Design and Implementation of Fully-Integrated Inductive DC-DC Converters in Standard CMOS (Analog Circuits and Signal Processing)

By Mike Wens, Michiel Steyaert

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CMOS DC-DC Converters aims to provide a comprehensive dissertation on the matter of monolithic inductive Direct-Current to Direct-Current (DC-DC) converters. For this purpose seven chapters are defined which will allow the designer to gain specific knowledge on the design and implementation of monolithic inductive DC-DC converters, starting from the very basics.

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- Sales Rank: #3957793 in Books
- Published on: 2011-05-19
- Original language: English
- Number of items: 1
- Dimensions: 9.21" h x .75" w x 6.14" l, 1.39 pounds
- Binding: Hardcover
- 282 pages

Editorial Review

From the Back Cover

Technological progress in the semiconductor industry has led to a revolution towards new advanced, miniaturized, intelligent, battery-operated and wireless electronic applications. The required supply voltage(s) of these applications seldom matches the varying battery voltage, due to technological reasons. Therefore, efficient voltage converters are crucial to bridge this voltage gap, without compromising the battery's autonomy as do linear voltage converters. In addition, both space and cost constraints form a strong incentive towards fully-integrated CMOS switched-mode DC-DC converters, effectively eliminating the need for large and expensive off-chip passives (inductors and capacitors).

To achieve this goal Fully-Integrated Inductive DC-DC Converters in Standard CMOS provides the following assets:

- A firm but comprehensive theoretical base on switched-mode DC-DC converters, giving the designer the crucial information for understanding the operating principles and fundamental limitations of different types of DC-DC converters, including linear converters, charge-pump converters and inductive converters.
- An overview and comparison of different types of inductive DC-DC converters and their mutual comparison towards monolithic integration provides a versatile knowledge base to match witch the constraints of the converter to be designed.
- An accurate and fast model for fully-integrated inductive DC-DC converters is discussed, taking into account all the significant losses in CMOS technologies. This model allows very accurate prediction of the steady-state parameters, including the efficiency. Furthermore, it allows a fast convergence towards the optimal design values, despite the multi-dimensional design-space.
- High-speed control schemes for controlling the output voltage are explained intuitively and from a practical point of view. In addition three new control concepts: COOT, SCOOT and F²SCOOT are revealed. Many concrete schematics are provided and explained, which are also used in the various chip realizations. As such, this hands-on approach provides the "feeling" for control system design for fully-integrated DC-DC converters to the designer.
- The book is concluded with seven practical proof-of-concept chip realizations of fully-integrated DC-DC converters, thereby using both bondwire and metal-track inductors. Many practical issues, such as chip lay-out and measurement setups, are discussed, providing the designer even more to-the-point practical information on the subject.

Fully-Integrated Inductive DC-DC Converters in Standard CMOS is an essential work for research and design engineers that are confronted with fully- and/or highly-integrated DC-DC converters. The approach in this book ranges from a firm theoretical base to understand the trade-offs, towards a highly practical and realistic mindset.

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Lois Araiza:

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