

Preface

The electronics and information technology revolution continues, but it is a critical time in the development of technology. Once again, we stand on the brink of a new era where emerging research will yield exciting applications and products destined to transform and enrich our daily lives! The potential is staggering and the ultimate impact is unimaginable, considering the continuing marriage of technology with fields such as medicine, communications and entertainment, to name only a few.

But who will actually be responsible for transforming these potential new products into reality? The answer, of course, is today's (and tomorrow's) design engineers!

The design of integrated circuits today remains an essential discipline in support of technological progress, and the authors of this book have taken a giant step forward in the development of a practice-oriented treatise for design engineers who are interested in the practical, industry-driven world of integrated circuit design.

The authors, Giovanni Campardo and Rino Micheloni, are very well qualified to effectively address this challenging objective. Both have a solid track record of leading design activities at the STMicroelectronics Flash Division. I should probably mention at this point my association with and knowledge of the accomplishments of these authors. In April 2003, they published a unique Special Issue on the subject of Flash Memories for the Proceedings of the IEEE, the journal for which I am Managing Editor. Therefore, I have firsthand knowledge of their approach to the development of very well crafted technical material.

In addition, a third member of the author team, David Novosel, has provided invaluable assistance, particularly in the translation efforts on this material. David is President and founder of Intelligent Micro Design, Inc. which specializes in the design of custom memories and analog circuits, which is located in Pittsburgh, PA.

This book is intended for Electrical Engineering graduates who want to enter into the integrated circuit design world. Nonvolatile memories, in many cases, are treated as an example to explain general design concepts (basic circuits, layout, design flow, etc.). Practical illustrative examples of nonvolatile memories, including flash types, are showcased to give insightful examples of the design approaches that are discussed. The authors introduce the key nonvolatile memories design issues in the first section and they discuss the various functions and capabilities of these memories; much of these discussions are based on their recently published Special Issue on the subject of Flash memories.

After a complete review of the general design issues, the authors begin to focus on the important concepts that should be understood. For example, they introduce MOS Process and briefly review the CMOS building blocks and the four available components. In the next section the authors describe Memory cell operations including Read and Erase operations, as well as coverage of software and program issues.

Comprehensive sections on Design Building Blocks, Integrated circuits layout, and Matrix architecture are included. They explore in some depth Input buffers, Output Buffers Decoders and Program and Erase operations circuitry. They discuss the subjects of Timers and Read operation sensing techniques.

Two sections deal with quality and dependability-related issues, and cover the subjects of Redundancy and Test Modes. Coverage is also provided on ESD & latch-up issues as well as Embedded Flash algorithms.

A collection of photos is included to make the reader familiar with silicon aspects.

Throughout all parts of this book, the authors have taken a practical and applications-driven point of view, providing a comprehensive and easily understood approach to all the concepts discussed.

I greatly appreciate the very kind invitation of the authors to submit these words of introduction for their exciting new book. I wish them continued success in their latest publishing enterprise, but more importantly I hope that all who are reading these words will derive knowledge and understanding from the sincere and dedicated efforts of the authors.

Jim Calder
Managing Editor
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VLSI-Design of Non-Volatile Memories

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