Ultra-Low-Power DC/DC Converters for Battery-Powered and Energy-Harvesting Applications

When Nanoamperes Matter

Texas Instruments

As battery-powered and energy harvesting applications become more feature-rich, achieving longer battery life and application run time pose serious design challenges. Traditional battery technology cannot keepup with the requirements. Energy harvesters struggle to provide enough energy. Ultra-low-power DC/DC converters from Texas Instruments (TI) help you solve these challenges by enabling peak performance at the lowest power level possible—the nanoampere level. The converters consume the lowest power possible in standby and idle, while still providing high efficiency at very low current levels for longer battery life and application run time.

Key Features and Benefits

- Highest efficiency, >90%, at 10-µA load current
- Lowest quiescent currents (360 nA typical)
- Selectable output voltages in 100-mV steps with dynamic voltage scaling capability

Featured Ultra-Low-Power DC/DC Converters

Device	Quiescient Current	Special Features	Output Current	Input Range (V)	Packages (mm)
Buck Converters					
TPS62120	11-µA Iq	Wide UVLO hysteresis window	75 mA	2 to 15	2x2 QFN, SOT23-8
TPS62125	13-µA Iq	Input SVS (supply voltage supervisor) with adjustable enable threshold and hysteresis	300 mA	3 to 17	2x2 QFN
TPS62743	360 nA	DVS with eight selectable output voltages	300 mA	2 to 5.5	1.6x0.9 8-WCSP
TPS62746	360 nA	Two selectable output voltages (1.2V and 1.8V) with integrated VIN switch	300 mA	2 to 5.5	1.6x0.9 8-WCSP
TPS62748	360nA	Two selectable output voltages (1.2 V and 1.8 V) with integrated load switch	300 mA	2 to 5.5	1.6x0.9 8-WCSP
TPS62770	370nA	Tiny single-chip dual output with 370-nA Iq buck with integrated load switch and up to 15-V dual-mode boost	300-mA for buck, 970-mA switch current limit for boost	2 to 5.5	1.58x1.58 WCSP
TPS62745	400 nA	Dual-cell input, two selectable output voltages with integrated VIN switch	300 mA	3.3 to 10	2x3 QFN
TPS62730	30-nA Iq bypass mode	Bypass mode	100 mA	1.9 to 3.9	1x1.5 QFN
TPS62740	360-nA Iq	DVS and integrated load switch	300 mA	2.2 to 5.5	3x2 QFN
TPS62742	360-nA Iq	DVS and integrated load switch	400 mA	2.2 to 5.5	3x2 QFN
TPS82740	360-nA Iq	DVS and integrated load switch	200 mA	2.2 to 5.5	2.3x2.9 MicroSiP™
Boost Converters					
TPS61291	15-nA Iq in bypass mode 5.5-µA Iq in boost mode	Bypass switch between VIN and VOUT, pin selectable output voltages(3.3 V, 3 V, 2.5 V)	1-A switch current limit	0.9 to 5	2x2 SON
TPS61251	2-µA Iq in snooze mode	Adjustable switch current limit	100-mA to 1.5-A adjustable switch current limit	2.3 to 6	2x2 QFN
TPS61220	5.5-µA Iq	Adjustable output voltage from 1.8 V to 6 V	400-mA switch current limit	0.7 to 5.5	2x1.25 SC-70
TPS61046	110 µA	Integrated power diode with input/output isolation output up to 28 V	900-mA switch current limit	1.8 to 5.5	0.8x1.2 WCSP
TPS61098/ 981/ 982	300 nA	300-nA dual-output boost converter with integrated LDO with VOUT up to 4.3 V	480-mA switch current limit	0.7 to 4.5	1.5x1.5 6-SON
TPS610985/ 86	300 nA	300-nA dual-output boost converter with integrated load switch	480-mA switch current limit	0.7 to 4.5	1.5x1.5 6-SON
TPS61021	17 µA	PFM operation in light load, true disconnect between input and output, output range from 1.8 V to 4 V	3-A switch current limit	0.5 to 4.4	2x2 SON

TPS62770

Tiny, Single Chip, Dual Output with 370-nA Iq Step-Down and Dual-Mode Step-Up Converter in WCSP

Key Features

- 90% efficiency at 10-µA load
- 370-nA Iq step-down converter with integrated load switch
- Dual-mode step-up converter to drive white LED or PMOLED up to 15V
- Eight selectable output voltages for buck converter from 1 V to 3 V
- Slew-rate controlled load switch with discharge function
- Tiny 1.65 x 1.65-mm WCSP package

TPS61098/ 81/ 982/ 85/ 86

300-nA Iq Synchronous Step-Up Converter with Integrated LDO/Load Switch

Key Features

- 88% efficiency at 10-µA load, 93% at 5-mA to 100-mA load
- Dual output: Boost+LDO/load switch featuring active mode and low-power mode control
- Supports automatic pass-through
- Overload and thermal shutdown protection
- Tiny 1.5 x 1.5-mm WSON package

TPS62743/ 46/ 48

360-nA Iq Step-down Converter in Tiny 8-WSCP

Key Features

- 90% efficiency at 10-µA load
- Integrated V_{IN} switch (TPS62746)
- Integrated load switch (TPS62743/ 48)
- Eight selectable output voltages (TPS62743)
- Two selectable output voltages (1.2 V and 1.8 V)
- RF friendly DCS-control™ topology
- Tiny 1.6x0.9-mm, 8-ball WCSP package

TPS61021

Ultra-Low Input 3-A Boost Converter

Key Features

- 91% efficiency at V_{IN} = 2.4 V, V_{OUT} = 3.3 V and I_{OUT} = 1.5-A load
- Input voltage range: 0.5 V to 4.4 V and output voltage range: 1.8 V to 4 V
- ±2.5% reference voltage accuracy over -40°C to 125°C
- True disconnection between input and output during shutdown
- Small 2x2-mm WSON package

www.ti.com/microsip
www.ti.com/dcs-control

TIDesigns

If you want to speed your time to market, check out the TI Designs below. They include comprehensive designs with schematics or block diagrams, BOMs, design files and test reports created by experts with deep system and product knowledge.

Device	Reference Design	Description
TPS62770	PMP9792	Multi-Rail, Low-Iq Power Reference Design for Wearable Applications
TPS61046	PMP11311.5	Power Reference Design for a Wearable Device with Wireless Charging Using the bq51003 and bq25120
TPS62730	TIDC-WMBUS-169 MHZ CC1120+TPS62730 CC1120DCDCEM868-RD CC2540TPS62730EM-RD CC2541-TPS62730EM-RD	ETSI Cat. 1 Receiver-Capable wM-Bus 169-MHz RF Subsystem for Smart Gas and Water Meters CC1120 with TPS62730 EM 868-MHz and 915-MHz Reference Design CC2540 and TPS62730 (Bluetooth® Low Energy) Evaluation Module Reference Design CC2541-TPS62730EM (Bluetooth Low Energy) Reference Design
TPS62740	PMP9754 TIDM-ULTRASONIC-FLOW-TDC	Solar Dice: A Sensor Node in the Internet of Things (IoT) Reference Design. TPS62740 + CC430 Ultrasonic TDC Flowmeter Reference Design Built using Time-to-Digital Converter and an Ultra-Low-power MCU
TPS62120	PMP5539.2	Isolated Flyback, Bucks (3.3V@35mA) for Consumer Applications

WEBENCH® Design Center for TPS6x Products and Solutions

WEBENCH® Design Environments are unique and powerful software tools that deliver customized power designs for TPS6x products in seconds to you. These easy-to-use tools help you generate, optimize and simulate designs that conform to your unique specifications. **www.ti.com/webench**

TI E2E™ Community

E2E Power Management Forum: www.ti.com/e2epower

Learn more about TI's complete Ultra-Low-Power DC/DC Converters: www.ti.com/dcdcregulators

Texas Instruments

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as “components”) are sold subject to TI’s terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI’s terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

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

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license 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 significant portions of TI 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. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

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

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI’s goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or “enhanced plastic” are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have ***not*** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products		**Applications**	
Audio	www.ti.com/audio	Automotive and Transportation	www.ti.com/automotive
Amplifiers	amplifier.ti.com	Communications and Telecom	www.ti.com/communications
Data Converters	dataconverter.ti.com	Computers and Peripherals	www.ti.com/computers
DLP® Products	www.dlp.com	Consumer Electronics	www.ti.com/consumer-apps
DSP	dsp.ti.com	Energy and Lighting	www.ti.com/energy
Clocks and Timers	www.ti.com/clocks	Industrial	www.ti.com/industrial
Interface	interface.ti.com	Medical	www.ti.com/medical
Logic	logic.ti.com	Security	www.ti.com/security
Power Mgmt	power.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Applications Processors	www.ti.com/omap	**TI E2E Community**	e2e.ti.com
Wireless Connectivity	www.ti.com/wirelessconnectivity		

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