■ General Description

The CE8405 is a compact, high-efficiency, fixed frequency, synchronous step-up DC-DC converter. This family of devices provides an easy-to-use power supply solution for applications powered by either one-cell, two-cell or three-cell alkaline, NiCd, NiMH, one-cell Li-Ion or Li-Polymer batteries. A low-voltage technology allows the regulator to start up without high inrush current or output voltage overshoot from a low voltage input. High efficiency is accomplished by integrating the low-resistance N-Channel boost switch and synchronous P-Channel switch. All compensation and protection circuitry are integrated to minimize external components. CE8405 operates and consumes less than 14 μA from battery, while operating at no load (V_{OUT} = 3.3V, V_{IN} = 1.5V). The devices provide a true disconnect from input to output (CE8405AE) or an input-to-output bypass (CE8405BE), while in shutdown (EN = GND). Both options consume less than 0.6μA from battery. Output voltage is set by a small external resistor divider.

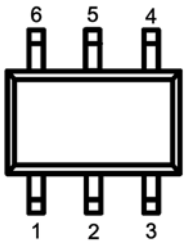
■ Applications

- One, Two and Three Cell Alkaline and NiMH/NiCd Portable Products
- Solar Cell Applications
- Personal Care and Medical Products
- Bias for Status LEDs
- Smartphones, MP3 Players, Digital Cameras
- Remote controllers, Portable Instruments
- Wireless Sensors
- Bluetooth Headsets
- +3.3V to +5.0V Distributed Power Supply

■ Features

- Up to 96% Typical Efficiency
- 1.0A Typical Peak Input Current Limit:
  -I_{OUT} > 200mA @ 3.3V V_{OUT}, 1.2V V_{IN}
  -I_{OUT} > 400mA @ 3.3V V_{OUT}, 2.4V V_{IN}
  -I_{OUT} > 400mA @ 5.0V V_{OUT}, 3.3V V_{IN}
- Low Device Quiescent Current:
  -Output Quiescent Current: < 4μA typical, device is not switching (V_{OUT} > V_{IN}, excluding feedback divider current)
  -Input Sleep Current: 1μA
  -No Load Input Current: 14μA typical
- Shutdown Current: 0.6μA typical
- Low Start-up Voltage: 0.82V, 1mA load
- Low Operating Input Voltage: down to 0.65V
- Adjustable Output Voltage Range: 2.2V to 5.5V
- Maximum Input Voltage ≤ V_{OUT} < 5.5V
- Automatic PFM/PWM Operation:
  -PWM Operation: 500KHz
  -PFM Output Ripple: 150mV typical
- Feedback voltage: 1.215V
- Internal Synchronous Rectifier
- Internal Compensation
- Inrush Current Limiting and Internal Soft Start (1ms typical)
- Selectable, Logic Controlled, Shutdown States:
  -True Load Disconnect Option (CE8405AE)
  -Input to Output Bypass Option (CE8405BE)
- Anti-Ringing Control
- Over temperature Protection
- Output Short Protection
- Available Packages:
  -SOT-23-6

■ PIN CONFIGURATION



CE8405①②

DESIGNATOR	SYMBOL	DESCRIPTION
①	A	Disconnect option
	B	Bypass option
②	E/ER	Package：SOT-23-6

PIN NO.		PIN NAME	FUNCTION
E	ER		
1	1	SW	Switch Node, Boost Inductor Input Pin
2	2	GND	Ground Pin
3	4	V_{FB}	Feedback Voltage Pin
4	3	EN	Enable Control Input Pin
5	5	V_{OUT}	Output Voltage Pin
6	6	V_{IN}	Input Voltage Pin

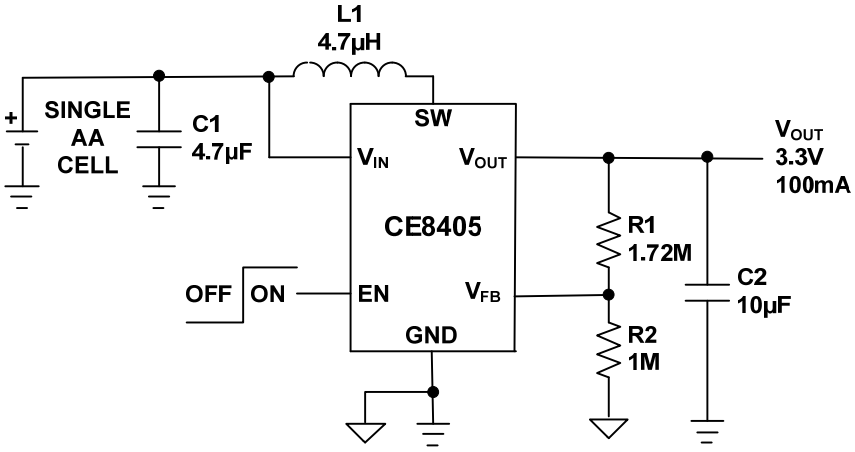
■ ABSOLUTE MAXIMUM RATINGS

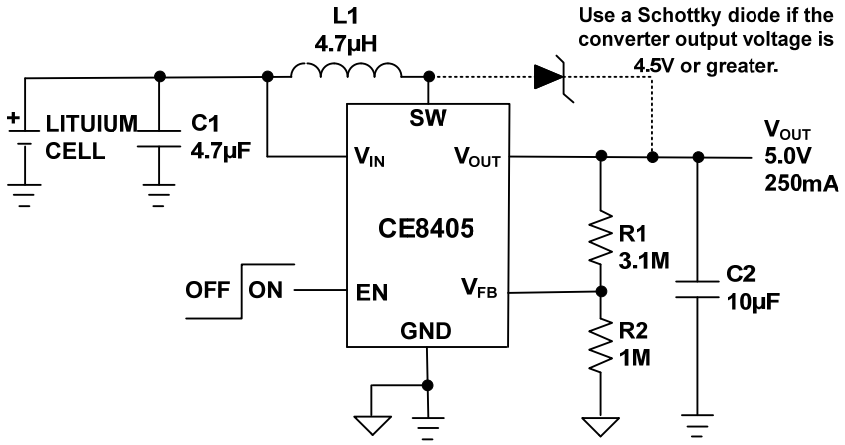
(T_A = 25°C, unless otherwise specified)

PARAMETER	SYMBOL	RATINGS	UNITS
Input Voltage	V_{IN}	-0.3 ~ 6	V
SW Voltage		-0.3 ~ 6	V
CE, FB Voltage		-0.3 ~ 6	V
Output Voltage	V_{OUT}	-0.3 ~ 6	V
Output Current Bypass Mode		1000	mA
Power dissipation	PD	Internally Limited	mW
Ambient Temp. with Power Applied	Topr	-40 ~ +85	°C
Operating Junction Temperature	T_{stg}	-40 ~ +125	°C
Soldering Temperature	T_{solder}	-65 ~ +150	°C
ESD rating	Human Body Model-(HBM)	2	KV
	Machine Model-(MM)	200	V

Notice: Stresses above those listed under “Maximum Ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operational sections of this specification is not intended. Exposure to maximum rating conditions for extended periods may affect device reliability.

■ Typical Application





Note: $V_{OUT} = V_{FB} \times (1 + R1/R2)$

■ ELECTRICAL CHARACTERISTICS

(Unless otherwise indicated, V_{IN} = 1.5V, C_{OUT} = C_{IN} = 10μF, L = 4.7μH, V_{OUT} = 3.3V, I_{OUT} = 0mA, T_A = +25°C. Boldface specifications apply over the T_A range of -40°C to +85°C.)

Parameters	Sym	Min	Typ	Max	Units	Conditions
Minimum Start-Up Voltage	V_{IN}	—	0.82	—	V	Note1
Minimum Input Voltage After Start-Up	V_{IN}	—	0.65	—	V	Note1
Input Voltage range	V_{IN}	0.82		5.5	V	
Output Voltage Adjust Range	V_{OUT}	2.2		5.5	V	V_{OUT} ≥ V_{IN}; Note2
Maximum Output Current	I_{OUT}		200	—	mA	1.2V V_{IN}, 3.3V V_{OUT}
			400	—		2.4V V_{IN}, 3.3V V_{OUT}
			400	—		3.3V V_{IN}, 5.0V V_{OUT}
Feedback Voltage	V_{FB}	1.179	1.215	1.251	V	
Feedback Input Bias Current	I_{VFB}	—	10	—	nA	
V_{OUT} Quiescent Current	I_{QOUT}	—	4.0	8	μA	I_{OUT} = 0mA, device is not switching, EN = V_{IN} = 4.0V, V_{OUT} = 5.0V, does not include feedback divider current; Note3
V_{IN} Sleep Current	I_{QIN}	—	1.0	2.3	μA	I_{OUT} = 0mA, EN = V_{IN} Note3, Note5
No Load Input Current	I_{IN0}	—	14	25	μA	I_{OUT} = 0mA, device is switching
Quiescent Current – Shutdown	I_{QSHDN}	—	0.6	—	μA	V_{OUT} = EN = GND; includes N-Channel and P-Channel Switch Leakage

Note :

1. 3.3 kΩ resistive load, 3.3V_{OUT} (1mA).
2. For V_{IN} > V_{OUT}, V_{OUT} will not remain in regulation.
3. I_{QOUT} is measured at V_{OUT}, V_{OUT} is external supplied for V_{OUT} > V_{IN} (device is not switching), I_{QIN} is measured at V_{IN} pin during Sleep period, no load.
4. 220Ω resistive load, 3.3V_{OUT} (15mA).
5. Determined by characterization, not production tested.

■ ELECTRICAL CHARACTERISTICS (CONTINUED)

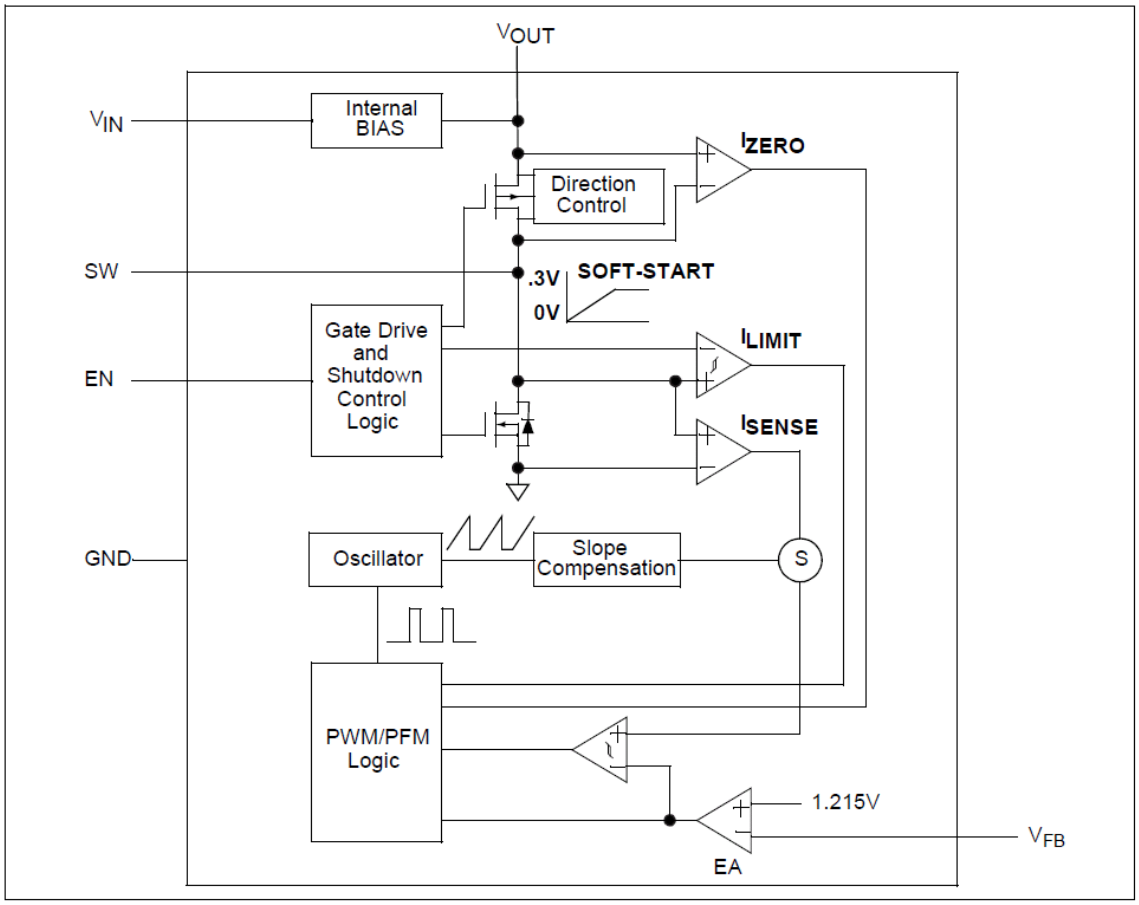
(Unless otherwise indicated, V_{IN} = 1.5V, C_{OUT} = C_{IN} = 10μF, L = 4.7μH, V_{OUT} = 3.3V, I_{OUT} = 0mA, T_A = +25°C. Boldface specifications apply over the T_A range of -40°C to +85°C.)

Parameters	Sym	Min	Typ	Max	Units	Conditions
NMOS Switch Leakage	I_{NLK}	—	0.15	—	μA	V_{IN} = V_{SW} = 5V V_{OUT} = 5.5V V_{EN} = V_{FB} = GND
PMOS Switch Leakage	I_{PLK}	—	0.15	—	μA	V_{IN} = V_{SW} = GND; V_{OUT} = 5.5V
NMOS Switch ON Resistance	$R_{DS(ON)N}$	—	0.25	—	Ω	V_{IN} = 3.3V, I_{SW} = 100mA
PMOS Switch ON Resistance	$R_{DS(ON)P}$	—	0.5	—	Ω	V_{IN} = 3.3V, I_{SW} = 100mA
NMOS Peak Switch Current Limit	$I_{N(MAX)}$	—	1	—	A	Note5
V_{OUT} Accuracy	$V_{OUT\%}$	-3	—	+3	%	Includes Line and Load Regulation; V_{IN} = 1.5V
Line Regulation	$\lvert(\Delta V_{OUT}/V_{OUT})/\Delta V_{IN}\rvert$	-0.4	0.3	0.4	%/V	V_{IN} = 1.5V to 2.8V I_{OUT} = 50mA
Load Regulation	$\lvert\Delta V_{OUT}/V_{OUT}\rvert$	-1.5	0.1	1.5	%	I_{OUT} = 25mA to 100mA; V_{IN} = 1.5V
Maximum Duty Cycle	DC_{MAX}	87	89	91	%	Note5
Switching Frequency	f_{SW}		500		KHz	
EN Input Logic High	V_{IH}	70	—	—	% of V_{IN}	I_{OUT} = 1mA
EN Input Logic Low	V_{IL}	—	—	20	% of V_{IN}	I_{OUT} = 1mA
EN Input Leakage Current	I_{ENLK}	—	5.0	—	nA	V_{EN} = 5V
Soft Start Time	t_{SS}	—	1		ms	EN Low to High, 90% of V_{OUT}; Note4, Note5
Thermal Shutdown Die Temperature	T_{SD}	—	160	—	°C	I_{OUT} = 20mA, V_{IN} > 1.4V
Die Temperature Hysteresis	T_{SDHYS}	—	20	—	°C	

Note ：

1. 3.3kΩ resistive load, 3.3V_{OUT} (1mA).
2. For V_{IN} > V_{OUT}, V_{OUT} will not remain in regulation.
3. I_{QOUT} is measured at V_{OUT}, V_{OUT} is external supplied for V_{OUT} > V_{IN} (device is not switching), I_{QIN} is measured at V_{IN} pin during Sleep period, no load.
4. 220Ω resistive load, 3.3V_{OUT} (15mA).
5. Determined by characterization, not production tested.

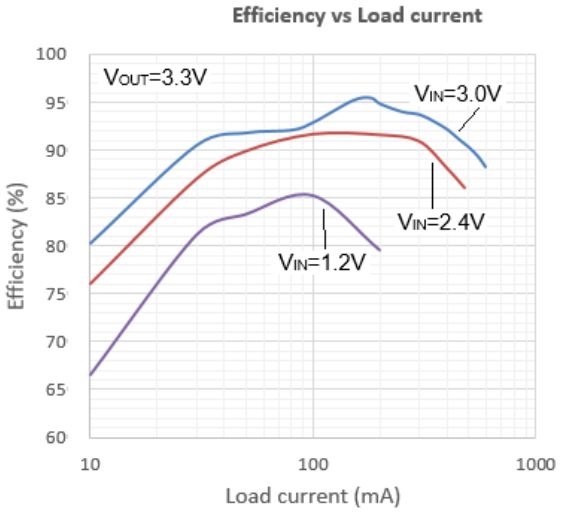
■ Functional Description

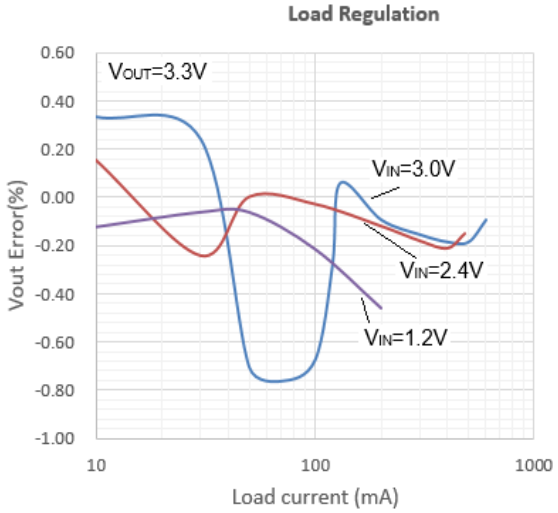


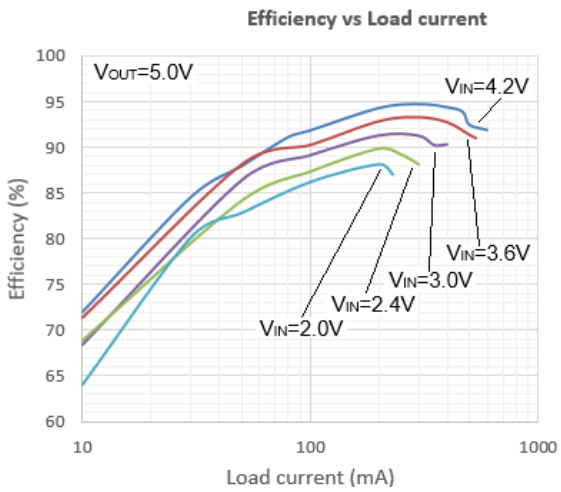
CE8405 Block Diagram

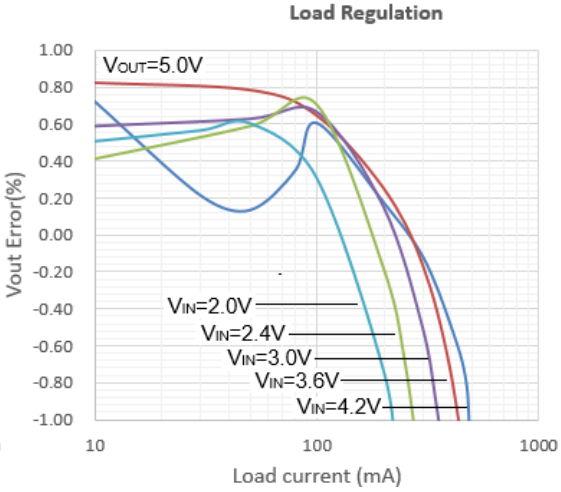
■ TYPICAL PERFORMANCE CHARACTERISTICS

(T_A = 25℃, unless otherwise specified)



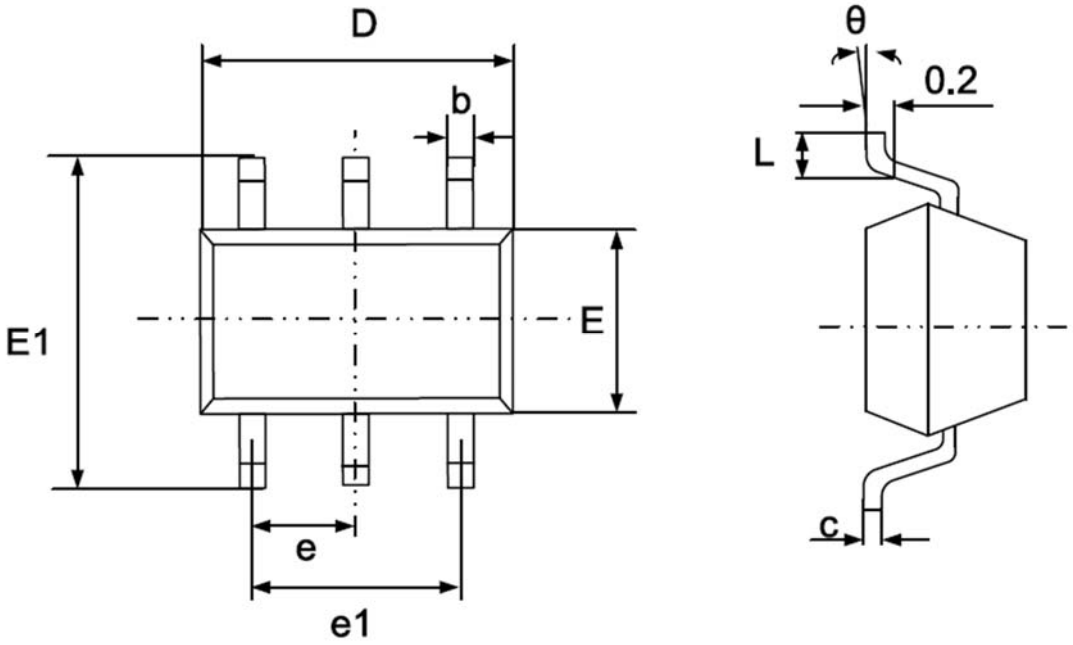


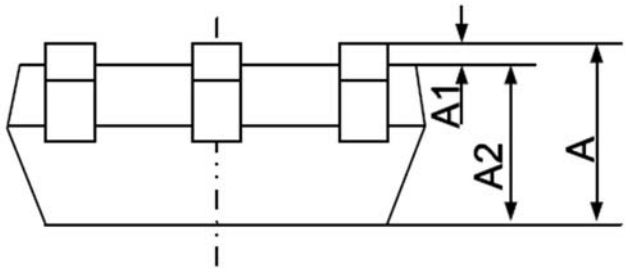




■ PACKAGING INFORMATION

- **SOT23-6 Package Outline Dimensions**





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°