Preface

The goal of this book is to provide the essential steps required in the physical design of Application Specific Integrated Circuits (ASIC). It is the intention that the book present self-contained material and enough detail so as to give the reader a basic idea of ASIC design implementation.

The first generation of modern electronics is thought to have begun in 1942 with the invention of electronic switches and miniature vacuum tubes. By 1946, a large-scale computing device based on these new inventions was developed. The computing device was known as Electronic Numerical Integration and Calculation (ENIAC). ENIAC could perform thousands of calculations per second and was used in many applications such as scientific research and weather predictions.

With the introduction of the first working transistor in 1948, the second generation of the electronic era began. This era was mainly characterized by the change from vacuum tubes to transistor technology. Vacuum tubes were gradually replaced in the design of switching circuits by discrete transistors.

By 1965, the third generation of electronics began with the development of the Integrated Circuit (IC). The IC started to replace discrete transistor circuits. In addition, semiconductor memories, such the Read Only Memory (ROM) and Random Access Memory (RAM), began to augment the system designs. This resulted in the substantial reduction of the physical size and cost of the systems. This generation propelled the rapid integration of circuit design forms (small, medium, and large) to very large devices that contained millions of transistors.

These tremendous achievements were made possible by the development of IC processing equipment, design tools, and software. In the past fifteen years, the world not only has been witness to the rapid reduction in the feature size of transistors (from 1000 to 45 nanometer), but also to the dramatic innovation of sophisticated physical design automation tools.

The complexities of today's ASIC physical designs require a mix of backgrounds in electrical engineering, computer science, and IC processes. Such diversified knowledge has created a new discipline in engineering – the physical design engineer. Today's physical design engineers are expected to be conversant with all aspects of ASIC design implementation stages that include device processes, library development, place-and-route algorithms, verification and testing.

This book is arranged in a format that follows the industry-common ASIC physical design flow. It begins with the general concept of an ASIC library, then covers floorplanning, placement, routing, verification, and finally, testing. Topics covered include:

- Basic standard cell design, transistor sizing, and layout styles
- Linear, nonlinear, and polynomial characterization
- Physical design constraints and floorplanning styles
- Algorithms used for placement
- Clock Tree Synthesis
- Algorithms used for global and detailed routing
- Parasitic extraction
- Functional, timing, and physical methods of verification
- Functional, scan, parametric, memory and parallel module test

Rather than go into lengthy technical depths, the emphasis has been placed on short, clear descriptions complemented by references to authoritative manuscripts for those desiring further information on each chapter. It is the goal of this book to capture the essence of physical design, and to introduce to the reader the challenging and diversified field of physical design engineering.

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