

THE
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ELECTRONICS
HANDBOOK

INDUSTRIAL ELECTRONICS SERIES

Edited by
TIMOTHY L. SKVARENINA



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Preface

Introduction

The control of electric power with power electronic devices has become increasingly important over the last 20 years. Whole new classes of motors have been enabled by power electronics, and the future offers the possibility of more effective control of the electric power grid using power electronics. *The Power Electronics Handbook* is intended to provide a reference that is both concise and useful for individuals, ranging from students in engineering to experienced, practicing professionals. The Handbook covers the very wide range of topics that comprise the subject of power electronics blending many of the traditional topics with the new and innovative technologies that are at the leading edge of advances being made in this subject. Emphasis has been placed on the practical application of the technologies discussed to enhance the value of the book to the reader and to enable a clearer understanding of the material. The presentations are deliberately tutorial in nature, and examples of the practical use of the technology described have been included.

The contributors to this Handbook span the globe and include some of the leading authorities in their areas of expertise. They are from industry, government, and academia. All of them have been chosen because of their intimate knowledge of their subjects as well as their ability to present them in an easily understandable manner.

Organization

The book is organized into three parts. Part I presents an overview of the semiconductor devices that are used, or projected to be used, in power electronic devices. Part II explains the operation of circuits used in power electronic devices, and Part III describes a number of applications for power electronics, including motor drives, utility applications, and electric vehicles.

The Power Electronics Handbook is designed to provide both the young engineer and the experienced professional with answers to questions involving the wide spectrum of power electronics technology covered in this book. The hope is that the topical coverage, as well as the numerous avenues to its access, will effectively satisfy the reader's needs.

Acknowledgments

First and foremost, I wish to thank the authors of the individual sections and the editorial advisors for their assistance. Obviously, this handbook would not be possible without them. I would like to thank all the people who were involved in the preparation of this handbook at CRC Press, especially Nora Konopka and Christine Andreasen for their guidance and patience. Finally, my deepest appreciation goes to my wife Carol who graciously allows me to pursue activities such as this despite the time involved.

The Editor

Timothy L. Skvarenina received his B.S.E.E. and M.S.E.E. degrees from the Illinois Institute of Technology in 1969 and 1970, respectively, and his Ph.D. in electrical engineering from Purdue University in 1979. In 1970, he entered active duty with the U.S. Air Force, where he served 21 years, retiring as a lieutenant colonel in 1991. During his Air Force career, he spent 6 years designing, constructing, and inspecting electric power distribution projects for a variety of facilities. He also was assigned to the faculty of the Air Force Institute of Technology (AFIT) for 3 years, where he taught and researched conventional power systems and pulsed-power systems, including railguns, high-power switches, and magnetocumulative generators. Dr. Skvarenina received the Air Force Meritorious Service Medal for his contributions to the AFIT curriculum in 1984. He also spent 4 years with the Strategic Defense Initiative Office (SDIO), where he conducted and directed large-scale systems analysis studies. He received the Department of Defense Superior Service Medal in 1991 for his contributions to SDIO.

In 1991, Dr. Skvarenina joined the faculty of the School of Technology at Purdue University, where he currently teaches undergraduate courses in electrical machines and power systems, as well as a graduate course in facilities engineering. He is a senior member of the IEEE; a member of the American Society for Engineering Education (ASEE), Tau Beta Pi, and Eta Kappa Nu; and a registered professional engineer in the state of Colorado.

Dr. Skvarenina has been active in both IEEE and ASEE. He has held the offices of secretary, vice-chair, and chair of the Central Indiana chapter of the IEEE Power Engineering Society. At the national level he is a member of the Power Engineering Society Education Committee. He has also been active in the IEEE Education Society, serving as an associate editor of the *Transactions on Education* and co-program chair for the 1999 and 2003 Frontiers in Education Conferences. For his activity and contributions to the Education Society, he received the IEEE Third Millennium Medal in 2000.

Within ASEE, Dr. Skvarenina has been an active member of the Energy Conversion and Conservation Division, serving in a series of offices including division chair. In 1999, he was elected by the ASEE membership to the Board of Directors for a 2-year term as Chair, Professional Interest Council III. In June 2000, he was elected by the Board of Directors as Vice-President for Profession Interest Councils for the year 2000–2001.

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Power Electronics

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