POWER ELECTRONICS

CIRCUITS, DEVICES, AND APPLICATIONS



Prentice-Hall International Editions

M. H. RASHID

Power Electronics Circuits, Devices, and Applications

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ISBN 0-13-686619-0

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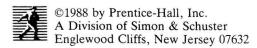
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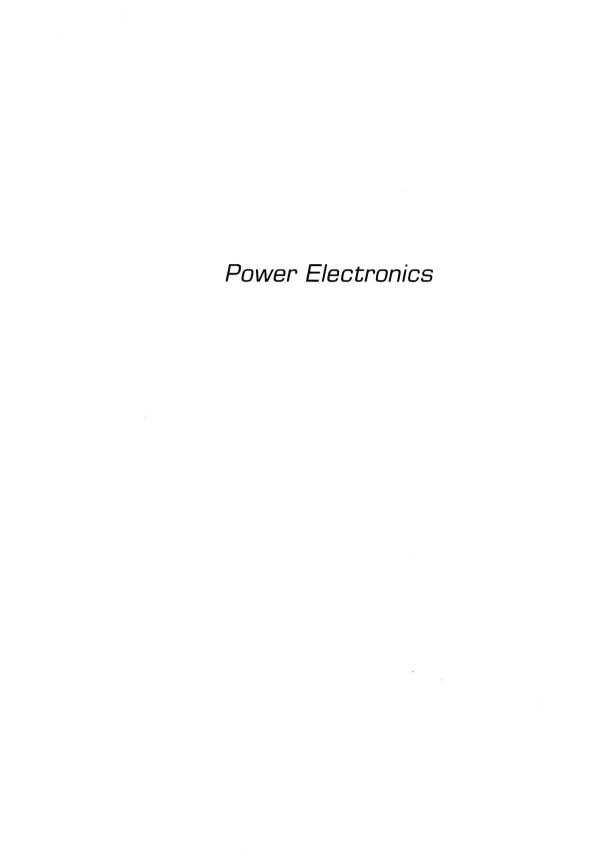
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Printed in the United States of America

10 9 8 7 6 5 4 3 2

128N 0-13-686619-0

Prentice Hall International (UK) Limited, London
Prentice Hall of Australia Pty. Limited, Sydney
Prentice Hall Canada Inc., Toronto
Prentice Hall Hispanoamericana, S.A., Mexico
Prentice Hall of India Private Limited, New Delhi
Prentice Hall of Japan, Inc., Tokyo
Simon & Schuster Asia Pte. Ltd., Singapore
Editora Prentice-Hall do Brasil, Ltda., Rio de Janeiro
Prentice Hall, Englewood Cliffs, New Jersey



To my parents, my wife Fatema and my children, Faeza, Farzana, and Hasan

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Preface

Power electronics deals with the applications of solid-state electronics for the control and conversion of electric power. Conversion techniques require the switching on and off of power semiconductor devices. Low-level electronics circuits, which normally consist of integrated circuits and discrete components, generate the required gating signals for the power devices. Integrated circuits and discrete components are being replaced by microprocessors.

An ideal power device should have no switching-on and -off limitations in terms of turn-on time, turn-off time, current, and voltage handling capabilities. Power semiconductor technology is rapidly developing fast switching power devices with increasing voltage and current limits. Power switching devices such as power BJTs, power MOSFETs, MOSIGTs, SCRs, TRIACS, GTOs, and other semiconductor devices are finding increasing applications in a wide range of products. With the availability of faster switching devices, the applications of modern microprocessors in synthesizing the control strategy for gating power devices to meet the conversion specifications are widening the scope of power electronics. The potential applications of power electronics is yet to be fully explored.

The time allocated to a course on power electronics in a typical undergraduate curriculum is normally only one semester. Power electronics has already advanced to the point where it is difficult to cover the entire subject in a one-semester course. The fundamentals of power electronics are well established and they do not change

rapidly. However, the device characteristics are changing continuously. *Power Electronics*, which employs the top-down approach, covers conversion techniques first, and then applications and device characteristics. It emphasizes the fundamental principles of power conversions. The book is divided into five parts:

- 1. Introduction—Chapter 1
- **2.** Commutation techniques of SCRs and power conversion techniques—Chapters 2, 3, 4, 6, 7, and 8
- 3. Applications—Chapters 5, 9, 10, and 11
- 4. Devices—Chapters 12, 13, and 14
- 5. Protections—Chapter 15

Topics like three-phase circuits, magnetic circuits, switching functions of converters, dc transient analysis, and Fourier analysis are reviewed in the Appendixes.

Power Electronics is intended as a textbook for a course on "power electronics/ static power converters" for junior or senior undergraduate students in electrical and electronic engineering. It could also be used as a textbook for graduate students and could be a reference book for practicing engineers involved in the design and applications of power electronics. The prerequisites would be courses on basic electronics and basic electrical circuits. The content of Power Electronics is beyond the scope of a one-semester course. For an undergraduate course, Chapters 1 to 9 should be adequate to provide a strong background on power electronics. Chapters 9 to 15 could be left for other courses or included in a graduate course.

Muhammad H. Rashid Munster, Indiana

COMMENTS ON THE ENCLOSED FLOPPY DISK

A floppy disk has been enclosed with this text. It contains 51 programs written in Advanced BASIC and saved in ASCII characters. These programs can be used for the solutions of some worked-out examples and generating data for some figures, especially with pulse width modulation. The filenames on the disk begin with 'EX' for worked-out examples and 'FIG' for figures. For example, Figure 4-14 has a filename of 'FIG-14'. The filenames can be listed by directory listing. The disk has a double-sided 360 kB format readable by any personal computer with a PC-DOS or an MS-DOS 2 or 3 operating system, such as IBM PC, XT or AT. Questions regarding the software may be directed to the author:

Dr. Muhammad H. Rashid Professor of Electrical Engineering PURDUE UNIVERSITY Calumet Hammond, Indiana 46323

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EX3-9	.BAS	Ex8-7 .BAS	Ex11-9 .BAS
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Ex4-6	.BAS	EX8-11 .BAS	FIG11-4 .BAS
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Acknowledgments

I would like to thank the following reviewers for their comments and suggestions:

Ashoka K. S. Bhat—University of Victoria, Canada Fred Brockhurst—Rose-Hulman Institute of Technology Joseph M. Crowley—University of Illinois, Urbana—Champaign Mehrad Ehsani—Texas A&M University Shahidul I. Khan—Concordia University, Canada Peter Lauritzen—University of Washington Marrija Ilic-Spong—University of Illinois, Urbana—Champaign

It has been a great pleasure working with the editor, Tim Bozik, and his assistant, Kitty Monahan. Finally, I would thank my family for their love, patience, and understanding.

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