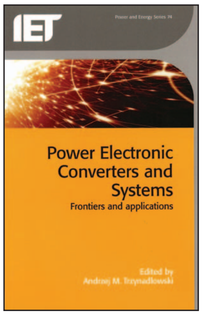
3) "Piezoelectric Transducers," by Bernhard Brunner, Matthias Kurch, and William Kaal
   3.1) History
   3.2) Material Processing
   3.3) Power Conversion
   3.4) Impedance of the Electric Network
   3.5) Application of Several Identical Transducers
   3.6) Conclusion
4) "Electromagnetic Transducers," by Dirk Spreemann and Bernd Folkmer
   4.1) Literature Review and "State of the Art" in Electromagnetic Vibration Transducers
   4.2) Conclusions from the Literature
   4.3–4.8) Analytical Description—Basic Tools for the Design of Resonant Vibration Transducers (Mechanical Subsystem, Electromagnetic Subsystem, Overall System, Characterization and Handling of Machinery-Induced Vibration, Conclusions from Analytical Analyses)
   4.9–4.12) Application-Oriented Design of an Electromagnetic Vibration Transducer (Introduction, Available Vibration: The Basis for Development, Optimization Procedure, Resonator Design)
   4.13–4.14) Prototype Performance (Transduction Factor, Frequency Response Characterization)
5) "Electrostatic Transducers," by Daniel Hoffmann and Bernd Folkmer
   5.1) Physical Principle
   5.2) Implementation
   5.3) Analytical and Numerical Models
   5.4) Numerical Model
   5.5) Power Output and Device Behavior
   5.6) Device Fabrication and Characterization
   5.7) Optimization Considerations
6) "Thermoelectric Generators," by Robert Hahn and Jan D. Konig
   6.1) The Seebeck, Peltier, Thomson Effects, and Kelvin Relation
   6.2) Conversion Efficiency and Figure of Merit
   6.3) Thermoelectric Materials
   6.4) Thermoelectric Module Construction
   6.5) Microgenerators
   6.6) System-Level Design and TEG Integration into Energy-Harvesting Applications
   6.7) Conclusions
7) "Solar Cells," by Monika Freunek Muller, Birger Zimmermann, and Uli Wurfel
   7.1) Photovoltaic Devices
   7.2) Photovoltaics in Micro Energy Harvesting Applications
   7.3) Tailoring the Current, Voltage, and Power Output of Photovoltaic Cells
   7.4) Concluding Remarks
8) "DC–DC Converters," by Markus Pollak
   8.1) Linear Regulators
   8.2) Switching Regulators (Converters, Matching Loads, Efficiency Considerations)
9) "AC–DC Converters," by Loreto Mateu and Peter Spies
   9.1) AC–DC Converters for Piezoelectric Transducers (Converters, Nonlinear Techniques, AC–DC Inductive Step-Up Converter)
   9.2) AC–DC Converters for Electrostatic Transducers (Physical Principles Charge-Constrained Conversion Cycle, Voltage-Constrained Energy Conversion Cycle)
   9.3) AC–DC Converters for Electrodynamic Transducers (Dual Polarity Boost Converter, Direct AC–DC Conversion, Split Capacitor Converter)
   9.4) Conclusion
10) "Radio Frequency Power Transmission," by Josef Bernhard, Tobias Drager, and Alexander Popugaev
   10.1) Introduction
   10.2) Physical Principles (Inductive Coupling, Far-Field Radio Transmission)
   10.3) Design Optimization (Generation and Amplification of High-Frequency Signals, Antennas and Matching, Voltage Rectification and Stabilization)
   10.4) Efficiency of Wireless Power Transmission
   10.5) Example Applications: Passive RFID Systems
11) "Electrical Buffer Storage for Energy Harvesting," by Robert Hahn and Kai-C. Moller
   11.1) Introduction
   11.2) Physical Principles: Secondary Batteries, Solid-State Thin-Film Lithium Batteries, Supercapacitors
   11.3) Realization of Micro Secondary Battery Technology
   11.4) Battery Dynamic Behavior and Equivalent Circuits
   11.5) Outlook
12) "Applications of Energy Harvesting Power Supplies," by Peter Spies
   12.1) Building Automation
   12.2) Condition Monitoring
   12.3) Structural Health Monitoring
   12.4) Transport
   12.5) Logistics
   12.6) Consumer Electronics
   12.7) Conclusions.

The book editors, Peter Spies, Markus Pollak, and Loreto Mateu, are experienced and successful engineers in energy harvesting at the leading facilities of applied research in Germany, the Fraunhofer-Gesellschaft and the Hahn-Schickard-Gesellschaft. The book provides the fundamentals of energy-harvesting technology and focuses on application-oriented implementation. It is a timely and unique book, highlighting modern and highly successful state-of-the-art energy-harvesting technologies and methods. It fosters further discussion, research, and development. Therefore, this book is valuable for teachers, undergraduate and graduate students, industry engineers, and researchers in the field of energy harvesting, material science, small-scale energy storage, and electronic power conversion.

Power Electronic Converters and Systems: Frontiers and Applications



By Andrzej M. Trzynadlowski (Ed.), The Institution of Engineering and Technology, United Kingdom, 2015, Hardback, 638 Pages, ISBN: 978-1-84919-826-4.

Future power electronics will be dependent on recent silicon carbide (SiC) power semiconductor

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devices like SiC metal oxide field effect transistor (MOSFET), SiC insulated gate bipolar transistor (IGBT), and SiC junction field effect transistor (JFET), capable of up to 15 kV hold-off voltages. Compared to silicon (Si), SiC-based power-switching devices present much lower leakage currents, higher blocking voltages, higher operating temperatures, lower on-state voltage drops, higher switching frequency, and higher thermal conductivity. These advanced semiconductor devices integrated within smart power electronic modules can be used to build advanced power converters such as multi-input, multiport converters; modular multilevel cascaded converters (MMCCs); and matrix, Z-source, and Y-source converters.

Up-to-date electronic power conversion is priceless for applications like permanent magnet synchronous motor (PMSM) drives, induction motor (IM) drives, renewable energy systems (wind, photovoltaic), energy storage, fuel cells, and electrical vehicles (EV). Power electronic conversion is also the core of modern shipboard power systems, more electric aircrafts, flexible ac power transmission systems, distributed generation (DG) and microgrids, uninterruptible power supplies (UPS), and wireless power transfer (WPT).

Assuming the reader is already familiar with the fundamentals of power semiconductors [1], [2], electronic power converters [2], [3], and their control [4], [5], *Power Electronic Converters and Systems: Frontiers and Applications* explores and suggests new trends and frontiers in the interdisciplinary field of power electronics systems (PES). The book includes contributions from an international panel of 44 PES experts covering subjects such as SiC devices, multilevel and matrix converters (MC), smart power electronic modules, zero voltage switching (ZVS) and zero current switching (ZCS), switching power supplies, EVs, sliding mode and intelligent direct torque control (DTC) of IM drives, sliding mode observers, and model-based predictive control (MPC) [6], [7], [8] of PMSM drives and wind turbines (WTs).

The book is also matchless in performing detailed study of contactless power (WPT) and in sequence-based control (SBC) together with the implementation of high-frequency solid-state power transformer (SST) using three-level neutral point clamped multilevel converters built with 15 kV SiC IGBTs.

The book is divided in two parts and 20 chapters. It includes preface, table of contents, index, and references at the end of each chapter. Some highlights follow.

Part I Converters

1) Semiconductor power devices (characterization of 15 kV SiC N-IGBTs, 10 kV SiC MOSFETs, low-voltage SiC devices, 1.2 kV 100 A SiC MOSFET, 1.7 kV SiC MOSFET, 1.2 kV 45 A SiC JFET, SiC super-junction transistor, soft-switching of 12 kV SiC IGBTs, SiC-based SST)
2) multilevel converters (basic concepts of multilevel converters, electronic switches to implement the converters, three-phase multilevel converters, modulation strategies for multilevel converters)
3) multi-input converters (realizing multi-input converter topologies, multiport converters, applications of multiport power converters)
4) modular converters (modular converter topologies and description, control strategies, modulation techniques, fault-tolerant operation and floating dc capacitor precharging in MMCCs, main applications)
5) MC (direct matrix converter, indirect matrix converter, technological issues of MCs, MC versus voltage back-to-back converter)
6) soft-switching converters (resonant converters, quasi-resonant converters, multiresonant converters, quasi-square-wave converters, other types of ZVS and ZCS converters)
7) Z-source converters (basic principles, categories of impedance source power converters based on conversion functionality, impedance source network topologies)
8) switching power supplies (nonisolated converter topologies, isolated converter topologies, parasitics in dc–dc converters, continuous and discontinuous conduction modes, synchronous rectification, bidirectional converters, interleaving, control principles)
9) smart power electronic modules (history, technology background, packaging technologies, basic usage, reliability, variety of products, future usage and emerging solutions).

Part II Applications

1) PMSM drives (trends in sensorless control of PMSM, trends in MPC of PMSM, hints about energy efficiency in PMSM drives)
2) IM drives (IM model, variable frequency drives, DTC schemes: space vector modulation DTC, feedback linearization and sliding mode DTC, intelligent DTC schemes, IM speed estimation with Kalman filtering, switched reluctance sensorless drives)
3) wind energy systems (overview, power electronic interfaces for variable speed WTs, control algorithms for PECs, maximum power point tracking, field-oriented control, DTC-space vector modulated, voltage-oriented control, direct power control-space vector modulated, control for stand-alone mode of operation)
4) photovoltaic energy systems (brief overview of photovoltaic generation, state-of-the-art technologies, reliability, grid interface, protection, islanding, power quality, ancillary services, field measurements)
5) automotive energy systems (electric vehicle batteries, EV charging, wireless charging)
6) shipboard power systems (shipboard power system topologies, shipboard propulsion drives, power quality requirements in shipboard systems, harmonic mitigation in shipboard systems, frequency variation and converter control, concepts for future shipboard power systems)
7) converters in power grid (power converter topologies, application examples of power converters in power grid: shunt compensation, series compensation, shunt-series compensation, series–series compensation, high-voltage direct current

transmission, low-frequency high-voltage ac transmission, SST)

8) DG and microgrids (distribution generators, microgrid, dc and ac microgrids, stand-alone microgrids, grid-tied microgrids, centralized control, conventional droop control method, local control, multifunctionalities)
9) UPS [topologies: online UPS, offline UPS, line-interactive UPS, delta conversion UPS, tri-mode UPS, rotary UPS, hybrid static and rotary UPS, flywheels, dc UPS for pulse load with power leveling, redundant bus, controls for UPS systems, applications (personal computers, industrial systems, data centers, medical equipment)]
10) WPT (basic principles and two fundamental concepts of WPT, different forms of WPT systems: two-, three-, and four-coil systems, WPT with relay and domino resonators, power electronics and control, safety regulations: electromagnetic compatibility, human exposure)
11) advanced control of power electronic systems (brief overview of historic advanced nonlinear controllers for PES applications, switching SBC, SBC for standalone PES, SBC for networked PES).

The book editor, Prof. Andrzej M. Trzynadlowski of the Department of Electrical and Biomedical Engineering, University of Nevada, Reno, is a Life Fellow of the IEEE. Highlighting several pioneering devices, converters, and applications, the book encourages further discussion, research, and development. It is suited for teachers, students, and researchers in the field of power electronics, as well as industry professionals and practicing engineers willing to contribute to cutting-edge technology in power electronic converters and systems.

References

[1] J. Jayant Baliga, *Advanced High Voltage Power Device Concepts*. New York: SpringerVerlag, 2012.

[2] M. H. Rashid, Ed., *Power Electronics Handbook*, 3rd ed. Oxford, U.K.: Elsevier, 2011.

[3] A. Ioinovici, *Fundamentals and Hard-Switching Converters* (Power Electronics and Energy Conversion Systems, vol. 1). Hoboken, NJ: Wiley, 2013.

[4] J. F. Silva and S. F. Pinto, *Advanced Control of Switching Power Converters, in Power Electronics Handbook,* 3rd ed., M. Rashid, et al., Eds. Elsevier, 2011, ch. 36, pp. 1037–1114.

[5] S. Ryvkin and E. Palomar Lever, *Sliding Mode Control for Synchronous Electric Drives*. Boca Raton, FL: CRC Press, 2012.

[6] S. A. Gonzalez, S. Verne, and M. I. V., *Multilevel Converters for Industrial Applications*. Boca Raton, FL: CRC Press, 2013.

[7] J. Rodriguez and P. Cortes. *Predictive Control of Power Converters and Electrical Drives*. Hoboken, NJ: Wiley-IEEE Press, 2012.

[8] M. Chaves, E. Margato, J. F. Silva, S. F. Pinto, and J. Santana, "Fast optimum-predictive control and capacitor voltage balancing strategy for bipolar back-to-back NPC converters in high-voltage direct current transmission systems," *IET Gen. Transmission Distr.* vol. 5, no. 3, pp. 368–375, 2011.