

Keywords: flyback, continuous conduction mode, CCM, discontinuous conduction mode, DCM, transformer, optoisolated feedback, error amplifier compensation, pi controller, biasing optocoupler, flyback converter, peak current mode controller, MAX17595/MAX17596

APPLICATION NOTE 5504

Designing Flyback Converters Using Peak-Current-Mode Controllers

By: Srinivasa Rao Meesala
Nov 27, 2012

Abstract: Flyback converter design using MAX17595/MAX17596 is outlined. Design methodology and calculations for components value selection are presented. Continuous conduction mode (CCM) and discontinuous conduction mode (DCM) are treated individually.

Introduction

This application note describes the methodology of designing flyback converters using the [MAX17595/MAX17596](#) peak-current-mode controllers. Flyback converters may be operated in discontinuous conduction mode (DCM) or continuous conduction mode (CCM). The component choices, stress level in power devices, and controller design vary depending on the operating mode of the converter. Formulas for calculating component values and ratings are also presented.

DCM Flyback

Primary Inductance Selection

In a DCM flyback converter, the energy stored in the primary inductance of the flyback transformer is delivered entirely to the output. The maximum primary-inductance value for which the converter remains in DCM at all operating conditions can be calculated as:

$$L_{PRIMAX} \leq \frac{(V_{SMIN} \times D_{MAX})^2 \times 0.4}{(V_{OUT} + V_D) \times I_{OUT} \times F_{SW}} \quad (\text{Eq. 1})$$

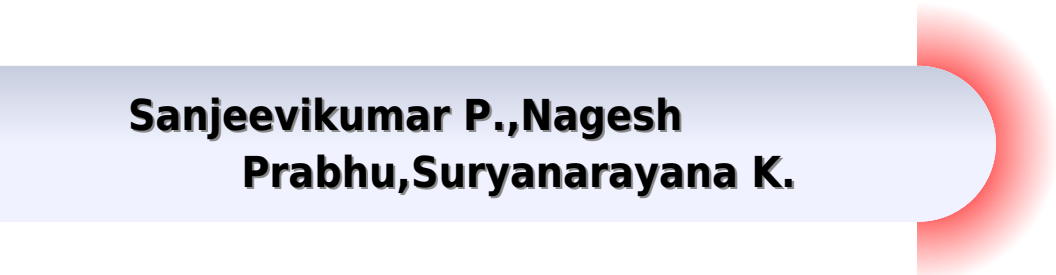
Where D_{MAX} is chosen as 0.43 for the MAX17595/MAX17596, V_D is the voltage drop of the output rectifier diode on the secondary winding, and F_{SW} is the switching frequency of the power converter. Choose the primary inductance value to be less than L_{PRIMAX} .

Duty Cycle Calculation

The accurate value of the duty cycle (D_{NEW}) for the selected primary inductance (L_{PR}) can be

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Prabhu, Suryanarayana K.**



Designing Flyback Converters Using Peak Current Mode:

Pulsewidth Modulated DC-to-DC Power Conversion Byungcho Choi, 2021-10-04 ORGANIC REACTIONS CYCLIZATION REACTIONS OF NITROGEN CENTERED RADICALS Stuart W McCombie B atrice Quiclet Sire and Samir Z Zard TRANSITION METAL CATALYZED AMINOOXYGENATION OF ALKENES Sherry R Chemler Dake Chen Shuklendu D Karyakarte Jonathan M Shikora and Tomasz Wdowik *Pulse Width Modulated DC-DC Converters* Keng Chih Wu, 2012-12-06 For the first time in power electronics this comprehensive treatment of switch mode DC DC converter designs addresses many analytical closed form equations such as duty cycle prediction output regulation output ripple control loop gain and steady state time domain waveform Each of these equations are given various topologists and configurations including forward flyback and boost converters Pulse Width Modulated DC DC Converters begins with a detailed approach to the quiescent operating locus of a power plant under open loop The reader is then led through other supporting circuits once again in the quiescent condition These exercises result in the close loop formulations of the subject system providing designers with the ability to study the sensitivities of a system against disturbances With the quiescent conditions well established the book then guides the reader further into the territories of system stability where small signal behaviors are explored Finally some important large signal time domain studies cap the treatment Some distinctive features of this book include detailed coverage of dynamic close loop converter simulations using only personal computer and modern mathematical software Steady state time domain analysis based on the concept of continuity of states Voltage mode and current mode control techniques and their differences of merits A detailed description on setting up different equations for DC DC converters simulation using only PC *Transformer and Inductor Design Handbook, Third Edition* Colonel Wm. T. McLyman, 2004-03-31 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 Control and Nonlinear Dynamics on Energy Conversion Systems Herbert Ho-Ching Iu, Abdelali El Aroudi, 2019-07-01 The ever increasing need for higher efficiency smaller size and lower cost make the analysis understanding and design of energy conversion systems extremely important interesting and even imperative One of the most neglected features in the study of such systems is the effect of the inherent nonlinearities on the stability of the system Due to these nonlinearities these devices may exhibit undesirable and complex dynamics which are the focus of many researchers Even though a lot of research has taken place in this area during the last 20 years it is still an active research topic for mainstream power engineers This research has

demonstrated that these systems can become unstable with a direct result in increased losses extra subharmonics and even uncontrollability unobservability The detailed study of these systems can help in the design of smaller lighter and less expensive converters that are particularly important in emerging areas of research like electric vehicles smart grids renewable energy sources and others The aim of this Special Issue is to cover control and nonlinear aspects of instabilities in different energy conversion systems theoretical analysis modelling and practical solutions for such emerging applications In this Special Issue we present novel research works in different areas of the control and nonlinear dynamics of energy conversion systems

Practical Lighting Design with LEDs Ron Lenk, Carol Lenk, 2017-03-10 The essential how to guide to designing and building LED systems revised and updated The second edition of Practical Lighting Design with LEDs has been revised and updated to provide the most current information for developing light emitting diodes products The authors noted authorities in the field offer a review of the most relevant topics including optical performance materials thermal design and modeling and measurement Comprehensive in scope the text covers all the information needed to design LEDs into end products The user friendly text also contains numerous drawings and schematics that show how things such as measurements are actually made and show how circuits actually work Designed to be practical the text includes myriad notes and illustrative examples that give pointers and how to guides on many of the book's topics In addition the book's equations are used only for practical calculations and are kept at the level of high school algebra This thoroughly expanded second edition offers New chapters on the design of an LED flashlight USB light automotive taillight and LED light bulbs A practical and user friendly guide with dozens of new illustrations The nitty gritty day to day engineering and systems used to design and build complete LED systems An essential resource on the cutting edge technology of Light Emitting Diodes Practical Lighting Design with LEDs helps engineers and managers meet the demand for the surge in usage for products using light emitting diodes with a practical guide that takes them through the relevant fields of light electronic and thermal design

Practical Switching Power Supply Design Martin C. Brown, 2012-12-02 Take the black magic out of switching power supplies with Practical Switching Power Supply Design This is a comprehensive hands on guide to the theory behind and design of PWM and resonant switching supplies You'll find information on switching supply operation and selecting an appropriate topology for your application There's extensive coverage of buck boost flyback push pull half bridge and full bridge regulator circuits Special attention is given to semiconductors used in switching supplies RFI EMI reduction grounding testing and safety standards are also detailed Numerous design examples and equations are given and discussed Even if your primary expertise is in logic or microprocessor engineering you'll be able to design a power supply that's right for your application with this essential guide and reference Gives special attention to resonant switching power supplies a state of the art trend in switching power supply design Approaches switching power supplies in an organized way beginning with the advantages of switching supplies and their basic operating principles Explores various configurations of pulse width

modulated PWM switching supplies and gives readers ideas for the direction of their designs Especially useful for practicing design engineers whose primary specialty is not in analog or power engineering fields **Power Electronics Design Handbook** Nihal Kularatna,1998-09-09 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 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 **Fundamentals of Power Electronics** Robert W. Erickson,Dragan Maksimović,2020-07-14 Fundamentals of Power Electronics Third 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 new material on switching loss mechanisms and their modeling wide bandgap semiconductor devices a more rigorous treatment of averaging explanation of the Nyquist stability criterion incorporation of the Tan and Middlebrook model for current programmed control a new chapter on digital control of switching converters major new chapters on advanced techniques of design oriented analysis including feedback and extra element theorems average current control new material on input filter design new treatment of averaged switch modeling simulation and indirect power and sampling effects in DCM CPM and digital control Fundamentals of Power Electronics Third 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 analog and digital electronics **Electrical Generation and Distribution Systems and Power Quality Disturbances** Gregorio Romero,Luisa Martinez,2011-11-21 The utilization of renewable energy sources such as wind energy or solar energy among others is currently of greater interest Nevertheless since their availability is arbitrary and unstable this can lead to frequency variation to grid instability and to a total or partial loss of load power supply being not appropriate sources to be directly connected to the main utility grid Additionally the presence of a static converter as output interface of the generating plants introduces voltage and current harmonics into the electrical system that negatively affect system power quality By integrating distributed power generation systems closed to the loads in

the electric grid we can eliminate the need to transfer energy over long distances through the electric grid In this book the reader will be introduced to different power generation and distribution systems with an analysis of some types of existing disturbances and a study of different industrial applications such as battery charges

Origin of Power Converters

Tsai-Fu Wu, Yu-Kai Chen, 2020-04-14 A comprehensive guide to approaches to decoding synthesizing and modeling pulse width modulation PWM converters Origin of Power Converters explores the original converter and provides a systematic examination of the development and modeling of power converters based on decoding and synthesizing approaches The authors noted experts on the topic present an introduction to the origins of the converter and detail the fundamentals related to power the converter s evolution They cover a range of converter synthesis approaches synthesis of multi stage multi level converters extension of hard switching converters to soft switching ones and determination of switch voltage stresses in the converters In later chapters this comprehensive resource reviews conventional two port network theory and the state space averaged SSA modeling approach from which systematic modeling approaches are based on the graft switch technique In addition the book reviews the converter layer scheme and some fundamental circuit theories This important book Contains a review of several typical transfer codes such as step down step up step up down and step up down Describes the syntheses of pulse width modulation PWM converters such as voltage fed z source current fed z source quasi z source switched capacitor and switched inductor converters Presents two application examples based on previously proposed modeling approaches Written for academic researchers graduate students and seniors in power electronics Origin of Power Converters provides a comprehensive understanding of the evolution of the converter and its applications

Power Electronics, A First Course

Ned Mohan, Siddharth Raju, 2023-01-12 POWER ELECTRONICS A FIRST COURSE Enables students to understand power electronics systems as one course in an integrated electric energy systems curriculum Power Electronics A First Course provides instruction on fundamental concepts related to power electronics to undergraduate electrical engineering students beginning with an introductory chapter and moving on to discussing topics such as switching power poles switch mode dc dc converters and feedback controllers The authors also cover diode rectifiers power factor correction PFC circuits and switch mode dc power supplies Later chapters touch on soft switching in dc dc power converters voltage and current requirements imposed by various power applications dc and low frequency sinusoidal ac voltages thyristor converters and the utility applications of harnessing energy from renewable sources Power Electronics A First Course is the only textbook that is integrated with hardware experiments and simulation results The simulation files are available on a website associated with this textbook The hardware experiments will be available through a University of Minnesota startup at a low cost In Power Electronics A First Course readers can expect to find detailed information on Availability of various power semiconductor devices that are essential in power electronic systems plus their switching characteristics and various tradeoffs Common foundational unit of various converters and their operation plus fundamental concepts for feedback control illustrated by

means of regulated dc dc converters Basic concepts associated with magnetic circuits to develop an understanding of inductors and transformers needed in power electronics Problems associated with hard switching and some of the practical circuits where this problem can be minimized with soft switching Power Electronics A First Course is an ideal textbook for Junior Senior Undergraduate students in Electrical and Computer Engineering ECE It is also valuable to students outside of ECE such as those in more general engineering fields Basic understanding of electrical engineering concepts and control systems is a prerequisite

Power Converter Circuits William Shepherd, Li Zhang, 2004-03-12 This text reveals all key components of rectification inversion cycloconversion and conversion circuits It authoritatively describes switching voltage and current relationships and converter properties operation control and performance as utilized in most practical applications Authored jointly by a veteran scholar and an accomplished researcher in the field Power Converter Circuits highlights methods grounded in classical mathematics and includes an abundance of numerical worked examples Features hundreds of chapter specific problems with solutions provided separately at the end of the book

Power Electronic Converters Teuvo Suntio, Tuomas Messo, Joonas Puukko, 2017-09-12 Ein Referenzwerk mit Erläuterungen zum Verhalten von elektronischen Leistungswandlern fehlte bislang Dieses Fachbuch bietet Informationen die in vergleichbaren Publikationen zur Leistungselektronik nicht enthalten sind In einer übersichtlichen Struktur werden in vier Abschnitten die folgenden Themen behandelt Der erste Abschnitt beschäftigt sich mit der Dynamik und Steuerung herkömmlicher Leistungswandler Dynamik und Steuerung von Gleichspannungswandlern in Anwendungen mit erneuerbaren Energien sind Gegenstand des zweiten Abschnitts der auch eine Einführung in die Quellen und das Design von stromgespeisten Leistungswandlern nach dem Prinzip der Dualitätstransformation Der dritte Abschnitt beschreibt die Dynamik und Steuerung von dreiphasigen Gleichrichtern in spannungsgespeisten Anwendungen Im letzten Abschnitt geht es um die Dynamik und Steuerung von dreiphasigen VS Umrichtern bei Anwendungen mit erneuerbaren Energien Dieses zukunftsorientierte Fachbuch mit fundierten Informationen aus erster Hand ist das Referenzwerk der Wahl für Forscher und Ingenieure die ein zugehöriges Nachschlagewerk zu Design und Steuerung von elektronischen Leistungswandlern benötigen

Power-Switching Converters Simon Ang, Alejandro Oliva, Gary Griffiths, Richard Harrison, 2010-12-20 Significantly expanded and updated with extensive revisions new material and a new chapter on emerging applications of switching converters Power Switching Converters Third Edition offers the same trusted accessible and comprehensive information as its bestselling predecessors Similar to the two previous editions this book can be used for a

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.

Power Converters with Digital Filter Feedback Control Keng C. Wu, 2016-01-22. Power Converter with Digital Filter Feedback Control presents a logical sequence that leads to the identification, extraction, formulation, conversion, and implementation for the control function needed in electrical power equipment systems. This book builds a bridge for moving a power converter with conventional analog feedback to one with modern digital filter control and enlists the state space averaging technique to identify the core control function in analytical close form in the s domain Laplace. It is a useful reference for all professionals and electrical engineers engaged in electrical power equipment systems design, integration, and management. Offers logical sequences to identification, extraction, formulation, conversion, and implementation for the control function needed. Contains step by step instructions on how to take existing analog designed power processors and move them to the digital realm. Presents ways to extract gain functions for many power converters, power processing stages, and their supporting circuitry.

Power Sources and Supplies: World Class Designs Marty Brown, 2011-04-08. Newnes has worked with Marty Brown, a leader in the field of power design, to select the very best design specific material from the Newnes portfolio. Marty selected material for its timelessness, its relevance to current power supply design needs, and its real world approach to design issues. Special attention is given to switching power supplies and their design issues, including component selection, minimization of EMI, toroid selection, and breadboarding of designs. Emphasis is also placed on design strategies for power supplies, including case histories and design examples. This is a book that belongs on the workbench of every power supply designer. Marty Brown, author and power supply design consultant, has personally selected all content for its relevance and usefulness. Covers best design practices for switching power supplies and power converters. Emphasis is on pragmatic solutions to commonly encountered design problems and tasks.

Power Electronic Converters for Solar Photovoltaic Systems L. Ashok Kumar, S. Albert Alexander, Madhuvanthani Rajendran, 2020-11-01. Power Electronic Converters for Solar Photovoltaic Systems provides design and implementation procedures for power electronic converters and advanced controllers to improve standalone and grid environment solar photovoltaics performance. Sections cover performance and improvement of solar photovoltaics under various conditions with the aid of intelligent controllers, allowing readers to better understand the nuances of power electronic converters for renewable energy systems. With algorithm development and real time implementation procedures, this reference is useful for those interested in power electronics for performance improvement in

distributed energy resources design of advanced controllers and measurement of critical parameters surrounding renewable energy systems By providing a complete solution for performance improvement in solar PV with novel control techniques this book will appeal to researchers and engineers working in power electronic converters renewable energy and power quality Includes simulation studies and photovoltaic performance analysis Uses case studies as a reference for design and research Covers different varieties of power converters from fundamentals to implementation

Advances in Renewable Energy and Electric Vehicles Sanjeevikumar P.,Nagesh Prabhu,Suryanarayana K.,2021-08-20 This book presents select proceedings of the International Conference on Advances in Renewable Energy and Electric Vehicles AREEV 2020 and examines related emerging trends feasible solutions to shape and enable the development of mankind The topics covered include renewable energy sources electric vehicles energy storage systems power system protection security smart grid and wide band gap semiconductor technologies The book also discusses applications of signal processing artificial neural networks optimal and robust control systems and modeling and simulation of power electronic converters The book will be a valuable reference for beginners researchers and professionals interested in power systems renewable energy and electric vehicles

Advances in Electrical and Computer Technologies Thangaprakash Sengodan,M. Murugappan,Sanjay Misra,2020-09-07 The book comprises select proceedings of the first International Conference on Advances in Electrical and Computer Technologies 2019 ICAECT 2019 The papers presented in this book are peer reviewed and cover wide range of topics in Electrical and Computer Engineering fields This book contains the papers presenting the latest developments in the areas of Electrical Electronics Communication systems and Computer Science such as smart grids soft computing techniques in power systems smart energy management systems power electronics feedback control systems biomedical engineering geo informative systems grid computing data mining image and signal processing video processing computer vision pattern recognition cloud computing pervasive computing intelligent systems artificial intelligence neural network and fuzzy logic broad band communication mobile and optical communication network security VLSI embedded systems optical networks and wireless communication This book will be of great use to the researchers and students in the areas of Electrical and Electronics Engineering Communication systems and Computer Science

The Top Books of the Year Designing Flyback Converters Using Peak Current Mode The year 2023 has witnessed a noteworthy surge in literary brilliance, with numerous captivating novels enthralling the hearts of readers worldwide. Lets delve into the realm of popular books, exploring the fascinating narratives that have charmed audiences this year. Designing Flyback Converters Using Peak Current Mode : Colleen Hoover's "It Ends with Us" This heartfelt tale of love, loss, and resilience has captivated readers with its raw and emotional exploration of domestic abuse. Hoover expertly weaves a story of hope and healing, reminding us that even in the darkest of times, the human spirit can triumph. Designing Flyback Converters Using Peak Current Mode : Taylor Jenkins Reid's "The Seven Husbands of Evelyn Hugo" This spellbinding historical fiction novel unravels the life of Evelyn Hugo, a Hollywood icon who defies expectations and societal norms to pursue her dreams. Reid's absorbing storytelling and compelling characters transport readers to a bygone era, immersing them in a world of glamour, ambition, and self-discovery. Discover the Magic : Delia Owens' "Where the Crawdads Sing" This mesmerizing coming-of-age story follows Kya Clark, a young woman who grows up alone in the marshes of North Carolina. Owens crafts a tale of resilience, survival, and the transformative power of nature, captivating readers with its evocative prose and mesmerizing setting. These top-selling novels represent just a fraction of the literary treasures that have emerged in 2023. Whether you seek tales of romance, adventure, or personal growth, the world of literature offers an abundance of engaging stories waiting to be discovered. The novel begins with Richard Papen, a bright but troubled young man, arriving at Hampden College. Richard is immediately drawn to the group of students who call themselves the Classics Club. The club is led by Henry Winter, a brilliant and charismatic young man. Henry is obsessed with Greek mythology and philosophy, and he quickly draws Richard into his world. The other members of the Classics Club are equally as fascinating. Bunny Corcoran is a wealthy and spoiled young man who is always looking for a good time. Charles Tavis is a quiet and reserved young man who is deeply in love with Henry. Camilla Macaulay is a beautiful and intelligent young woman who is drawn to the power and danger of the Classics Club. The students are all deeply in love with Morrow, and they are willing to do anything to please him. Morrow is a complex and mysterious figure, and he seems to be manipulating the students for his own purposes. As the students become more involved with Morrow, they begin to commit increasingly dangerous acts. The Secret History is a masterful and suspenseful novel that will keep you wondering until the very end. The novel is a cautionary tale about the dangers of obsession and the power of evil.

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