The Essential Collection of DC/DC Buck Switching Regulator Technical Documentation

TEXAS INSTRUMENTS

TI's diverse portfolio of DC/DC buck switching regulators provides best-in-class power solutions for any application. This extensive family of products spans power modules, converters, and controllers, and includes the SIMPLE SWITCHER® and SWIFT™ converter brands.The portfolio is supported by WEBENCH® Designer software, evaluation modules, and a variety of technical resources, leading to shorter design cycles and a faster time-to-market. This guide serves as an aggregation of all of the most critical technical documents for engineers designing with TI's DC/DC buck regulator portfolio.

Featured Technical Content

Literature Title	Literature Description
Basic Overview	
Benefits of a Multiphase Buck Converter **(SLYT449)**	Benefits of using a multi-phase buck converter versus a single-phase converter.
Switching Regulator Fundamentals **(SNVA559)**	Details of the operating principles of the four most commonly used switching types.
How to Select Digital Power ICs **(SPRY279)**	Overview of digital power & detail of four different digital power solutions.
Comparing the Merits of Integrated Power Modules versus Discrete Regulators (PD-129) **(SNVA635)**	Benefits of using power modules versus a converter versus discrete controllers.
Low EMI	
Reduce Buck-Converter EMI and Voltage Stress by Minimizing Inductive Parasitics **(SLYT682)**	Details the role of power-stage inductive parasitics in EMI generation & offers suggestions to reduce the broadband EMI signature.
Reducing Noise on the Output of a Switching Regulator **(SLYT740)**	Details several solutions to reduce noise generated by DC/DC converters including test data.
Not All Jitter is Created Equal **(SLUA747)**	Details a tutorial discussion on jitter in switching DC/DC converters.
Simplify Low-EMI Design with Power Modules **(SLYY123)**	Details the sources of EMI in a switching power supply and methods or technologies for mitigating EMI.
Seminar 900 Topic 2 – Snubber Circuits: Theory, Design and Application **(SLUP100)**	Details various types of snubbers, where they are used, how they function, how they are designed & what their limitations are.
Thermals	
Semiconductor and IC Package Thermal Metrics **(SPRA953)**	Details thermal metrics & puts their application in perspective with respect to system-level junction temperature estimation.
Thermal Design by Insight, not Hindsight **(SNVA419)**	Details the definition of thermal parameters used in datasheets & recommendations for thermal design of a DC/DC converter.
Techniques for Thermal Analysis of Switching Power Supply Designs **(SNVA207)**	Details three main ways of thermally analyzing a design & explains the precision of each approach.
How to Evaluate Junction Temperature Properly with Thermal Metrics **(SLUA844)**	Details how to properly evaluate the thermal stress or junction temperature of a semiconductor device.
Improving the Thermal Performance of a MicroSiP™ Power Module **(SLYT724)**	Details JEDEC's PCB design & compares it to various real-world PCB designs that show the impact of PCB design on thermals.
Control Mode	
Choosing the Right Fixed-Frequency Buck-Regulator Control Strategy **(SLUP317)**	Trade-offs between two fixed-frequency control strategies & some enhancements to extend their capabilities.
Choosing the Right Variable-Frequency Buck-Regulator Control Strategy **(SLUP319)**	Trade-offs between two variable frequency control strategies & some enhancements to extend their capabilities.
Internally Compensated Advanced Current Mode (ACM) **(SLYY118)**	Details a new DC/DC control topology, ACM, that employs internal compensation with low noise & fast transient response.
Understanding Frequency Variation in the DCS-Control™ Topology **(SLYT646)**	Details the factors that cause frequency variation in the DCS-Control topology.
Comparing Internally-compensated Advanced Current Mode (ACM) with D-CAP3™ Control **(SLYT732)**	A comparison of load-transient performance and jitter of DC/DC converters operating in ACM & D-CAP3 control modes.
How to Measure the Loop Transfer Function of Power Supplies **(SNVA364)**	How to measure the critical points of a bode plot with only an audio generator & an oscilloscope.
FPGA	
Power-Supply Sequencing for FPGAs **(SLYT598)**	Details sequencing solutions to reduce excessive current draw that can damage FPGAs.
Power Supply Design Considerations for Modern FPGAs (Power Designer 121) **(SNOA864)**	Details output voltage, sequencing, startup/power on, & soft-start requirements of FPGAs.
Calculating Output Capacitance to Meet Transient and Ripple Requirements of Integrated POL **(SLVA874)**	Details how to calculate the amount of output capacitance needed to meet the transient & ripple requirements of buck converters designs.
Accuracy-Enhanced Ramp-Generation Design for D-CAP3™ Modulation **(SLVA762)**	Introduction of new D-CAP3 control scheme which improves DC accuracy of the converter while maintaining fast transient response.
Remote Sensing for Power Supplies **(SLYT467)**	Details design considerations for remote sensing, including power-plane shortages, component placement, parasitic resistance, & oscillations.

Literature Title	Literature Description
Efficiency	
Understanding Eco-Mode™ Operation **(SLVA388)**	Details Eco-Mode operation & the advantages and disadvantages of using this feature.
MOSFET Power Losses and How They Affect Power-Supply Efficiency **(SLYT664)**	Details basic principles of power supplies & addresses how MOSFETs affect efficiency.
Accurately Measuring Efficiency of Ultralow-IQ Devices **(SLYT558)**	Details the basics of measuring efficiency, common mistakes in measuring the LLE of ultralow-I_Q devices & how to overcome them.
I_Q: What it is, What it isn't, and How to use it **(SLYT412)**	Definition of I_Q, how it is measured, and design considerations on how to use I_Q while avoiding common measurement errors.
Packaging	
QFN/SON PCB Attachment **(SLUA271)**	Details introductory information about attaching QFN/SON devices to printed circuit boards (PCBs).
PowerPAD™ Thermally Enhanced Package **(SLMA002)**	Details the specifics of integrating a PowerPAD package into PCB design.
Benefits and Trade-offs of Various Power-Module Package Options **(SLYY120)**	Details a few power-module package options & the benefits and trade-offs of each.
HotRod™ QFN Package PCB Attachment **(SLUA715)**	Details information about attaching HotRod QFN devices to PCBs.
Layout	
Five Steps to a Great PCB Layout for a Step-Down Converter **(SLYT614)**	Details five steps to ensure your step-down converter's PCB layout is robust & ready for prototyping.
Layout Tips for EMI Reduction in DC/DC Converters **(SNVA638)**	Details how the layout of a DC/DC power supply can affect the amount of EMI that it produces.
A Guide to Board Layout for Best Thermal Resistance for Exposed Packages **(SNVA183)**	Guidelines for the optimal board layout to achieve the best thermal resistance for exposed packages.
Layout Guidelines for Switching Power Supplies **(SNVA021)**	Details mistakes in layout designs and guidelines to help minimize these problems.
High Power Density	
Space Optimized, "Clam Shell" Layout for Step-Down DC/DC Converters **(SLVA818)**	Details the use of both sides of the PCB to achieve the most space efficient DC/DC converter layout while maintaining performance.
Breakthrough Power Delivery for Space-Constrained Applications **(SSZY023)**	Details a new capacitive convertsion topology for on-board power supplies.
Topology	
Designing a Negative Boost Converter from a Standard Positive Buck Converter **(SLYT516)**	Details a method of using a standard positive buck converter to form a negative boost converter.
Designing an Isolated Buck (Fly-Buck™) Converter **(SNVA674)**	Details the basic operating principle of an insolated buck (Fly-Buck) converter.
Understanding Buck Power Stages in Switchmode Power Supplies **(SLVA057)**	Details the steady state operation of the buck power stage in continuous-mode & discontinuous-mode operation with ideal waveforms given.
Selection Guides	
Control-Mode Quick Reference Guide **(SLYT710)**	Details TI's 12 types of control architectures for non-isolated TPS- & LM-series switching DC/DC converters & controllers.
SWIFT™ DC/DC Converters Selector Guide **(SLVT165)**	Selection guide of TI's newest SWIFT converters for high-density, high-performance, & ease-to-use power supplies.
SIMPLE SWITCHER® Overview Brochure **(SLYB196)**	Selection guide of TI's newest SIMPLE SWITCHER power modules, converters, and controllers.
DC/DC Buck-Controller Solutions Selection Guide **(SLYT741)**	Selection guide of TI's portfolio of buck controllers – sigle phase to multiphase, analog to PMBus, & low to wide V_{IN}.
Innovative DC/DC Power Modules Selection Guide **(SLYT685)**	Overview of TI's DC/DC power module portfolio with featured products & available packages.
Low-Power DC/DC Converter Overview Guide **(SLYT522)**	Selection guide of TI's TPS61K boost, TPS62K buck, & TPS63K buck-boost power solutions.
Real World Applications	
Using DC/DC Controllers to Improve Bitcoin Miner Designs **(SNVT005)**	Cryptocurrency
Designing the Front-End DC/DC Conversion Stage to Withstand Automotive Transients **(SLYT707)**	ADAS and Infotainment
Extending Battery Life in Smart Locks **(SLYY107)**	Smart Locks
Innovative Semiconductor Packaging Solutions Differentiate Health Care Electronics **(SSZY016)**	Medical Imaging
Simplify Voltage and Current Measurement in Battery Test Equipment **(SBOA236)**	Battery Test Equipment
Powering Drones With a Wide V_{IN} DC/DC Converter **(SNVA806)**	Non-Military Drones
Designing High-Performance, Low-EMI, Automotive Power Supplies **(SNVA780)**	ADAS and Infotainment
Low-I_Q Synchronous Buck Converter Enables Intelligent Field-Sensor Applications **(SLYT671)**	Field Transmitter
Automotive Line Transient Protection Circuit **(SNVA717)**	ADAS and Infotainment

Resources

- Learn more: **www.ti.com/stepdownbuck**
- Create, manage and share your power supply designs at: **www.ti.com/webench**
- Technical design support: **e2e.ti.com**

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