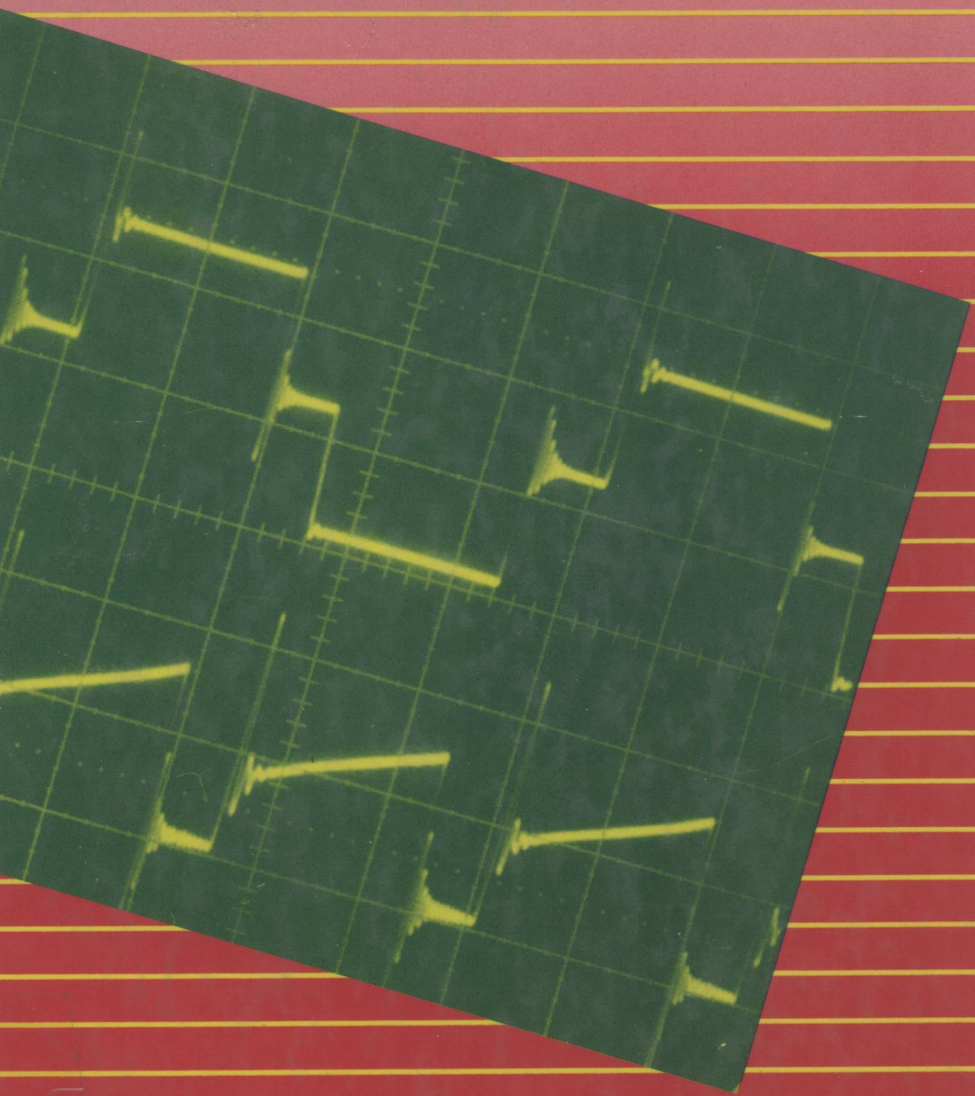
SWITCHING POWER SUPPLY DESIGN



ABRAHAM I. PRESSMAN

Switching Power Supply Design

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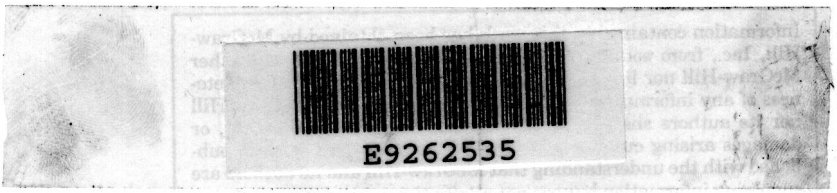

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To my wife Annie

Preface

Much has changed in the power conversion field since the author's previous book on switching power supply design (*Switching and Linear Power Supply, Power Converter Design*, 1978).

The main goal of these changes has been to make the power supply smaller. As integrated circuits packed more features in a smaller volume, it became essential also to decrease the size of a system's power supply. Switching power supply packing density currently ranges from 2 to 6 load watts per cubic inch (W/in^3) as compared to about 1 W/in^3 a decade ago. Newer resonant converter techniques offer a possibility of 20 to 40 W/in^3.

Higher switching frequencies, made possible by power MOSFET transistors, newer topologies, and integrated-circuit pulse-width-modulating chips, which pack more control and supervisory features in a smaller volume, have contributed to making present-day power supplies smaller. All these new technologies are covered in this book.

It has been the author's experience, in teaching a course on modern switching power supply design to all levels of engineers from most of the major American electronics companies, that those who have a good understanding of the fundamental principles can easily solve their day-to-day design problems as well as assess and adapt to new technologies.

Thus, this book covers the new technologies in a tutorial way so that the reader can understand the fundamental reasons for various effects. Explanations for various significant waveshapes and explanations for alternative design decisions are given. Care has been taken to avoid offering "handy-dandy" design equations without showing how they were derived. All equations that effect a design decision are derived from fundamental relations.

Magnetics design is emphasized; for, the majority of power supply designers are primarily circuits-oriented. They appreciate and can analyze problems when they can see DC voltage levels, voltage spikes, and waveshapes on an oscilloscope. But the locus of operation on a *BH* loop cannot be seen on an oscilloscope. Thus, circuits designers too often shy away from or do not fully understand magnetics design. They leave that to a magnetics specialist who may not appreciate how cir-

cuits characteristics effect magnetics design decisions. It is hoped the emphasis on magnetics herein may help correct that problem.

Throughout this text and throughout the literature, idealized voltage-current waveforms are often shown. But I feel it is very valuable from a tutorial viewpoint to view actual Polaroid waveforms taken at critical points on working circuits. Seeing an actual photographed waveform with its spikes, rings, and oddities conveys a great deal more information and confidence about a circuit than does an idealized, hand-drawn waveform. Such photographed waveforms are presented at critical points at various frequencies on some of the most commonly used topologies.

This book is directed primarily to design engineers and engineering students at the undergraduate and graduate level. It may also be of significant value to people who are not directly involved in start-from-scratch designs, and whose main interest is power supply design analysis, design review, test, and debugging.

The material contained herein is a consolidation and, hopefully, a simpler, clearer explanation and logical reorganization of the highpoints of all the proven and practical aspects of modern switching power supply technology. As such, credit for the material belongs to the innumerable engineers, designers in industry, and universities that have brought switching power supply technology to its present advanced state.

Abraham I. Pressman

ABOUT THE AUTHOR

ABRAHAM I. PRESSMAN is founder and president of Switchtronix Power, Inc., a company specializing in power supply design, design review, and consultation. He is well known as the author of the best-selling book, *Switching and Linear Power Supply Design, Power Converter Design* (1978). Mr. Pressman teaches a course on switching power supply design that has been attended by groups from major international electronics, communications, and computer corporations.

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