



LC3501

0.9V startup, 1MHz, 300mA Iout, Low Iq, Synchronous Boost converter

DESCRIPTION

The LC3501 is a step-up converter that provides a boosted output voltage from a low voltage source. Because of its proprietary design, it starts up at a very low input voltage down to 0.9V, and only consumes 15uA at standby, making it an ideal choice for single cell alkaline/NiMH battery operations.

A switching frequency of 1MHz minimizes solution footprint by allowing the use of tiny, low profile inductors and ceramic capacitors. The current mode PWM design is internally compensated, reducing external parts count.

LC3501 is available in SOT23-5 Package.

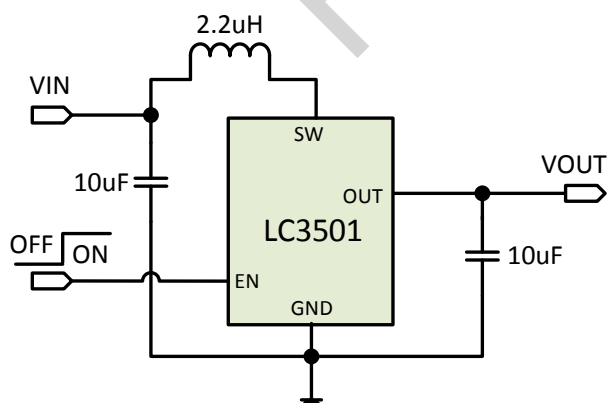
FEATURES

- Efficiency up to 94%@Vin=3.0V, Vout=5.0V
- Typical 15uA standby current
- 1MHz Switching Frequency allows small inductor and output cap
- Input boost-strapping allows using small or no input cap
- Low Vin Start-up Voltage down to 0.9V Ideal for Single Alkaline Cell operations
- Maximum Output Current up to 300mA
- Low Noise PWM control
- Internally Compensated Current Mode Control
- Internal Synchronous Rectifier
- Logic Control Shutdown (IQ<1uA)
- Available in SOT23-5

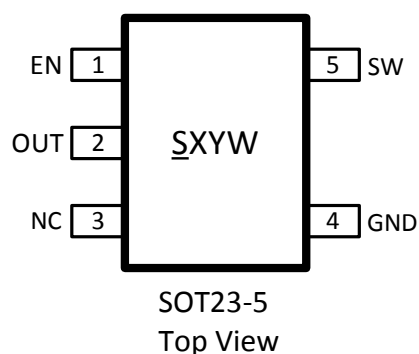
APPLICATIONS

- One to Three Cell Battery Operated Devices
- Medical Instruments
- Bluetooth Headsets
- Flash-Based MP3 Players
- Noise Canceling Headphones

TYPICAL APPLICATION



PIN OUT & MARKING



S: Product Code
X: Output Voltage
YW: Date code (Year & Week)

ORDERING INFORMATION

PART No.	PACKAGE	Tape&Reel
LC3501CB5TR	SOT23-5	3000/Reel

ABSOLUTE MAXIMUM RATING

Parameter	Value
SW Voltage	-0.3 ~ 6V
EN, OUT Voltage	-0.3 ~ 6V
Max Operating Junction Temperature(Tj)	125°C
Maximum Power Dissipation	SOT23-5 450mW
Ambient Temperature(Ta)	-40°C – 85°C
Storage Temperature(Ts)	-55°C - 150°C
Lead Temperature & Time	260°C, 10S

Note: Exceed these limits to damage to the device.

Exposure to absolute maximum rating conditions may affect device reliability.

ELECTRICAL CHARACTERISTICS

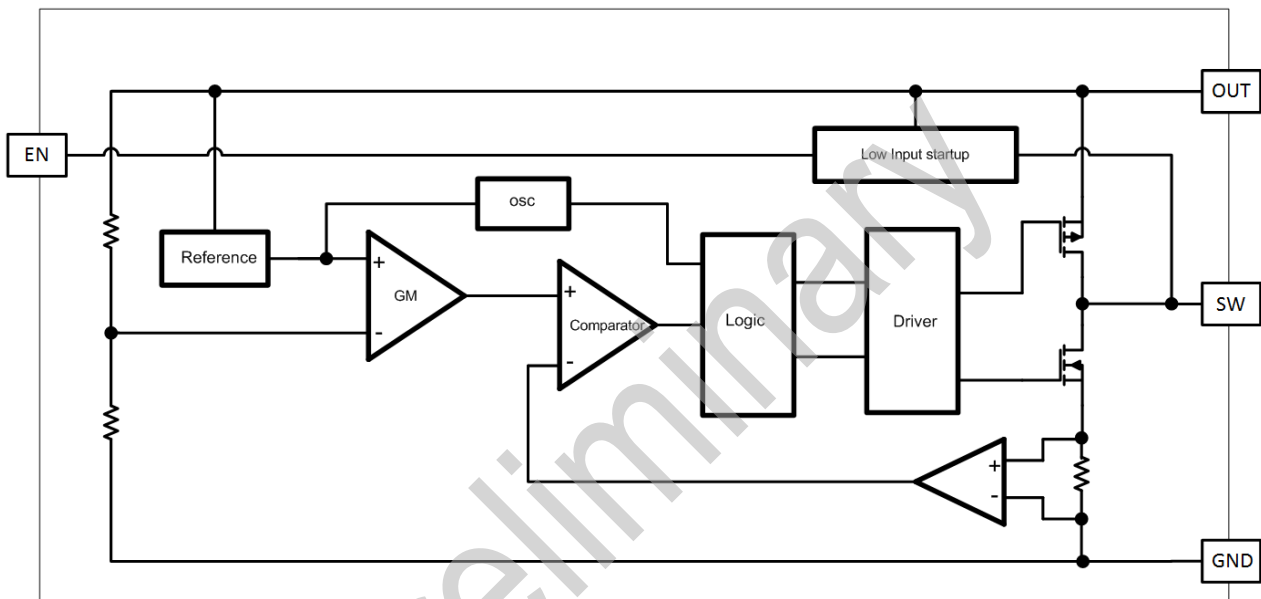
(T_A=25°C)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{in}	Input Voltage Range		0.9		5	V
V _{start}	Startup Voltage	I _{out} = 1mA		0.9		V
V _{hold}	Hold Voltage	I _{out} = 50mA		0.5	0.7	V
V _{out}	Output Voltage Range		1.8		5.5	V
	Output voltage accuracy	I _{out} = 0mA		2		%
	Line regulation	I _{out} = 50mA		0.1	0.2	%/V
	Load regulation	I _{out} = 0~300mA		1	2	%
F _{sw}	Switching Frequency	V _{out} =0.95V _o , No inductor	0.7	1	1.4	MHz
	Max Duty cycle	V _{out} =0.95V _o , No inductor	85	90	95	%
I _q	Quiescent Current at V _{out}	V _{out} =1.05*V _o	5	8	15	uA
	Supply current at V _{in}	I _{out} = 0mA			20	uA
	Shutdown Supply Current at V _{in}	EN=0		0.1	1	uA
	Efficiency	I _{out} = 100mA	85			%
R _{dsonP}	PMOS R _{dson}	I _{sw} =100mA		400	600	mohm
R _{dsonN}	NMOS R _{dson}	I _{sw} =100mA		200	300	mohm
I _{swlk}	SW Leakage Current	V _{out} =5.2V, V _{sw} =0 or 5.2V, EN=0			1	uA
V _{h_en}	EN Input High Voltage		1			V
V _{l_en}	EN Input Low Voltage				0.3	V

PIN DESCRIPTION

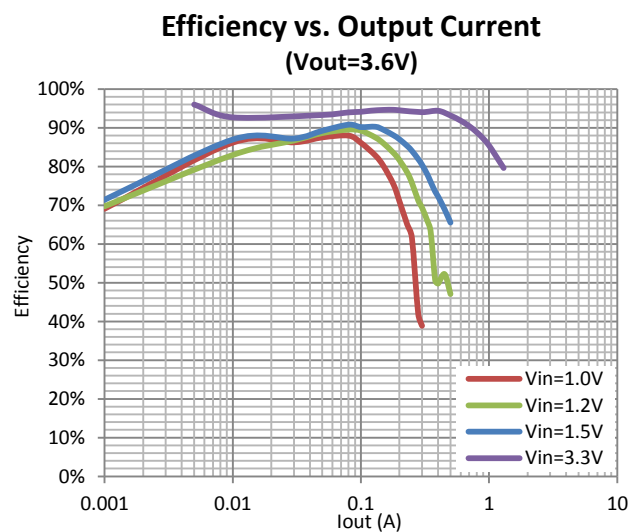
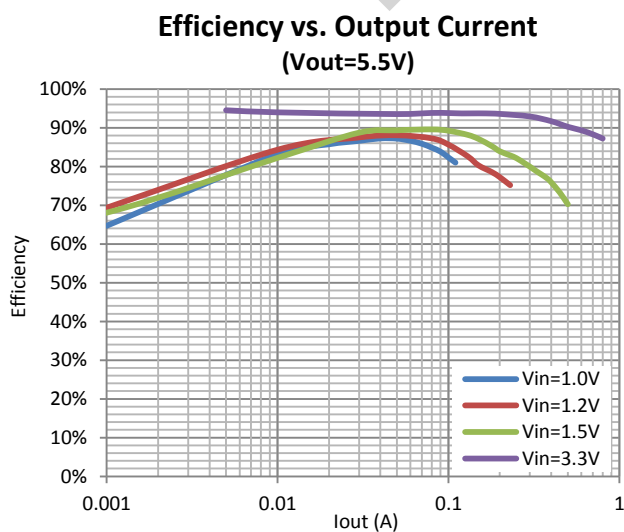
PIN #	NAME	DESCRIPTION
1	EN	Enable pin for the IC. Drive the pin to high to enable the part, and low to disable
2	OUT	Output voltage pin, with 10uF ceramic capacitor closely connected to GND
3	NC	No connection
4	GND	Ground
5	SW	To connect inductor to VIN

BLOCK DIAGRAM

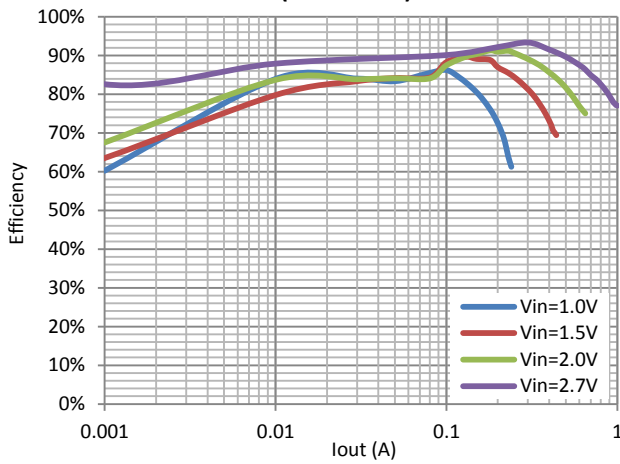


ELECTRICAL PERFORMANCE

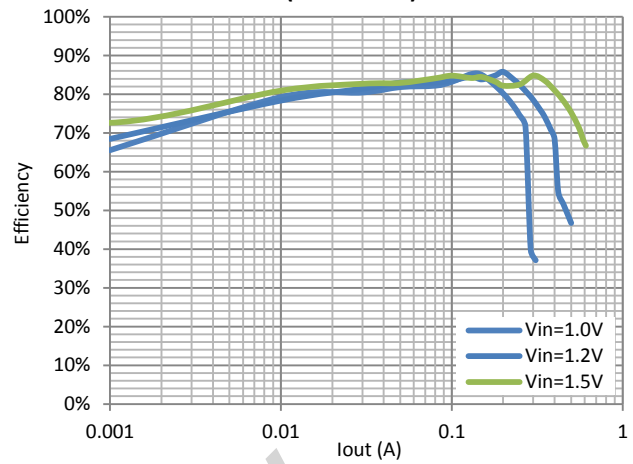
Tested under $C_{in}=C_{out}=10\mu F$, $L=2.2\mu H$, $T_A=25^\circ C$, unless otherwise specified



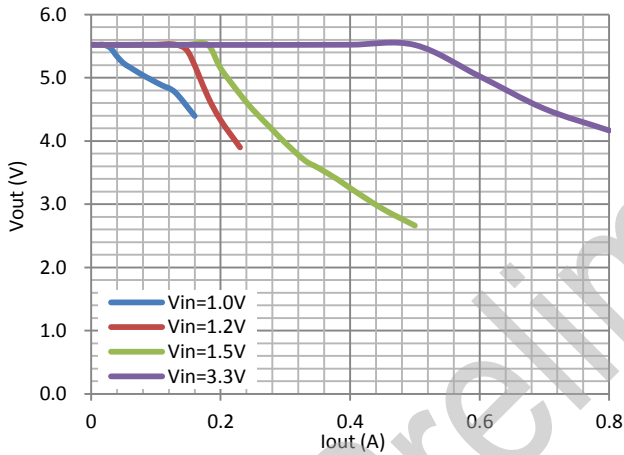
Efficiency vs. Output Current
(Vout=3.3V)



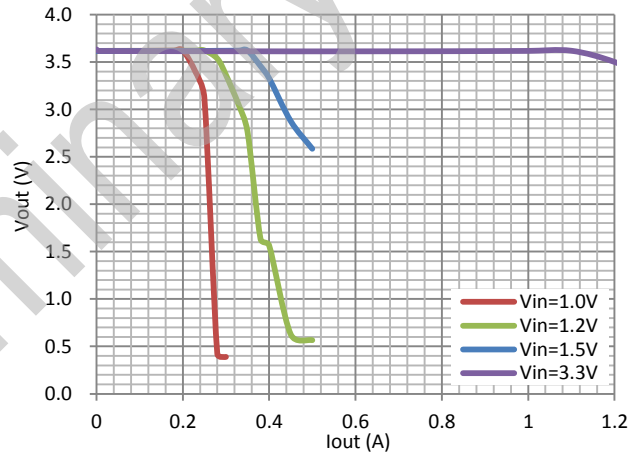
Efficiency vs. Output Current
(Vout=1.8V)



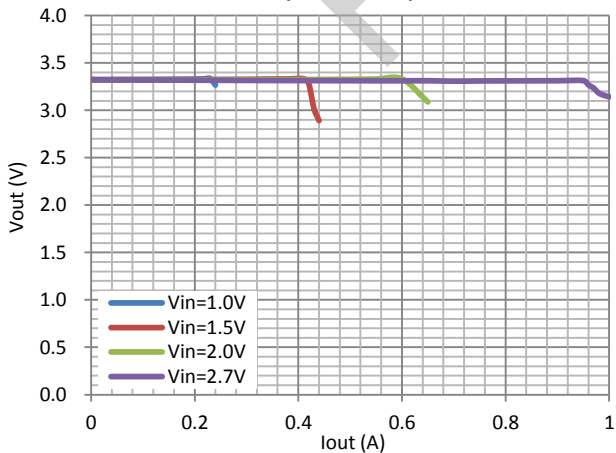
Output Voltage vs. Output Current
(Vout=5.5V)



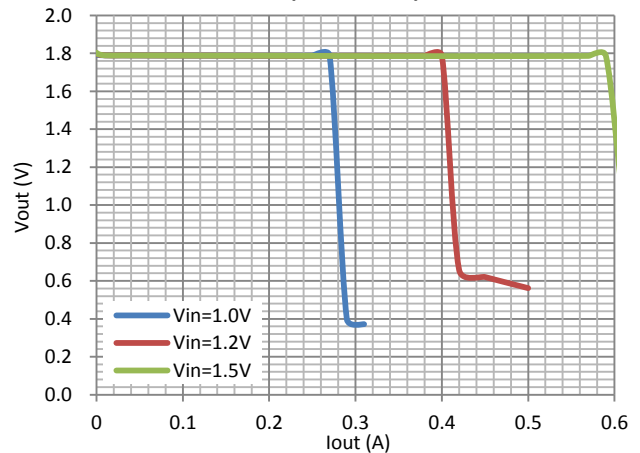
Output Voltage vs. Output Current
(Vout=3.6V)



Output Voltage vs. Output Current
(Vout=3.3V)



Output Voltage vs. Output Current
(Vout=1.8V)



DETAILED DESCRIPTION

LC3501 is a low input voltage start up, current mode DC-DC step up converter. It's operation can be best understood by referring to the block diagram. Upon starting up, the low voltage startup circuitry drives SW with on-off cycles, transferring energy from input to OUT by storing energy in the inductor during on-time and releasing it to the output during off-time. When OUT reaches 2V, the startup circuit turns off and the main controller takes over. The main control loop consists of a reference, a GM error amplifier, a PWM controller, a current sense amplifier, an oscillator, a PWM logic control, and it is power stage including its driver. The main control loop is a classic current mode control loop. The GM stage integrates the error between FB and REF, and its output is used to compare with a triangular wave which the summing result of the current sense amplifier output and a slope compensation voltage. The output of the comparator is used to drive the power stage to reach regulation.

APPLICATION INFORMATION

Inductor selection

With switching frequency up to 1MHz, small surface mount inductors can be used with values from 2.2uH to 4.7uH. For a given chosen inductor value and application conditions make sure the peak inductor current does not exceed the maximum current rating of the selected vendor's inductor.

Input and output capacitor selection

The LC3501's bootstrap architecture allows the use of very small input capacitor. For applications that only need to drive small output load current, the input capacitor is optional, because once output is started up, the IC's is powered by OUT, a quiet power supply.

The output capacitor is used to stabilize the loop and provide ac current to the load. A low ESR ceramic cap with values from 2.2uF to 22uF can be used. Smaller value capacitors are generally cheaper with small footprints, while larger capacitor provides lower ripples and better transient load responses. Also, when extreme low startup voltage is needed, larger output capacitors are needed for the part to startup under heavy load condition.

PACKAGE OUTLINE

Package	SOT-23-5	Devices per reel	3000Pcs	Unit	mm
Package specification:					
<p>The drawing shows the mechanical specifications for the SOT-23-5 package. The top view shows a rectangular body with a total width of 2.9 ± 0.2 mm and a body width of 1.9 ± 0.2 mm. The distance between the two side pins (4 and 5) is 0.95 mm. The distance between the two bottom pins (1 and 2) is 0.4 ± 0.1 mm. The total height of the package is 2.8 ± 0.3 mm, with a body height of 1.6 ± 0.1 mm. The side view shows a maximum height of 1.1 ± 0.2 mm, a pin height of 0.8 ± 0.1 mm, and a pin diameter of 0.15 ± 0.05 mm. The bottom view shows a trapezoidal shape with a minimum height of 0.2 mm.</p>					