

Section 5 Inductor and Flyback Transformer Design

Filter inductors, boost inductors and flyback transformers are all members of the "power inductor" family. They all function by taking energy from the electrical circuit, storing it in a magnetic field, and subsequently returning this energy (minus losses) to the circuit. A flyback transformer is actually a multi-winding coupled inductor, unlike the true transformer discussed in Section 4, whose energy storage is indefinitely.

Application Considerations

Design considerations for this family of inductors vary widely, depending on the type of circuit application and such factors as operating frequency and ripple current.

Inductor applications in switching power supplies can be defined as follows (see Fig. 5-1):

- *Single winding inductors:*
 - Output filter inductor (buck-derived)
 - Boost inductor
 - Flyback (buck-derived) inductor
 - Input filter inductor
- *Multiple winding inductors:*
 - Coupled output filter inductor⁽¹⁾
 - Flyback transformer

Inductor design also depends greatly on the inductor current operating mode (Figure 5-2):

- *Discontinuous inductor current mode*, when the instantaneous temperature (limited in all voltage ripples) does not rise for a portion of each switching period.
- *Continuous inductor current mode*, in which the total temperature does not dwell at zero (although the current may pass through zero).

In the continuous current mode, the ripple current is often small enough that no winding loss and no core loss may be significant, but in the discontinuous mode, no losses may dominate.

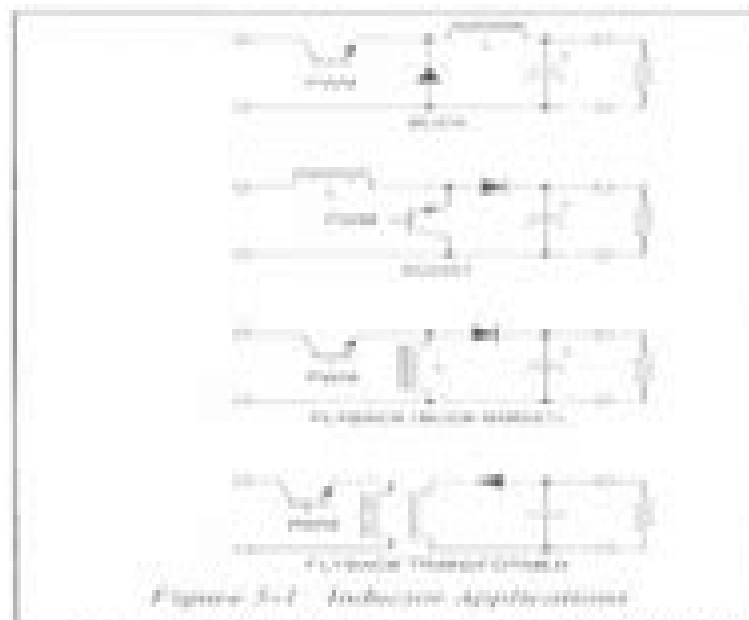


Figure 5-1 Inductor Applications

Design limitations: The most important limiting factors in inductor design are (a) temperature rise and efficiency considerations arising from core losses and ac and dc winding losses, and (b) core saturation.

Output filter inductor (buck-derived) — single and multiple windings are seldom operated in the discontinuous current mode because of the added burden this places on the output filter capacitor, and because it results in poor cross-regulation in multiple output supplies. Typically operated in the continuous mode with peak peak ripple current much smaller than full load current, ac winding loss is usually not significant compared to dc loss.

Magnetics Design 5 Inductor And Flyback Transformer Design

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Magnetics Design 5 Inductor And Flyback Transformer Design:

Fundamentals of Power Electronics Robert W. Erickson, Dragan Maksimovic, 2007-05-08 Fundamentals of Power Electronics Second Edition is an up to date and authoritative text and reference book on power electronics This new edition retains the original objective and philosophy of focusing on the fundamental principles models and technical requirements needed for designing practical power electronic systems while adding a wealth of new material Improved features of this new edition include A new chapter on input filters showing how to design single and multiple section filters Major revisions of material on averaged switch modeling low harmonic rectifiers and the chapter on AC modeling of the discontinuous conduction mode New material on soft switching active clamp snubbers zero voltage transition full bridge converter and auxiliary resonant commutated pole Also new sections on design of multiple winding magnetic and resonant inverter design Additional appendices on Computer Simulation of Converters using averaged switch modeling and Middlebrook's Extra Element Theorem including four tutorial examples and Expanded treatment of current programmed control with complete results for basic converters and much more This edition includes many new examples illustrations and exercises to guide students and professionals through the intricacies of power electronics design Fundamentals of Power Electronics Second Edition is intended for use in introductory power electronics courses and related fields for both senior undergraduates and first year graduate students interested in converter circuits and electronics control systems and magnetic and power systems It will also be an invaluable reference for professionals working in power electronics power conversion and analogue and digital electronics

Magnetic Components for Power Electronics Alex Goldman, 2012-12-06 Magnetic Components for Power Electronics concerns the important considerations necessary in the choice of the optimum magnetic component for power electronic applications These include the topology of the converter circuit the core material shape size and others such as cost and potential component suppliers These are all important for the design engineer due to the emergence of new materials changes in supplier management and the examples of several component choices Suppliers using this volume will also understand the needs of designers Highlights include Emphasis on recently introduced new ferrite materials such as those operating at megahertz frequencies and under higher DC drive conditions Discussion of amorphous and nanocrystalline metal materials New technologies such as resonance converters power factors correction PFC and soft switching Catalog information from over 40 magnetic component suppliers Examples of methods of component choice for ferrites amorphous nanocrystalline materials Information on suppliers management changes such as those occurring at Siemens Philips Thomson and Allied Signal Attention to the increasingly important concerns about EMI This book should be especially helpful for power electronic circuit designers technical executives and material science engineers involved with power electronic components

CMOS Analog Circuit Design Phillip E. Allen, Douglas R. Holberg, 2011 A textbook for 4th year undergraduate first year graduate electrical engineering students

Analog Circuit Design Bob Dobkin, Jim

Williams,2011-09-26 Analog circuit and system design today is more essential than ever before With the growth of digital systems wireless communications complex industrial and automotive systems designers are challenged to develop sophisticated analog solutions This comprehensive source book of circuit design solutions will aid systems designers with elegant and practical design techniques that focus on common circuit design challenges The book s in depth application examples provide insight into circuit design and application solutions that you can apply in today s demanding designs Covers the fundamentals of linear analog circuit and system design to guide engineers with their design challenges Based on the Application Notes of Linear Technology the foremost designer of high performance analog products readers will gain practical insights into design techniques and practice Broad range of topics including power management tutorials switching regulator design linear regulator design data conversion signal conditioning and high frequency RF design Contributors include the leading lights in analog design Robert Dobkin Jim Williams and Carl Nelson among others **Switch-Mode**

Power Supplies Spice Simulations and Practical Designs Christophe Basso,2008-01-14 Harness Powerful SPICE Simulation and Design Tools to Develop Cutting Edge Switch Mode Power Supplies Switch Mode Power Supplies SPICE Simulations and Practical Designs is a comprehensive resource on using SPICE as a power conversion design companion This book uniquely bridges analysis and market reality to teach the development and marketing of state of the art switching converters Invaluable to both the graduating student and the experienced design engineer this guide explains how to derive founding equations of the most popular converters design safe reliable converters through numerous practical examples and utilize SPICE simulations to virtually breadboard a converter on the PC before using the soldering iron Filled with more than 600 illustrations Switch Mode Power Supplies SPICE Simulations and Practical Designs enables you to Derive founding equations of popular converters Understand and implement loop control via the book exclusive small signal models Design safe reliable converters through practical examples Use SPICE simulations to virtually breadboard a converter on the PC Access design spreadsheets and simulation templates on the accompanying CD ROM with numerous examples running on OrCAD ICAPS Cap TINA and more Inside This Powerful SPICE Simulation and Design Resource Introduction to Power Conversion Small Signal Modeling Feedback and Control Loops Basic Blocks and Generic Models Simulation and Design of Nonisolated Converters Simulation and Design of Isolated Converters Front End Rectification and Power Factor Correction Simulation and Design of Isolated Converters The Flyback Simulation and Design of Isolated Converters The Forward

Performance of High-Frequency High-Flux Magnetic Cores at Cryogenic Temperatures ,2002 *Power Electronics Step-by-Step: Design, Modeling, Simulation, and Control* Weidong Xiao,2021-02-05 Explore the latest power electronics principles practices and applications This electrical engineering guide offers comprehensive coverage of design modeling simulation and control for power electronics The book describes real world applications for the technology and features case studies worked out in both MATLAB and Simulink Presented in an accessible style Power Electronics Step by

Step Design Modeling Simulation and Control focuses on the latest technologies such as DC based systems and emphasizes the averaging technique for both simulation and modeling You will get photos diagrams flowcharts graphs equations and tables that illustrate each topic Circuit components Non isolated DC DC conversion Power analysis DC to single phase AC conversion Single phase AC to DC conversion Galvanic isolated DC DC conversion Power conversion for three phase AC Bidirectional power conversion Averaging model for simulation Dynamic modeling of DC DC converters Regulation of voltage and current Design of Solid-State Power Supplies Eugene R. Hnatek,1989-09-21 Power supply topologies Switching supply design hints Transformer and inductor design Power switch considerations IC voltage regulators and power supply ICs Magnetic amplifiers Electromagnetic compatibility Converter and inverter design considerations and examples

Conference Proceedings 1988 ,1988 **Transformer and Inductor Design Handbook** Colonel Wm. T. McLyman,2017-12-19 With its practical approach to design Transformer and Inductor Design Handbook Fourth Edition distinguishes itself from other books by presenting information and guidance that is shaped primarily by the user s needs and point of view Expanded and revised to address recent industry developments the fourth edition of this classic reference is re organized and improved again serving as a constant aid for anyone seeking to apply the state of the art in transformer and inductor design Carefully considering key factors such as overall system weight power conversion efficiency and cost the author introduces his own new equation for the power handling ability of the core intended to give engineers faster and tighter design control The book begins by providing the basic fundamentals of magnetics followed by an explanation of design using the Kg or Ap techniques It also covers subjects such as laminations tape cores powder cores and ferrites and iron alloys In addition new topics include Autotransformer design Common mode inductor design Series saturable reactor design Self saturating magnetic amplifier Designing inductors for a given resistance With the goal of making inductors that are lighter and smaller but still meet requirements this book helps users avoid many antiquated rules of thumb to achieve a better more economical design Presenting transformer design examples with step by step directions and numerous tables and graphics for comparison it remains a trusted guide for the engineers technicians and other professionals who design and evaluate transformers and inductors It also serves as an ideal primer for students illustrating the field for them from the ground up *Switch-Mode Power Supplies, Second Edition* Christophe P. Basso,2014-06-04 THE LATEST SPICE SIMULATION AND DESIGN TOOLS FOR CREATING STATE OF THE ART SWITCHMODE POWER SUPPLIES Fully updated to incorporate new SPICE features and capabilities this practical guide explains step by step how to simulate test and improve switch mode power supply designs Detailed formulas with founding equations are included Based on the author s continued research and in depth handson work in the field this revised resource offers a collection of the latest SPICE solutions to the most difficult problem facing power supply designers creating smaller more heat efficient power supplies in shorter design cycles NEW to this edition Complete analysis of rms currents for the three basic cells in CCM and DCM PWM

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