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Radiation Hardening by Design (RHBD) Analog Integrated Circuits

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Description:

The book is intended for researchers and professionals interested in understanding how to design and make a preliminary characterization of Radiation Hardened (rad-hard) analog and mixed-signal circuits, exploiting standard CMOS manufacturing processes available from different silicon foundries and using different technology nodes.

It starts with an introductory overview of the effects of radiation in space and harsh environments with a specific focus on analog circuits to enable the reader to understand why specific design solutions are adopted to mitigate hard/soft errors. The following four Chapters are devoted to RHBD (Radiation Hardening by Design) techniques for semiconductor components applied to Operational Amplifiers, Voltage References, Analog-to-Digital (ADC) and Digital-to-Analog (DAC) converters. Each Chapter is organized with a first part which recalls the basic working principles of such circuit and a second part which describes the main RHBD techniques proposed in the literature to make them resilient to radiation. The approach follows a top-down scheme starting from RHBD at circuit level (how to mitigate radiation effects by handling transistors in the proper way) and finishing at layout level (how to shape a layout to mitigate radiation effects).

The last-but-one Chapter is devoted to a special class of analog circuit, the dosimeters, which are gaining importance in space, health and nuclear applications. By leveraging the characteristic of a Flash-memory cell, a re-usable dosimeter is described which includes the sensitive element itself, the analog interface and the process of characterization.

The last part is an overview of the strategies adopted for the testing of analog and mixed-signal circuits. In particular, it will focus also on the measurement campaigns performed by the Authors aiming for the characterization of developed rad-hard components under total dose (TID) and single-events (SEE).

Technical topics discussed in the book include:

- Radiation effects on semiconductor components (TID, SEE)
- Radiation Hardening by Design (RHBD) Techniques
- Rad-hard Operational Amplifiers
- Rad-hard Voltage References
- Rad-hard ADC
- Rad-hard DAC
- Rad-hard Special Circuits
- Testing Strategies

Keywords: Rad-Hard Integrated Circuits Design, Radiation-Hardened by Design Techniques, Microelectronics for Harsh Environments, Analog and Mixed-Signal Integrated Circuits, ADC/DAC, Operational Amplifiers

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