

Planar Integrated Magnetics Design In Wide Input Range Dc

"Preface I have had many requests to update my book Transformer and Inductor Design Handbook, because of the way power electronics has changed in the past few years. I have been requested to add and expand on the present Chapters. There are now twenty-six Chapters. The new Chapters are autotransformer design, common-mode inductor design, series saturable reactor design, self-saturating magnetic amplifier and designing inductors for a given resistance, all with step-by-step design examples. This book offers a practical approach with design examples for design engineers and system engineers in the electronics industry, as well as the aerospace industry. While there are other books available on electronic transformers, none of them seem to have been written with the user's viewpoint in mind. The material in this book is organized so that the design engineer, student engineer or technician, starting at the beginning of the book and continuing through the end, will gain a comprehensive knowledge of the state of the art in transformer and inductor design. The more experienced engineers and system engineers will find this book a useful tool when designing or evaluating transformers and inductors. Transformers are to be found in virtually all electronic circuits. This book can easily be used to design lightweight, high-frequency aerospace transformers or low-frequency commercial transformers. It is, therefore, a design manual"--

Below is a copy of Professor Takeshi Takei's original preface that he wrote for my first book, Modern Ferrite Technology. I was proud to receive this preface and include it here with pride and affection. We were saddened to learn of his death at 92 on March 12, 1992. Preface It is now some 50 years

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since ferrites debuted as an important new category of magnetic materials. They were prized for a range of properties that had no equivalents in existing metal magnetic materials, and it was not long before full-fledged research and development efforts were underway. Today, ferrites are employed in a truly wide range of applications, and the efforts of the many men and women working in the field are yielding many highly intriguing results. New, high-performance products are appearing one after another, and it would seem we have only scratched the surface of the hidden possibilities of these fascinating materials. Dr. Alex Goldman is well qualified to talk about the state of the art in ferrites. For many years Dr. Goldman has been heavily involved in the field as director of the research and development division of Spang & Co. and other enterprises. This book, *Modern Ferrite Technology*, based in part on his own experiences, presents a valuable overview of the field. It is testimony to his commitment and bountiful knowledge about one of today's most intriguing areas of technology.

This book gives an in-depth account of GaAs, InP and SiGe, technologies and describes all the key techniques for the design of amplifiers, ranging from filters and data converters to image oscillators, mixers, switches, variable attenuators, phase shifters, integrated antennas and complete monolithic transceivers.

Nowadays, power electronics is an enabling technology in the energy development scenario. Furthermore, power electronics is strictly linked with several fields of technological growth, such as consumer electronics, IT and communications, electrical networks, utilities, industrial drives and robotics, and transportation and automotive sectors.

Moreover, the widespread use of power electronics enables cost savings and minimization of losses in several technology applications required for sustainable economic growth. The

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topologies of DC–DC power converters and switching converters are under continuous development and deserve special attention to highlight the advantages and disadvantages for use increasingly oriented towards green and sustainable development. DC–DC converter topologies are developed in consideration of higher efficiency, reliable control switching strategies, and fault-tolerant configurations. Several types of switching converter topologies are involved in isolated DC–DC converter and nonisolated DC–DC converter solutions operating in hard-switching and soft-switching conditions. Switching converters have applications in a broad range of areas in both low and high power densities. The articles presented in the Special Issue titled "Advanced DC-DC Power Converters and Switching Converters" consolidate the work on the investigation of the switching converter topology considering the technological advances offered by innovative wide-bandgap devices and performance optimization methods in control strategies used. Written by well-known experts in the field, this first systematic overview of multiferroic heterostructures summarizes the latest developments, first presenting the fundamental mechanisms, including multiferroic materials synthesis, structures and mechanisms, before going on to look at device applications. The resulting text offers insight and understanding for scientists and students new to this area. Power Electronics Design Handbook covers the basics of power electronics theory and components while emphasizing modern low-power components and applications. Coverage includes power semiconductors, converters, power supplies, batteries, protection systems, and power ICs. One of the unique features of the Power Electronics Design Handbook is the integration of component and system theory with practical applications, particularly energy-saving low-power applications. Many chapters also include a section that looks

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forward to future developments in that area. References for further information or more in-depth technical reading are also included. Nihal Kularatna is a principal research engineer with the Arthur C. Clarke Foundation in Sri Lanka. He is also the author of *Modern Electronic Test and Measuring Instruments*, published by the Institute of Electrical Engineers. Emphasizes low- and medium-power components Offers a unique mix of theory and practical application Provides a useful guide to further reading

Extensively revised and expanded to present the state-of-the-art in the field of magnetic design, this third edition presents a practical approach to transformer and inductor design and covers extensively essential topics such as the area product, A_p , and core geometry, K_g . The book provides complete information on magnetic materials and core characteristics using step-by-step design examples and presents all the key components for the design of lightweight, high-frequency aerospace transformers or low-frequency commercial transformers. Written by a specialist with more than 47 years of experience in the field, this volume covers magnetic design theory with all of the relevant formulas.

The two volumes LNAI 2773 and LNAI 2774 constitute the refereed proceedings of the 7th International Conference on Knowledge-Based Intelligent Information and Engineering Systems, KES 2003, held in Oxford, UK in September 2003. The 390 revised papers and poster papers presented were carefully reviewed and selected from numerous submissions. Among the areas covered are knowledge-based systems, neural computing, fuzzy logic, uncertainty, machine learning, soft computing, agent systems, intelligent agents, data mining, knowledge discovery, hybrid intelligent systems, natural language processing, information retrieval, Web applications, case-based reasoning, evolutionary computing, signal processing, ontologies, decision making, human-

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computer interaction, intelligent user interfaces, neuroscience, intelligent agents, biocomputing, etc.

The book gathers the major issues involved in the practical design of Power Management solutions in wireless products as Internet-of-things. Presentation is not about state-of-the-art but about appropriation of validated recent technologies by practicing engineers. The book delivers insights on major trade-offs and a presentation of examples as a cookbook. The content is segmented in chapters to make access easier for the lay-person.

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

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components.

APEC focuses on the practical and applied aspects of the power electronics business. Not just a power designer's conference, APEC has something of interest for anyone involved in power electronics including Equipment OEMs that use power supplies and converters in their equipment, Designers of power supplies, dc, dc converters, motor drives, uninterruptable power supplies, inverters and any other power electronic circuits, equipments and systems, Manufacturers and suppliers of components and assemblies used in power electronics, manufacturing, quality and test engineers involved with power electronics equipment, Marketing, sales and anyone involved in the business of power electronic, Compliance engineers testing and qualifying power electronics equipment or equipment that uses power electronics.

Planar Magnetics is replacing conventional magnetic structures in many applications. Especially Planar transformers are good choice for applications requiring integrated magnetics. LLC converter takes advantage of the features of planar magnetics resulting in power density improvement of the converter system. This thesis deals with design of one such integrated planar transformer for LLC converter. Design flow of integrated planar magnetics is discussed in detail. The major issue of high frequency eddy current loss and achieving required leakage inductance are highlighted. The reason behind the high frequency eddy current losses due to proximity effect and skin effect are discussed and solution to address the high frequency loss are provide. It is shown that the solutions to reduce eddy current losses reduces leakage inductance which is good for converter systems where only magnetizing inductance of transformer plays vital role and the leakage inductance, a parasitic parameter causes undesired effects.

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Design and Analysis of Integrated Planar Transformer for LLC Converter

This book describes the structured design and optimization of efficient, energy processing integrated circuits. The approach is multidisciplinary, covering the monolithic integration of IC design techniques, power electronics and control theory. In particular, this book enables readers to conceive, synthesize, design and implement integrated circuits with high-density high-efficiency on-chip switching power regulators. Topics covered encompass the structured design of the on-chip power supply, efficiency optimization, IC-compatible power inductors and capacitors, power MOSFET switches and efficient switch drivers in standard CMOS technologies.

While most books approach power electronics and renewable energy as two separate subjects, *Power Electronics for Renewable and Distributed Energy Systems* takes an integrative approach; discussing power electronic converters topologies, controls and integration that are specific to the renewable and distributed energy system applications. An overview of power electronic technologies is followed by the introduction of various renewable and distributed energy resources that includes photovoltaics, wind, small hydroelectric, fuel cells, microturbines and variable speed generation. Energy storage systems such as battery and fast response storage systems are discussed along with application-specific examples. After setting forth the fundamentals, the chapters focus on more complex topics such as modular power electronics,

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microgrids and smart grids for integrating renewable and distributed energy. Emerging topics such as advanced electric vehicles and distributed control paradigm for power system control are discussed in the last two chapters. With contributions from subject matter experts, the diagrams and detailed examples provided in each chapter make *Power Electronics for Renewable and Distributed Energy Systems* a sourcebook for electrical engineers and consultants working to deploy various renewable and distributed energy systems and can serve as a comprehensive guide for the upper-level undergraduates and graduate students across the globe. Based on the fundamentals of electromagnetics, this clear and concise text explains basic and applied principles of transformer and inductor design for power electronic applications. It details both the theory and practice of inductors and transformers employed to filter currents, store electromagnetic energy, provide physical isolation between circuits, and perform stepping up and down of DC and AC voltages. The authors present a broad range of applications from modern power conversion systems. They provide rigorous design guidelines based on a robust methodology for inductor and transformer design. They offer real design examples, informed by proven and working field examples. Key features include: emphasis on high frequency design, including optimisation of the winding layout and treatment of non-sinusoidal waveforms a chapter on planar magnetic with analytical models and descriptions of the processing technologies analysis of the role of variable inductors, and their applications for

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power factor correction and solar power unique coverage on the measurements of inductance and transformer capacitance, as well as tests for core losses at high frequency worked examples in MATLAB, end-of-chapter problems, and an accompanying website containing solutions, a full set of instructors' presentations, and copies of all the figures. Covering the basics of the magnetic components of power electronic converters, this book is a comprehensive reference for students and professional engineers dealing with specialised inductor and transformer design. It is especially useful for senior undergraduate and graduate students in electrical engineering and electrical energy systems, and engineers working with power supplies and energy conversion systems who want to update their knowledge on a field that has progressed considerably in recent years.

Revision of a classic reference on ferrite technology Includes fundamentals as well as applications Covers new areas such as nanoferrites, new high frequency power supply materials, magnetoresistive ferrites for magnetic recording

As we increasingly use electronic devices to direct our daily lives, so grows our dependence on reliable energy sources to power them. Because modern electronic systems demand steady, efficient, reliable DC voltage sources—often at a sub-1V level—commercial AC lines, batteries, and other common resources no longer suffice. New technologies also require intricate techniques to protect against natural and manmade disasters. Still, despite its importance, practical information on this

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critical subject remains hard to find. Using simple, accessible language to balance coverage of theoretical and practical aspects, DC Power Supplies, Power Management and Surge Protection details the essentials of power electronics circuits applicable to low-power systems, including modern portable devices. A summary of underlying principles and essential design points, it compares academic research and industry publications and reviews DC power supply fundamentals, including linear and low-dropout regulators. Content also addresses common switching regulator topologies, exploring resonant conversion approaches. Coverage includes other important topics such as: Control aspects and control theory Digital control and control ICs used in switching regulators Power management and energy efficiency Overall power conversion stage and basic protection strategies for higher reliability Battery management and comparison of battery chemistries and charge/discharge management Surge and transient protection of circuits designed with modern semiconductors based on submicron dimension transistors This specialized design resource explores applicable fundamental elements of power sources, with numerous cited references and discussion of commercial components and manufacturers. Regardless of their previous experience level, this information will greatly aid designers, researchers, and academics who, study, design, and produce the viable new power sources needed to propel our modern electronic world. CRC Press Authors Speak Nihal Kularatna introduces his book. Watch the video

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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.

As each area of technology with a potential for significantly impacting any major segment of the electronics industry evolves, it often is accompanied by the development of a succession of new circuits. Each new circuit indeed appears

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different, employing different components in differing configurations, and claims an assortment of distinct features of "improved performance." Without a considerable investment of laboratory time to construct, evaluate, and compare each candidate circuit, it usually is difficult to realistically appraise the relative merits of one approach over another. It often is even more difficult to identify the underlying principles which point up basic similarities and differences. Such is the situation in the new and rapidly expanding area known as electronic power processing or switching mode power supplies. The area of switching power supplies has been spurred by the need for power sources of higher performance, smaller volume, and lighter weight in order to achieve compatibility with the shrinking size of all forms of communication and data handling systems, and particularly with the portable battery-operated equipment in everything from home appliances and handtools to mobile communication equipment. Static dc-to-dc converters and dc-to-ac inverters provide a natural interface with the new direct energy sources such as solar cells, fuel cells, thermoelectric generators, and the like, and form the central ingredient in most uninterruptable power sources.

The book addresses the critical challenges faced by the ever-expanding wireless communication market and the increasing frequency of operation due to continuous innovation of high performance integrated passive devices. The challenges like low quality factor, design complexity, manufacturability, processing cost, etc., are studied with examples and specifics. Silicon on-chip inductor was first reported in 1990 by Nguyen and Meyer in a 0.8 μm silicon bipolar complementary metal oxide semiconductor technology (BiCMOS). Since then, there has been an enormous progress in the research on the performance trends, design and optimization, modeling, quality factor enhancement

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techniques, etc., of spiral inductors and significant results are reported in literature for various applications. This book introduces an efficient method of determining the optimized layout of on chip spiral inductor. The important fundamental tradeoffs of the design like quality factor and area, quality factor and inductance, quality factor and operating frequency, maximum quality factor and the peak frequency is also explored. The authors proposed an algorithm for accurate design and optimization of spiral inductors using a 3D electromagnetic simulator with minimum number of inductor structure simulations and thereby reducing its long computation time. A new multilayer pyramidal symmetric inductor structure is also proposed in this book. Being multilevel, the proposed inductor achieves high inductance to area ratio and hence occupies smaller silicon area.

Grounding design and installation is critical for the safety and performance of any electrical or electronic system. Blending theory and practice, this is the first book to provide a thorough approach to grounding from circuit to system. It covers: grounding for safety aspects in facilities, lightning, and NEMP; grounding in printed circuit board, cable shields, and enclosure grounding; and applications in fixed and mobile facilities on land, at sea, and in air. It's an indispensable resource for electrical and electronic engineers concerned with the design of electronic circuits and systems.

Spotlight on Modern Transformer Design introduces a novel approach to transformer design using artificial intelligence (AI) techniques in combination with finite element method (FEM). Today, AI is widely used for modeling nonlinear and large-scale systems, especially when explicit mathematical models are difficult to obtain or completely lacking. Moreover, AI is computationally efficient in solving hard optimization problems. Many numerical examples throughout the book illustrate the application of the techniques discussed to a

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variety of real-life transformer design problems, including: • problems relating to the prediction of no-load losses; • winding material selection; • transformer design optimisation; • and transformer selection. Spotlight on Modern Transformer Design is a valuable learning tool for advanced undergraduate and graduate students, as well as researchers and power engineering professionals working in electric utilities and industries, public authorities, and design offices. This book focuses on emerging wireless power/data and energy harvesting technologies, and highlights their fundamental requirements, followed by recent advancements. It provides a various technical overview and analysis of key techniques for wireless power/data and energy harvesting system design. The state-of-the-art system introduced in this book will benefit designers looking to develop wireless power transfer and energy harvesting technologies in a variety of fields, such as wearable, implantable devices, home appliances, and electric vehicles.

With the increasing demand for small and cost efficient DC/DC converters, the power converters are expected to operate with high efficiency. Magnetics components design is one of the biggest challenges in achieving the higher power density and higher efficiency due to the significant portion of magnetics components volume in the whole power system. At the same time, most of the experimental phenomena are related to the magnetics components. So, good magnetics components design is one of the key issues to implement low voltage high current DC/DC converter. Planar technology has many advantages. It has low profile construction, low leakage inductance and inter-winding capacitance, excellent repeatability of parasitic properties, cost efficiency, great

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reliability, and excellent thermal characteristics. On the other side, however, planar technology also has some disadvantages. Although it improves thermal performance, the planar format increases footprint area. The fact that windings can be placed closer in planar technology to reduce leakage inductance also often has an unwanted effect of increasing parasitic capacitances. In this dissertation, the planar magnetics designs for high current low voltage applications are thoroughly investigated and one CAD design methodology based on FEA numerical analysis is proposed. Because the frequency dependant parasitic parameters of magnetics components are included in the circuit model, the whole circuit analysis is more accurate. When it is implemented correctly, integrated magnetics technique can produce a significant reduction in the magnetic core content number and it can also result in cost efficient designs with less weight and smaller volume. These will increase the whole converter's power density and power efficiency. For high output current and low output voltage applications, half bridge in primary and current doublers in secondary are proved to be a very good solution. Based on this topology, four different integrated magnetics structures are analyzed and compared with each other. One unified model is introduced and implemented in the circuit analysis. A new integrated magnetics component core shape is proposed. All simulation and experimental results verify the integrated magnetics design. There are several new magnetics components applications shown in the dissertation. Active transient voltage compensator is a good solution

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to the challenging high slew rate load current transient requirement of VRM. The transformer works as an extra voltage source. During the transient periods, the transformer injects or absorbs the extra transient to or from the circuit. A peak current mode controlled integrated magnetics structure is proposed in the dissertation. Two transformers and two inductors are integrated in one core. It can force the two input capacitors of half bridge topology to have the same voltage potential and solve the voltage unbalance issue. The proposed integrated magnetics structure is simple compared with other methods implementing the current mode control to half bridge topology. Circuit analysis, simulation and experimental results verify the feasibility of these applications.

Expanded edition of the 1969 work on the theory, data, and procedures required for the design of ferrite cored devices. Covers the technically important properties of magnetically soft ferrites at frequencies up to 100 MHz, and the application of those ferrites to inductors, transformers and related devices. A comprehensive list of references and bibliography follow each chapter. Annotation copyrighted by Book News, Inc., Portland, OR

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