

# Preface

Power Electronics is one of modern and key technologies in Electrical and Electronics Engineering for green power, sustainable energy systems, and smart grids. Especially, the transformation of existing electric power systems into smart grids is currently a global trend. The gradual increase of distributed generators in smart grids indicates a wide and important role for power electronic converters in the electric power system, also with the increased use of power electronics devices (nonlinear loads) and motor loadings, low cost, low-loss and high-performance shunt current quality compensators are highly demanded by power customers to solve current quality problems caused by those loadings. In distributed systems, three-phase four-wire systems are mainly installed for reducing the terminal phase voltage fluctuation. As a result, understanding the principles and operations of power converters in three-phase four-wire systems is important and helpful for Electrical and Electronic Engineers.

In this book, parallel three-phase four-wire power electronic converters are mainly focused. The content starts by reviewing the power quality issues, power quality standards, and comparing different power filter topologies, etc., in Chap. 1. In Chap. 2, the influences of reactive, harmonics, and unbalanced current problems on the electric power system are included; the instantaneous power theory and different coordinate control and transformations are discussed; different power electronic converter topologies and their corresponding space vector allocations are compared, which provides systematic, comprehensive, and detailed coverage of operation principles of three-phase four-wire power electronic filters. Chapter 3 is dedicated for active power filters (APFs), in which their corresponding circuits, mathematical models, 2D and 3D space vectors, pulse width modulations, DC voltage control, generalization control in multi-level algorithm and parameter design are described. Undoubtedly, lower cost, lower loss, and better performances of power converters will be the development trends and goals in these coming decades. Among different current quality compensators, hybrid active power filter (HAPF) possesses high potential to get balance amount cost, loss, and performance. In Chap. 4, with the comprehensive consideration of the cost, loss, performance,

and anti-resonance capability, the design and control of a HAPF topology are given as the prospective solution for the low-cost, low-loss, and high-performance current quality compensation. In addition, the system performance analysis method, design, control techniques, system implementation, and their corresponding hardware platforms presented in this book can be extendable to other compensators and power converters.

The book is intended for researchers, Ph.D. students, postgraduates, and electrical power engineers who are specializing in power quality compensation, in which they can gain the specific knowledge of the design and control of parallel three-phase four-wire power electronics filters. Moreover, it is intended for bachelor students and postgraduates who are specializing in electrical engineering, in which they can gain the basic knowledge of current quality problems and its different compensating methods, power electronics converters, pulse width modulation (PWM), etc.

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Principle, Control and Design

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