BL9362

60V, 2MHz，600mA Step-Down Converter

Description

BL9362 is a wide input range, high-efficiency, and high frequency DC-to-DC step-down switching regulator, capable of delivering up to 0.6A of output current.

With a fixed switching frequency of 2MHz, this current mode PWM controlled converter allows the use of small external components, such as ceramic input and output caps, as well as small inductors.

Including cold crank and double battery jump-starts, the minimum input voltage may be as low as 4.5V and the maximum up to 60V, with even higher transient voltages. With these high input voltages, linear regulators cannot be used for high supply currents without overheating the regulator. Instead, high efficiency switching regulators such as BL9362 must be used to minimize thermal dissipation.

Features

- Wide Input Operating Range from 4.5V to 60V
- 850mΩ internal NMOS
- Up to 95% Efficiency at 16V in 12V out L=47uH with 300mA loading
- Internal compensation
- Capable of Delivering 600mA continuous output current
- Fixed 2MHz PWM operation
- Internal soft start
- Output voltage adjustable down to 0.795V
- Cycle-by-cycle current limit
- Current Mode control
- Short-circuit protection
- Logic Control Shutdown EN can be short to VIN
- Thermal shutdown and UVLO

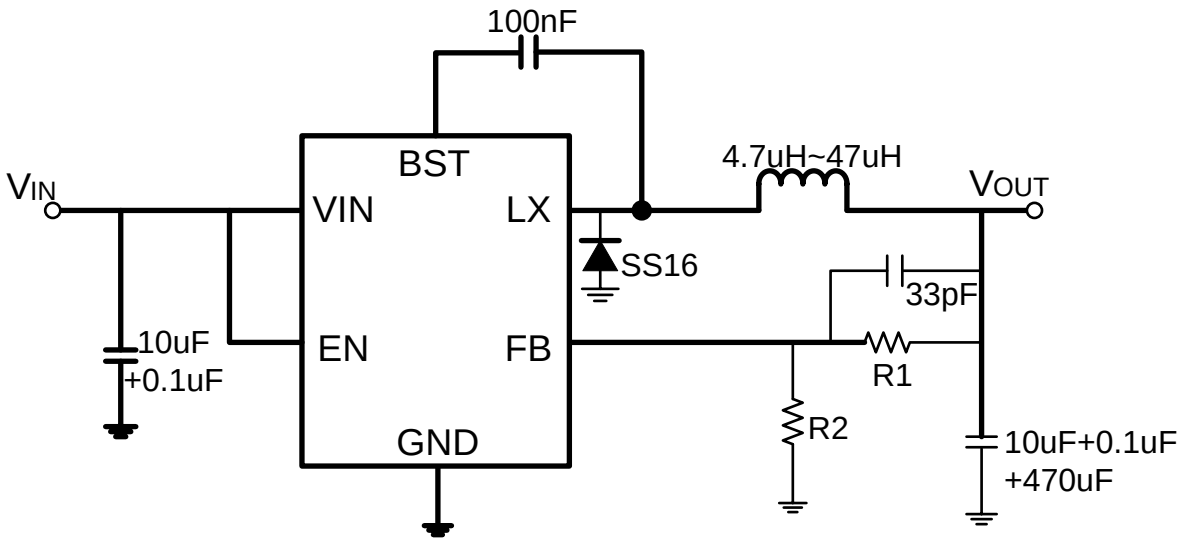
Applications

- Smart/Industrial/Power Meters
- Industrial Applications
- Automotive Applications

Package

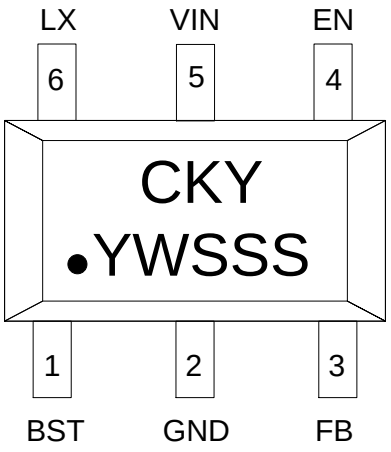
- 6-pin SOT23-6

Typical Application Circuit



Notice：BL9362 minimum duty cycle = 20%, and the relationship between duty cycle to output voltage and input voltage is duty cycle = output voltage / input voltage, so the maximum input voltage = output voltage / 0.2 to ensure that SW does not cause frequency hopping due to too small duty cycle.

Pin Configuration and Marking Information



CKY: Product Code

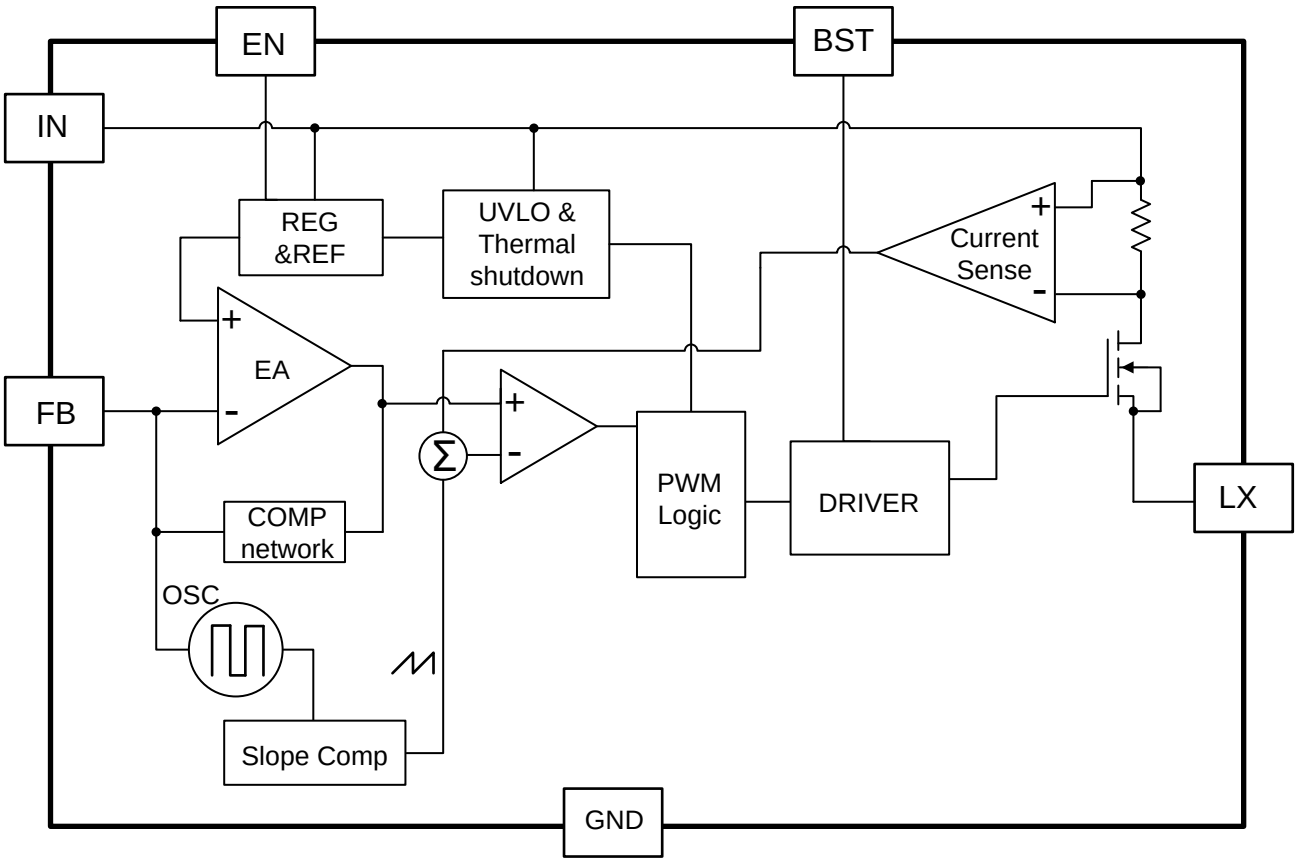
YW: Date Code (Year & Week)

SSS: Lot No.

Pin Assignment

Pin No.	Symbol	Function
1	BST	Bootstrap pin for top Switch. In Typ. application, a 0.1uF or larger capacitor should be connected between this pin and the LX pin to supply current to the top Switch gate and top Switch driver.
2	GND	Analog Ground.
3	FB	Output feedback pin. In Typ. application, FB senses the output voltage and is regulated by the control loop to 795mV. Connect a resistive divider at FB.
4	EN	Drive EN pin high to turn on the regulator and low to turn off the regulator.
5	V_{IN}	Input voltage pin, In Typ. application, VIN supplies power to the IC. Connect a 4.5V to 60V supply to VIN and bypass VIN to GND with a suitably large capacitor to eliminate noise on the input to the IC.
6	LX	LX is the Switching node that supplies power to the output Connect the output LC filter from LX to the output load.

Block Diagram



Absolute Maximum Ratings

Parameter		Range	Unit
Input Voltage (V_{IN})		-0.3 ~ 65	V
Maximum Operating Junction Temperature (T_J)		150	℃
LX, EN Voltage		-0.3V to V_{IN}+0.3V	V
BST Voltage		-0.3V to LX+6V	V
FB Voltage		-0.3V to 6V	V
LX to ground current		Internally limited	A
Operating Temperature(T_{Opr})		-40~+85	℃
Package Thermal Resistance(θ_{JC})	SOT23-6	110	°C / W
Storage temperature (T_{STG})		-55 ~ +150	℃
ESD Rating		2500	V

Note:

Exceed these limits to damage to the device. Exposure to absolute maximum rating conditions may affect device reliability.

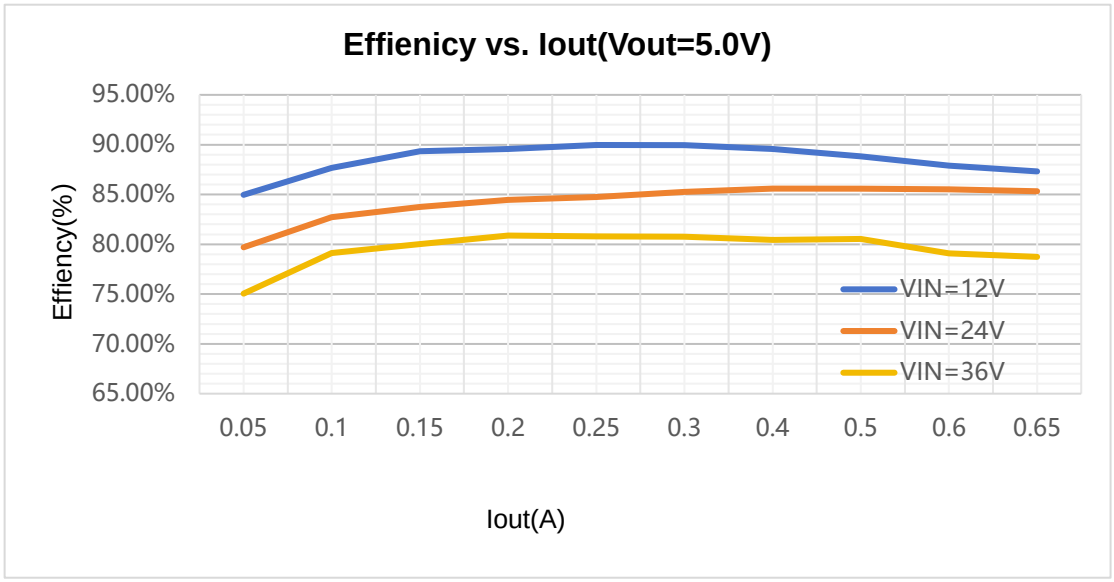
Electrical Characteristics

V_{IN}= V_{EN} =16V, T_A=25℃, unless otherwise specified.

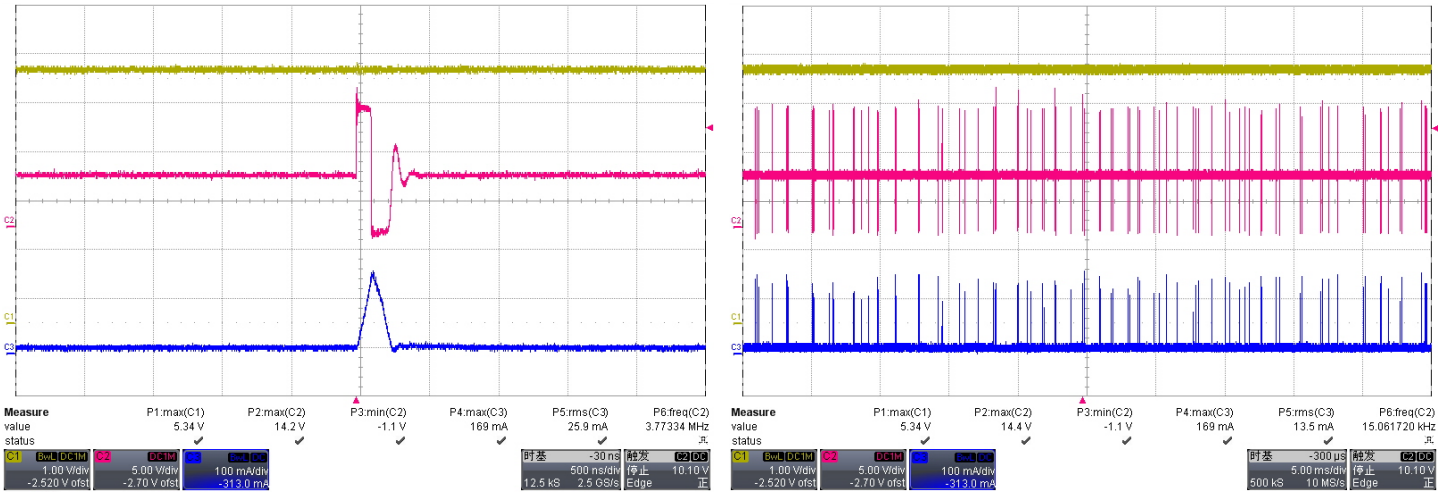
Parameter	Symbol	Test Condition	Min	Typ.	Max	Unit
Input Voltage Range	V_{IN}		4.5		60	V
Input Supply Current	I_Q	V_{FB}=5V no loading		648		uA
Input Shutdown Current	Isd	V_{EN}<0.3V		0.2	3	uA
Feedback Voltage	V_{FB}	4.5V<V_{IN}<60V	0.780	0.795	0.810	V
ENABLE						
EN high level	V_{EN}_ON	V_{FB}=0V,rising	1.23	2.5		V
EN low level	V_{EN}_OFF	V_{FB}=0V,falling		1	1.13	V
EN Hysteresis	EN hys	V_{FB}=0V		0.10		V
Enable input current	I_{EN}	V_{EN}=16V		4.4		uA
MODULATOR						
OSC frequency	Fosc		1.6	2	2.4	MHz
Maximum Duty Cycle	D_{MAX}			87		%
Minimum on time	Ton $_{MIN}$			100		nS
Limited current	I_{LIM}			0.95		A
Thermal shutdown	T_{HSD}	Temp rising		160		℃
		Temp falling		140		℃
Power stage output						
NMOS leakage	$I_{leakage}$	V_{EN}=0V, V_{LX}=0V			10	uA
NMOS on resistance	RD_{SON}	V_{IN}=12V V_{BST}-V_{LX}=5V		850		mΩ

Typical Performance Characteristics

Tested under T_A=25°C, unless otherwise specified.

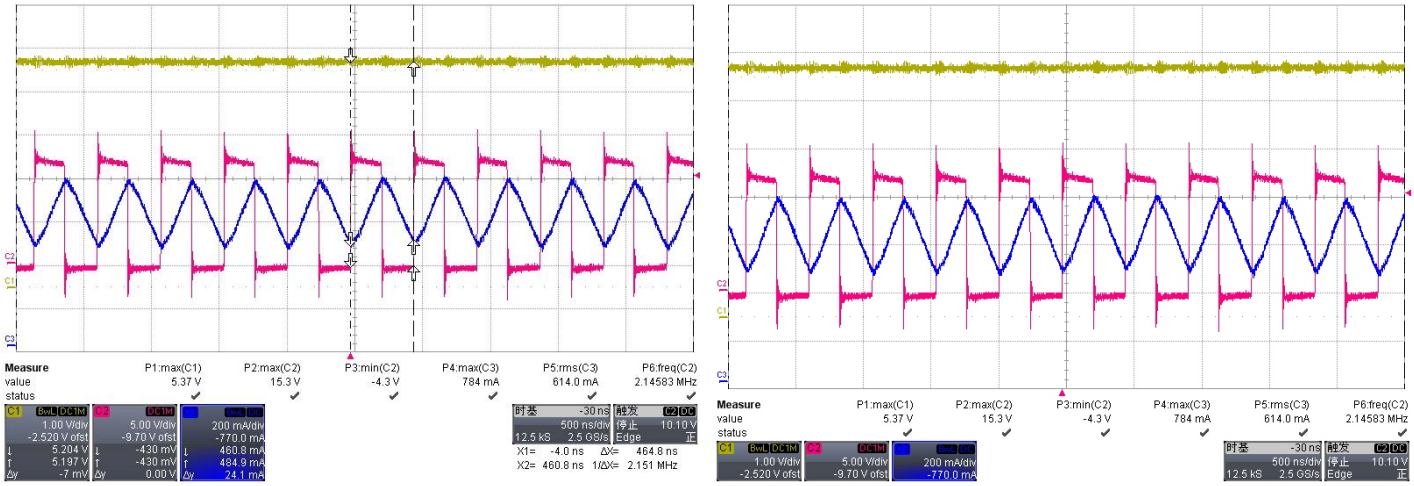


Output Voltage and SW at 0A load (V_{IN}=12V, V_{OUT}=5V)



Ch1—V_{OUT}, Ch2—V_{SW}, Ch3—I_L

Output Voltage and SW at 0.6A load (V_{IN}=12V, V_{OUT}=5V)



Ch1—V_{OUT}, Ch2—V_{SW}, Ch3—I_L

Functional Description

Loop Operation

The BL9362 is a wide input range, high-efficiency, DC-to-DC step-down switching regulator, capable of delivering up to 0.6A of output current, integrated with a 850mΩ high side MOSFET. It uses a PWM current-mode control scheme. An error amplifier integrates error between the FB signal and the internal reference voltage. The output of the integrator is then compared to the sum of a current-sense signal and the slope compensation ramp. This operation generates a PWM signal that modulates the duty cycle of the power MOSFETs to achieve regulation for output voltage.

Application Information

Setting Output Voltages

Output voltages are set by external resistors. The FB threshold is 0.795V.

$$R_{TOP} = R_{BOTTOM} * (\frac{V_{OUT}}{0.795} - 1)$$

Inductor Selection

The peak-to-peak ripple is limited to 30% of the maximum output current. This places the peak current far enough from the minimum over current trip level to ensure reliable operation while providing enough current ripples for the current mode converter to operate stably. In this case, for 0.6A maximum output current, the maximum inductor ripple current is 300 mA. The inductor size is estimated as following equation:

$$L_{IDEAL} = \frac{V_{IN(MAX)} - V_{OUT}}{I_{RIPPLE}} * D_{MIN} * \frac{1}{F_{OSC}}$$

Therefore, for V_{OUT}=5V, the inductor values is calculated to be L = 13μH. Chose 10μH or 15μH.

For V_{OUT} =3.3V, the inductor values is calculated to be L = 9.2μH. Chose 10μH.

Output Capacitor Selection

For most applications a nominal 22μF or larger capacitor is suitable. The BL9362 internal compensation is designed for a fixed corner frequency that is equal to FC= 8.7KHz

For example, for V_{OUT}=5V, L=15μH, C_{OUT}=22μF.

The output capacitor keeps output ripple small and ensures control-loop stability. The output capacitor must also have low impedance at the switching frequency. Ceramic, polymer, and tantalum capacitors are suitable, with ceramic exhibiting the lowest ESR and high-frequency impedance. Output ripple with a ceramic output capacitor is approximately as follows:

$$V_{RIPPLE} = I_{L(PEAK)} * \frac{1}{2\pi * F_{OSC} * C_{OUT}}$$

If the capacitor has significant ESR, the output ripple component due to capacitor ESR is as follows:

$$V_{RIPPLE(ESR)} = I_{L(PEAK)} * ESR$$

Input Capacitor Selection

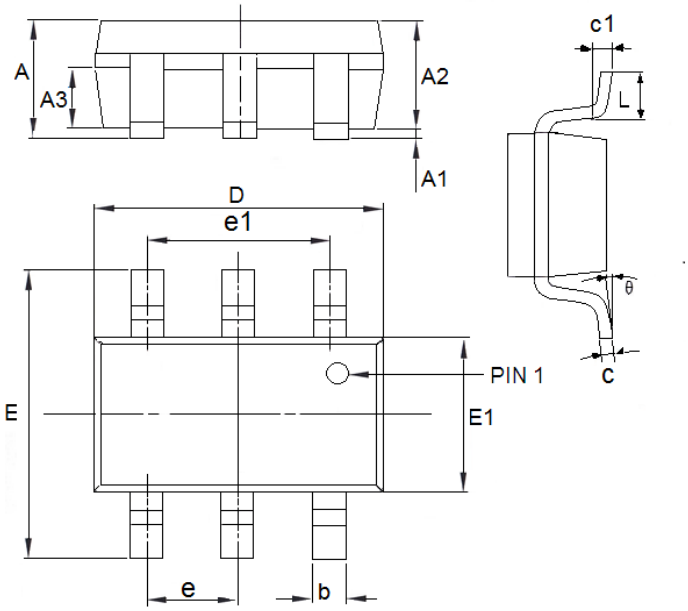
The input capacitor in a DC-to-DC converter reduces current peaks drawn from the battery or other input power source and reduces switching noise in the controller. The impedance of the input capacitor at the switching frequency should be less than that of the input source so high-frequency switching currents do not pass through the input source. The output capacitor keeps output ripple small and ensures control-loop stability.

Components Selection

R1(K)	Vo(V)	R2(K)	Recommend
127	12	9.00	9.09K
127	5	23.97	23.7K
127	3.3	40.24	40.2K

Package Information

Package	SOT23-6	Devices per reel	3000 pcs



DIM	Millimeters		Inches	
	Min	Max	Min	Max
A	1.05	1.45	0.0413	0.0571
A1	0	0.15	0.0000	0.0059
A2	0.9	1.3	0.0354	0.0512
A3	0.55	0.75	0.0217	0.0295
b	0.25	0.5	0.0098	0.0197
c	0.1	0.25	0.0039	0.0098
D	2.7	3.12	0.1063	0.1228
e1	1.9(TYP)		0.0748(TYP)	
E	2.6	3.1	0.1024	0.1220
E1	1.4	1.8	0.0551	0.0709
e	0.95(TYP)		0.0374(TYP)	
L	0.25	0.6	0.0098	0.0236
θ	0	8°	0.0000	8°
c1	0.2(TYP)		0.0079(TYP)	