

# Power Supply Topologies

→ **Texas Instruments, the Power Behind Your Designs**

Type of Converter	BUCK	BOOST	BUCK BOOST (Inverting)	SEPIC	FLYBACK	FORWARD	2 SWITCH FORWARD	ACTIVE CLAMP FORWARD	HALF BRIDGE	PUSH PULL	FULL BRIDGE	PHASE SHIFT ZVT																		
Circuit Configuration																														
Ideal Transfer Function*	$\frac{V_{OUT}}{V_{IN}} = \left(\frac{t_{ON}}{T_P}\right) = D$	$\frac{V_{OUT}}{V_{IN}} = \left(\frac{T_P}{T_P - t_{ON}}\right) = \frac{1}{1-D}$	$\frac{V_{OUT}}{V_{IN}} = \left(\frac{t_{ON}}{T_P - t_{ON}}\right) = -\left(\frac{D}{1-D}\right)$	$\frac{V_{OUT}}{V_{IN}} = \left(\frac{D}{1-D}\right)$	$\frac{V_{OUT}}{V_{IN}} = D \times \sqrt{\frac{T_P \times V_{OUT}}{2 \times I_{OUT} \times L_P}}$	$\frac{V_{OUT}}{V_{IN}} = \left(\frac{N_S}{N_P}\right) \times \left(\frac{t_{ON}}{T_P}\right) = \left(\frac{N_S}{N_P}\right) \times D$	$\frac{V_{OUT}}{V_{IN}} = \left(\frac{N_S}{N_P}\right) \times \left(\frac{t_{ON}}{T_P}\right) = \left(\frac{N_S}{N_P}\right) \times D$	$\frac{V_{OUT}}{V_{IN}} = \left(\frac{N_S}{N_P}\right) \times \left(\frac{t_{ON}}{T_P}\right) = \left(\frac{N_S}{N_P}\right) \times D$	$\frac{V_{OUT}}{V_{IN}} = \left(\frac{N_S}{N_P}\right) \times \left(\frac{t_{ON}}{T_P}\right) = \left(\frac{N_S}{N_P}\right) \times D$	$\frac{V_{OUT}}{V_{IN}} = 2 \times \left(\frac{N_S}{N_P}\right) \times \left(\frac{t_{ON}}{T_P}\right) = 2 \times \left(\frac{N_S}{N_P}\right) \times D$	$\frac{V_{OUT}}{V_{IN}} = 2 \times \left(\frac{N_S}{N_P}\right) \times \left(\frac{t_{ON}}{T_P}\right) = 2 \times \left(\frac{N_S}{N_P}\right) \times D$	$\frac{V_{OUT}}{V_{IN}} = 2 \times \left(\frac{N_S}{N_P}\right) \times \left(\frac{t_{ON}}{T_P}\right) = 2 \times \left(\frac{N_S}{N_P}\right) \times D$																		
Drain Current*	$I_{Q1} (max) = I_{OUT}$	$I_{Q1} (max) = I_{OUT} \times \left(\frac{1}{1-D}\right)$	$I_{Q1} (max) = I_{OUT} \times \left(\frac{1}{1-D}\right)$	$I_{Q1} (max) = I_{OUT} \times \left(\frac{D}{1-D}\right)$	$I_{Q1} (max) = \left(\frac{V_{IN} \times t_{ON}}{L_P}\right)$	$I_{Q1} (max) = \left(\frac{N_S}{N_P}\right) \times I_{OUT}$	$I_{Q1} (max) = \left(\frac{N_S}{N_P}\right) \times I_{OUT}$	$I_{Q1} (max) = \left(\frac{N_S}{N_P}\right) \times I_{OUT}$	$I_{Q1} (max) = \left(\frac{N_S}{N_P}\right) \times I_{OUT}$	$I_{Q1} (max) = \left(\frac{N_S}{N_P}\right) \times I_{OUT}$	$I_{Q1} (max) = \left(\frac{N_S}{N_P}\right) \times I_{OUT}$	$I_{Q1} (max) = \left(\frac{N_S}{N_P}\right) \times I_{OUT}$																		
Drain Voltage*	$V_{DS} = V_{IN}$	$V_{DS} = V_{OUT}$	$V_{DS} = V_{IN} - V_{OUT}$	$V_{DS} = V_{IN} + V_{OUT}$	$V_{DS} = V_{IN} + V_{OUT} \times \left(\frac{N_P}{N_S}\right)$	$V_{DS} = 2 \times V_{IN}$	$V_{DS} = V_{IN}$	$V_{DS} = V_{IN} \times \left(\frac{1}{1-D}\right)$	$V_{DS} = V_{IN}$	$V_{DS} = 2 \times V_{IN}$	$V_{DS} = V_{IN}$	$V_{DS} = V_{IN}$																		
Diode Current*	$I_{D1} = I_{OUT} \times (1-D)$	$I_{D1} = I_{OUT}$	$I_{D1} = I_{OUT}$	$I_{D1} = I_{OUT}$	$I_{D1} = I_{OUT}$	$I_{D1} = I_{OUT} \times D$	$I_{D1} = I_{OUT} \times D$	$I_{D1} = I_{OUT} \times D$	$I_{D1} = (I_{OUT} \times D) + \frac{I_{OUT}}{2} \times (1-2D)$	$I_{D1} = (I_{OUT} \times D) + \frac{I_{OUT}}{2} \times (1-2D)$	$I_{D1} = (I_{OUT} \times D) + \frac{I_{OUT}}{2} \times (1-2D)$	$I_{D1} = \frac{1}{2} \times I_{OUT}$																		
Diode Reverse Voltage*	$V_{D1} = V_{IN}$	$V_{D1} = V_{OUT}$	$V_{D1} = V_{IN} - V_{OUT}$	$V_{D1} = V_{OUT} + V_{IN}$	$V_{D1} = V_{OUT} + V_{IN} \times \left(\frac{N_S}{N_P}\right)$	$V_{D1} = V_{OUT} + V_{IN} \times \left(\frac{N_S}{N_P}\right)$	$V_{D1} = V_{OUT} + V_{IN} \times \left(\frac{N_S}{N_P}\right)$	$V_{D1} = V_{OUT} + V_{IN} \times \left(\frac{N_S}{N_P}\right) \times \left(\frac{1}{1-D}\right)$	$V_{D1} = \frac{V_{IN}}{2} \times \left(\frac{N_S}{N_P}\right)$	$V_{D1} = V_{IN} \times \left(\frac{N_S}{N_P}\right)$	$V_{D1} = V_{IN} \times \left(\frac{N_S}{N_P}\right)$	$V_{D1} = V_{IN} \times \left(\frac{N_S}{N_P}\right)$																		
Voltage and Current Waveforms																														
*Excludes ripple current and output diode voltage drop.																														
** Go to: <a href="http://power.ti.com">power.ti.com</a> and place literature number in the "Key Word" box. For SEM topics, go to: <a href="http://power.ti.com/seminars">power.ti.com/seminars</a>																														
<b>Application Notes:**</b>	Understanding Buck Power Stages in Switchmode Power Supplies (SLVA057)		Understanding Boost Power Stages in Switchmode Power Supplies (SLVA061)		Understanding Buck-Boost Power Stages in Switchmode Power Supplies (SLVA059A)		Versatile Low Power SEPIC Converter Accepts Wide Input Voltage Range (SLUA158)		Design of Flyback Transformers and Inductors (SEM400)		25-W Forward Converter Design Review (SLUA276)		150-W Off-Line Forward Converter Design Review (SEM400)		Active Clamp and Reset Technique Enhances Forward Converter Performance (SEM1000)		Practical Considerations in Current Mode Power Supplies (SLUA110)		Practical Considerations in Current Mode Power Supplies (SLUA110)		1.5-MHz Current Mode IC Controlled 50-Watt Power Supply (SLUA053)		The UC3823A,B and UC3825A,B Enhanced Generation of PWM Controllers (SLUA125)		The UC3823A,B and UC3825A,B Enhanced Generation of PWM Controllers (SLUA125)		Designing a Phase Shifted Zero Voltage Transition Power Converter (SEM900)		Design Review: 500-W, 40-W/in <sup>3</sup> Phase Shifted ZVT Power Converter (SEM900)	
<b>Controllers:</b>	TPS40000	TPS40050	UC3800	UC38042	UC3572	UC38042	UC3800	UC38042	UC35701	UC28220	UC35701	UC28220	UC35701	UC28220	UC2891, 2, 3, 4, 7	UC28025	UC3806	UC28025	UC3806	UC28025	UC3806	UC28025	UC3806	UC3808A	UC3825A, B	UC28025	UC3806	UC3895	UC3879	
	TPS62000	TPS62040	TPS61100	UC3809-1	TPS40050	UC3809-1	TPS43000	UC3809-1	UC38080	UC3809-1	UC38080	UC3809-1	UC38080	UC3809-1	UC3580-1	UC3808A	UC3808A	UC3808A	UC3808A	UC3808A	UC3808A	UC3808A	UC3808A	UC3808A	UC3808A	UC3808A	UC3808A	UC3808A	UC3808A	
	TPS54350	TPS54350	TPS61042	UC3809-1	TPS6735	UC3809-1	TPS61130	UC3809-1	UC38042	UC28220	UC38042	UC28220	UC38042	UC28220	UC38042	UC38083	UC3806	UC38083	UC3806	UC38083	UC3806	UC38083	UC3806	UC38083	UC3806	UC38083	UC3806	UC38083	UC3806	

## IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

<b>Products</b>		<b>Applications</b>	
Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>	Audio	<a href="http://www.ti.com/audio">www.ti.com/audio</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>	Automotive	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>	Broadband	<a href="http://www.ti.com/broadband">www.ti.com/broadband</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>	Digital Control	<a href="http://www.ti.com/digitalcontrol">www.ti.com/digitalcontrol</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>	Military	<a href="http://www.ti.com/military">www.ti.com/military</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>	Optical Networking	<a href="http://www.ti.com/opticalnetwork">www.ti.com/opticalnetwork</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>	Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
		Telephony	<a href="http://www.ti.com/telephony">www.ti.com/telephony</a>
		Video & Imaging	<a href="http://www.ti.com/video">www.ti.com/video</a>
		Wireless	<a href="http://www.ti.com/wireless">www.ti.com/wireless</a>

Mailing Address: Texas Instruments  
Post Office Box 655303 Dallas, Texas 75265