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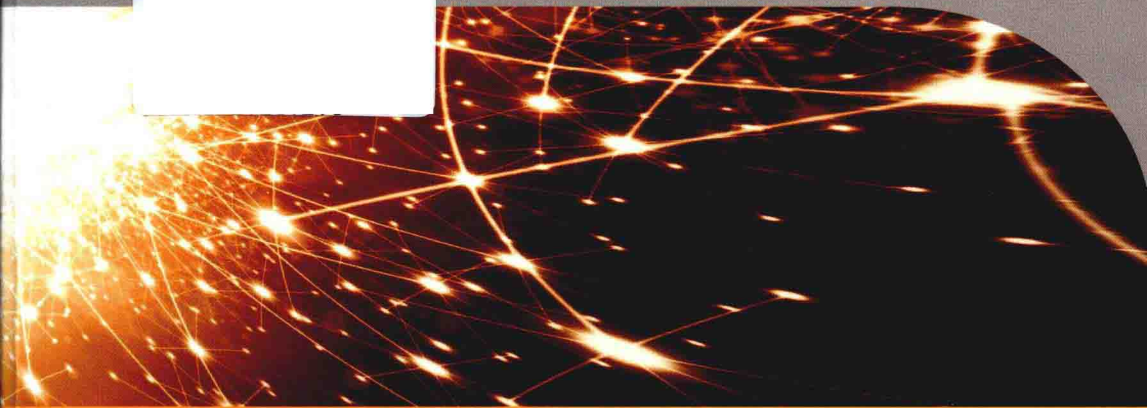

Power Electronic Converters and Systems

Frontiers and applications

Edited by
Andrzej M. Trzynadlowski

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The Institution of Engineering and Technology

Published by The Institution of Engineering and Technology, London, United Kingdom

The Institution of Engineering and Technology is registered as a Charity in England & Wales (no. 211014) and Scotland (no. SC038698).

First published 2015

The Institution of Engineering and Technology
Michael Faraday House
Six Hills Way, Stevenage
Herts, SG1 2AY, United Kingdom

www.theiet.org

British Library Cataloguing in Publication Data
A catalogue record for this product is available from the British Library

ISBN 978-1-84919-826-4 (hardback)
ISBN 978-1-84919-827-1 (PDF)

Typeset in India by MPS Limited
Printed in the UK by CPI Group (UK) Ltd, Croydon

IET POWER AND ENERGY SERIES 74

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This book is dedicated to those countless researchers and engineers around the world who diligently strive to maintain the high rate of progress in modern power electronics

Preface

The era of modern power electronics began in the late 1950s when the silicon-controlled rectifier (SCR) was developed by General Electric Corporation. Most of the early applications of SCRs involved electric drives. In recent decades, power electronic converters spread to the electric grid, distributed generation systems, renewable energy sources, transportation, and a variety of industrial processes. Today's power electronics is sustaining a robust growth.

This book is intended as a reference for professionals who are already familiar with the fundamentals of power electronics. Consequently, in contrast to typical textbooks, no coverage of basic principles of electric power conditioning is provided. It is assumed that Readers do not need explanation of such terms as the rectifier, inverter, chopper, or pulse width modulation.

The content of the book is mostly focused on recent advances in power electronic converters and systems, but the technological progress in the area of the associated semiconductor devices cannot be overlooked. The traditional silicon-based semiconductor power switches, such as thyristors or IGBTs, are reaching limits of their highly impressive operating parameters and characteristics. However, a new era of the so-called wide bandgap (WBG) semiconductor devices has already begun, promising revolutionary enhancement of the existing power electronic circuits. The most advanced WBG technology is that of silicon carbide devices, which are described in details in Chapter 1.

Most of the first part of the book deals with those power electronic converters, which thanks to their unique properties, enjoy currently high interest of researchers. Thus, the subjects of Chapters 2–7 include multilevel, multi-input, modular, matrix, soft switching, and *Z*-source converters. Switching power supplies, explained in Chapter 8, provide high-quality power to electronic devices, including the ubiquitous laptops, tablets, and smart phones. Chapter 9 describes "smart" power electronic modules, which combine power and control circuits in the same package.

The second part of the book describes the most common applications of modern power electronics systems. Electric drives with synchronous and induction motors have always been in the mainstream of power electronics. Photovoltaic and most of the wind energy sources are interfaced with the power grid through power electronic converters. Recently, battery-fed electric cars, with a power electronic inverter driving an ac motor, have been gaining popularity. Hybrid cars, in which sophisticated gearing links an electric drive system with an internal combustion engine, have already entered the mainstream of automobile markets. Shipboard power systems progressively employ power electronics. Those topics are covered in Chapters 10–15.

Modern power grids increasingly use power electronic systems for energy conversion, control of the power flow, and stability enhancement. Integration of the renewable energy sources through distributed generation and microgrids would not be possible without those systems. The ubiquitous data and communication centers require uninterruptable power supplies to prevent catastrophic information loss due to power outages and disturbances. Wireless power transfer allows remote energizing of battery-fed devices and vehicles. All the sophisticated power electronic systems need correspondingly advanced control methods. Chapters 16–20 deal with the aforementioned issues.

The Editor wants to express his deep gratitude to the forty-four contributing Authors, all accomplished specialists in various areas of power electronics and its applications. Their collective expertise and efforts, supported by the most helpful Publisher's personnel, made this book a highly valuable source of engineering knowledge.

A.M. TRZYNADLOWSKI

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