

Description

The BP1808 is a DC/DC constant current LED driver with an integrated 70V/300mΩ MOSFET designed for a wide input-voltage range of 3V to 60V. The BP1808 can be configured as Buck, Boost and Buck-Boost topology.

With a current sense reference of 200mV, the LED current is programmed by an external current sense resistor and the power loss is minimized. The BP1808 allows both analog and PWM dimming by DIM pin.

The fixed 420kHz operating frequency minimizes size of external inductor, input and output capacitor. Current mode operation provides fast transient response and easy loop stability.

BP1808 offers rich protection functions including VDD under voltage protection, output over voltage protection, cycle-by-cycle peak current limit and thermal regulation.

The BP1808 adopts SOP8-EP package for enhanced power dissipation.

Typical Application (Boost)

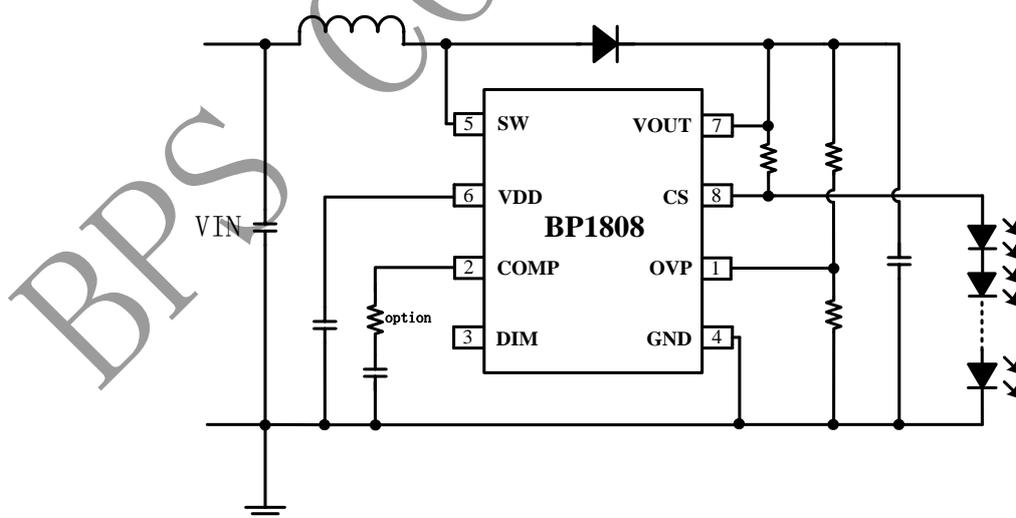


Figure 1. Typical application (Boost)

Features

- Wide 3V to 60V Input Voltage Range
- Supporting Boost, Buck-Boost, Buck Topology
- Integrated 70V/300mΩ MOSFET
- $\pm 3\%$ LED Output Current Accuracy
- Combined Analog and PWM Dimming
- Fixed 420kHz operating Frequency
- Adjustable Soft-Start
- Cycle-by-Cycle Peak Current Limiting
- VDD Under Voltage Protection
- Programmable Over Voltage Protection
- Thermal Regulation Function
- Available in SOP8-EP Package

Applications

- MR16 LED Lighting
- Smart Dimming LED lighting
- Automotive LED Lighting
- Solar LED lighting
- Other LED Lighting

Ordering Information

Part Number	Package	Operating Temperature	Packing Method	Marking
BP1808	SOP8-EP	-40 °C to 105 °C	Tape 4,000 pcs/Reel	BP1808 XXXXXX YYY

Pin Configuration and Marking Information

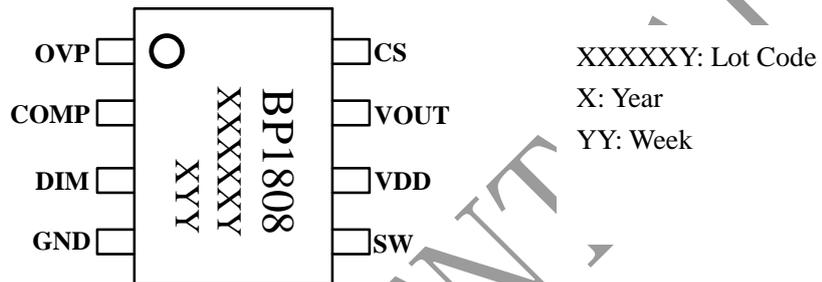


Figure 2. Pin configuration

Pin Definition

Pin No.	Name	Description
1	OVP	Over Voltage Protection Pin.
2	COMP	Loop Compensation Pin.
3	DIM	Dimming Signal Input Pin.
4	GND	Ground Pin.
5	SW	Drain Connection of Internal Low-Side Switch.
6	VDD	Internal Regulator Output. Bypass VDD to GND with a 1uF ceramic capacitor.
7	VOUT	Output Voltage connect, IC Power Supply Pin.
8	CS	Current Sense Pin. Connect a resistor to VOUT to sense the LED current.

Absolute Maximum Ratings (note1)

Symbol	Parameters	Range	Units
SW	Internal MOSFET drain voltage	-0.3~70	V
VOUT	Output voltage	-0.3~70	V
CS	CS pin voltage	-0.3~70	V
OVP	OVP pin voltage	-0.3~70	V
VDD	Internal regulator output voltage	-0.3~6	V
COMP	Compensation pin voltage	-0.3~6	V
DIM	Dimming signal input pin voltage	-0.3~6	V
P _{DMAX}	Power dissipation (note 2)	1	W
θ _{JA}	Thermal resistance (Junction to Ambient)	60	°C/W
T _J	Operating junction temperature	-40 to 150	°C
T _{STG}	Storage temperature range	-55 to 150	°C
	ESD (note 3)	2	kV

Note 1: Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. Under “recommended operating conditions” the device operation is assured, but some particular parameter may not be achieved. The electrical characteristics table defines the operation range of the device, the electrical characteristics is assured on DC and AC voltage by test program. For the parameters without minimum and maximum value in the EC table, the typical value defines the operation range, the accuracy is not guaranteed by spec.

Note 2: The maximum power dissipation decrease if temperature rise, it is decided by T_{JMAX} , θ_{JA} , and environment temperature (T_A). The maximum power dissipation is the lower one between $P_{DMAX} = (T_{JMAX} - T_A) / \theta_{JA}$ and the number listed in the maximum table.

Note 3: Human Body mode, 100pF capacitor discharge on 1.5kΩ resistor



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Boost, Buck and Buck-Boost DC/DC LED Driver

BP1808

Electrical Characteristics (Notes 3, 4) (Unless otherwise specified, $V_{OUT}=15V$ and $T_A=25\text{ }^\circ\text{C}$)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Supply Voltage Section						
V_{IN}	Input Voltage		3		60	V
V_{DD_ON}	V_{DD} Turn On Threshold	V_{DD} Rising		2.5		V
$V_{DD_UVLO,HYS}$	V_{DD} Turn off Hysteresis Voltage	V_{DD} Falling		200		mV
V_{DD_REG}	V_{DD} Regulation	$V_{out}=6V$		4.9		V
Operating Current and Frequency Section						
I_{SD}	Shutdown Current	$V_{DIM}=0V$		80		μA
I_Q	Quiescent Current	$V_{COMP}=0V$		200		μA
f_{SW}	Switching Frequency			420		kHz
D_{MAX}	Maximum Duty Cycle		85			%
Over Voltage Protection Section						
V_{OVP}	Over Voltage Protection Threshold			1.2		V
Enable and Dimming Section						
V_{EN}	Enable Threshold	DIM Rising		0.4		V
V_{EN_HYS}	Enable Hysteresis Voltage	DIM Falling		200		mV
I_{DIM}	DIM Pin Pull-up Current	$V_{DIM}=0V$		1.3		μA
V_{DIM_LOW}	Dim Low			0.55		V
V_{DIM_HIGH}	Dim High			1.75		V
f_{DIM}	PWM Dimming Frequency Range		0.1		1	kHz
$T_{Shutdown}$	DIM Shutdown Delay	V_{DIM} Keep Low		15		ms
Current Sense Section						
$V_{OUT-VCS}$	Current sense voltage			200		mV
MOSFET Section						
R_{DS_ON}	Static Drain-source On-resistance	$I_D=200\text{mA}$		300		$\text{m}\Omega$
I_{LIM}	Current Limit			3		A
BV_{DSS}	Drain-Source Breakdown Voltage	$V_{GS}=0V/I_{DS}=10\mu\text{A}$	70			V
Thermal Regulation Section						
Symbol	Parameter	Conditions	Min	Typ	Max	Units
T_{REG}	Thermal Regulation Temperature			140		$^\circ\text{C}$

Note 3: production testing of the chip is performed at 25 $^\circ\text{C}$.

Note 4: the maximum and minimum parameters specified are guaranteed by test, the typical value are guaranteed by design, characterization and statistical analysis

Application Information

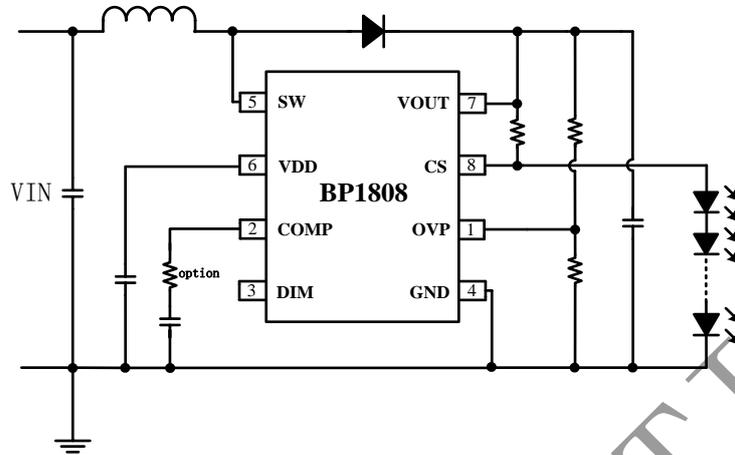


Figure 4. Typical Application-Boost ($V_{in} < V_o$)

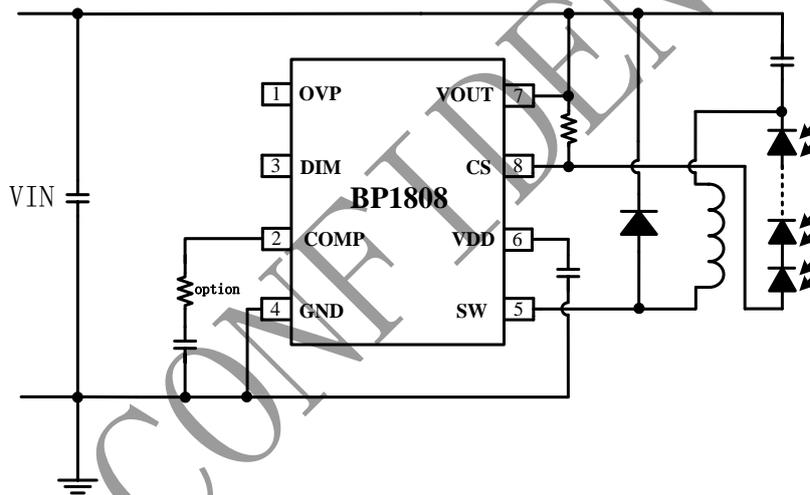


Figure 5. Typical Application-Buck ($V_{in} > V_o$)

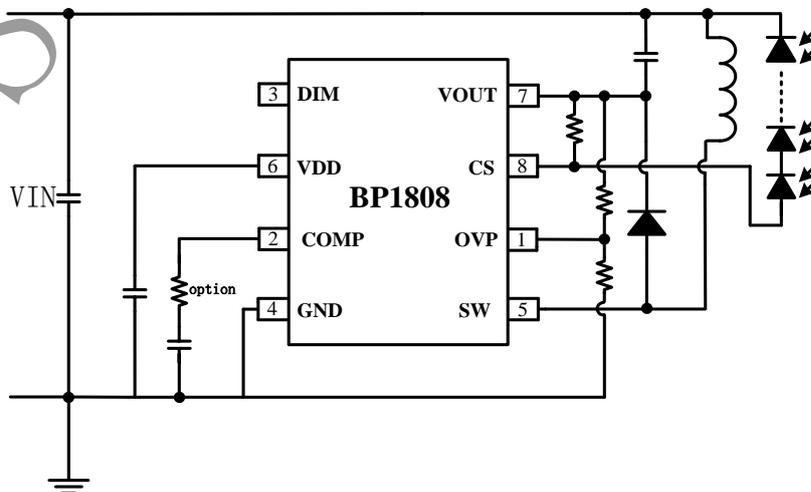


Figure 6. Typical Application-Buck-Boost ($V_{in} < V_o$ or $V_{in} > V_o$)

The BP1808 is a DC/DC convertor with a wide input-voltage range of 3V to 60V. The device can operate in Boost, Buck and Buck-Boost application.

Start Up

The BP1808 integrates a soft-start circuit. When V_{COMP} rises above 1.0V, the internal MOSFET begins switching with an increasing duty cycle.

When the value of C_{COMP} is less than 8nF, the BP1808 has internal soft-start by charging C_{COMP} with a rate of 1V/ms, and the time of soft-start is 1ms. If the system needs longer soft-start time, a larger C_{COMP} can be used. A fixed current source (8 μ A) will charge C_{COMP} to 1V. Use equation below to calculate the soft-start time (t_{SS}) when C_{COMP} is larger than 8nF.

$$t_{SS} = \frac{1V * C_{COMP}}{8\mu A} (ms)$$

The relationship between t_{SS} and C_{COMP} is shown as in Figure 7

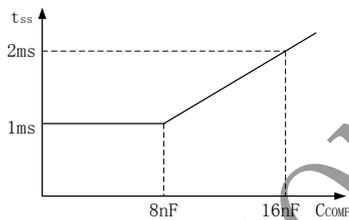


Figure 7. t_{SS} VS C_{COMP}

Shutdown

The BP1808 enters shutdown mode when V_{DIM} is less than 200mV for more than 15ms. In shutdown mode, supply current is reduced to 80 μ A, C_{COMP} is discharged to zero during shutdown period.

Constant Current Control

The current in LED can be programmed by external current sense resistor through the equation:

$$R_{CS} = \frac{0.2}{I_{LED}}$$

Analog and PWM Dimming

The BP1808 allows both analog and PWM dimming. When V_{DIM} is less than 0.2V, the device is turned off. For analog dimming, when V_{DIM} rises from 0.55V to 1.75V, the LED current will change from 0% to 100% of the maximum LED current. If V_{DIM} is higher than 1.75V, maximum LED current is generated. If a PWM signal is used, its amplitude V_{DIM} must exceed 1.75V. Apply a 100Hz to 1 kHz PWM signal to DIM pin, the LED current will change from 0% to 100% according to the duty cycle.

Over Voltage Protection

Over Voltage Protection (OVP) occurs when the LED is open in Boost and Buck-Boost application. The OVP comparator threshold is 1.2V with 100mV hysteresis. In normal operation, the recommended OVP threshold is about 1.3~1.5 times higher than the normal output voltage.

Thermal Regulation

The BP1808 integrates thermal regulation function. When the system is over temperature, the output current is gradually reduced, and the output power and thermal dissipation are also reduced. The system temperature is regulated and the system reliability is improved. The thermal regulation temperature is set to 140 $^{\circ}$ C internally.

Capacitor Selection

The typical value for the input capacitor is 10 μ F and the typical value for the output capacitor is 1 μ F. Larger value capacitors can be used to further reduce input and output ripple. Keep the capacitor impedance low at switching frequency is important, ceramic capacitors with at least X7R dielectrics are highly recommended. C_{COMP} stabilizes the loop and controls soft-start time. Connect a 1nF capacitor from COMP pin to GND.

**Inductor Selection**

Inductor value ranges from 10 μ H to 47 μ H in typical. To prevent core saturation, ensure that the inductor saturation current rating exceeds about 30%-40% of the peak inductor current for the application.

Schottky Diode Selection

The BP1808's high switching frequency demands a high-speed rectification diode for optimum efficiency. A Schottky diode is recommended due to its fast recovery time and low forward-voltage drop. Ensure that the diode's average and peak current rating exceed the average output current and peak inductor current. In addition, the diode's reverse breakdown voltage must exceed the maximum output voltage.

PCB Layout

The following rules should be followed in BP1808 PCB layout:

Bypass Capacitor

The VDD and COMP bypass capacitors need to be placed as close as possible to the device. In particular, place the VDD bypass capacitors very close to the GND of device.

Ground Path

Minimize ground noise by connecting the IC-GND lead, the input bypass capacitor ground lead, and the output filter capacitor ground lead to a single point. A ground plane is required. Minimize lead lengths to reduce stray capacitance, trace resistance, and radiated noise.

The Area of Power Loop

The area of main current loop should be as small as possible to reduce EMI radiation, such as the inductor, the power MOSFET, the output diode and the bus capacitor loop.

The Trace

When laying out a board, minimize trace lengths

between the chip and Rcs, the inductor, the diode, the input capacitor, and the output capacitor. Keep traces short, direct, and wide. Keep noisy traces, such as the SW node trace, away from Rcs.

Package and Physical Dimensions
