Fundamentals of Power Electronics

R. W. Erickson

Accompanying material for instructors

The materials below are intended to be used by instructors of power electronics classes who have adopted *Fundamentals of Power Electronics* as a text. These instructors may download and use the files for educational purposes free of charge. Students and others who have purchased the text may also use the slides as an educational supplement to the text. Other uses of these materials is prohibited.

The slides for each chapter are contained in a .pdf file. These files can be read using the Adobe Acrobat viewer, available free from the Adobe Acrobat web site. Slides and overhead transpariencies covering the material of the entire book can be produced using these files.

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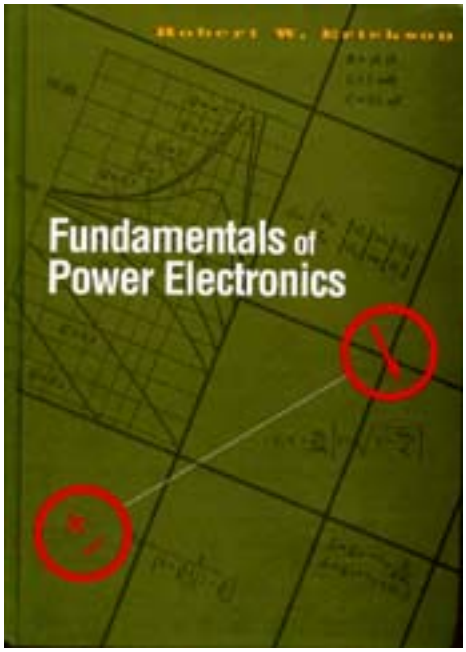
Fundamentals of Power Electronics

First Edition
R. W. Erickson

Power Electronics Group, University of Colorado at Boulder

About the second edition



A new textbook on power electronics converters. This book is intended for use in introductory power electronics courses at the senior and first-year graduate level. It is also intended as a source for professionals working in power electronics, power conversion, and analog electronics. It emphasizes the fundamental concepts of power electronics, including averaged modeling of PWM converters and fundamentals of converter circuits and electronics, control systems, magnetics, low-harmonic rectifiers, and resonant converters.

Publisher and vitals

New York: Chapman and Hall, May 1997.
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Note: Chapman and Hall has recently been acquired by Kluwer Academic Publishers

Note to instructors: how to obtain a copy

More information regarding contents of book

- Complete Table of Contents
- Abridged Table of Contents: Chapter titles only
- Preface

- Index 101kB -searchable with Adobe Acrobat

Errata, first printing

Supplementary material for instructors

- Slides
- Solutions to selected problems

Other supplementary material

Proximity effect: computer functions 70kB

Ferrite toroid data: Excel 5 spreadsheet

Derivation of Gg0, Eqs. (11.84) and (11.85)

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CoPEC

Colorado Power Electronics Center

University of Colorado, Boulder

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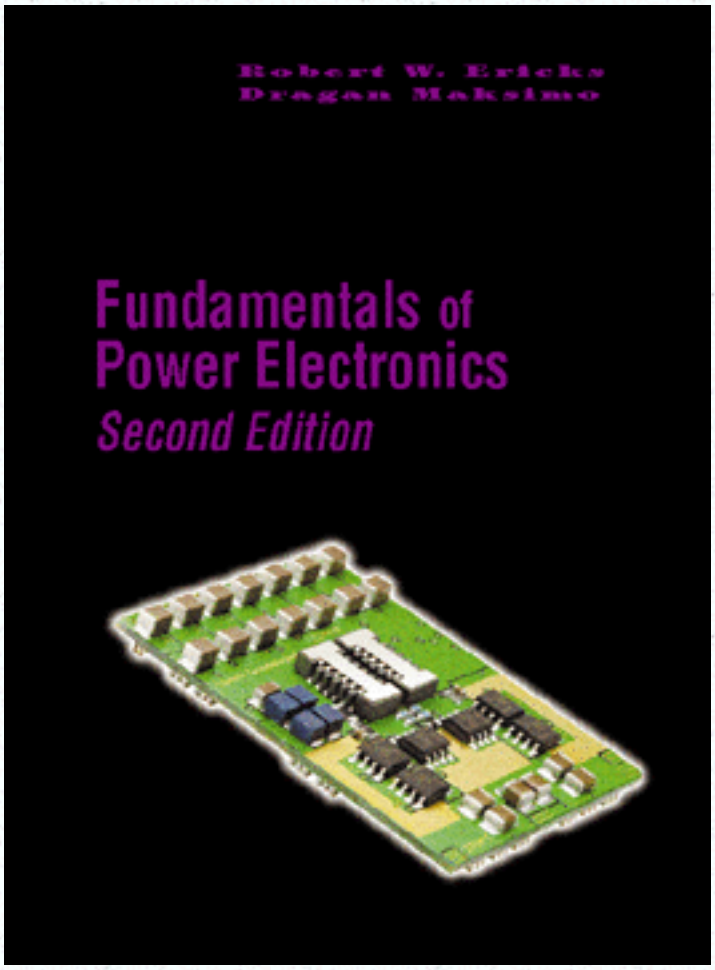
Fundamentals of Power Electronics
Second Edition



Authors: R. W. Erickson and D. Maksimovic
University of Colorado, Boulder

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- First edition web site
- To order directly from the publisher
- Note to instructors: how to obtain desk copies
- Errata, second edition, first printing
- Errata, second edition, second printing
- New Certificate Program in Power Electronics
- PSPICE circuit files and library
- Courses at the University of Colorado that use the second edition
    - ECEN 5797 Power

- Electronics 1
  - ECEN 5807 Power Electronics 2
  - ECEN 5817 Power Electronics 3

Major Features of the Second Edition

- New material on converter simulation using averaged switch models
- Major revision of material on current mode control, including tables of transfer functions of basic converters
- Major revision of material on averaged switch modeling
- New material covering input filter design and Middlebrook's extra element theorem
- Improved explanations of the proximity effect and MMF diagrams
- New section on design of multiple-winding magnetics using the Kg method, including new examples
- New material on soft switching, including active clamp snubbers, the ZVT full bridge converter, and ARCP
- Major revision of material on low-harmonic rectifiers, to improve flow and readability. New material on critical conduction mode control
- Major revision and simplification of the chapter on ac modeling of the discontinuous conduction mode
- Revised problems, and a solutions manual

Detailed description of revisions

Part 1. Converters in Equilibrium

There are no substantial changes to the chapters of Part 1.

Part 2. Converter Dynamics and Control

Chapter 7 has been revised to improve the logical flow, including incorporation of the First Edition Appendix 3 into the chapter. The treatment of circuit averaging and averaged switch modeling (Section 7.4) has undergone major revision. Other changes include Fig. 7.4 and the related text, and Sections 7.2.2, 7.2.7.

Major revisions to Chapter 8 include a new introduction, a new input filter example in Section 8.1.8, and substantial changes to the buck-boost converter example of Section 8.2.1 and the material of Sections 8.3 and 8.4.

Only minor changes to Chapter 9 were made.

This is an entirely new chapter that treats how input filters modify the transfer functions of a dc-dc

converter, and how to design an input filter that is adequately damped. The approach is based on Middlebrook's Extra Element Theorem (EET) of Appendix C, although it is possible to teach this chapter without use of the EET.

- Chapter 11 AC and DC Equivalent Circuit Modeling of the Discontinuous Conduction Mode

This chapter has been entirely revised and simplified.

- Chapter 12 Current Programmed Control

Treatment of the "more accurate model" in Section 12.3 has undergone a major revision. The explanation is more straightforward, and results are summarized for the basic buck, boost, and buck-boost converters. The results of simulation are used to illustrate how current programming changes the converter transfer function. The treatment of discontinuous conduction mode in Section 12.4 has been shortened.

Part 3. Magnetics

- Chapter 13 Basic Magnetics Theory

The material on the skin and proximity effects has undergone a major revision, to better introduce the concepts of the proximity effect and MMF diagrams. The summary of operation of different magnetic devices has been moved from the filter inductor design chapter into this chapter.

- Chapter 14 Inductor Design

A new section on design of multiple-winding inductors using the Kg method has been added, including two new examples. The summary of different magnetic devices has been moved to the previous chapter, and the material on winding area optimization (previously in the transformer design chapter) has been moved into this chapter.

- Chapter 15 Transformer Design

Notation regarding maximum, peak, and saturation flux density has been made more clear. The section on winding area optimization has been moved to the previous chapter.

Part 4. Modern Rectifiers, Inverters, and Power System Harmonics

- Chapter 16 Power and Harmonics in Nonsinusoidal Systems

Information on harmonic standards has been updated.

- Chapter 17 Line-Commutated Rectifiers

There is little change to this chapter.

- Chapter 18 Pulse-Width Modulated Rectifiers

Chapter 18 is a consolidation of Chapters 17 and 18 of the First Edition. The material has been completely reorganized, to improve its flow. A new section 18.2.2 has been added. Section 18.3.3 has been expanded, to better cover critical conduction mode control. The material on three-phase rectifier topologies has been streamlined.

Part 5. Resonant Converters

- Chapter 19 Resonant Conversion

The order of the sections has been changed, to improve readability. Section 19.4 has been modified, to include better explanation of resonant inverter/electronic ballast design, and two examples have been added. The material on the ZVT converter has been moved to Chapter 20.

- Chapter 20 Soft Switching

A new Section 20.1 compares the turn-on and turn-off transitions of diode, MOSFET, and IGBT devices under the conditions of hard switching, zero-current switching, and zero-voltage switching. The material on quasi-resonant converters is unchanged. Coverage of multi-resonant and quasi-squarewave switches has been exapanded, and includes plots of switch characteristics. A new Section 20.4 has been added, which covers soft-switching techniques. Included in Section 20.4 is an expanded explanation of the ZVT full-bridge converter, new material on active-clamp snubbers, and a short treatment of the auxiliary resonant commutated pole. The material on ac modeling of ZCS quasi-resonant converters has been dropped.

Appendices

- Appendix A RMS Values of Commonly Observed Converter Waveforms