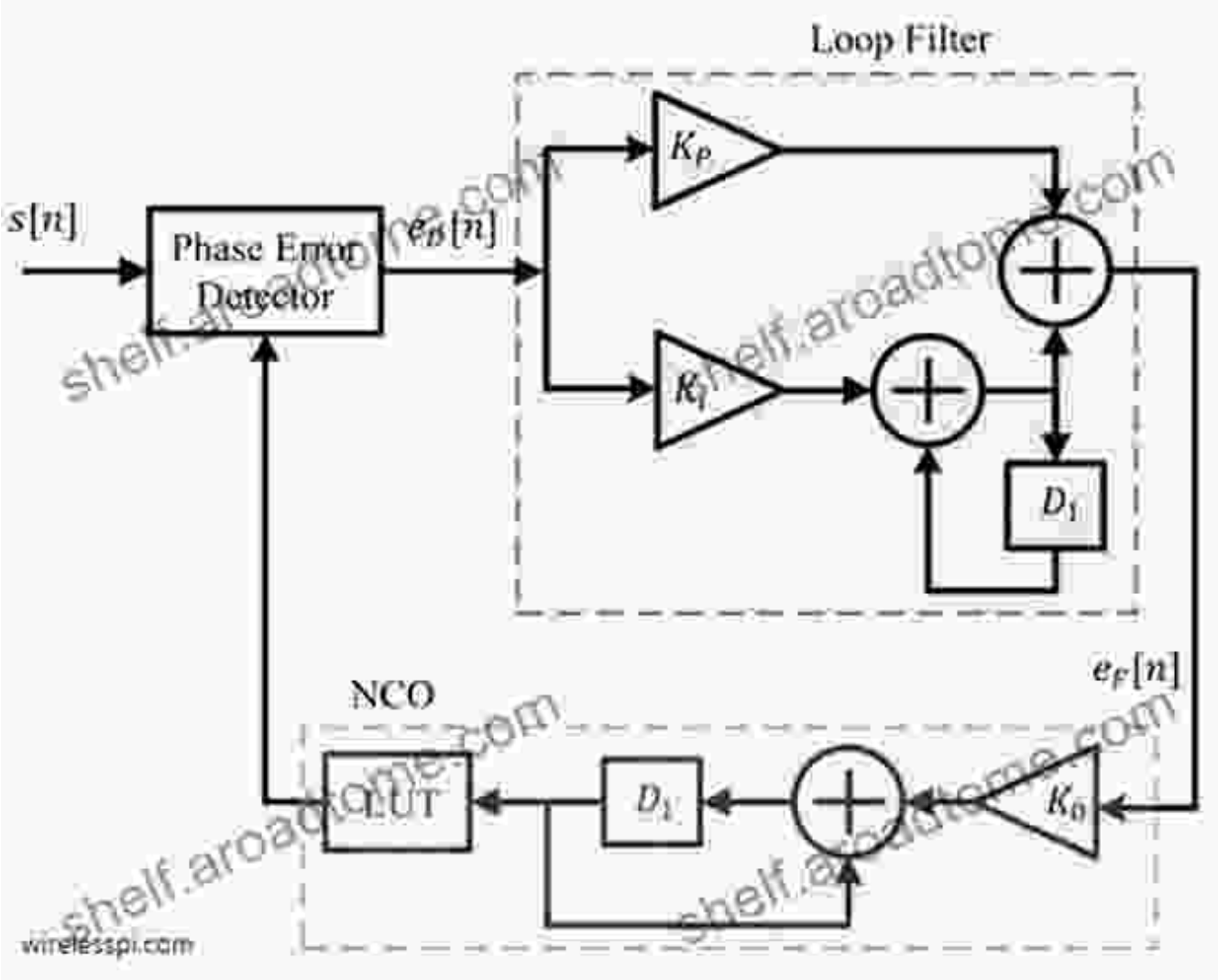
1. VCO-Based Signal Generators

Voltage-controlled oscillators (VCOs) are widely used for generating sinusoidal and triangular waveforms. They offer high frequency resolution and linearity, making them suitable for testing analog-to-digital converters (ADCs) and digital-to-analog converters (DACs).



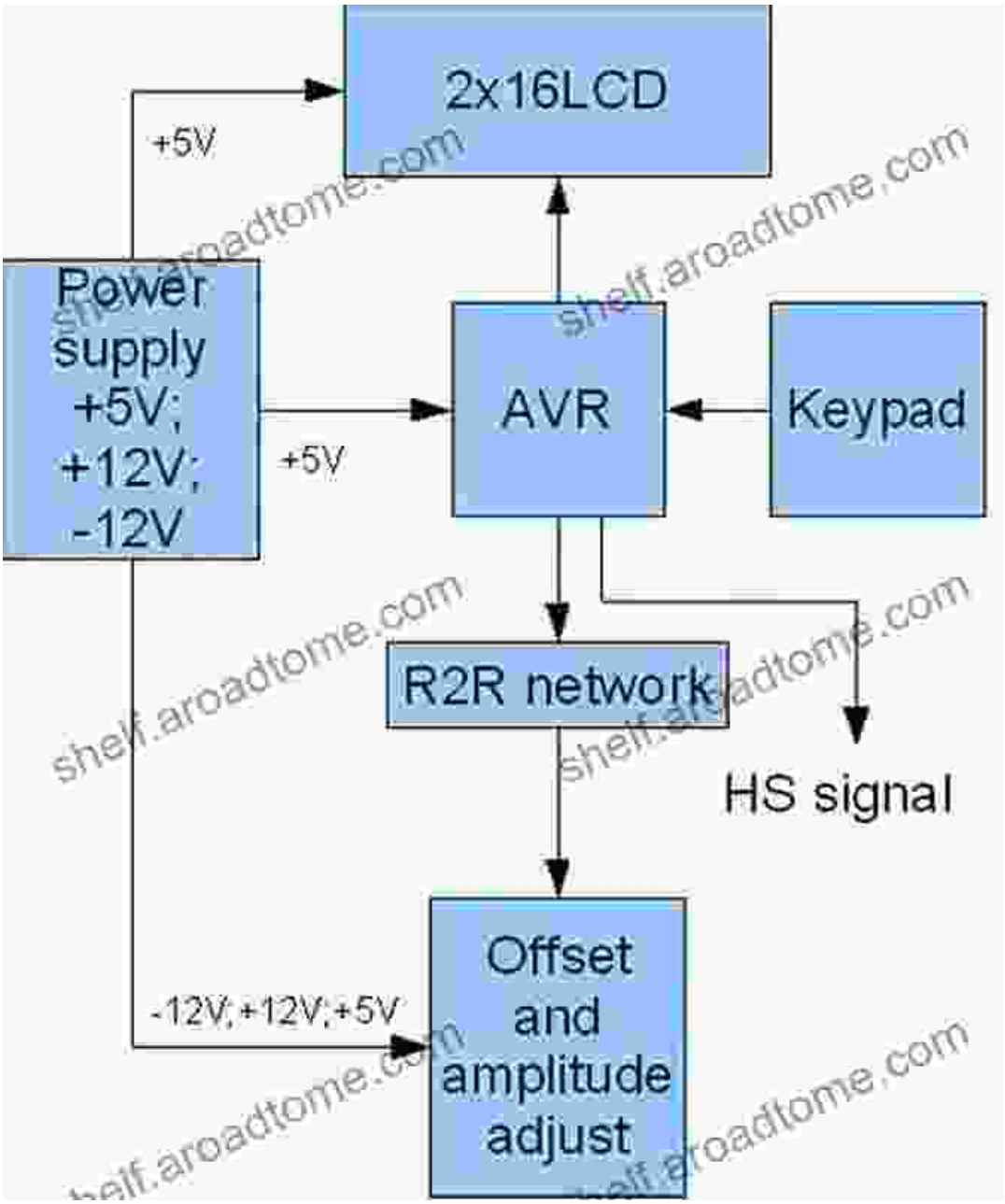
2. PLL-Based Signal Generators

Phase-locked loops (PLLs) are used to generate frequency-coherent waveforms with low phase noise. They are particularly useful for testing clock and data recovery circuits, as well as for generating multi-tone signals.



3. DDS-Based Signal Generators

Direct digital synthesizers (DDSs) offer precise frequency and amplitude control. They are often used for generating arbitrary waveforms, including complex modulation schemes such as QAM and OFDM.



Design and Implementation of Analog Signal Generators

The design and implementation of analog signal generators for BIST require careful consideration of several factors, including:

1. Frequency Range and Resolution

The frequency range and resolution of the signal generator must match the requirements of the IC under test. For example, testing high-speed ADCs may require generators capable of generating frequencies in the GHz range with fine resolution.

2. Signal Purity

The generated signal should have minimal noise and distortion to ensure accurate testing. Low-noise amplifiers, filters, and compensation techniques are often used to improve signal purity.

3. Power Consumption

Power consumption is a key consideration for on-chip BIST. Low-power design techniques, such as power gating and dynamic voltage scaling, are employed to minimize power dissipation.

4. Area and Cost

The area and cost of the signal generator must be minimized to make BIST practical for large-scale ICs. Compact circuit topologies and cost-effective implementation techniques are used to achieve this goal.

BIST Pattern Generation Techniques

BIST pattern generation techniques play a vital role in ensuring comprehensive testing of the IC under test. Here are the most common techniques:

1. Pseudo-Random Pattern Generation

Pseudo-random pattern generation (PRPG) produces a seemingly random sequence of bits that resembles actual circuit stimuli. PRPGs are simple to

implement and can provide good coverage for basic testing.

2. Deterministic Pattern Generation

Deterministic pattern generation (DPG) produces a predefined sequence of patterns that target specific faults in the IC under test. DPG is more complex to implement than PRPG, but it can provide higher test coverage.

3. Built-in Self-Learning Pattern Generation

Built-in self-learning pattern generation (BSLPG) involves generating patterns based on the observed responses of the IC under test. BSLPG can adapt to specific device characteristics and improve test coverage over time.

Analog signal generation is an essential component of BIST for mixed-signal ICs. By understanding the different types of signal generators, their design and implementation, and the various BIST pattern generation techniques, engineers can effectively test and debug complex mixed-signal systems.

This article provided a comprehensive overview of analog signal generation for BIST. For further in-depth study, we recommend referring to specialized textbooks and research papers on the topic.

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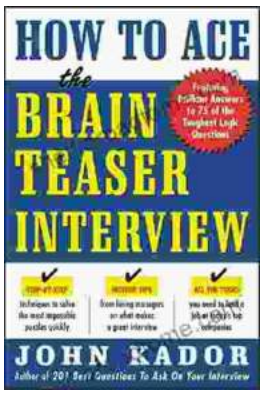

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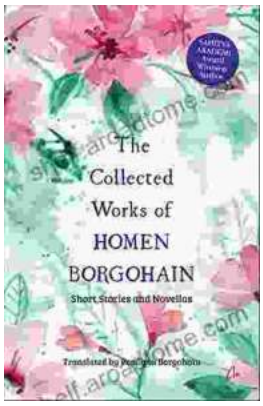

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