



晶丰明源半导体

BP3198

High Precision PSR Constant Current LED Driver

With Wall Switch Color dimming

Description

BP3198 is a high precision PSR constant current LED driver with wall switch color dimming, and is suitable for 85Vac~265Vac universal input offline LED lighting.

BP3198 utilizes patent dimming control mode, by simple peripheral circuit, it can realize 2/3 kinds of fixed brightness dimming or 3 kinds of adjustable brightness dimming. In the 3 kinds of fixed brightness dimming, the output current presents three status 100%---60%--12%. In the 2 kinds of fixed brightness dimming, the output current presents 2 status 100%---8%. In the 3 kinds of adjustable brightness dimming, the output current of the second and the third status can be set by external resistors.

BP3198 work in inductor current discontinuous conduction mode, when it works in full brightness condition. Since adopting primary sense and feedback control technology, the secondary sense and feedback circuit is eliminated. The loop compensation components are also removed while maintaining stability overall operating conditions.

Since using the proprietary high accurate current sense method, the BP3198 realizes $\pm 5\%$ accuracy of LED current along with excellent line and load regulation.

The BP3198 offers rich protection functions including LED open/short circuit protection, CS resistor short circuit protection, over-temperature protection, VCC under voltage protection.

BP3198 is available in SOT23-6 package

Feature

- Wall Switch Color Dimming
- Flexible Brightness Settings
- Ultra-low Operating Current
- Wide Input Voltage
- $\pm 5\%$ LED Output Current Accuracy
- LED Open Protection
- LED Short Protection
- VCC Under Voltage Protection
- VCC Over Voltage Protection
- Thermal Regulation Function
- Available in SOT23-6 Package

Applications

- LED fluorescent lamp
- LED Ceiling Lamp
- LED Bulb
- Other LED Lighting

Typical Application

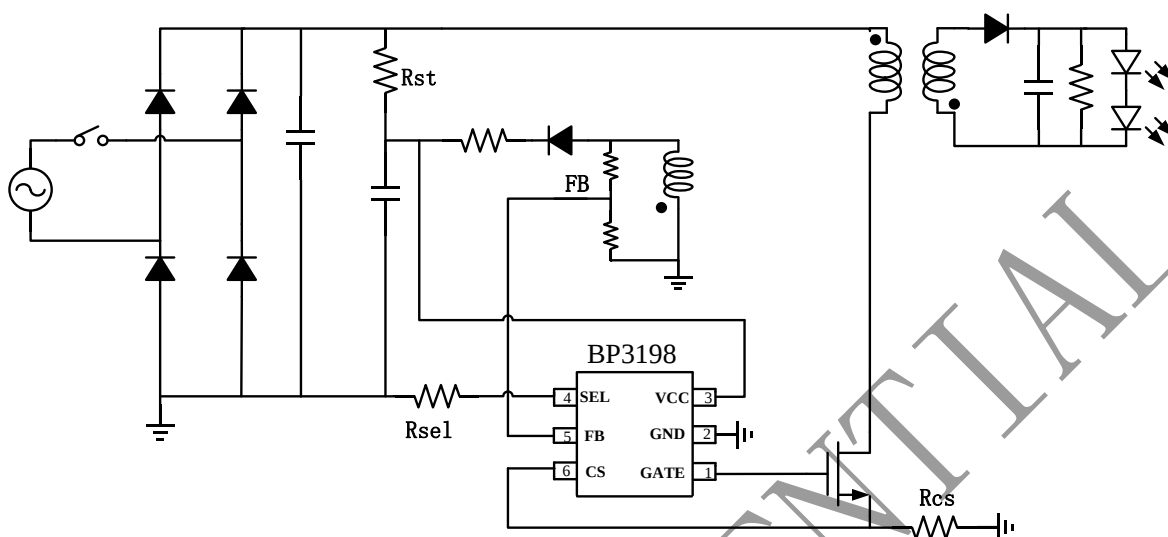


Figure 1. Typical application circuit for BP3198

Ordering Information

Part Number	Package	Operating Temperature	Packing Method	Marking
BP3198	SOT23-6	-40 °C 到 105 °C	Tape 3,000 Piece/Reel	3198

Pin Configuration and Marking Information

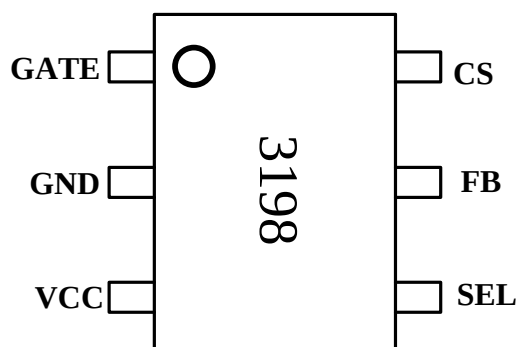


Figure 2. Pin configuration



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Pin Definition

Pin No.	Name	Description
1	GATE	Gate driver pin. Connect this pin to the gate of external power MOSFET.
2	GND	Ground
3	VCC	Power supply
4	SEL	Dimming brightness selection input pin
5	FB	Feedback voltage input pin.
6	CS	Current sense. This pin connects a current sense resistor to GND



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Absolute Maximum Ratings (note1)

Symbol	Parameters	Range	Units
I _{CC_MAX}	VCC pin maximum sink current	5	mA
CS	Current sense pin input voltage	-0.3~6	V
FB	Feedback pin input voltage	-0.3~6	V
P _{DMAX}	Power dissipation (note2)	0.3	W
θ _{JA}	Thermal resistance (Junction to Ambient)	240	°C/W
T _J	Operating junction temperature	-40 to 150	°C
T _{STG}	Storage temperature range	-55 to 150	°C
	ESD (note3)	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)/θ_{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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Electrical Characteristics (Notes 4, 5) (Unless otherwise specified, $V_{CC}=14V$ and $T_A=25^\circ C$)

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Units
Supply Voltage Section						
V_{CC_ON}	Turn On Threshold Voltage	VCC Rising		20		V
V_{CC_UVLO}	Turn Off Threshold Voltage	VCC Falling		13		V
V_{CC_RST}	VCC Reset Voltage	VCC Falling		7		V
V_{CC_OVP}	VCC Over Voltage	VCC Rising		28		V
I_{ST}	VCC Startup Current	$V_{CC}=V_{CC_ON}-1V$		43		μA
I_{HOLD}	VCC Holding Current	$V_{CC}=V_{CC_UVLO}-1V$		35		μA
I_{OP}	VCC Operating Current	50kHz		1.2		mA
Current Sense Section						
V_{CS_TH}	Threshold Voltage For Peak Current Limit			800		mV
T_{LEB}	Leading Edge Blanking Time For Current Sense			530		ns
T_{DELAY}	Switch Off Delay Time			200		ns
Feedback Section						
V_{FB_FALL}	FB Falling Edge Threshold Voltage	FB Falling		0.1		V
V_{FB_HYS}	FB Hysteresis Voltage	FB Rising		0.12		V
V_{FB_OVP}	FB Over Voltage Protection Threshold			4		V
Dimming control						
V_{SEL}	SEL internal voltage			490		mV
Internal Time Control Section						
T_{OFF_MIN}	Minimum OFF Time			4		μs
T_{OFF_MAX}	Maximum OFF Time			240		μs
T_{ON_MAX}	Maximum On Time			40		μs
Driver Section						
I_{SOURCE_MAX}	GATE pin Maximum Sourcing Current			60		mA
I_{SINK_MAX}	GATE pin Maximum Sinking Current			300		mA
Thermal Regulation Section						
T_{REG}	Thermal Regulation Temperature			150		$^\circ C$

Note 4: production testing of the chip is performed at 25 $^\circ C$.

Note 5: the maximum and minimum parameters specified are guaranteed by test, the typical value are guaranteed by design, characterization and statistical analysis



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Internal Block Diagram

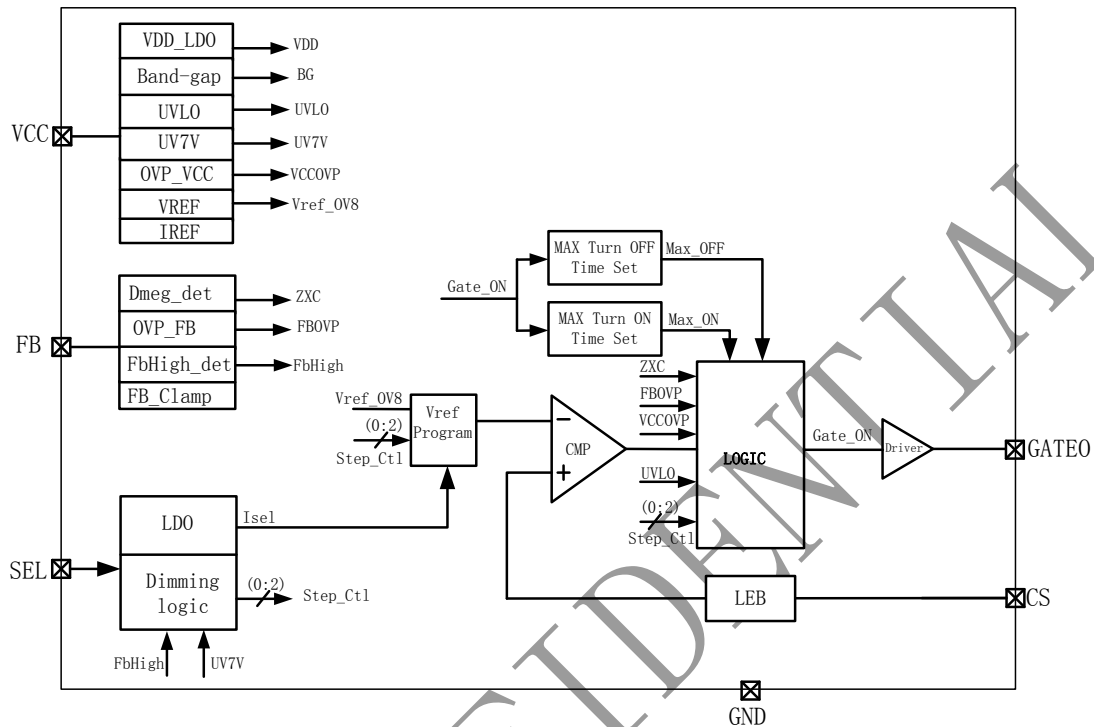


Figure 3. BP3198 Internal Block Diagram

Function Description

BP3198 is a high precision PSR constant current LED driver with wall switch color dimming, utilizing patent dimming control mode, only very few external components can achieve excellent constant current and dimming characteristics.

Start Up

After system powered up, the VCC pin capacitor is charged up by the start-up resistor. When the VCC pin voltage reaches the turn on threshold, the internal circuits start working. BP3198 can work in a wide VCC voltage from 13V to 28V.

Constant Current Control, Output Current Setting

Cycle-by-Cycle current sense is adopted in BP3198, the CS is connected to the current sense comparator, and the voltage on CS will be compared with the

internal 800mV reference voltage, the MOSFET will be switched off when the voltage on CS reaches the threshold. The output of the comparator includes a 530ns leading edge blanking time.

The primary peak current is given by:

$$I_{PK} = \frac{800}{R_{CS}} (mA)$$

The current in LED can be calculated by the equation:

$$I_{LED} = \frac{I_{PK}}{4} * \frac{N_P}{N_S}$$

Where,

N_P : primary winding turns of transformer

N_S : secondary winding turns of transformer



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I_{P_PK} : peak current in MOSFET

Operating Switching Frequency

The BP3198 is designed to work in discontinuous conduction mode at full brightness condition and no external loop compensation component is required while maintaining stability. The maximum duty cycle is limited to 42%. Usually the system center frequency is set between 40kHz ~ 48kHz. Recommended maximum operating frequency is less than 100kHz, the minimum operating frequency is greater than 20kHz. The system limits the maximum and the minimum operating frequency to guarantee the system stability.

The switching frequency can be set by the formula:

$$f = \frac{N_p^2 \times V_{LED}}{8 \times N_s^2 \times L_p \times I_{LED}}$$

Where, L_p is the primary winding inductance of transformer.

Switch Dimming

BP3198 can be well compatible with the input power switch (ON / OFF) dimming settings.

When SEL is floating, the system presents 3 kinds of fixed brightness dimming status. The output current: 100%---60%--12%.

When the SEL pin is shorted to ground, the system presents 2 kinds of fixed brightness dimming status. The output current: 100%---8%.

When the SEL pin connects to the external resistance about 50K-100K, the system presents 3 kinds of adjustable brightness dimming status. By the external resistor, a controlling current I_{SEL} will adjust the output current of the second and the third status

$$I_{SEL} = \frac{V_{SEL}}{R_{SEL}}$$

The external SEL resistor allows the load current to vary over the range:

100%--- (30%---60%) -- (6%--12%)

Feedback Network

BP3198 senses the output current zero crossing information through the feedback network, the FB falling threshold voltage is set to 0.1V with 0.12V hysteresis. The FB pin is also used to detect output OVP, the threshold voltage is 4V. The ratio of FB upper resistor to lower resistor can be set as:

$$\frac{V_{OVP} * R_{FBL}}{R_{FBL} + R_{FBH}} = 4$$

Where,

R_{FBL} : The lower resistor of the feedback network

R_{FBH} : The upper resistor of the feedback network

V_{OVP} : Output over voltage setting point

It is recommended that the FB lower resistor set to 2kΩ—5kΩ. And connect a capacitor about 22pF in parallel to prevent switching noise from triggering OVP. The OVP voltage is recommended to be set about 30% higher than the maximum load voltage.

Protection Function

BP3198 has integrated rich protection functions, LED open/short protection, CS resistor short circuit protection, VCC under voltage protection, over temperature protection, and so on. When the LED is open circuit, it will trigger over-voltage protection logic and latch, the system stops switching immediately.

When the LED short circuit is detected, the system works at low frequency ($F_{op}=5kHz$), so the power consumption is low.

When the VCC voltage falls down to the UVLO threshold, the system will re-start again. If the fault condition is removed, the system will recover to normal operation.



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Thermal Regulation

The BP3198 integrates thermal regulation function. When the system is over temperature, the output current is gradually reduced; 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 150°C internally.

PCB Layout

The following guidelines should be followed in BP3198 PCB layout:

Bypass Capacitor

The bypass capacitor on VCC pin should be as close as possible to the VCC and GND pins.

Ground Path

The power ground path for current sense should be short, and the power ground path should be separated from small signal ground path before connecting to the negative node of the bulk capacitor.

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 feedback resistor divider should be as close as possible to the FB pin, and the trace must keep away from dynamic node of the inductor and MOSFET DRAIN trace, otherwise the FB pin OVP function might have risk to be mis-triggered by the system noise.

Physical Dimensions

