# Mosfets Zero Voltage Switching Full Bridge Converter

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Hard and soft switching of PWM converters Zero Voltage Switching - ZVS for DC Converter MATLAB \u0026 PSIM Simulation **ECEN 5817 Resonant and Soft Switching Techniques in Power Electronics - Sample Lecture** ~~MOSFET Switching Explained~~ ~~Power Electronics - 2.2.7 - MOSFET Gate Drivers~~ ~~ZVS Zero Voltage Switch testings and and have fun!~~ ~~MOSFET switching losses: Explanation and demonstration by simulation~~ Power MOSFET drivers **Zero Voltage Switching (ZVS) driver** Zero Voltage Switching (ZVS Converter) **Mosfet as Switch SOFT SWITCHING Master Ivo circuit replication part 2** *High Side Inductive Switching with a N-Mosfet Radiant Half Bridge, Isolated Gate Driver PCB, Up Close Electronic Basics #28: IGBT and when to use them How a ZVS Fly-back Driver Circuit Works and How to Build One µReview #14 | 4 ch. Opto-Isolated MOSFET Switch | www.icstation.com*

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Electronic Basics #23: Transistor (MOSFET) as a Switch*Amplified series parallel bifilar coil resonance,* *from a single mosfet switch* ~~New Super Powerful Double Mosfet ZVS Driver and Lots of Nice Arcs~~ ~~High Voltage DCDC converter module YH11068 - close look at and test with sparks~~ *Soft Switching Part 1* High Voltage MOSFET Switch Tutorial

LTspice - simulate hw problems with MOSFETs*Resonant converter: Zero current Switching* #233 How to find Equivalent or Substitute of MOSFET or Transistor / SCR / IGBT ~~How a Switching Power Supply Works and How to Make One~~ The CMOS Switch ~~How to Use a MOSFET as a Switch~~

Mosfets Zero Voltage Switching Full

WHY ZERO-VOLTAGE SWITCHING When a MOSFET turns on, there are losses due to voltage and current overlap (Figure 3) and the discharge of stored energy in its Coss capacitor. In ZVS the Coss is tricked into discharging its energy prior to turning on the MOSFET. Usually the MOSFET's body diode goes into conduction in the process.

MOSFETs Zero-Voltage Switching Full-Bridge Converter ...

Mosfets Zero Voltage Switching Full WHY ZERO-VOLTAGE SWITCHING When a MOSFET turns on, there are losses due to voltage and current overlap (Figure 3) and the discharge of stored energy in its Coss capacitor. In ZVS the Coss is tricked into discharging its energy prior to turning on the MOSFET.

Mosfets Zero Voltage Switching Full Bridge Converter

MOSFET Failure Modes in the Zero-Voltage-Switched Full-Bridge Switching Mode Power Supply Applications Alexander Fiel and Thomas Wu International Rectifier Applications Department El

Segundo, CA 90245, USA Abstract-As the demand for the telecom/server power is growing exponentially, the need for higher power density increases each year.

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MOSFET Failure Modes in the Zero-Voltage-Switched Full ...

Mosfets Zero Voltage Switching Full WHY ZERO-VOLTAGE SWITCHING When a MOSFET turns on, there are losses due to voltage and current overlap (Figure 3) and the discharge of stored energy in its Coss capacitor. In ZVS the Coss is tricked into discharging its energy prior to turning on the MOSFET. Usually the MOSFET's body diode goes into conduction in the process. MOSFETs Zero-Voltage Switching Full-Bridge Converter ...

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Mosfets Zero Voltage Switching Full Bridge Converter

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Mosfets Zero Voltage Switching Full Bridge Converter

Quasi-resonant switching is a good technique for improving voltage-converter efficiency, but things can be further improved by implementing full soft switching. During soft switching the voltage falls to zero (rather than just a minimum) before the MOSFET is turned on or off, eliminating any overlap between voltage and current and minimizing losses. (The technique can also be used to switch the MOSFET when current, rather than voltage, reaches zero. This is known as Zero Current Switching ...

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A Review of Zero-Voltage Switching and Importance | DigiKey

Zero Voltage Switching Resonant Power Conversion Bill Andreycak ing zero current, hence zero power switching. And while true, two obvious concerns can in1pede the quest for high efficiency operation with high voltage inputs. By nature of the resonant tank and zero current switching limitation, the peak switch

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Zero Voltage Switching - Texas Instruments

The ISL675x family of controllers consists of high-performance, low-pin-count alternative zero voltage switching (ZVS) full bridge pulse width modulating (PWM) controllers. These parts achieve ZVS operation by driving the upper bridge FETs at a fixed 50% duty cycle while the lower bridge FETS are trailing-edge modulated with adjustable resonant switching delays.

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Zero Voltage Switching (ZVS) Full Bridge Controllers | Renesas

The basic idea of zero voltage switching is simple. Prior to turn on, the MOSFET V DS is at a high voltage, which is also the voltage to which C OSS is charged. To achieve ZVS, the C OSS is tricked into discharging its energy before the gate signal is applied. Even a partial discharge is beneficial though ideally, all of the energy stored in C OSS

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Beware of Zero Voltage Switching - Mouser Electronics

the source voltage, i.e., v 2 = V DC, and switch S 1 turns on at zero voltage. As a result of the transition, the charge Qoss was moved from switch S 1 to the dc source and the energy of the inductor L? is zero whereas the total energy stored in the MOSFET bridge leg remains unchanged. Thus, the condition for complete soft switching equals 1 2 LI

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ZVS of Power MOSFETs Revisited - ETH Z

September 2007 Rev 1 1/13. AN2626 Application note. MOSFET body diode recovery mechanism in a phase-shifted ZVS full bridge DC/DC converter. Introduction. The ZVS exploits the parasitic circuit elements to guarantee zero voltage across the switching device before turn on, eliminating hence any power losses due to the simultaneous overlap of switch current and voltage at each transition [1].

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AN2626 Application note - STMicroelectronics

This issue is being addressed through the development of ‘soft-switching’ converters that try to transition at zero voltage or current. The latest versions of this approach are the LLC and phase-shifted full bridge (PSFB) circuit topologies shown in Figure 1.

United Silicon Carbide Inc. Achieving more efficient power ...

Quadrilateral Current Mode (QCM) Paralleling of Power MOSFETs for Zero-Voltage Switching (ZVS) Abstract:This paper proposes a generic zero-voltage switching (ZVS) scheme for parallel power MOSFETs. Uncoupled or inversely-coupled differential-mode (DM) commutation inductors are added to the midpoints (AC terminals) of parallel MOSFET half-bridges (HBs), and a time-delay-based control scheme is applied, generating a circulating current flowing through these commutation inductors.

Quadrilateral Current Mode (QCM) Paralleling of Power ...

charge forces the voltage across MOSFET A to zero (MOS-FET B ZVS occurs during the cycles second half), enabling zero voltage switching to take place. Here the MOSFETs output capacitances form a resonant circuit with the reso-nant inductance. The charge is displaced in a time equal to one-fourth the resonant period. As a result, the left leg transi-

AN9506: A 50W, 500kHz, Full-Bridge, Phase-Shift, ZVS ...

The MOSFET is the most common choice of controlled switch in the zero-voltage-switching full-bridge converter. The MOSFET is capable of very fast commutations and its intrinsic body diode saves an additional external component that would otherwise be necessary to clamp the switch voltage to the input supply voltage. Both the internal body diode and the output capacitance become essential components for the

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High-Voltage MOSFET Behavior in Soft-Switching Converters ...

Infineon's 40V and 60V MOSFET product families feature not only the industry’s lowest R DS(on) but also a perfect switching behavior for fast switching applications. 15% lower R DS(on) and 31% lower figure of merit (R DS(on) x Q g) compared to alternative devices has been realized by advanced thin wafer technology.

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BSC010N04LS - Infineon Technologies

The MOSFET is switched off within milliseconds, with the cap now holding a higher voltage than the input. The result of it all is that the capacitor soaks up almost all the voltage it can get, with no diode forward voltage drop involved. When the input voltage drops, the circuit disconnects it from the cap so it’ll retain its charge.

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» Zero voltage diode » JeeLabs

Abstract: In this article, the effects of the parameters of GaN HEMTs and Si mosfets and the load conditions on the radiated electromagnetic interference (EMI) are analyzed based on the compositions of the equivalent noise voltage sources. These compositions include the rising and falling edges of the switching voltages, the zero-voltage-switching voltage drops and the parasitic ringing.

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Analysis and Comparison of the Radiated Electromagnetic ...

? Designed and developed for “soft switching” or “zero voltage switching” topologies such as: o Half bridge (LLC) o Phase-shifted full bridge o Can be also be used for “hard switching” topologies where the body diode MOSFET operates only in the first quadrant (never turns on) ? Power factor correction (PFC) ? Two-switch forward converter ? Flyback converter ? Forward converter

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.

This thesis explores a zero-voltage switching (ZVS) method that can be used to decrease the frequency dependent losses in a buck converter. The specific application for this thesis was a buck converter IC with an input voltage of up to 42V. The method utilizes the addition of an auxiliary circuit composed of a helper inductor and two helper power MOSFETs that compliment the switching transition of a conventional synchronous buck converter topology. It is shown in this thesis that by using the described topology, the switching losses of the high-side power MOSFET in a synchronous buck converter can be reduced by up to 45%. Furthermore, it is shown that a similar helper circuit could be used to reduce the gate drive losses for both power MOSFETs in a synchronous buck converter by up to 60%. Since the method requires the use of an additional helper inductor with a small value (10-50 nH), various methods to integrate this inductor into an IC package are investigated. 0.35[mu]m BiCMOS technology was used to simulate and analyze the merits of the described topology and compare it to the LT8697, a hard-switched synchronous buck converter IC.

Increasing demand for efficiency and power density pushes Si-based devices to some of their inherent material limits, including those related to temperature operation, switching frequency, and blocking voltage. Recently, SiC-based power devices are promising candidates for high-power and high-frequency switching applications. Today, SiC MOSFETs are commercially available from several manufacturers. Although technology affiliated with SiC MOSFETs is improving rapidly, many challenges remain, and some of them are investigated in this work. The research work in this dissertation is divided into the three following parts. Firstly, the static and switching characteristics of the state-of-the-art 1.2 kV planar and double-trench SiC MOSFETs from two different manufacturers are evaluated. The effects of different biasing voltages, DC link voltages, and temperatures are analysed. The characterisation results show that the devices exhibit superior switching performances under different operating conditions. Moreover, several aspects of using the SiC MOSFET’s body diode in a DC/DC converter are investigated, comparing the body-diodes of planar and double-trench devices. Reverse recovery is evaluated in switching tests considering the case temperature, switching rate, forward current, and applied voltage. Based on the measurement results, the junction temperature is estimated to guarantee safe operation. A simple electro-thermal model is proposed in order to estimate the maximum allowed switching frequency based on the thermal design of the SiC devices. Using these results, hard- and soft-switching converters are designed, and devices are characterised as being in continuous operation at a very high switching frequency of 1 MHz. Thereafter, the SiC MOSFETs are operated in a continuous mode in a 10 kW / 100-250 kHz buck converter, comparing synchronous rectification, the use of the body diode, and the use of an external Schottky diode. Further, the parallel operation of the planar devices is considered. Thus, the paralleling of SiC MOSFETs is investigated before comparing the devices in continuous converter operation. In this regard, the impact of the most common mismatch parameters on the static and dynamic current sharing of the transistors is evaluated, showing that paralleling of SiC MOSFETs is feasible. Subsequently, an analytical model of SiC MOSFETs for switching loss optimisation is proposed. The analytical model exhibits relatively close agreement with measurement results under different test conditions. The proposed model tracks the oscillation effectively during both turn-on and –off transitions. This has been achieved by considering the influence of the most crucial parasitic elements in both power and gate loops. In the second part, a comprehensive short-circuit ruggedness evaluation focusing on different failure modes of the planar and double-trench SiC devices is presented. The effects of different biasing voltages, DC link voltages, and gate resistances are evaluated. Additionally, the temperature-dependence of the short-circuit capability is evaluated, and the associated failure modes are analysed. Subsequently, the design and test of two different methods for overcurrent protection are proposed. The desaturation technique is applied to the SiC MOSFETs and compared to a second method that depends on the stray inductance of the devices. Finally, the benefits of using SiC devices in continuous high-frequency, high-power DC/DC converters is experimentally evaluated. In this regard, a design optimisation of a high-frequency transformer is introduced, and the impact of different core materials, conductor designs, and winding arrangements are evaluated. A ZVZCS Phase-Shift Full-Bridge unidirectional DC/DC converter is proposed, using only the parasitic leakage inductance of the transformer. Experimental results for a 10 kW, (100-250) kHz prototype indicate an efficiency of up to 98.1% for the whole converter. Furthermore, an optimized control method is proposed to minimise the circulation current in the isolated bidirectional dual active bridge DC/DC converter, based on a modified dual-phase-shift control method. This control method is also experimentally compared with traditional single-phase shift control, yielding a significant improvement in efficiency. The experimental results confirm the theoretical analysis and show that the proposed control can enhance the overall converter efficiency and expand the ZVZCS range. Die steigende Nachfrage nach Effizienz und Leistungsdichte bringt Si-basierte eistungsbauteile an einige inhärente Materialgrenzen, die unter anderem mit der Temperaturbelastung, der Schaltfrequenz und der Blockierspannung in Zusammenhang stehen. In jüngster Zeit sind SiC-basierte Leistungsbauelemente vielversprechende Kandidaten für Hochleistungs- und Hochfrequenzanwendungen. Aktuell sind SiC-MOSFETs von mehreren Herstellern im Handel erhältlich. Obwohl sich die Technologie der SiC-MOSFETs rasch verbessert, werden viele Herausforderungen bestehen bleiben. Einige dieser Herausforderungen werden in dieser Arbeit untersucht. Die Untersuchungen in dieser Dissertation gliedern sich in die drei folgenden Teile: Im ersten Teil erfolgt, die statische und die transiente Charakterisierung der aktuellen 1,2 kV Planarund Doubletrench SiC-MOSFETs verschiedener Hersteller. Die Auswirkungen unterschiedlicher Gatespannungen, Zwischenkreisspannungen und Temperaturen werden analysiert. Die Ergebnisse der Charakterisierung zeigen, dass die Bauteile überlegene Schaltleistungen unter verschiedenen Betriebsbedingungen aufweisen. Darüber hinaus wird der Einsatz der internen SiC-Bodydioden in einem DC/DC-Wandler untersucht, wobei die Unterschiede zwischen Planar- und Doppeltrench-Bauteilen aufgezeigt werden. Das Reverse-Recovery-Verhalten wird unter Berücksichtigung der Gehäusetemperatur, der Schaltgeschwindigkeit, des Durchlassstroms und der angelegten Spannung bewertet. Anhand der Messergebnisse wird die Sperrschichttemperatur geschätzt, damit ein sicherer Betrieb gewährleistet ist. Ein einfaches elektrothermisches Modell wird vorgestellt, um die maximal zulässige Schaltfrequenz auf der Grundlage des thermischen Designs der SiC-Bauteile abzuschätzen. Anhand dieser Ergebnisse werden hart- und weichschaltende Umrichter konzipiert und die Bauteile werden im Dauerbetrieb mit einer sehr hohen Schaltfrequenz von 1 MHz untersucht. Danach werden die SiC-MOSFETs im Dauerbetrieb in einem 10 kW / 100-250 kHz-

Tiefsetzsteller betrieben. Dabei wird die Synchrongleichrichtung, die Verwendung der internen Diode und die Verwendung einer externen Schottky-Diode verglichen. Außerdem wird die Parallelisierung von SiC-MOSFETs untersucht, bevor die Parallelschaltung der verschiedenen Bauelemente ebenso im kontinuierlichen Konverterbetrieb verglichen wird. Es wird der Einfluss der häufigsten Parametervariationen auf die statische und dynamische Stromaufteilung der Transistoren analysiert, was zeigt, dass eine Parallelisierung von SiC-MOSFETs möglich ist. Anschließend wird ein analytisches Modell der SiC-MOSFETs zur Schaltverlustoptimierung vorgeschlagen. Das analytische Modell zeigt eine relativ enge Übereinstimmung mit den Messergebnissen unter verschiedenen Testbedingungen. Das vorgeschlagene Modell bildet die Schwingungen sowohl beim Ein- als auch beim Ausschalten effektiv nach. Dies wurde durch die Berücksichtigung der wichtigsten parasitären Elemente in Strom- und Gatekreisen erreicht. Im zweiten Teil wird eine umfassende Bewertung der Kurzschlussfestigkeit mit Fokus auf verschiedene Ausfallmodi der planaren und double-trench SiC-Bauelemente vorgestellt. Die Auswirkungen unterschiedlicher Gatespannungen, Zwischenkreisspannungen und Gate-Widerstände werden ausgewertet. Zusätzlich wird die temperaturabhängige Kurzschlussfähigkeit ausgewertet und die zugehörigen Fehlerfälle werden analysiert. Anschließend wird die Auslegung und Prüfung von zwei verschiedenen Verfahren zum Überstromschutz evaluiert. Die „Desaturation“-Technik wird auf SiC-MOSFETs angewendet und mit einer zweiten Methode verglichen, welche die parasitäre Induktivität der Bauelemente nutzt. Schließlich wird der Nutzen des Einsatzes von SiC-Bauteilen in kontinuierlichen Hochfrequenz-Hochleistungs-DC/DC-Wandlern experimentell untersucht. In diesem Zusammenhang wird eine Designoptimierung eines Hochfrequenztransformators vorgestellt und der Einfluss verschiedener Kernmaterialien, Leiterausführungen und Wicklungsanordnungen wird bewertet. Es wird ein unidirektionaler ZVZCS Vollbrücken-DC/DC-Wandler vorgestellt, der nur die parasitäre

Streuinduktivität des Transformators verwendet. Experimentelle Ergebnisse für einen 10 kW, (100-250) kHz Prototyp zeigen einenWirkungsgrad von bis zu 98,1% für den gesamten Umrichter. Abschließend wird ein optimiertes Regelverfahren verwendet, welches auf einem modifizierten Dual-Phase-Shift-Regelverfahren basiert, um den Kreisstrom im isolierten bidirektionalen Dual-Aktiv-Brücken-DC/DC-Wandler zu minimieren. Diese Regelmethode wird experimentell mit der herkömmlichen Single-Phase-Shift-Regelung verglichen. Hierbei zeigt sich eine deutliche Effizienzsteigerung durch die neue Regelmethode. Die experimentellen Ergebnisse bestätigen die theoretische Analyse und zeigen, dass die vorgeschlagene Regelung den Gesamtwirkungsgrad des Umrichters erhöhen und den ZVZCS-Bereich erweitern kann.

The latest developments in the field of hybrid electric vehicles Hybrid Electric Vehicles provides an introduction to hybrid vehicles, which include purely electric, hybrid electric, hybrid hydraulic, fuel cell vehicles, plug-in hybrid electric, and off-road hybrid vehicular systems. It focuses on the power and propulsion systems for these vehicles, including issues related to power and energy management. Other topics covered include hybrid vs. pure electric, HEV system architecture (including plug-in & charging control and hydraulic), off-road and other industrial utility vehicles, safety and EMC, storage technologies, vehicular power and energy management, diagnostics and prognostics, and electromechanical vibration issues. Hybrid Electric Vehicles, Second Edition is a comprehensively updated new edition with four new chapters covering recent advances in hybrid vehicle technology. New areas covered include battery modelling, charger design, and wireless charging. Substantial details have also been included on the architecture of hybrid excavators in the chapter related to special hybrid vehicles. Also included is a chapter providing an overview of hybrid vehicle technology, which offers a perspective on the current debate on sustainability and the environmental impact of hybrid and electric vehicle technology. Completely updated with new chapters Covers recent developments, breakthroughs, and technologies, including new drive topologies Explains HEV fundamentals and applications Offers a holistic perspective on vehicle electrification Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives, Second Edition is a great resource for researchers and practitioners in the automotive industry, as well as for graduate students in automotive engineering.

An advanced textbook covering the fundamental theory of RF power amplifiers and their uses, this book provides essential guidance for design procedures. The introduction explains the basic theory of RF power amplifiers besides providing the basic classification of the different types of RF power amplifier. It then systematically dedicates a chapter to each different of RF power amplifier covering A, B and C, D (full-bridge and half-bridge types), E (zero-voltage-switching and zero-current-switching), F and DE amplifiers. Throughout this comprehensive guide, the optimal operating conditions are explored and the possible causes for suboptimum operation explained. The book then considers integrated inductors and linearization techniques and LC Oscillators in the concluding chapters. A comprehensive text covering the fundamentals of RF power amplifiers and their range of applications in radio and TV broadcasting, wireless communications and radars. Presents accessible coverage of the complex principles of operation of RF power amplifiers and radio power systems. Introduces the fundamental design techniques and procedures for practitioners for RF power amplifiers. All chapters contain examples and design procedures throughout, with review questions and problems at the end of each chapter. A solutions manual is available for instructors upon enquiry

This book is devoted to resonant energy conversion in powerelectronics. It is a practical, systematic guide to the analysisand design of various dc-dc resonant inverters, high-frequencyrectifiers, and dc-dc resonant converters that are building blocksof many of today's high-frequency energy processors. Designed tofunction as both a superior senior-to-graduate level textbook forelectrical engineering courses and a valuable professionalreference for practicing engineers, it provides students andengineers with a solid grasp of existing high-frequency technology,while acquainting them with a number of easy-to-use tools for theanalysis and design of resonant power circuits. Resonant powerconversion technology is now a very hot area and in the center ofthe renewable energy and energy harvesting technologies.

Applications oriented, it contains all the pertinent and comprehensive information necessary to meet the growing demands placed upon solid-state power conversion equipment. These demands include improved reliability, increased efficiency, higher packing density, improved performance plus meeting safety and EMC regulations. Features a thorough assessment of basic electrical and magnetic aspects of power conversion as well as thermal, protection, radiation and reliability considerations. Stresses semiconductor and magnetic components and gives an analysis of diverse topologies.

Soft-Switching Technology for Three-phase Power Electronics Converters Discover foundational and advanced topics in soft-switching technology, including ZVS three-phase conversion In Soft-Switching Technology for Three-phase Power Electronics Converters, an expert team of researchers delivers a comprehensive exploration of soft-switching three-phase converters for applications including renewable energy and distribution power systems, AC power sources, UPS, motor drives, battery chargers, and more. The authors begin with an introduction to the fundamentals of the technology, providing the basic knowledge necessary for readers to understand the following articles. The book goes on to discuss three-phase rectifiers and three-phase grid inverters. It offers prototypes and experiments of each type of technology. Finally, the authors describe the impact of silicon carbide devices on soft-switching three-phase converters, studying the improvement in efficiency and power density created via the introduction of silicon carbide devices. Throughout, the authors put a special focus on a family of zero-voltage switching (ZVS) three-phase converters and related pulse width modulation (PWM) schemes. The book also includes: A thorough introduction to soft-switching techniques, including the classification of soft-switching for three phase converter topologies, soft-switching types and a generic soft-switching pulse-width-modulation known as Edge-Aligned PWM A comprehensive exploration of classical soft-switching three-phase converters, including the switching of power semiconductor devices and DC and AC side resonance Practical discussions of ZVS space vector modulation for three-phase converters, including the three-phase converter commutation process In-depth examinations of three-phase rectifiers with compound active clamping circuits Perfect for researchers, scientists, professional engineers, and undergraduate and graduate students studying or working in power electronics, Soft-Switching Technology for Three-phase Power Electronics Converters is also a must-read resource for research and development engineers involved with the design and development of power electronics.