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Rad-hard Analog ICs

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Rad-hard Analog ICs is a practical guide for researchers and engineers designing and preliminarily characterizing radiation-hardened analog and mixed-signal circuits in standard CMOS technologies across multiple foundries and nodes.

The opening chapter explains the fundamental radiation effects encountered in space and other harsh environments, establishing the scientific basis for radiation hardening by design (RHBD) techniques used to mitigate total ionizing dose (TID), single-event effects (SEE), and transient disturbances.

The core chapters focus on three essential building blocks—band-gap references (BGRs), digital-to-analog converters (DACs), and analog-to-digital converters (ADCs). Each chapter begins with a concise review of circuit operating principles, followed by a survey of leading RHBD strategies from the literature. The authors then present their own rad-hard implementations, detailing the complete design flow from transistor-level mitigation techniques to layout-level hardening strategies.

The final chapter provides a practical overview of radiation testing methodologies for analog and mixed-signal circuits, with emphasis on experimental campaigns conducted by the authors. Measured results under TID and SEE conditions illustrate both characterization techniques and real-world performance.
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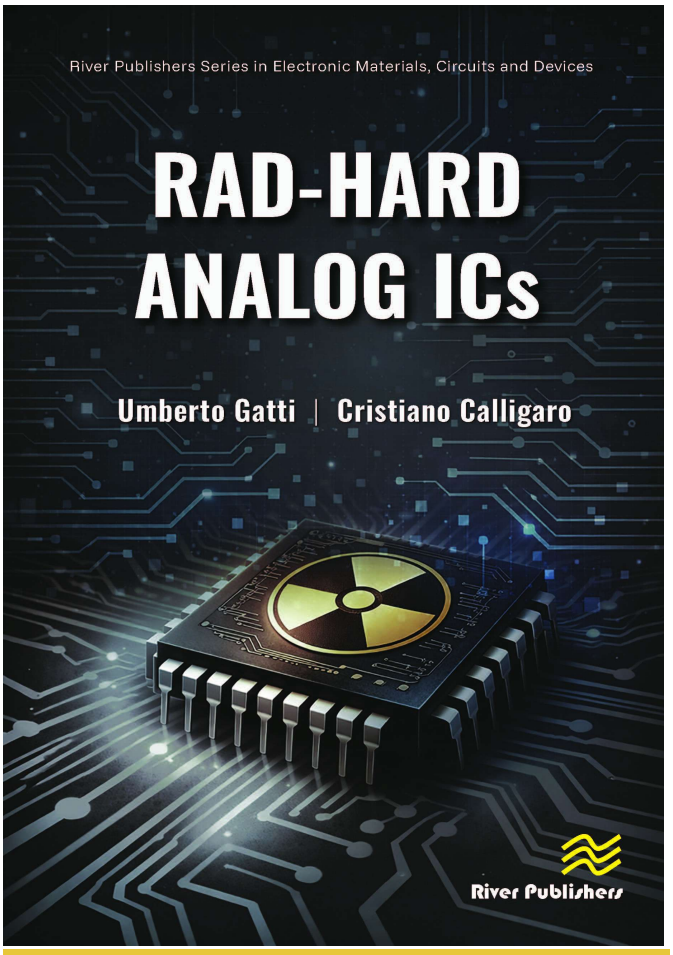

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Coulomb field, voltage references, band-gap references (BGR), radiation-hardened-by-design (RHBD), integrated circuits (ICs), digital-to-analog converter (DAC), analog-to-digital converter (ADC), single-event effect (SEE), total dose ionization (TID), graphic user interface (GUI), static test of converters, dynamic test of converter, operational amplifier, edge-less transistor (ELT), enhanced guard ring (EGR), foundry CMOS, linear energy transfer (LET), radiation hard, shallow trench isolation (STI), silicon on insulator (SOI), silicon on sapphire (SOS), total ionizing dose (TID)

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