Power Systems

More information about this series at http://www.springer.com/series/4622

Ivo Barbi · Fabiana Pöttker

Soft Commutation Isolated DC-DC Converters

Springer

Ivo Barbi
Federal University of Santa Catarina
Florianópolis, Santa Catarina, Brazil

Fabiana Pöttker
Department of Electronics
Federal University of Technology—Paraná
Curitiba, Paraná, Brazil

ISSN 1612-1287 ISSN 1860-4676 (electronic)
Power Systems
ISBN 978-3-319-96177-4 ISBN 978-3-319-96178-1 (eBook)
https://doi.org/10.1007/978-3-319-96178-1

Library of Congress Control Number: 2018948691

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

To Antônio Barbi and Adriana Barbi.

—Ivo Barbi

To my beloved husband, Douglas,
for his encouragement and support.

—Fabiana Pöttker

Preface

Power electronics can be defined as the applied science dedicated to the electrical energy processing by the use of power semiconductors as switches. The use of static converters in the processing and control of electrical energy matured in the twentieth century to the point of becoming a vital technology of great economical relevance to society. There is a number of benefits of power electronics when compared to previous techniques including lower cost, high efficiency, high power density, and simplicity of control.

The static power converters, according to whether the input and output are alternating current (AC) or direct current (DC), are classified into four basic types: DC-DC converters, AC-DC converters, DC-AC converters, and AC-AC converters. The DC-DC converters are designed to control the power flow from a DC power source to another. They may be unidirectional or bidirectional, isolated or not. Their power ranges from a few watts to hundreds of kilowatts, while their voltage ranges from a few volts to tens of kilovolts.

DC-DC converters are used in personal computers, mobiles, electrical vehicles, lighting, railway systems, microgrids, medical equipment, avionics, and many other applications.

To optimize the power efficiency of isolated DC-DC converters, soft commutation is mandatory, particularly in high power density applications.

The aim of the authors is to present a detailed description and a quantitative analysis of the most common unidirectional soft-commutated isolated DC-DC converters, focusing on the soft commutation process, its quantitative and mathematical analysis, and the quantification of the switching parameters.

This book evolved from the author's long-term experience at two Brazilian Universities: the Federal University of Santa Catarina (UFSC) and the Federal University of Technology—Paraná (UTFPR) for graduate and undergraduate electrical engineering students. Hence, this book provides valuable information for

power electronics engineers, graduate and undergraduate students, as well as researchers at universities and research institutes.

During the planning and writing of this book, we have incurred indebtedness to many people, particularly our graduate students who for years, through successive generations, have helped us to improve our texts, our methods of work, and especially our way of teaching.

Florianópolis, Santa Catarina, Brazil — Ivo Barbi
Curitiba, Paraná, Brazil — Fabiana Pöttker
June 2018

Acknowledgements

Ivo Barbi would like to thank and acknowledge valuable support provided by José Airton Beckhäuser Filho, Leonardo Freire Pacheco, Guilherme Martins Leandro, and Ygor Pereira Marca.

Fabiana Pöttker acknowledges the support of the Federal University of Technology—Paraná, for providing sufficient time and a three-month sabbatical to work on this book.

Contents

Abbreviations

CCM	Continuous conduction mode
CVC	Capacitor voltage clamped
DC	Direct current
DCM	Discontinuous conduction mode
FB	Full bridge
HB	Half bridge
LC	Inductor capacitor
LCT	Inductor capacitor thyristor
PFM	Pulse frequency modulation
PWM	Pulse width modulation
RC	Resistor capacitor
RCT	Resistor capacitor thyristor
RL	Resistor inductor
RLC	Resistor inductor capacitor
SRC	Series resonant converter
ZCS	Zero current switching
ZVS	Zero voltage switching