ADVANCED POWER ELECTRONICS CONVERTERS

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PWM Converters Processing AC Voltages

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CONTENTS

PREFACE

This book deals with a new methodology to present an important class of electrical devices, that is, power electronics converters. The common approach to teaching converters is to consider each type individually, in a separate and isolated fashion. The direct consequence is that the learning process becomes passive since the power electronics configurations are presented without consideration of their origin and development. Since the teaching process is based on the topology itself, students do not develop the ability to construct new topologies from the conventional ones.

A systematic approach is taken to the presentation of multilevel and back-to-back converters, instead of showing them separately, which is normally done in a conventional presentation. Another special aspect of this book is that it covers only subjects related to the converters themselves. This will give more room for exploring the details of each topology and its concept. In this way, the method of conceptual construction of power electronics converters can be highlighted appropriately.

While presenting the basics of power devices, as well as an overview of the main power converter topologies in Chapter 2, this book focuses primarily on configurations processing ac voltage through a dc-link stage. This text is ideally suited for students who have previously taken an introductory course on power electronics. It serves as a reference book to senior undergraduate and graduate students in electrical engineering courses. However, due to the content in Chapter 2, it is expected that even students who the lack knowledge of power devices and basic concepts of converters can understand the subject.

Although the primary market for this text is heavily academic, electrical engineers working in the field of power electronics, motor drive systems, power systems, and renewable energy systems will also find this book useful.

The organization of the book is as follows: Chapter 1 is the introductory chapter. Chapter 2 presents the basics of power devices as well as an overview of the main power converter topologies. Chapter 3 provides a brief review of the main power electronics converters that process ac voltage; additionally, it furnishes the introduction to the power blocks geometry (PBG), which will be used to describe the power converters described in this book. In fact, this chapter brings up a compilation of the topologies explained throughout this book. The fundamentals of PBG and its correlation to the development of power electronics converters are presented in a general way. Multilevel configurations are presented from Chapters 4–7. Neutral-point-clamped, cascade, flying capacitor, and other multilevel configurations are presented in Chapters 4–7, respectively. Chapter 8 deals with techniques for optimization of the pulse width modulation (PWM), considering the fact that the number of pole voltages is higher than the number of voltages demanded by the load. After describing many topologies throughout Chapters 2–7, highlighting the circuits

themselves, as well as PWM strategies in Chapter 8, Chapter 9 handles control actions needed to keep a specific variable of the converter under control. Chapter 9 is strategically placed before the presentation of the back-to-back converters (Chapters 10 and 11) due to their need for regulation of electrical variables. Single-phase to single-phase back-to-back converters are presented in Chapter 10, and the final chapter deals with three-phase to three-phase back-to-back converters.

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