

Preface

Power electronics is concerned with control power conversion between various forms and/or characteristics to suit particular applications, and to realize the high-efficiency energy conversion, which plays a key role in, especially, renewable energy. New power electronics converters should be designed to better meet the ever higher demand for renewable energy applications. Power electronics refer to three aspects, i.e. power switches, converter topologies, and control strategies; while the topology is the most important issue, since the other two aspects are based on a specific topology.

In terms of a converter's input source being either a voltage source or a current source, traditional converters fall into two categories: voltage-source and current-source converters. It is, however, known that voltage-source converters suffer from the shoot-through problem, the inapplicability to inductive loads, and a limited output-voltage gain; while current-source converters have the open-circuit problem, the inapplicability to capacitive loads, and a limited output-current gain, which have greatly hindered the application of conventional converters in modern energy, especially renewable energy. In order to solve these problems, the concept of Z-source has been proposed in 2003, where Z stands for impedance, which is a general source, taking voltage source and current source as two extreme cases.

Since then, various Z-source based converters have been coined for specific applications. The design is, however, dependent on experts' experience, lacking a systematic designing methodology. Therefore, the main purpose of this book is first to understand impedance networks of nonlinear switch circuits and impedance networks matching, which involves input impedance matching, output impedance matching, and load phase matching. Taking the three matchings together into account leads to a set of criteria for designing an impedance source converter, which is to replace the traditional tedious, manual and experience-dependent design methods.

We hope that this book can serve as a teaching material for graduates and guidelines for engineers as designing an impedance source converter.

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