TPS6306x High Input Voltage, Buck-Boost Converter With 2-A Switch Current

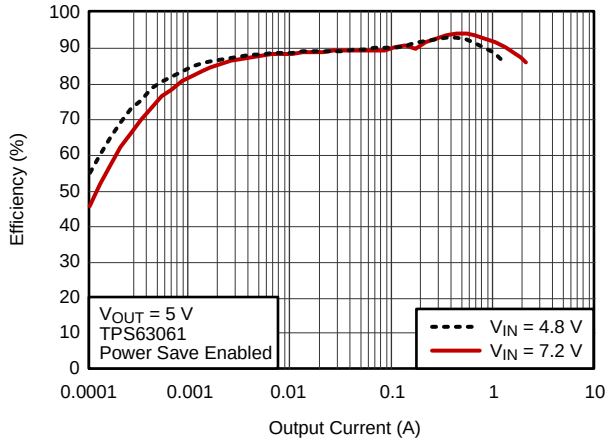
1 Features

- Input Voltage Range: 2.5 V to 12 V
- Efficiency: Up to 93%
- Output Current at 5 V (V_{IN}<10 V): 2 A in Buck Mode
- Output Current at 5 V (V_{IN}>4 V): 1.3 A in Boost Mode
- Automatic Transition Between Step Down and Boost Mode
- Typical Device Quiescent Current: < 30 µA
- Fixed and Adjustable Output Voltage Options from 2.5 V to 8 V
- Power-Save Mode for Improved Efficiency at Low Output Power
- Forced Fixed-Frequency Operation at 2.4 MHz and Synchronization Possible
- Power Good Output
- Buck-Boost Overlap Control™
- Load Disconnect During Shutdown
- Overtemperature Protection
- Overvoltage Protection

2 Applications

- Dual Li-Ion Application
- DSCs and Camcorders
- Notebook Computer
- Industrial Metering Equipment
- Ultra Mobile PCs and Mobile Internet Devices
- Personal Medical Products
- High-Power LEDs

Efficiency vs Output Current



3 Description

The TPS6306x devices provide a power supply solution for products powered by either three-cell up to six-cell alkaline, NiCd or NiMH battery, or a one-cell or dual-cell Li-Ion or Li-polymer battery. Output currents can go as high as 2-A while using a dual-cell Li-Ion or Li-polymer battery, and discharge it down to 5 V or lower. The buck-boost converter is based on a fixed frequency, pulse-width-modulation (PWM) controller using synchronous rectification to obtain maximum efficiency. At low load currents, the converter enters power-save mode to maintain high efficiency over a wide load current range. The power-save mode can be disabled, forcing the converter to operate at a fixed switching frequency. The maximum average current in the switches is limited to a typical value of 2.25 A. The output voltage is programmable using an external resistor divider, or is fixed internally on the chip. The converter can be disabled to minimize battery drain. During shutdown, the load is disconnected from the battery.

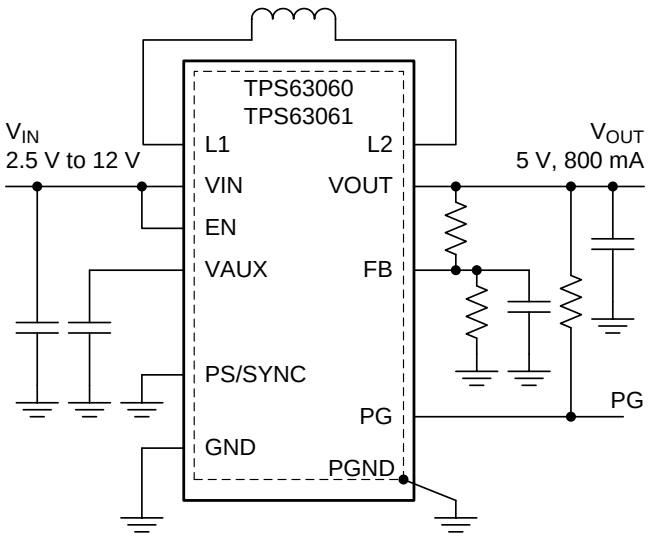
The devices are available in a 3 mm × 3 mm, 10-pin, WSON (DSC), PowerPAD™ package.

Device Information(1)

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TPS63060	WSON (10)	3.00 mm × 3.00 mm
TPS63061		

(1) For all available packages, see the orderable addendum at the end of the data sheet.

Simplified Schematic



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4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision A (February 2012) to Revision B **Page**

- Added *ESD Ratings* table, *Feature Description* section, *Device Functional Modes* section, *Application and Implementation* section, *Power Supply Recommendations* section, *Layout* section, *Device and Documentation Support* section, and *Mechanical, Packaging, and Orderable Information* section ... 1

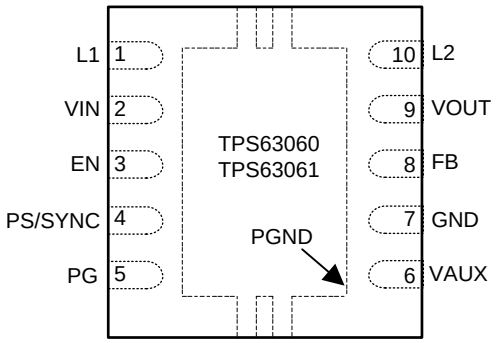
5 Device Comparison Table

ORDER NUMBER (1)(2)	PACKAGE MARKING	OUTPUT VOLTAGE DC/DC
TPS63060DSC	QUJ	Adjustable
TPS63061DSC	QUK	5 V

(1) For detailed ordering information please check the *Package Option Addendum* section at the end of this data sheet.
(2) Contact the factory to confirm availability of other fixed-output voltage versions.

6 Pin Configuration and Functions

DSC PACKAGE
10 PINS
(TOP VIEW)



Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
EN	3	I	Enable input. (1 enabled, 0 disabled)
FB	8	I	Voltage feedback of adjustable versions, must be connected to VOUT on fixed output voltage versions
GND	7		Control and logic ground
L1	1	I	Connection for Inductor
L2	10	I	Connection for Inductor
PG	5	O	Output power good (1 good, 0 failure; open drain)
PS/SYNC	4	I	Enable / disable power save mode (1 disabled, 0 enabled, clock signal for synchronization)
VAUX	6		Connection for Capacitor
VIN	2	I	Supply voltage for power stage
VOUT	9	O	Buck-boost converter output
PowerPAD™			Power ground. Must be soldered to achieve appropriate power dissipation. Must be connected to PGND.

7 Specifications

7.1 Absolute Maximum Ratings

over operating free-air temperature range (unless otherwise noted)(1)

		MIN	MAX	UNIT
Voltage range	EN, FB, PS/SYNC, VIN, VOUT, FB, PG, L2	–0.3	17	V
	L1	–0.3	V_{IN} + 0.3	V
	VAUX	–0.3	7.5	V
Operating virtual junction temperature range, T_J		–40	150	°C
Storage temperature, T_{stg}		–65	150	°C

(1) Stresses beyond those listed under *absolute maximum ratings* may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *recommended operating conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods my affect device reliability.

7.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001(1)	±3000	V
		Machine model (MM)	±200	
		Charged-device model (CDM), per JEDEC specification JESD22-C101(2)	±1500	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

7.3 Recommended Operating Conditions

	MIN	MAX	UNIT
Supply voltage at VIN	2.5	12	V
Output current I_{OUT}(1)		1	A
Operating free air temperature range, T_A	–40	85	°C
Operating virtual junction temperature range, T_J	–40	125	°C

(1) $10 \le V_{IN} \le 12$ V

7.4 Thermal Information

THERMAL METRIC(1)		TPS63060 TPS63061 DSC 10 PINS	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	48.7	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	54.8	
$R_{\theta JB}$	Junction-to-board thermal resistance	19.8	
ψ_{JT}	Junction-to-top characterization parameter	1.1	
ψ_{JB}	Junction-to-board characterization parameter	19.6	
$R_{\theta JC(bot)}$	Junction-to-case (bottom) thermal resistance	4.2	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, SPRA953.

7.5 Electrical Characteristics

over operating free-air temperature range (unless otherwise noted) T_A = 25°C)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
DC/DC STAGE							
V_{IN}	Input voltage range			2.5		12	V
V_{IIN}	Minimum input voltage for startup					2.5	V
V_{OUT}	Output voltage		TPS63060	2.5		8	V
		$V_{PS/SYNC}$ = GND Referenced to 5 V	TPS63061	0.6%		5%	
D_{MIN}	Minimum duty-cycle in step down conversion				10%	20%	
V_{FB}	Feedback voltage	$V_{PS/SYNC}$ = V_{IN}	TPS63060	495	500	505	mV
		$V_{PS/SYNC}$ = GND Referenced to 500 mV		0.6%		5%	
f_{OSC}	Oscillator frequency			2200	2400	2600	kHz
	Frequency range for synchronization			2200	2400	2600	kHz
I_{SW}	Average inductance current limit	V_{IN} = 5 V		2000	2250	2500	mA
$R_{DS(on)H}$	High-side MOSFET on-resistance	V_{IN} = 5 V			90		mΩ
$R_{DS(on)L}$	Low-side switch MOSFET on-resistance	V_{IN} = 5 V			95		mΩ
	Line regulation	Power save mode disabled			0.5%		
	Load regulation	Power save modee disabled			0.5%		
I_Q	Input voltage quiescent current	I_{OUT} = 0 mA, V_{EN} = V_{IN} = 5 V, V_{OUT} = 5 V			30	60	µA
I_Q	Output voltage quiescent current				7	15	µA
R_{FB}	FB input impedance	V_{EN} = HIGH	TPS63061		1.5		MΩ
I_S	Shutdown current	V_{EN} = 0 V, V_{IN} = 5 V			0.3	2	µA
CONTROL STAGE							
V_{AUX}	Maximum bias voltage	V_{IN} > V_{OUT}		V_{IN}		7	V
		V_{IN} < V_{OUT}		V_{OUT}		7	V
I_{AUX}	Load current at V_{AUX}					1	mA
UVLO	Under voltage lockout threshold	Input voltage falling		1.8	1.9	2.2	V
	UVLO hysteresis				300		mV
V_{IL}	EN, PS/SYNC input low voltage					0.4	V
V_{IH}	EN, PS/SYNC input high voltage			1.2			V
	EN, PS/SYNC input current	Clamped on GND or V_{IN}			0.01	0.1	µA
	PG output low voltage	V_{OUT} = 5 V, I_{PGL} = 10 µA			0.04	0.4	V
	PG output leakage current				0.01	0.1	µA
	Output overvoltage protection			12		16	V
	Overtemperature protection				140		°C
	Overtemperature hysteresis				20		°C