

## 3A, 20V High Efficiency Synchronous Step-Down Converter

### DESCRIPTION

The BL9384B is a wide input range, high efficiency, DC-to-DC step-down switching regulator, capable of delivering up to 3A of output current. Current mode PWM control allows the use of small external components, such as ceramic input and output caps, as well as small inductors, while still providing low output ripples. On top of the integrated internal synchronous rectifier that eliminates external Schottky diode, Overall BL9384B is a highly efficient and robust solution for DC-DC step-down applications that requires wide input ranges.

BL9384B is available ESOP8 Packages.

### FEATURES

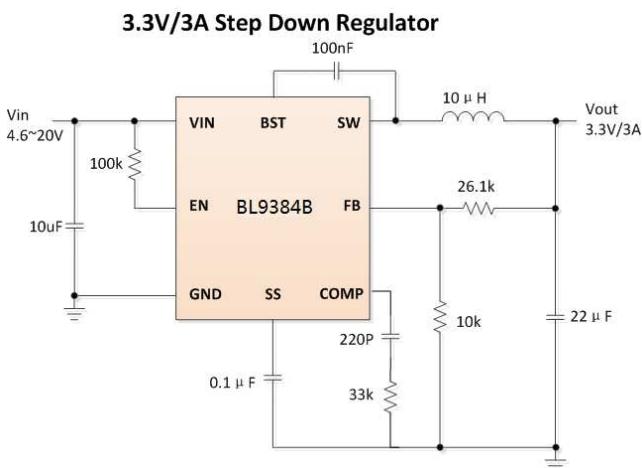
- Wide Input Operating Range from 4.5V to 20V
- Capable of Delivering 3A

- Up to 94% efficiency
- High efficiency (>85%) at light load
- No External Schottky Diode Needed
- Current Mode control
- 0.923V Reference for Low Output voltages
- Logic Control Shutdown
- Thermal shutdown and UVLO
- Start-up current run-away protection
- Short circuit protection
- Available in ESOP8 Package

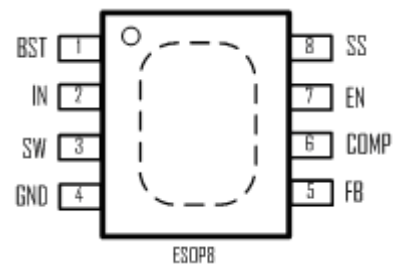
### APPLICATIONS

- LCD TVs
- Green Electronics/ Appliances
- Distributed Power Systems
- Notebook computers
- FPGA power supplies
- LED drivers

### TYPICAL APPLICATION



### PIN OUT



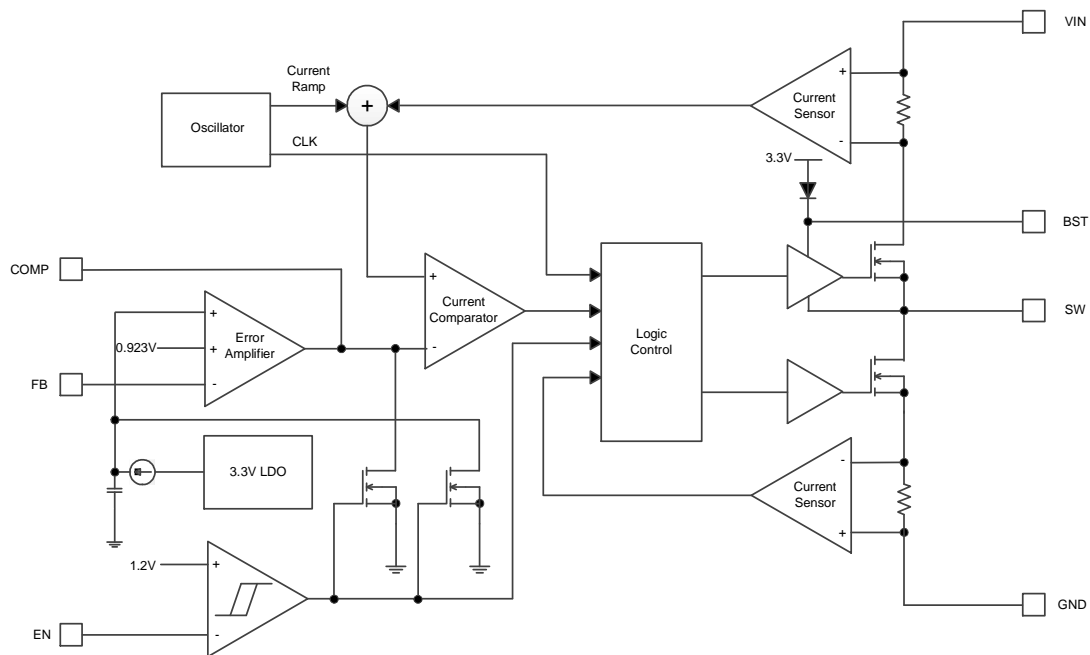
## MARK and ORDERING INFORMATION

Mark Explanation	
XX: Year	<div style="border: 1px solid black; padding: 10px; width: fit-content; margin: 0 auto;"> <p>BL9384B</p> <p>XXYY ZZ</p> </div>
YY: Week	
ZZ: Internal code	

## PINOUT DESCRIPTION

PIN #	NAME	DESCRIPTION
1	BST	Bootstrap pin. Connect a 100nF capacitor from this pin to SW
2	IN	Supply Voltage. Bypass with a 10 $\mu$ F ceramic capacitor to GND
3	SW	Inductor Connection. Connect an inductor Between SW and the regulator output.
4	GND	Ground
5	FB	Feedback Input. Connect an external resistor divider from the output to FB and GND to set VOUT
6	COMP	Compensation pin. COMP is used to compensate the regulation control loop. Connect a series RC network from COMP to GND to compensate the regulation control loop.
7	EN	Enable pin for the IC. Drive this pin to high to enable the part, low to disable.
8	SS	Soft start pin. Connect a 0.1 $\mu$ F capacitor from this pin to GND

## BLOCK DIAGRAM



## ABSOLUTE MAXIMUM RATING

Parameter	Value
Input Voltage Range, SW, EN Voltage	-0.3V-22V
Junction Temperature(Tj)	125°C
BST Voltage	-0.3V to SW+5V
FB Voltage	-0.3V to 6V
SW to ground curren	Internally limited
Operating Temperature(To)	-40°C -85°C
Package Thermal Resistance (θjc)	ESOP-8L 10°C / W
Storage Temperature(Ts)	-55°C - 150°C

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

## ELECTRICAL CHARACTERISTICS

(VIN=12V, unless otherwise specified. Typical values are at TA=25°C)

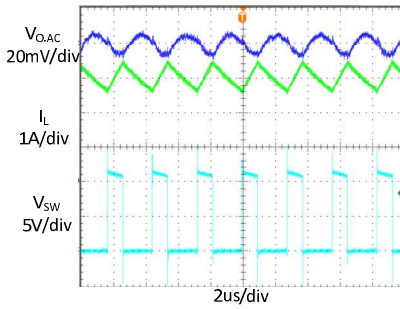
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VDD	Input Voltage Range		5		20	V
UVLO_UP	UVLO,IN UVLO Rising	Rising, Hysteresis=140mV		4.2		V
Vref	Feedback Voltage			0.923		V
I <sub>fb</sub>	Feedback Leakage current			0.1	0.4	uA
I <sub>q</sub>	Quiescent Current	Active, V <sub>fb</sub> =1V, No Switching		60		uA
		Shutdown		0.1	3	uA
F <sub>sw</sub>	Switching Frequency	V <sub>en</sub> =2V, V <sub>in</sub> =12V		360		KHz
R <sub>dsonP</sub>	PMOS R <sub>dson</sub>			185		mohm
R <sub>dsonN</sub>	NMOS R <sub>dson</sub>			100		mohm
I <sub>limit</sub>	Peak Current Limit			4.4		A
V <sub>en</sub>	EN Input Low Voltag		1.3			V
I <sub>sw</sub>	SW Leakage Current	V <sub>in</sub> =12V,V <sub>sw</sub> =0 or 12V, EN= GND			10	μA
TSD	Over Temperature Proection			150		°C

## TYPICAL PERFORMANCE CHARACTERISTICS

( $V_{in}=12V$ ,  $V_{out}=3.3V$ ,  $L=10\mu H$ ,  $C_{out}=47\mu F$ ,  $T_A=25^\circ C$ , unless otherwise stated)

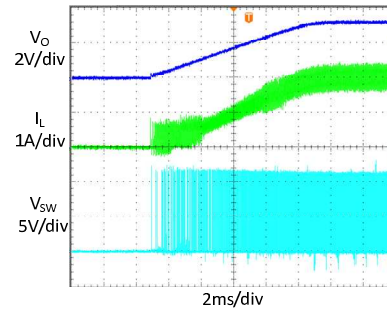
### Steady State Test

$V_{in}=12V$ ,  $V_{out}=3.3V$   
 $I_{out}=3A$ ,  $I_{in}=0.65A$



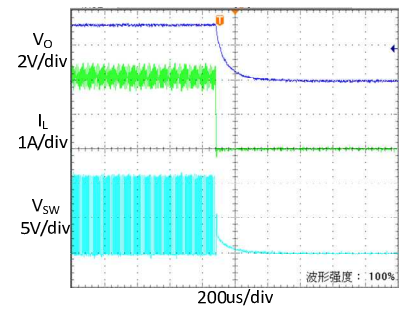
### Startup through Enable

$V_{in}=12V$ ,  $V_{out}=3.3V$   
 $I_{out}=2.5A$  (Resistance load)



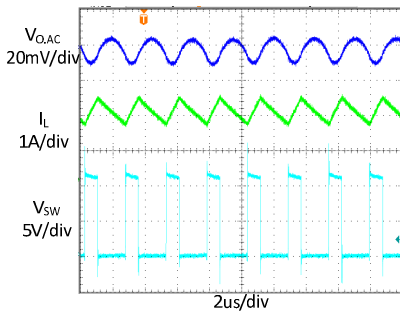
### Shutdown through Enable

$V_{in}=12V$ ,  $V_{out}=3.3V$   
 $I_{out}=2.5A$  (Resistance load)



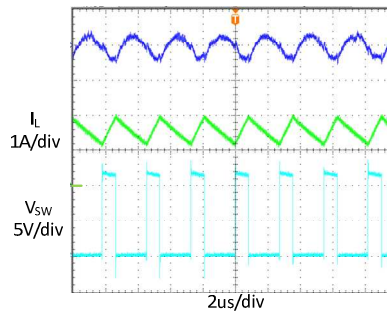
### Heavy Load Operation

3A LOAD



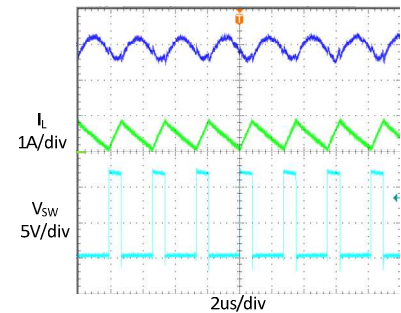
### Medium Load Operation

1.5A LOAD

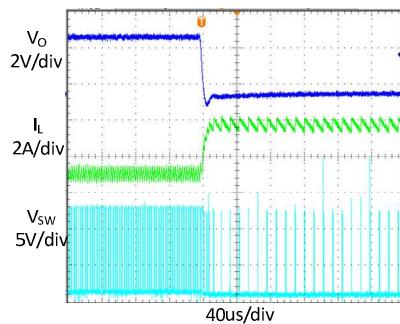


### Light Load Operation

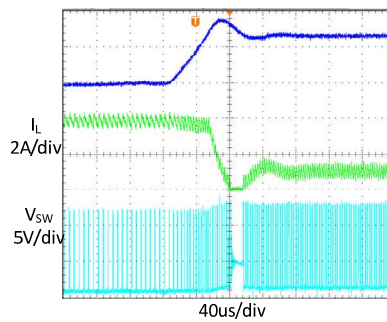
0.4A LOAD



### Short Circuit Protection

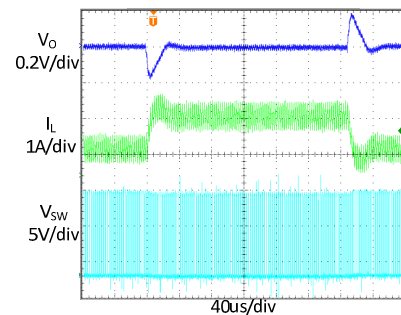


### Short Circuit Recovery



### Load Transient

1.5A LOAD  $\rightarrow$  3A LOAD  $\rightarrow$  1.5A LOAD



## FUNCTIONAL DESCRIPTION

The BL9384B is a synchronous, current-mode, step-down regulator. It regulates input voltages from 5V to 20V down to an output voltage as low as 0.923V, and is capable of supplying up to 3A of load current.

### Current-Mode Control

The BL9384B utilizes current-mode control to regulate the output voltage. The output voltage is measured at the FB pin through a resistive voltage divider and the error is amplified by the internal transconductance error amplifier. COMP pin is output of the internal error amplifier and is compared to the switch current measured internally to control the output current limit.

### PFM Mode

The BL9384B operates in PFM mode at light load. In PFM mode, switch frequency is continuously controlled in proportion to the load current, i.e. switch frequency is decreased when load current drops to boost power efficiency at light load by reducing switch-loss, while switch frequency is increased when load current rises, minimizing both load current and output voltage ripples.

### Shut-Down Mode

The BL9384B operates in shut-down mode when voltage at EN pin is driven below 0.3V. In shut-down mode, the entire regulator is off and the supply current consumed by the BL9384B drops below 1 $\mu$ A.

### Power Switch

N-Channel MOSFET switches are integrated on the BL9384B to down convert the input voltage to the regulated output voltage. Since the top MOSFET needs a gate voltage great than the input voltage, a boost capacitor connected between BST and SW pins is required to drive the gate of the top switch. The boost capacitor is charged by the internal 3.3V rail when SW is low.

### Vin Under-Voltage Protection

A resistive divider can be connected between Vin and ground, with the central tap connected to EN, so that when Vin drops to the pre-set value, EN drops below 1.2V to trigger input under voltage lockout protection.

### Output Current Run-Away Protection

At start-up, due to the high voltage at input and low voltage at output, current inertia of the output inductance can be easily built up, resulting in a large start-up output current. A valley current limit is designed in the BL9384B so that only when output current drops below the valley current limit can the bottom power switch be turned off. By such control mechanism, the output current at start-up is well controlled.

### Output Short Protection

When output is shorted to ground, output current rapidly reaches its peak current limit and the top power switch is turned off. Right after the top power switch is turned off, the bottom power switch is turned on and stay on until the output current falls below the valley current limit. When output

current is below the valley current limit, the top power switch will be turned on again and if the output short is still present, the top power switch is turned off when the peak current limit is reached and the bottom power switch is turned on. This cycle goes on until the output short is removed and the regulator comes into normal operation again.

## Thermal Protection

When the temperature of the BL9384B rises above 150° C, it is forced into thermal shut-down. Only when core temperature drops below 125° C can the regulator becomes active again.

## PCB Layout Note

1. Place the input decoupling capacitor as close to BL9384B (VIN pin and PGND) as possible to eliminate noise at the input pin.
2. Put the feedback trace as far away from the inductor and noisy power traces as possible.
3. The ground plane on the PCB should be as large as possible for better heat dissipation.

## PACKAGE OUTLINE

