

Preface

If you have an extreme passion for producing great products, it pushes you to be integrated... It takes a lot of hard work to make something simple, to truly understand the underlying challenges and come up with elegant solutions.

Steve Jobs

We are rarely aware, in our daily use of smartphones, notebooks, etc., that the development of mobile electronic devices started only a few decades ago. After the discovery of the transistor in 1948, the first integrated circuit was built in 1960, followed by the microprocessor in 1971. Then in 1973, Motorola developed the first prototype mobile phone, in 1976, Apple Computer introduced the *Apple I*, and IBM introduced the *IBM PC* in 1981. The popularity in the late 1990s of cell phones and increasingly powerful laptop computers foreshadowed the *iPhones* and *iPads* that became ubiquitous at the turn of the century. We have truly become a society immersed in mobile electronic devices.

The packaging density, i.e., the number of components per unit volume, has increased consistently throughout this period and shows little indication of slowing down. The resulting amount of heat to be dissipated increased as well, putting the spotlight on heat transfer issues. It further became obvious that the reliability, i.e., the function and durability of electronic components, depends greatly on temperature. Another problem identified was the undesirable influence of switching functions, caused by unwanted signals inside and outside packages. These issues came under the heading of *electronic systems design*, which quickly became an important interdisciplinary subdiscipline of electrical engineering.

Since the first appearance of mobile electronic devices, such as the transistor radio in 1954, components have undergone massive development and miniaturization; integrated circuits have reached unheard of complexity levels, and new packaging methods coupled with computer-aided design (CAD) have revolutionized the design of electronic systems. More recently, recycling and environmental requirements were also added to the mix. It is amazing to realize that every smartphone today has more computing power than the on-board computer in

Apollo 11, which transported the first humans to another astronomical object back in 1969.

This book addresses this enormous scientific progress and offers a review of the current state of the art in the development of electronic systems. It is the result of the extensive experience of its two authors in industry, academic research, and teaching in electronic systems design. Its aim is to support the reader with the development and fabrication of modern electronic devices, taking all relevant aspects into consideration with a clear presentation of the underlying technical and scientific principles. The book elucidates a broad range of techniques that have helped keep German engineering at the cutting edge for several decades and will continue to do so for decades to come.

A book of such considerable scope can never be accomplished by one individual. The authors wish to express their warm appreciation and thanks to all who helped produce this publication. We would like to mention in particular Martin Forrestal for his key role in writing the English version of the book. Our warm thanks go to Dr. Mike Alexander who has greatly assisted in the preparation of the English text. We also wish to sincerely thank the following for their support with subsections of the manuscript: Dr. Alfred Kamusella (Sect. 2.6), Dr. Helmut Löbl (Chap. 5), Prof. Stefan Dickmann and Dr. Ralf Jacobs (Chap. 6), Prof. Karl-Heinz Gonschorek (Sect. 6.6), Prof. Günter Röhrs (Chap. 7), Steve Bigalke (Appendices 8.1 and 8.2), and Dr. Frank Reifegerste (Appendices 8.4 and 8.5). Thanks are also due to Nicole Lowary and Charles B. Glaser of Springer for being very supportive and going beyond their call of duty to help out with our requests.

Rapid progress will continue to be made in electronic systems design in the years to come, perhaps by some of the readers of this humble book. The authors are always grateful for any comments or ideas for the future development of the book, and wish you good luck in your careers.

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