Synchronous Boost DC/DC Converter

FEATURES

- High efficiency up to 96%
- 0.6V to 5V input voltage
- 2.5V to 6V output voltage
- Low start-up voltage: 0.9V
- Low switch on (internal switch) resistance: 0.35Ω
- 1.4MHz fixed frequency switching
- 6-lead SOT-23 package
- RoHS Compliant and 100% Lead (Pb) Free

APPLICATIONS

- Cellular phones
- Digital cameras
- MP3 players
- Portable instruments
- Wireless handsets

ORDERING INFORMATION

PART	PACKAGE	RoHS	Ship, Quantity
ZT3001S	SOT-23-6L	Yes	Tape and Reel, 3000

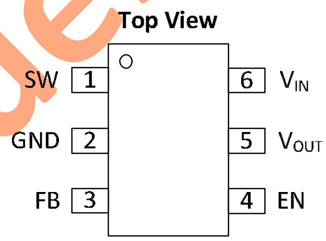
DESCRIPTION

The ZT3001 is a high efficiency, synchronous, 1.4MHz fixed frequency, PWM step-up DC/DC converter. It works with input voltage from 0.6V to 5V. The output voltage is from 2.5V to 6V. The internal synchronous switch is used in ZT3001 to provide high efficiency without the use of Schottky diode.

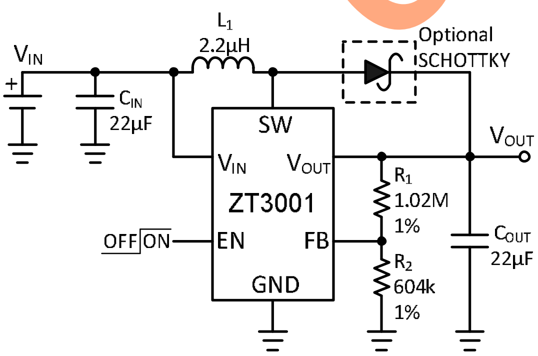
For 3V or 3.3V output, the ZT3001 can provide up to 260mA from a single AA cell, or up to 600mA from 2 serial AA cells.

The ZT3001 minimizes the footprint of overall solution by allowing the use of tiny, low profile inductors and ceramic capacitors. The ZT3001 is available in a 6-lead SOT-23 package and it is RoHS compliant and 100% lead (Pb) free.

Pins Configuration



Typical Application Circuit



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Absolute Maximum Ratings

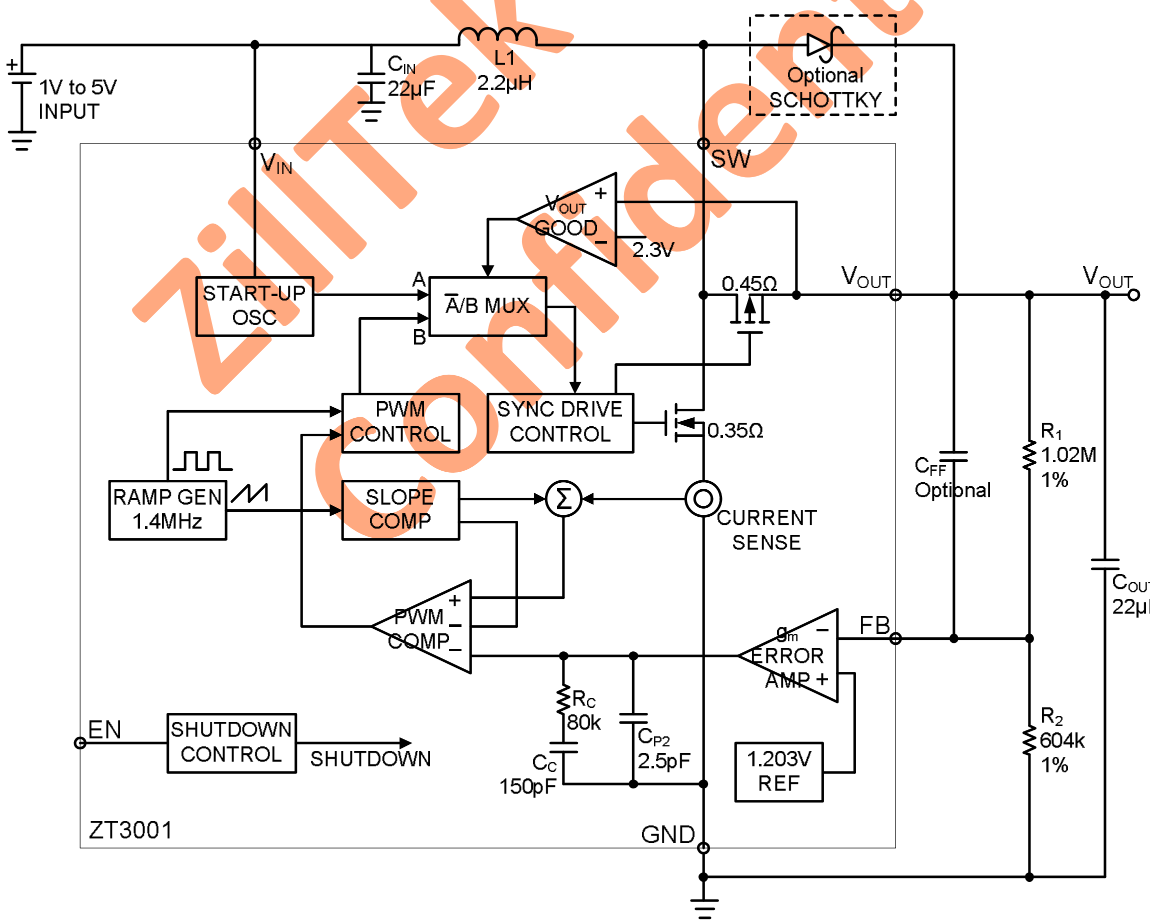
V_{IN} to GND .... –0.3V to +6V
SW Voltage to GND .... –0.3V to +6V
FB Voltage to GND .... –0.3V to +6V
EN Voltage to GND .... –0.3V to +6V
V_{OUT} to GND .... –0.3V to +6V
Power Dissipation .... Internally Limited
Operating Temperature Range .... –30°C to +85°C
Storage Temperature Range .... –65°C to 125°C
Lead Temperature (Soldering 10s) .... +300°C

CAUTION: Stresses above those listed in "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress only rating and operation of the device at these or any other conditions above those indicated in the operational sections of this specification is not implied.

Pins Description

Pin	Symbol	Description
1	SW	Switch.
2	GND	Ground.
3	FB	Feedback.
4	EN	ON/OFF control (HIGH enable).
5	V_{OUT}	Output.
6	V_{IN}	Input.

Functional Block Diagram



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Electrical Specifications

(T_A = 25°C, V_{IN} = 1.2V, V_{OUT} = 3.3V, unless otherwise noted.)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Output Voltage Range (Adjustable)		2.5		6	V
Minimum Start-up Voltage	I_{LOAD} = 1mA		0.9	1.1	V
Minimum Operating Voltage	EN = V_{IN}		0.6	0.75	V
Switching Frequency		1.1	1.4	1.7	MHz
Maximum Duty Cycle	V_{FB} = 1.15V	80	87		%
Current Limit Delay to Output			40		ns
Feedback Voltage		1.165	1.201	1.241	V
Feedback Input Current	V_{FB} = 1.22V		1		nA
NMOS Switch Leakage	V_{SW} = 5V		0.1	5	µA
PMOS Switch Leakage	V_{SW} = 0V		0.1	5	µA
NMOS Switch ON Resistance	V_{OUT} = 3.3V		0.35		Ω
PMOS Switch ON Resistance	V_{OUT} = 3.3V		0.45		Ω
NMOS Current Limit		700	950		mA
Quiescent Current (Active)	Measured on V_{OUT}, Non-Switching		300	500	µA
Shutdown Current	V_{EN} = 0V, Including Switch Leakage		0.1	1	µA
EN Input High		1			V
EN Input Low				0.35	V
EN Input Current	V_{EN} = 5.5V		0.01	1	µA

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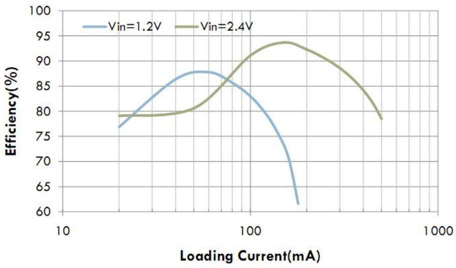
Typical Characteristics

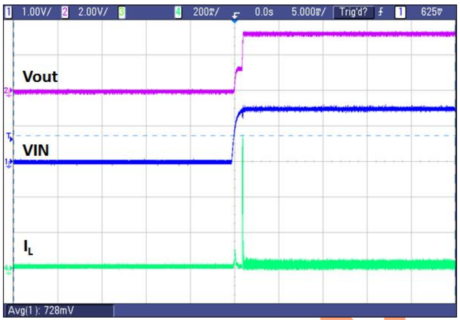
(V_{IN} = 1.5V, V_{OUT} = 3.3V, T_A = 25°C, unless otherwise noted.)

Efficiency vs. loading current



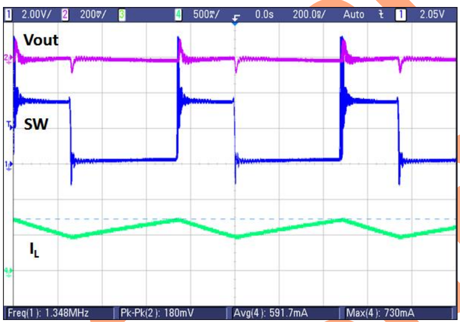
Min. start up voltage (VIN = 0.95V)

Soft start and inrush current



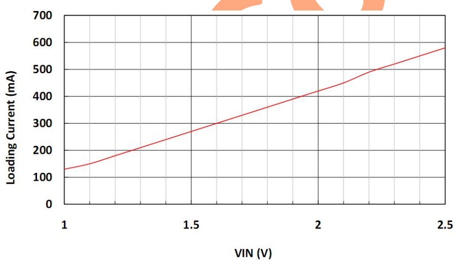
Medium loading operation (100mA)

Heavy loading operation (200mA)



Dynamic loading operation (I_L = 100 ~ 200mA)

VIN vs. loading current



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APPLICATION INFORMATION

Pin Assignment

SW (Pin 1): Switch Pin. Connect inductor between SW and V_{IN}. Keep these PCB trace lengths as short and wide as possible to reduce EMI and voltage overshoot.

GND (Pin 2): Signal and Power Ground. Provide a short direct PCB path between GND and the (–) side of the output capacitor(s).

FB (Pin 3): Feedback Input to the g_m Error Amplifier. Connect resistor divider tap to this pin. The output voltage can be adjusted from 2.5V to 6V by:

$$V_{OUT} = 1.203V \times (1 + \frac{R_1}{R_2})$$

EN (Pin 4): Logic Controlled Shutdown Input.

EN = HIGH: Normal free running operation, 1.4MHz typical operating frequency.

EN = LOW: Shutdown, quiescent current $\leq$ 1μA. Output capacitor can be completely discharged through the load or feedback resistors.

V_{OUT} (Pin 5): Output Voltage Sense Input and Drain of the Internal Synchronous Rectifier MOSFET. Bias is derived from V_{OUT}. PCB trace length from V_{OUT} to the output filter capacitor(s) should be as short and wide as possible.

V_{IN} (Pin 6): Battery Input Voltage. The device gets its start-up bias from V_{IN}. Once V_{OUT} exceeds V_{IN}, bias comes from V_{OUT}. Thus, once started, operation is completely independent from V_{IN}. Operation is only limited by the output power level and the battery's internal series resistance.

PCB Layout Guidelines

The high speed operation of the ZT3001 demands careful attention to board layout. You will not get advertised performance with careless layout. Figure 1 is an example which shows the recommended component placement with optional Schottky diode. A large ground pin copper area will help to lower the chip temperature. A multilayer board with a separate ground plane is ideal, but not absolutely necessary.

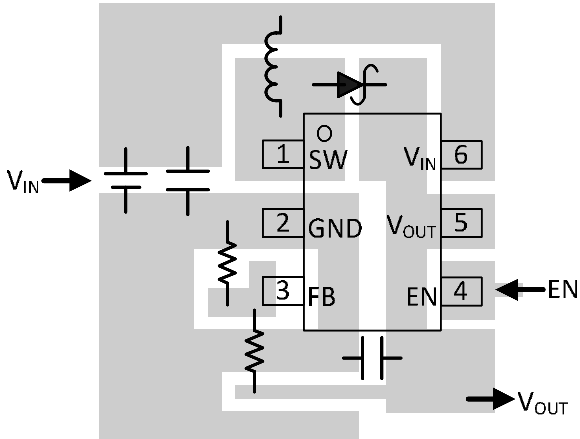

Figure 1: Recommended component placement for single layer board with optional Schottky diode. Traces carrying high current are direct. Trace area at FB pin is small. Lead length to battery is short.

Inductor Selection

The ZT3001 can utilize small surface mount and chip inductors due to its fast 1.4MHz switching frequency. Typically, a 2.2μH inductor is recommended for most applications. Larger values of inductance will allow greater output current capability by reducing the inductor ripple current. Increasing the inductance above 10μH will increase size while providing little improvement in output current capability.

$$I_{OUT(MAX)} = \eta \times (I_P - \frac{V_{IN} \times D}{2 \times f \times L}) \times (1 - D)$$

where:

η = estimated efficiency

I_P = peak current limit value (0.7A)

V_{IN} = input (battery) voltage

D = steady-state duty ratio = $(V_{OUT} - V_{IN})/V_{OUT}$

f = switching frequency (1.4MHz typical)

L = inductance value

The inductor current ripple is typically set for 20% to 40% of the maximum inductor current (I_P). High frequency ferrite core inductor materials reduce frequency dependent power losses compared to cheaper powdered iron types, improving efficiency. The inductor should have low ESR (series resistance of the windings) to reduce the I^2R power losses, and must be able to handle the peak inductor current without saturating. Molded chokes and some chip inductors usually do not have enough core to support the peak

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inductor currents of 950mA seen on the ZT3001. To minimize radiated noise, use a toroid, pot core or shielded bobbin inductor. See Table 1 for some suggested components and suppliers.

PART	L (μH)	MAX DCR mΩ	MAX DC CURRENT (A)	SIZE W x L x H (mm^3)	VENDOR
CDRH3D16	2.2	75	1.20	3.8 x 3.8 x 1.8	Sumida
CDH3B16	2.2	70	1.20	4.0 x 4.0 x 1.8	Ceaiya

Table 1: Recommended inductors.

Output and Input Capacitor Selection

Low ESR (equivalent series resistance) capacitors should be used to minimize the output voltage ripple. Multilayer ceramic capacitors are an excellent choice as they have extremely low ESR and are available in small footprints. A 4.7μF to 22μF output capacitor is sufficient for most applications. Larger values up to 22μF may be used to obtain extremely low output voltage ripple and improve transient response. An additional phase lead capacitor may be required with output capacitors larger than 10μF to maintain acceptable phase margin. X5R and X7R dielectric materials are preferred for their ability to maintain capacitance over wide voltage and temperature ranges.

Low ESR input capacitors reduce input switching noise and reduce the peak current drawn from the battery. It follows that ceramic capacitors are also a good choice for input decoupling and should be located as close as possible to the device. A 10μF input capacitor is sufficient for virtually any application. Larger values may be used without limitations. Table 2 shows a list of several ceramic capacitor manufacturers. Consult the manufacturers directly for detailed information on their entire selection of ceramic capacitors.

SUPPLIER	WEBSITE
AVX	www.avxcorp.com
Murata	www.murata.com
Taiyo Yuden	www.t-yuden.com

Table 2: Capacitor vendor information.

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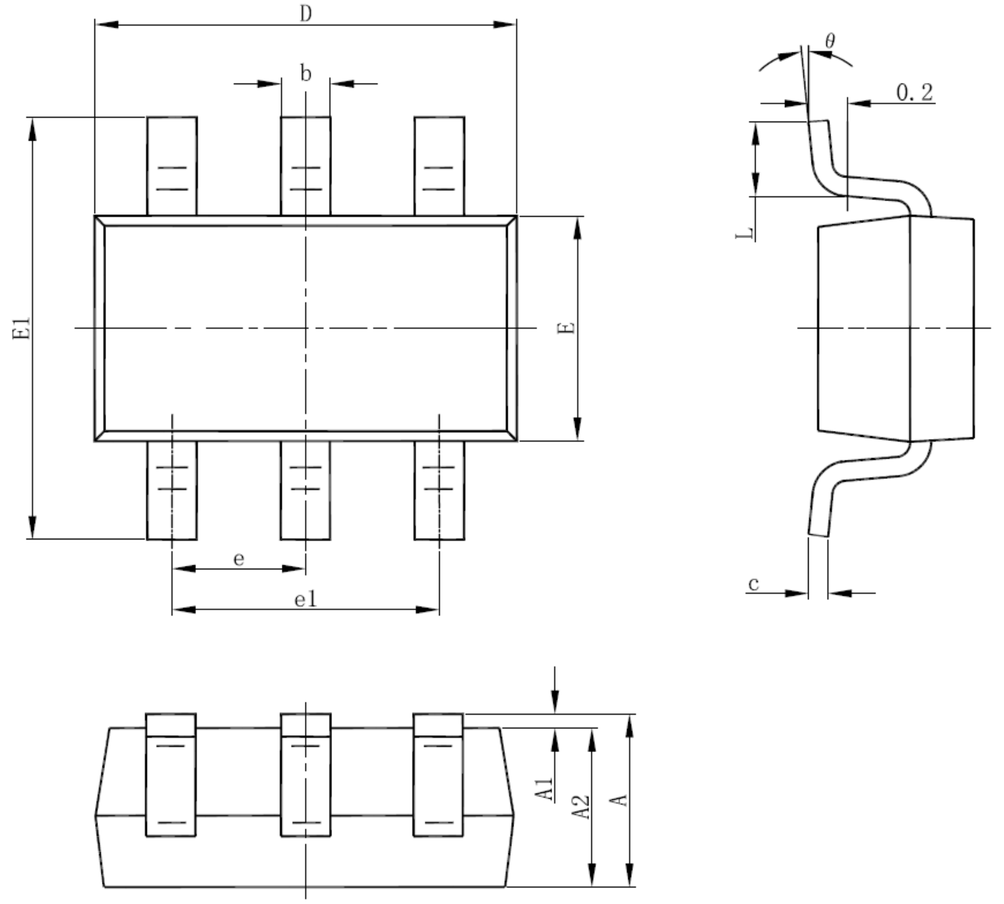
PACKAGE DIMENSION (SOT-23-6L)

SOT-23-6L 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°

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