



General Description

The SE3609 is a compact, high-efficiency, synchronous step-up converter with power MOSFETs integrated for a single-cell Li-ion/polymer battery. This converter consumes only 100uA quiescent current when no switching. When current load is light, this converter enters burst mode to obtain high efficiency. When current load is heavy enough, it enters fixed-frequency PWM mode. It adopts peak current mode for fast transient response with internal compensation. This converter contains cycle-by-cycle current limiting and short protection circuit. It is suitable for iPad-like computers, smart phones and portable handheld devices. The device is packed in PSOP8 package.

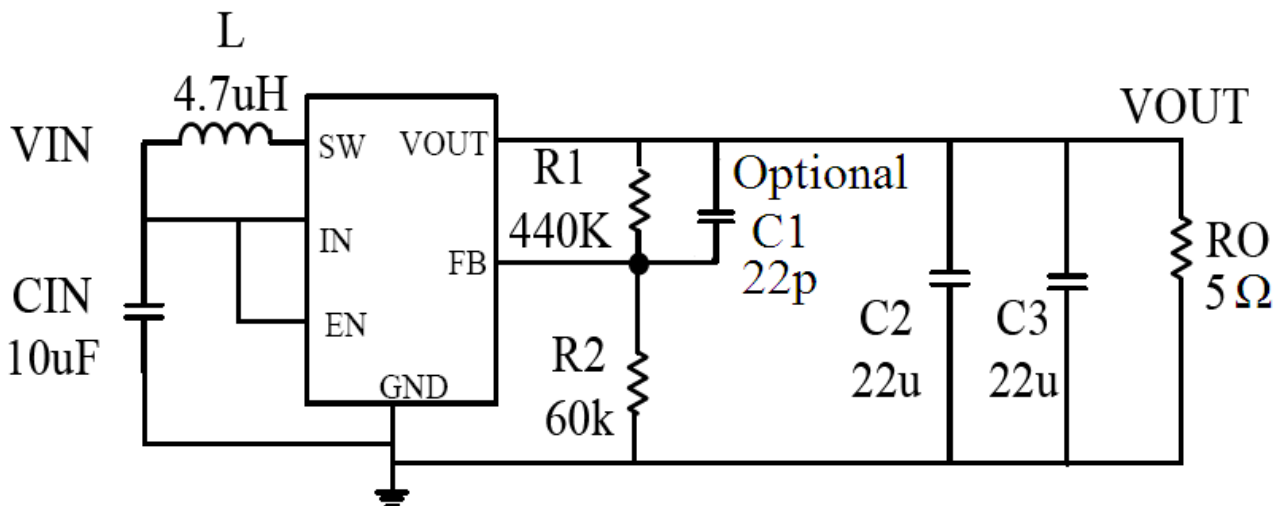
Features

- Wide input range: 2.6-5V input, 1.2A @5V Vout
- 1MHz switching frequency
- Low RDS(ON): 110mΩ@5V NMOS and 150mΩ@5V PMOS
- Up to 93% efficiency
- Accurate Reference: 0.6V Reference
- Under-Voltage lockout Protection
- Over-Temperature Protection
- Short Protection
- Internal Soft Start
- 1uA Shutdown current
- RoHS Compliant and Halogen Free
- Compact package: PSOP8

Applications

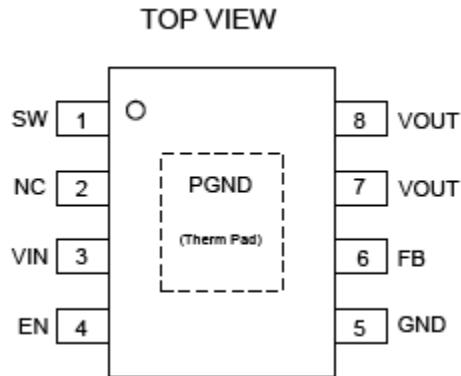
- iPad- like tablet computers
- Smart phones
- Other portable devices

Typical Application





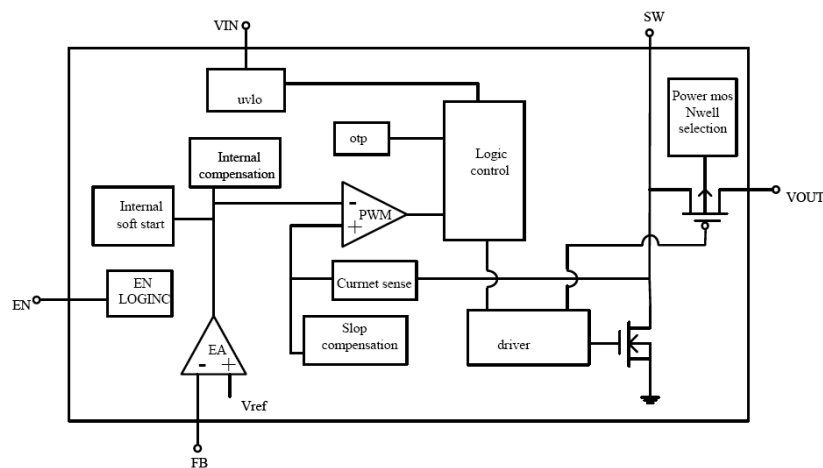
Pin Configuration



Pin Description

NO.	Pin Name	Pin Function Description
1	SW	Switching Terminal
2	NC	No Connection
3	VIN	Input Supply Pin. Must be locally bypassed.
4	EN	Enable pin. A high input at EN enables the device and a low input disables the devices. When not used, connect EN to the input source for automatic startup.
5	GND	Analog Ground
6	FB	Feedback pin.
7	VOUT	The Output of The Chip
8	VOUT	The Output of The Chip
9	PGND	Thermal Pad

Functional Block Diagram





Absolute Maximum Ratings

Symbol	Parameter	Maximum	Units
V _{IN}	V _{IN} Supply Voltage	-0.3~4.5	V
V _{SW}	Voltage at SW Pin	-0.5~6	V
V _{IO}	All Other I/O Pins	GND-0.3 to VDD+0.3	V
P _{TR1}	Thermal Resistance(PSOP8) Θ _{JA}	50	°C/W
T _{stg}	Storage Temperature	-55 to 150	°C
T _{solder}	Package Lead Soldering Temperature (10s)	260	°C
ESD Susceptibility	HBM(Human Body Mode)	2	kV

Note: Exceeding these ratings may damage the device.

Recommended Operating Conditions

Symbol	Parameter	Maximum	Units
V _{IN}	Input Voltage	2.8 to 4.5	V
V _{SW}	Output Voltage	V _{IN} to 6	V
T _{OPT}	Operating Temperature	-40 to +85	°C

Note: The device is not guaranteed to function outside of its operating rating.



Electrical Characteristics

($V_{IN} = V_{EN} = 3.3V$, $T_A = 25^\circ C$ unless otherwise specified)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Input Voltage		2.5		4.5	V
Feedback						
V_{FB}	Feedback Voltage		588	600	612	mV
I_{bias}	FB Pin Input Bias Current			0.05	1	μA
UVLO						
UVLO	Under Voltage Lock Out			2.8		V
I_{UVLO_HYS}				0.3		V
Operating Current						
I_{off}	Operating Current (Shutdown)	$V_{EN}=0V$		0.1	1	μA
I_{sby}	No Switching	$V_{in}=3V$ $V_{FB}=0.65V$		100		μA
F_{sw}	Switching Frequency			1		MHz
D_{max}	Maximum Duty Cycle	$V_{FB}=0V$		90		%
Chip Enable						
V_{EN_H}	EN Minimum High Level		1.5			V
V_{EN_L}	EN Maximum Low Level				0.4	V
V_{HYS}	EN Hysteresis			90		mV
I_{EN}	EN Input Bias Current	$V_{SW-ON}=0V,5V$			1	μA
OTP						
OTP				140		$^\circ C$
OTP Hysteresis				20		$^\circ C$
Output Switch						
$R_{ON(NMOS)}$	SW On Resistance (Note 3)			110		m Ω
$R_{ON(PMOS)}$				150		m Ω
I_{LIMIT}	SW Current Limit	$V_{OUT}=4.5V$		3.3		A
I_{LEAK}	SW Leakage Current	$V_{sw}=5V$		0.01	1	μA
Soft Start						
t_{ss}	Soft Start Time (Note 3)	V_{IN} Power On		400		μS

Note3: Guaranteed by design.



Typical Performance Characteristics

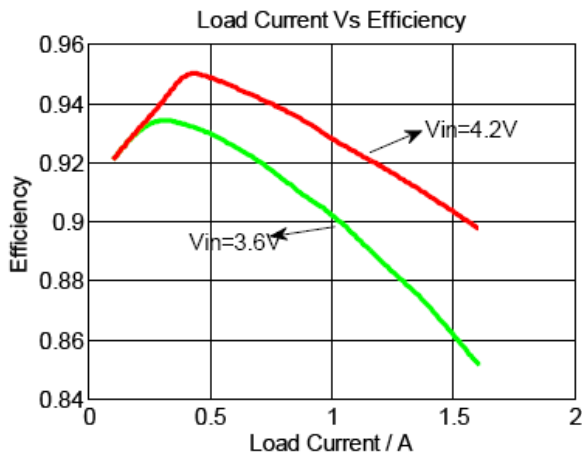


Fig 1 Efficiency Vs Load

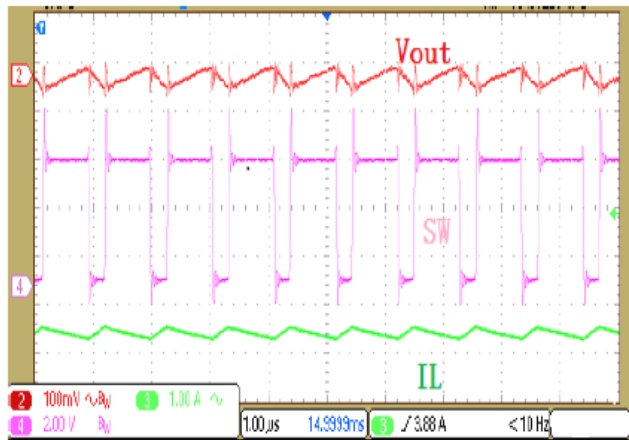


Fig 2 Steady-state Waveform

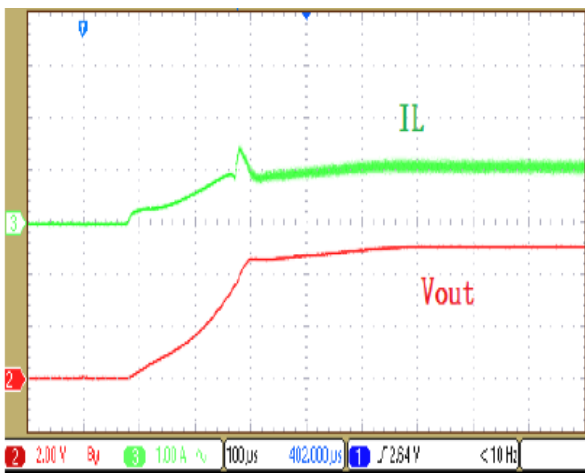


Fig 3 Startup Waveform

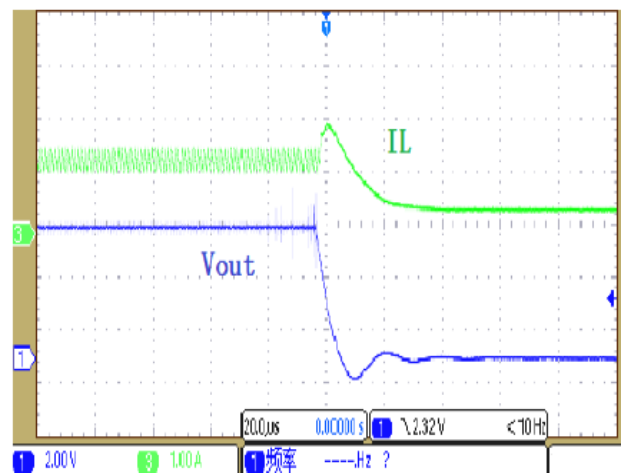


Fig 4 Short Waveform

Operation Description

Controller Circuit

The SE3609 current-mode step-up DC-DC switching converter uses a fixed-frequency PWM architecture with output short-protection function. The SE3609 step-up DC-DC switching converter typically generates a 5V output voltage from a single-cell battery input voltage. In light-load mode, the converter switches when needed, consumes only 130µA of quiescent current. In heavy-load mode, the converter switches every cycle at a constant frequency as fixed-PWM. The SE3609 is highly efficient, with internal and synchronous switches. Shutdown function reduces the quiescent current to less than 0.1µA. Low quiescent current and high efficiency make this device ideal for portable equipment. The SE3609 is optimized for use in iPad-like computers, smart phones, portable handheld devices and other applications requiring low quiescent current for maximum battery life.



Synchronous Rectifier

A special circuit is applied to disconnect the load from the input during shutdown of the converter. In conventional synchronous rectifier circuits, the back-gate diode of the high-side PMOS is forward biased in shutdown and allows current flowing from the battery to the output. This device however uses a special circuit which takes the cathode of the back-gate diode of the high-side PMOS and disconnects it from the source when the regulator is not enabled (EN = low). The benefit of this feature for the system design engineer is that the battery is not depleted during shutdown of the converter. No additional components have to be added to the design to make sure that the battery is disconnected from the output of the converter.

UnderVoltage Lockout

An under voltage lockout function prevents device start-up if the supply voltage on VBAT is lower than approximately 2.8V. When in operation and the battery is being discharged, the device automatically enters the shutdown mode if the voltage on VBAT drops below approximately 2.5V. This under voltage lockout function is implemented in order to prevent the malfunctioning of the converter.

SoftStart

When the device enables the internal start-up cycle, it starts with the first step, the precharge phase. During precharge, the rectifying switch is turned on until the output capacitor is charged to a value close to the input voltage. The rectifying switch current is limited in that phase. This also limits the output current under short-circuit conditions at the output. After charging the output capacitor to the input voltage the device starts switching.

Applications Information

Because of the high integration in the SE3609, the application circuit based on this regulator IC is rather simple. Only input capacitor CIN, output capacitor COUT, inductor L and feedback resistors (R1 and R2) need to be selected for the targeted applications specifications.

Feedback resistor dividers R1 and R2:

Choose R1 and R2 to program the proper output voltage. To minimize the power consumption under light loads, it is desirable to choose large resistance values for both R1 and R2. A value of between 10k and 1M is recommended for both resistors. If R1=200k is chosen, then R2 can be calculated to be:

$$R2 = (R1 \times 0.6V) / (VOUT - 0.6V)$$

Output capacitor COUT:

The output capacitor is selected to handle the output ripple noise requirements. Both steady state ripple and transient requirements must be taken into consideration when selecting this capacitor. For the best performance, it is recommended to use X5R or better grade ceramic capacitor with 10V rating and more than two pcs 22uF Capacitor.



Boost inductor L:

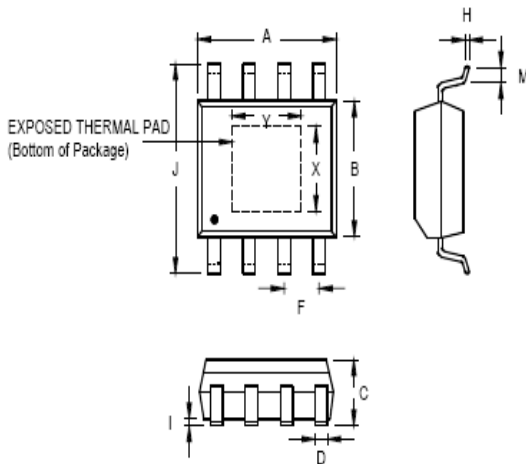
The recommended values of inductor are 2.2 to 4.7 μ H. Small size and better efficiency are the major concerns for portable device, such as SE3609 used for mobile phone. The inductor should have low core loss at 1MHz and low DCR for better efficiency. To avoid inductor saturation current rating should be considered.

Start-up and Inrush Current:

The SE3609 has internal soft start to limit the amount of current through VIN at startup and also limit the amount of overshoot on the output. The soft start is realized by gradually increasing the current limit during start-up.



Outline Drawing For PSOP8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	4.801	5.004	0.189	0.197
B	3.810	3.988	0.150	0.157
C	1.346	1.753	0.053	0.069
D	0.330	0.508	0.013	0.020
F	1.194	1.346	0.047	0.053
H	0.191	0.254	0.008	0.010
I	0.000	0.152	0.000	0.006
J	5.791	6.198	0.228	0.244
M	0.406	1.270	0.016	0.050
X	2.057	2.515	0.081	0.099
Y	2.057	3.404	0.081	0.134

联系方式:

北京思旺电子技术有限公司-中国总部

地址: 中国北京市海淀区信息路 22 号上地科技综合楼 B 座二层

邮编: 100085

电话:010-82895700/1/5

传真:010-82895706

Seaward Electronics Corporation – 台湾办事处

2F, #181, Sec. 3, Minquan East Rd,

Taipei, Taiwan R.O.C

电话: 886-2-2712-0307

传真: 886-2-2712-0191

Seaward Electronics Incorporated – 北美办事处

1512 Centre Pointe Dr.

Milpitas, CA95035, USA

电话: 1-408-821-6600