150 KHz, 2A Asynchronous Step-down Converter

Features

- 3.3V, 5V, 12V and Adjustable Output Version
- Adjustable Version Output Voltage Range, 1.23V to 37V +4% Max over Line and Load Condition
- Input Voltage Range up to 40V
- Output Load Current: 2A
- 150 KHz Fixed Frequency Internal Oscillator
- Voltage Mode Non-synchronous PWM Control
- Thermal-shutdown and Current-limit Protection
- ON/OFF Shutdown Control Input
- Low Power Standby Mode
- Built-in Switching Transistor on Chip
- SOP-8L package

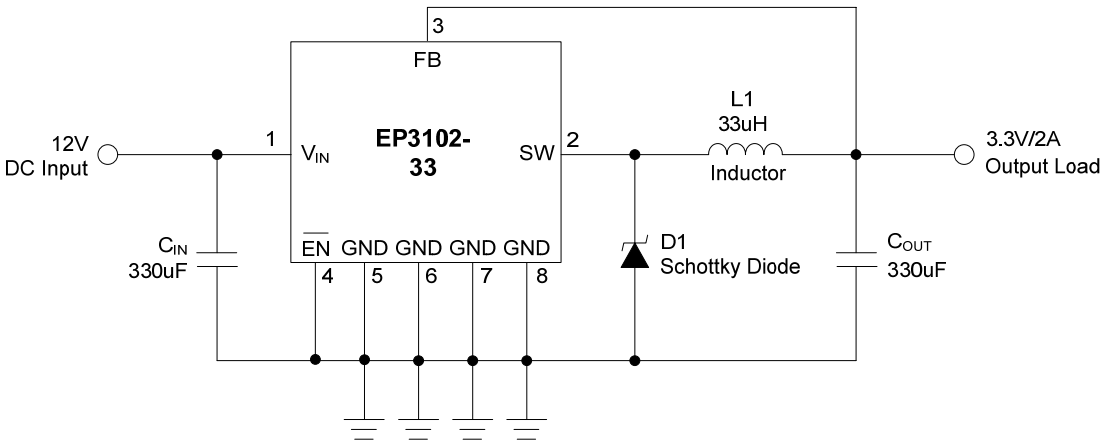
Applications

- Simple High-efficiency Step-down (Buck) Regulator
- Efficient Pre-regulator for Linear Regulators
- On-card Switching Regulators
- Positive to Negative Converter
- Battery Charger

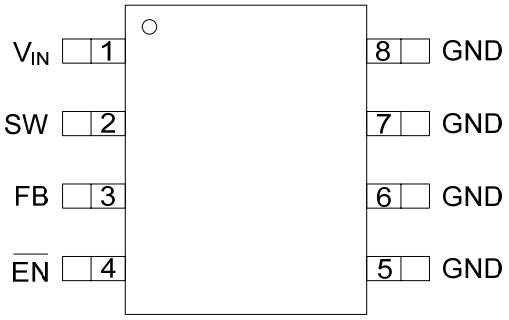
Description

The EP3102 is a monolithic integrated circuit that provide all the active functions for a step-down switching regulator, capable of driving a 2A load without additional transistor component. Requiring a minimum number of external component, the board space can be saved easily. The external shutdown function can be controlled by TTL logic level and then come into standby mode. The internal compensation makes feedback control have good line and load regulation without external design. Regarding protected function, thermal shutdown is to prevent over temperature operating from damage, and current limit is against over current operating of the output switch. The EP3102 operates at a switching frequency of 150KHz thus allowing smaller sized filter components than what would be needed with lower frequency switching regulators. Other features include a guaranteed +4% tolerance on output voltage under specified input voltage and output load conditions, and +15% on the oscillator frequency. The output version included fixed 3.3V, 5V, 12V, and an adjustable type. The package is available in a standard 8-lead SOP8.

Typical Application



Pin Assignment



SOP-8L

Ordering Information

EP3102 - X X X

Buck Regulator	Package	V_{OUT}	Packing
	S : SOP-8L	Blank: Adj 33 = 3.3V 50 = 5.0V 12 = 12V	R: Taping & Reel B: Bag

Pin Description

Pin	Name	Function
1	V_{IN}	This is the positive input supply for the IC switching regulator. A suitable input bypass capacitor must be present at this pin to minimize voltage transients and to supply the switching currents needed by the regulator.
2	SW	Internal switch. The voltage at this pin switches between ($+V_{IN}$-V_{SAT}) and approximately-0.5V, with a duty cycle of approximately V_{OUT}/V_{IN}. To minimize coupling to sensitive circuitry, the PC board copper area connected to this pin should be kept a minimum.
3	FB	Senses the regulated output voltage to complete the feedback loop.
4	$\overline{EN}$	Low enable. Allows the switching regulator circuit to be shutdown using logic level signals thus dropping the total input supply current to approximately 150uA. Pulling this pin below a threshold voltage of approximately 1.3V turns the regulator on, and pulling this pin above 1.3V (up to a maximum of 40V) shuts the regulator down. If this shutdown feature is not needed, the $\overline{EN}$ pin can be wired to the ground pin or it can be left open, in either case the regulator will be in the ON condition.
5~8	GND	Circuit ground.

Absolute Maximum Rating (Note 1)

Symbol	Item	Rating	Units
V_{IN}	Input Supply Voltage	+45	V
$V_{\overline{EN}}$	$\overline{EN}$ Pin Input Voltage	-0.3 ~ +25	V
V_{FB}	Feedback Pin Voltage	-0.3 ~ +25	V
V_{OUT}	Output Voltage to Ground	-1	V
V_{OP}	Operating Voltage	+4.5 ~+25	V
P_D	Power Dissipation	Internally Limited	W
T_{OP}	Operating Temperature Range	-40 ~ +125	°C
T_{STG}	Storage Temperature Range	-65 ~ +150	°C

Electrical Characteristics (All Output Voltage Versions) (Note 2)

Unless otherwise specified, V_{IN}=12V for 3.3V, 5V, adjustable version and V_{IN}=24V for the 12V version. I_{LOAD}=0.2A

Symbol	Parameter		Conditions		Min.	Typ.	Max.	Units
I_{FB}	Feedback Bias Current		V_{FB}=1.3V (Adjustable version only)			-10	-50 -100	nA
F_{OSC}	Oscillator Frequency				127 110	150	173 173	KHz
F_{SCP}	Oscillator Frequency of Short Circuit Protect		When current limit occurred and V_{FB}<0.55V			30	70	KHz
V_{SAT}	Saturation Voltage		I_{OUT}=1.5A no outside circuit V_{FB}=0V force driver on			1.25	1.4 1.5	V
DC	Max. Duty Cycle (ON)		V_{FB}=0V force driver on			100		%
	Min. Duty Cycle (OFF)		V_{FB}=12V force driver off			0		
I_{CL}	Current Limit		Peak Current no outside circuit V_{FB}=0V force driver on		2.4	2.8	3.3 3.6	A
I_L	Output=0	Output Leakage Current	No outside circuit V_{FB}=12V fore driver off				-200	μA
	Output=-1		V_{IN}=24V			-5		mA
I_Q	Quiescent Current		V_{FB}=12V force driver off			5	10	mA
I_{STBY}	Standby Quiescent Current		$\overline{EN}$ pin=5V V_{IN}=24V			70	150 200	μA
V_{IL}	$\overline{EN}$ Pin Logic Input Threshold Voltage		Low (regulator ON)			1.3	0.6	V
V_{IH}			High (regulator OFF)		2.0			
I_H	$\overline{EN}$ Pin Logic Input Current		V_{LOGIC}=2.5V (OFF)				-0.01	μA
I_L	$\overline{EN}$ Pin Input Current		V_{LOGIC}=0.5V (ON)			-0.1	-1	μA
T_S	Over Temperature Shutdown Threshold		T_J increasing			175		°C
			T_J decreasing			150		°C
θ_{JC}	Thermal Resistance		SOP-8L	Junction to Case		15		°C/W
θ_{JA}	Thermal Resistance with Copper Area of Approximately 3in^2		SOP-8L	Junction to Ambient		70		°C/W

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.
Note 2:100% production test at +25°C. Specifications over the temperature range are guaranteed by design and characterization.

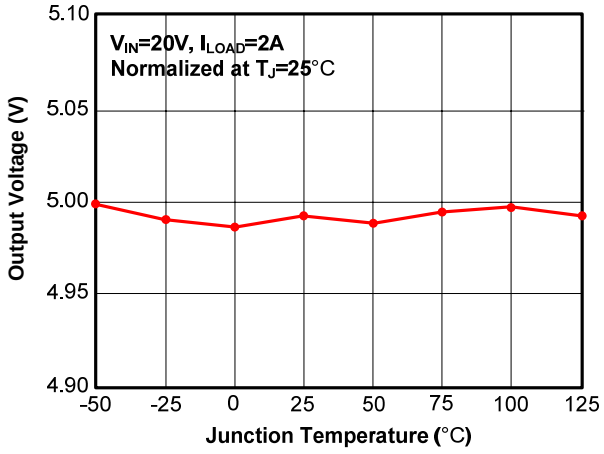
Electrical Characteristics (Continued)

Symbol	Parameter		Conditions	Typ.	Limit	Units
V_{FB}	Output Feedback	EP3102-ADJ	5V<V_{IN}<40V 0.2A<I_{LOAD}<2A V_{OUT} programmed for 3V	1.235	1.193/1.18 1.267/1.28	V V_{MIN} V_{MAX}
η	Efficiency		V_{IN}=12V, I_{LOAD}=2A	75		%
V_{OUT}	Output Voltage	EP3102-3.3V	5.5V<V_{IN}<40V 0.2A<I_{LOAD}<2A	3.3	3.168/3.135 3.432/3.465	V V_{MIN} V_{MAX}
η	Efficiency		V_{IN}=12V, I_{LOAD}=2A	75		%
V_{OUT}	Output Voltage	EP3102-5V	8V<V_{IN}<40V 0.2A<I_{LOAD}<2A	5	4.8/4.75 5.2/5.25	V V_{MIN} V_{MAX}
η	Efficiency		V_{IN}=12V, I_{LOAD}=2A	80		%
V_{OUT}	Output Voltage	EP3102-12V	15V<V_{IN}<40V 0.2A<I_{LOAD}<2A	12	11.52/11.4 12.48/12.6	V V_{MIN} V_{MAX}
η	Efficiency		V_{IN}=15V, I_{LOAD}=2A	90		%

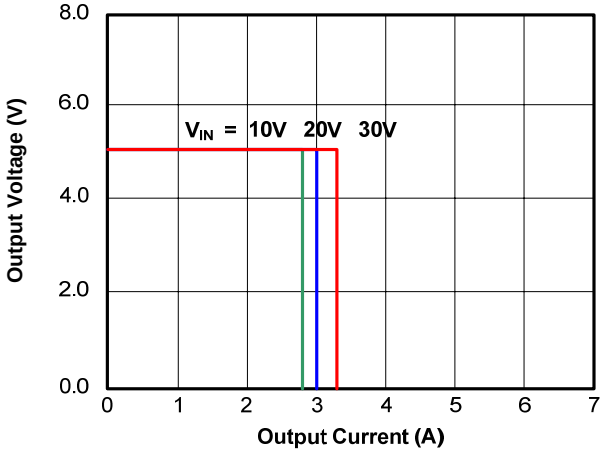
P.S. Specifications with boldface type are for full operating temperature range, the other type are for T_J=25ºC.

Typical Performance Characteristics

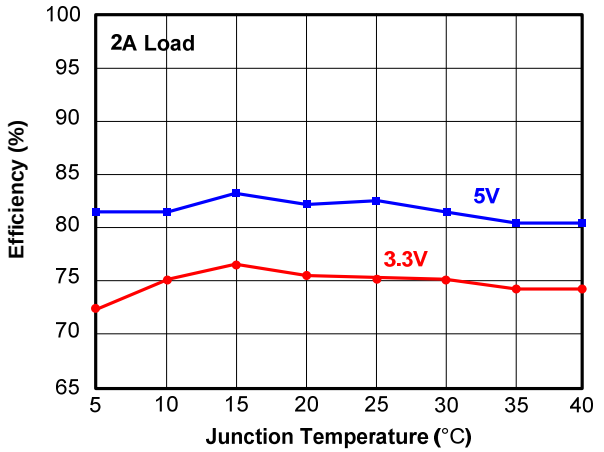
Normalized Output Voltage



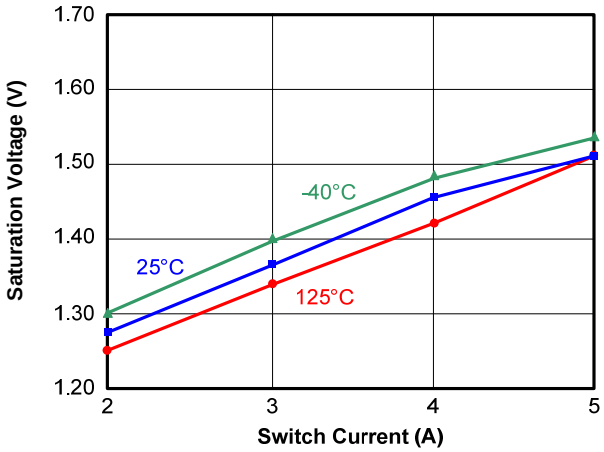
Switch Current Limit



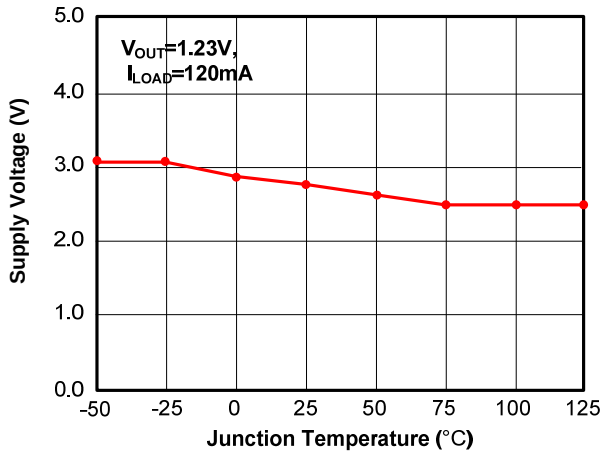
Efficiency



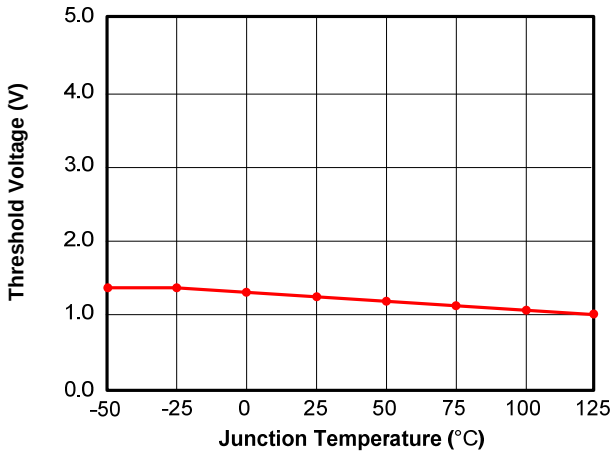
Switch Saturation Voltage



Minimum Operating Supply Voltage

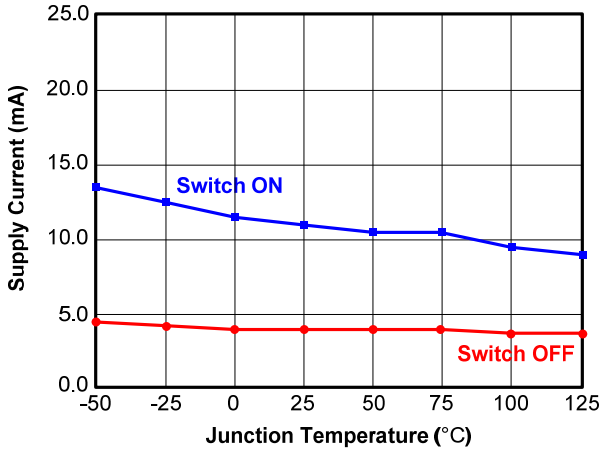


$\overline{EN}$ Threshold Voltage

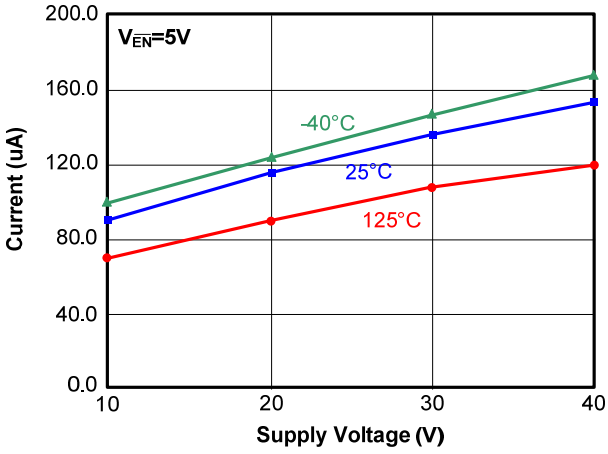


Typical Performance Characteristics (Continued)

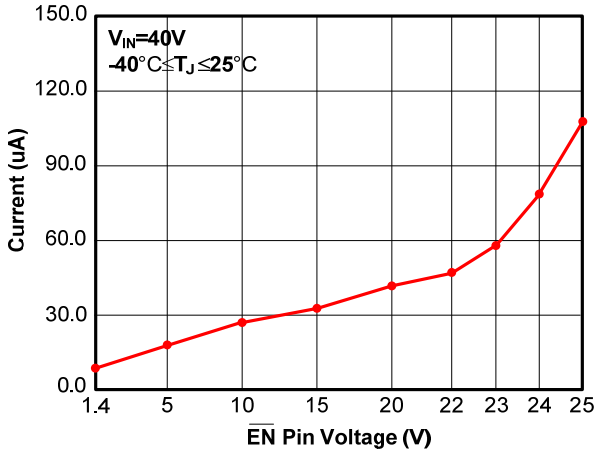
Operating Quiescent Current



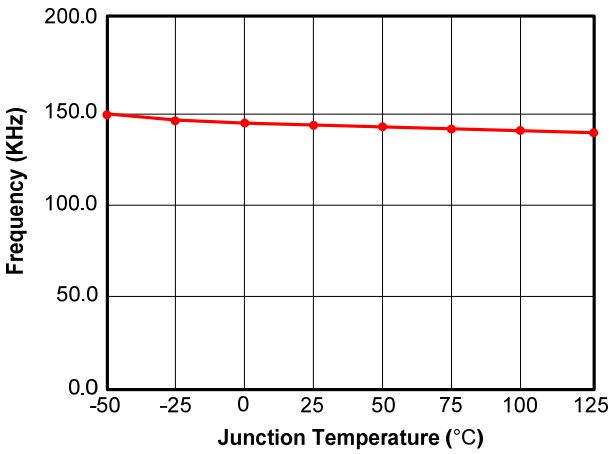
Shutdown Quiescent Current



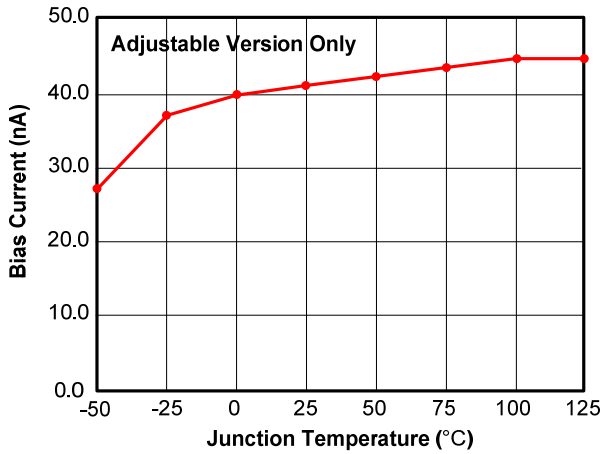
$\overline{EN}$ Pin Current (Sinking))



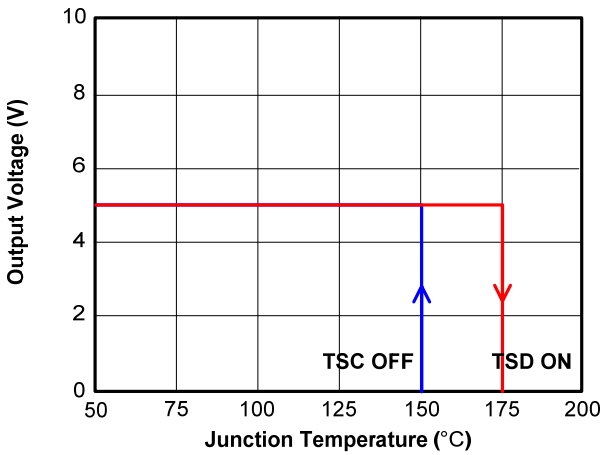
Switch Frequency



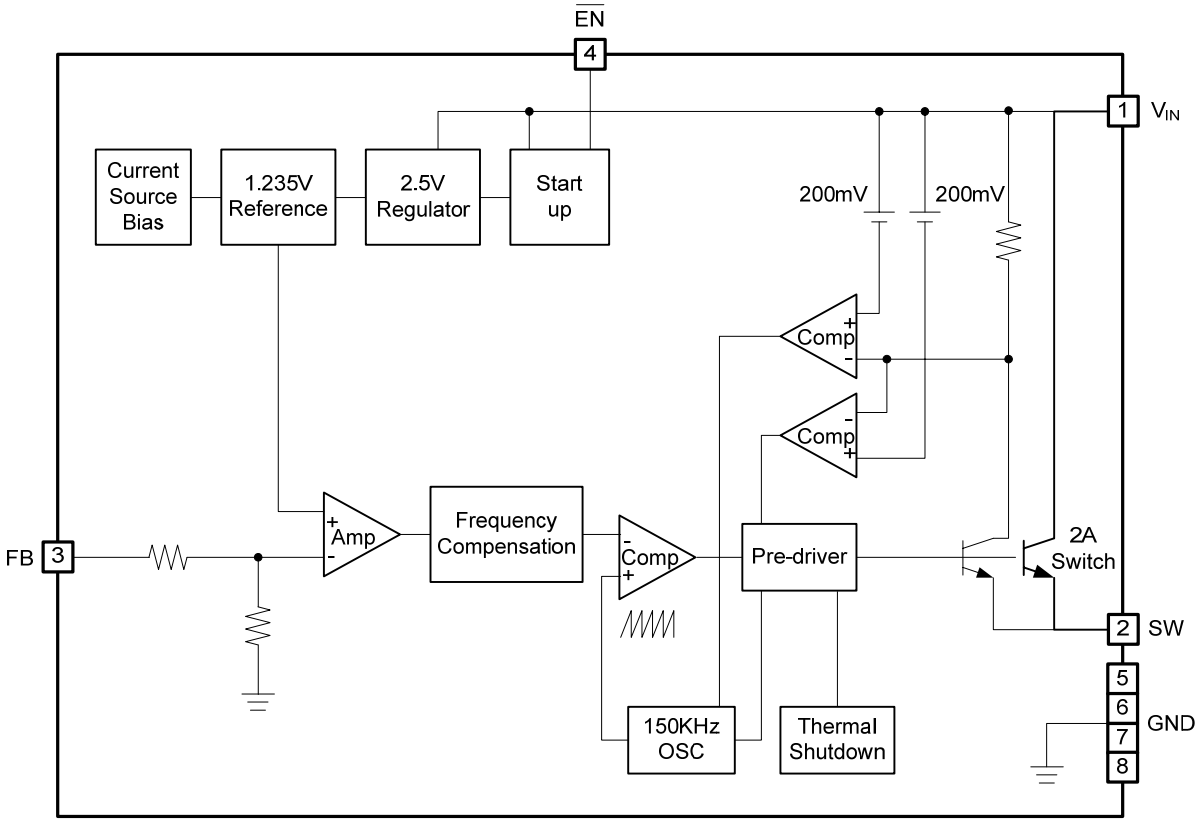
Feedback Pin Bias Current



Thermal Protection

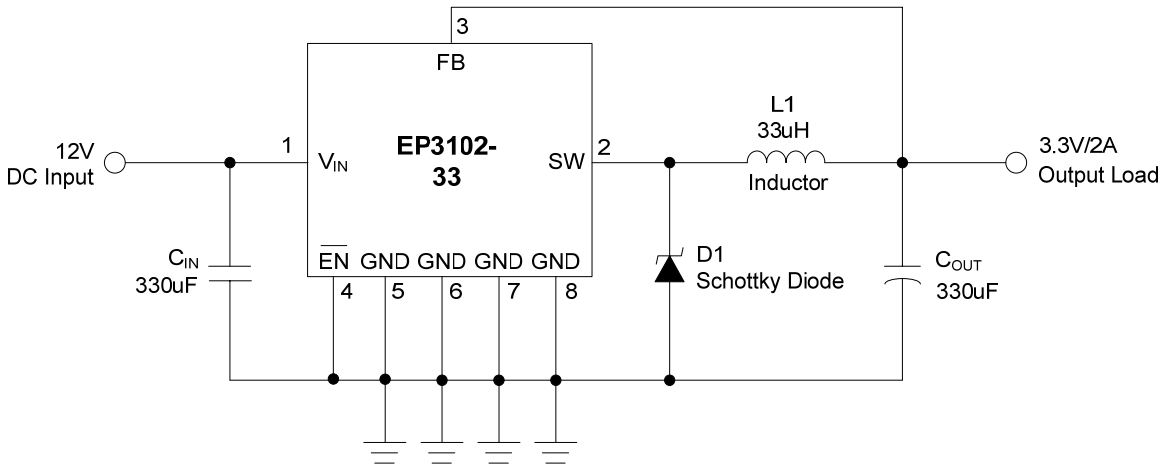


Functional Block Diagram



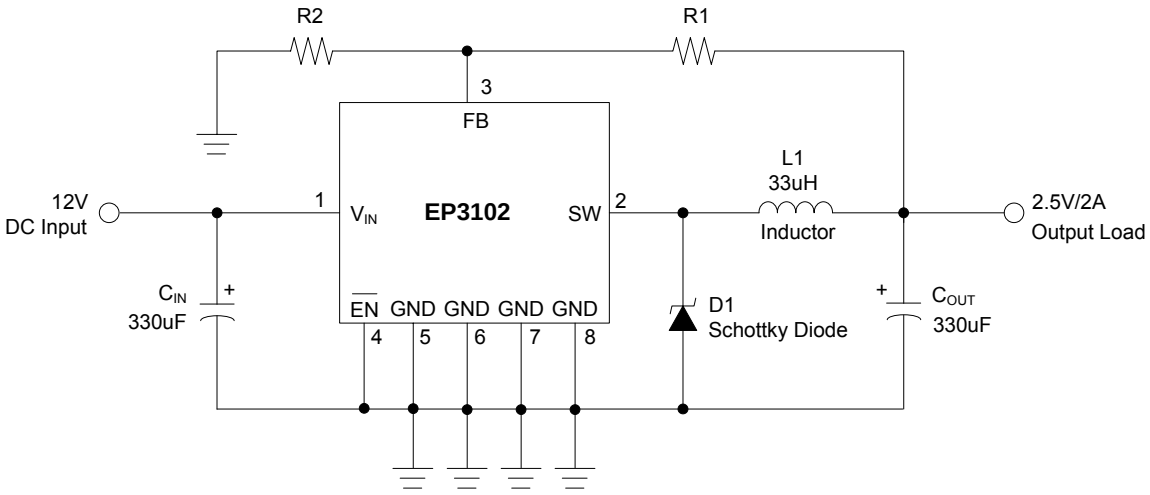
Applications Information

(1) Fixed Type Circuit



Applications Information (Continued)

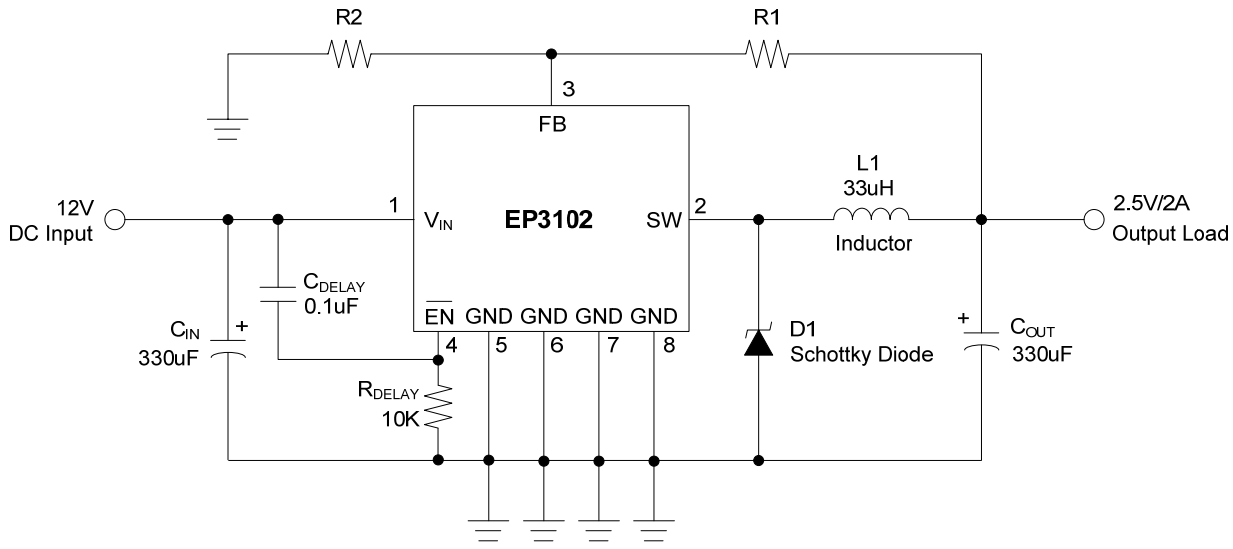
(2) Adjustable Type Circuit



$$V_{OUT} = V_{FB} \times \left(1 + \frac{R1}{R2}\right)$$

V_{FB}=1.23V
R2=1K ~ 3K

(3) Delay Start Circuit



Thermal Considerations

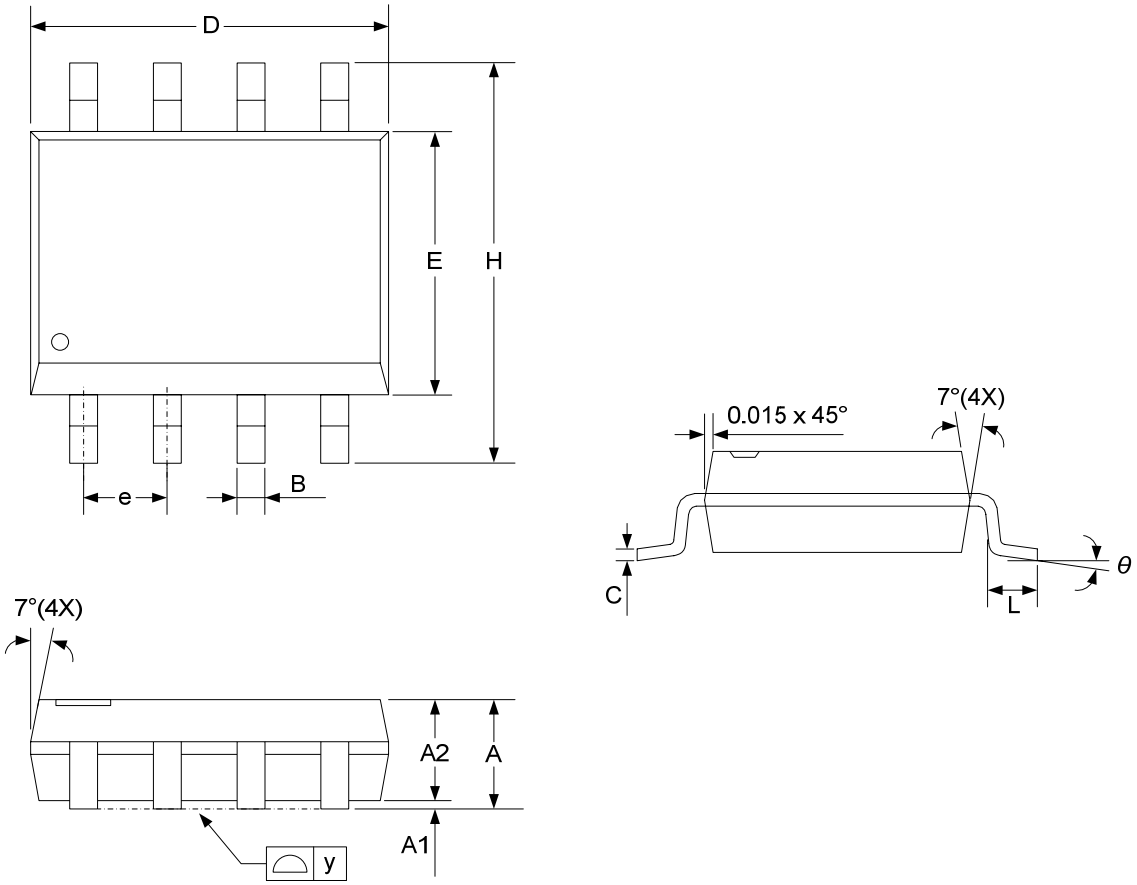
The SOP-8 package needs a heat sink under most conditions. The size of the heat-sink depends on the input voltage, the output voltage, the load current and the ambient temperature. The EP3102 junction temperature rises above ambient temperature for a 2A load and different input and output voltages. The data for these curves was taken with the EP3102 operating as a buck switching regulator in an ambient temperature of 25°C (still air). These temperature increments are all approximate and are affected by many factors. Some of these factors include board size, shape, thickness, position, location, and even board temperature. Other factors are traced width, total printed circuit copper area, copper thickness, single or double-sided, multi-layer board and amount of solder on the board. Higher ambient temperatures require more heat sinking.

For the best thermal performance, wide copper traces and generous amounts of printed circuit board copper should be used in the board layout. (One exception is the out (switch) pin, which should not have large areas of copper.) Large areas of copper provide the best transfer of heat (lower thermal resistance) to the surrounding air, and moving air lowers the thermal resistance even further.

The effectiveness of the PC board to dissipate heat also depends on the size, quantity and spacing of other components on the board, as well as whether the surrounding air is still or moving. Furthermore, some of these components such as the catch diode will add heat to the PC board and heat can vary as the input voltage changes. For the inductor, depending on the physical size, type of core material and the DC resistance, it could either act as a heat sink taking heat away from the board, or it could add heat to the board.

Package Description

SOP-8L



DIM	MILLIMETERS			INCHES		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.40	1.60	1.75	0.055	0.063	0.069
A1	0.10	–	0.25	0.040	–	0.100
A2	1.30	1.45	1.50	0.051	0.057	0.059
B	0.33	0.41	0.51	0.013	0.016	0.020
C	0.19	0.20	0.25	0.0075	0.008	0.010
D	4.80	4.85	5.05	0.189	0.191	0.199
E	3.80	3.91	4.00	0.150	0.154	0.157
e	–	1.27	–	–	0.050	–
H	5.79	5.99	6.20	0.228	0.236	0.244
L	0.38	0.71	1.27	0.015	0.028	0.050
y	–	–	0.10	–	–	0.004
θ	0°	–	8°	0°	–	8°