About CoPEC

Since it was founded in 1983, the power electronics group at the University of Colorado has maintained a tradition of innovative design-oriented and application-driven research. CoPEC activities now span the range of applications from high-efficiency milliwatt converters for portable battery-operated systems, to hundreds or thousands of watts for computer, aerospace, telecommunications, medical and automotive power conversion, to hundreds of kilowatts for wind generation systems. Our laboratory is equipped for both low-power and high-power experimental projects, with dc and ac service at up to 100 kVA.

Current research areas

- *High-efficiency, high-power converter technology*

Objectives are to extend high-frequency, high-efficiency conversion techniques to high-power applications such as wind energy systems. This work includes detailed loss modeling and novel rectifier and inverter configurations.

- *Power electronics for portable, battery-operated systems*

This activity encompasses design of very high-efficiency, low-voltage power supplies, and advanced on-chip power and clock distribution designs to significantly reduce power consumption in applications such as high-performance portable computers and wireless communication devices.

- *Converter modeling and computer-aided analysis*

Generalized SPICE-compatible models that allow simple but accurate simulation of complex converter systems are being derived using the averaged switch network modeling approach. Improved models of multiwinding magnetics have been introduced to predict cross-regulation, dynamics, and other features of complex converters. The modeling methods are complemented by numerical methods and software for fast switched-circuit simulation, and automated steady-state and dynamic analyses.

- *Low harmonic rectifier technology for single-phase and three-phase applications*

We are developing new low-cost high-performance approaches to single-phase and three-phase low-harmonic rectification, as well as improved control schemes and converter models.

- *Advanced control techniques and their mixed-signal ASIC implementation*

New control techniques, including nonlinear and discrete-time methods, are being developed to improve converter characteristics (such as large-signal and small-signal dynamics or efficiency over extremely wide range of loads), and to reduce system costs and design complexity. These novel techniques are implemented in low-cost, mixed-signal CMOS ASICs and tested in dc-dc, dc-ac, and ac-dc power electronics applications.

- *Links to other current research at the University of Colorado*

—including machines and power systems, microelectronics packaging, EMI, control, and semiconductor devices.

CoPEC sponsors' benefits

- Access to graduates with top educational background in power electronics and related electrical and computer engineering areas.
- Access to all educational materials developed by the CoPEC faculty and students.
- Ability to direct research topics and activities, and initiate joint research and development projects
- Immediate access to research results including: reports, seminars, publications, system and component models, software tools, and students' theses.
- Short courses given at sponsor's plant, at reduced cost.
- Interaction with companies having like interests

Selected Research Results

Our research has been supported by numerous industrial partners such as: Lockheed-Martin, General Motors, General Electric, StorageTek, Pfizer, IBM, and government agencies: National Science Foundation, National Renewable Energy Laboratory. Research accomplishments include:

- Simple, high-performance Nonlinear-Carrier Control method for power-factor correctors (IEEE PELS Prize Paper Award, 1997)
- High-efficiency, low-voltage power supplies for battery-operated applications
- Single-switch, soft-switching 3ø rectifiers
- Single-switch integrated high quality rectifier-regulators
- Numerical methods and simulation tool PETS
- Modeling of lossless power processing systems, including DC/DC converters and low-harmonic rectifiers, using power source, power sink and loss-free resistor elements
- General properties, synthesis and applications of switched-capacitor converters
- Input filter design for current-programmed converters
- High-efficiency low-noise electrosurgical generators with zero-voltage switching
- Spacecraft dc-dc converter technologies, modeling, and analysis
- Analysis and design of high-voltage resonant converters
- Nonlinear resonant switch concept and applications
- Methods for systematic synthesis of switching power converters
- Single-switch DC/DC converters with quadratic conversion ratios (Best Paper Award, HFPC 1989)
- Steady-state and dynamic models of resonant and quasi-resonant power converters
- Electric vehicle battery chargers using soft-switching IGBT's

Faculty

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Robert W. Erickson received the B.S., M.S., and Ph.D. degrees from the California Institute of Technology in 1978, 1980, and 1983, respectively. In 1982 he joined the faculty at the University of Colorado, Boulder, where he is currently an Associate Professor. He teaches courses in power electronics, energy conversion, circuits, and control. Current research interests include low harmonic rectification technology, wind energy systems, and modeling of converter systems and power components.

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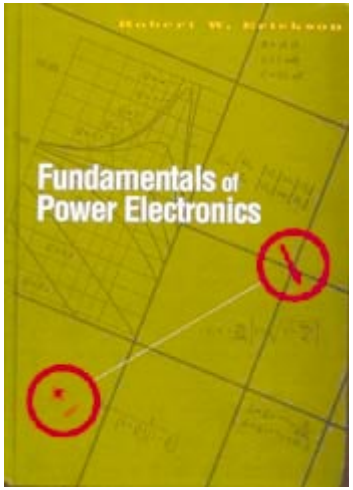
Dragan Maksimovic received his Ph.D. from the California Institute of Technology in 1989. In 1992 he joined the University of Colorado, Boulder, where he is currently an Assistant Professor. He is teaching courses in energy conversion, analog and power electronics, and analog integrated circuits. His research interests include control methods, computer-aided analysis techniques, and power converters for low-power electronics. He received the NSF CAREER Award in 1997.

Fundamentals of Power Electronics

by Robert W. Erickson



A new textbook on power electronics converters. This book is intended for use in introductory power electronics courses at the senior and first-year graduate level. It is also intended as a source for professionals working in power electronics, power conversion, and analog electronics. It emphasizes the fundamental concepts of power electronics, including averaged modeling of PWM converters and fundamentals of converter circuits and electronics, control systems, magnetics, low-harmonic rectifiers, and resonant converters.

This book is covered in a one-year course sequence at the University of Colorado, available to on-campus as well as continuing education students via CATECS and NTU.

http://ece-www.colorado.edu/~pwrelect/book

ISBN 0-412-08541-0
7"x10", 791 pages, 929 line illustrations.

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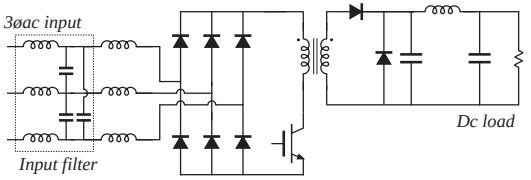
Colorado Power Electronics Center



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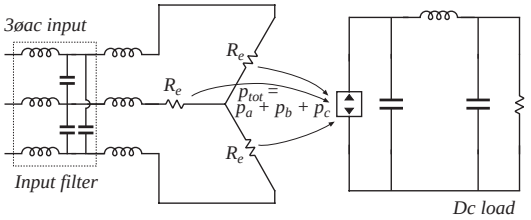

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