晶丰明源半导体

BP5609

LED CURRENT RIPPLE REMOVER

Description

The BP5609 is a LED current ripple remover, working with single-stage active PFC LED driver to remove the low frequency LED current ripple and the low frequency flicker.

The BP5609 utilizes patented high efficiency control scheme. It can automatically adapt to wide range LED voltage and current, removing the LED current ripple while keeping the MOSFET power loss to be minimum.

The BP5609 offers over temperature protection and VCC UVLO protection.

Features

- High Efficiency
- Adapt to All Kinds of Single Stage APFC LED Driver
- Simple Circuit
- No Magnetic Components
- Wide Range LED Voltage
- Wide Range LED Current
- VCC Under Voltage Protection
- Over Temperature Protection
- Available in SOT23-6 Package

Applications

- T8/T10 LED String
- GU10/E27 LED Bulb, Spot Light
- LED Ceiling Light
- Other LED Lighting

Typical Application

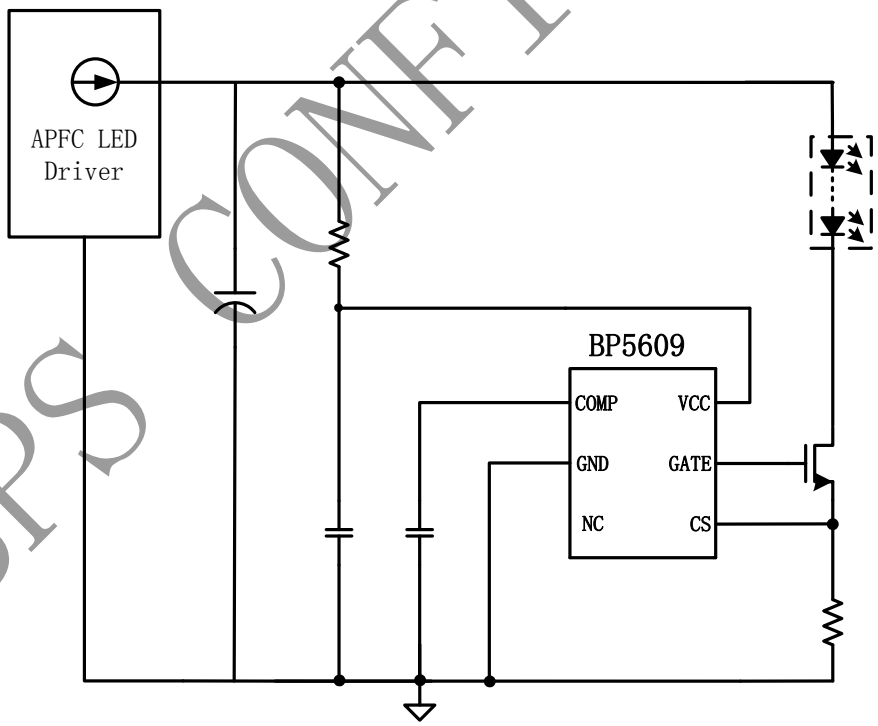


Figure 1. Typical application circuit for BP5609

Ordering Information

Part Number	Package	Operating Temperature	Packing Method	Marking
BP5609	SOP23-6	-40 ℃ to 105 ℃	Tape 3,000 Piece/Reel	5609

Pin Configuration and Marking Information

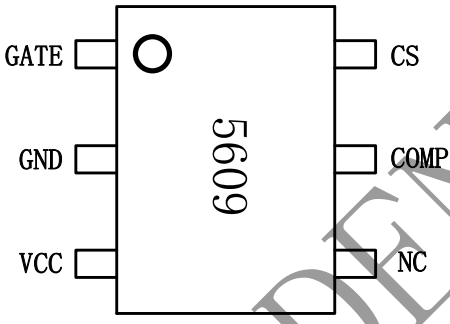


Figure 2. Pin configuration

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 Pin. Connect a bypass capacitor from this pin to GND.
4	NC	No Connection.
5	COMP	Loop Compensation Node. Connect a capacitor from this pin to GND.
6	CS	Current Sense Pin. Connect a resistor to GND to sense the LED current.

Absolute Maximum Ratings (note1)

Symbol	Parameters	Range	Units
I_{CC_MAX}	VCC pin maximum sink current	10	mA
COMP	Compensation pin voltage	−0. 3~6	V
CS	Current sense pin input voltage	−0. 3~6	V
GATE	Gate driver pin voltage	−0. 3~17	V
P_{DMAX}	Power dissipation (note2)	0. 3	W
θ_{JA}	Thermal resistance (Junction to Ambient)	240	℃/W
T_J	Operating junction temperature	−40 to 150	℃
T_{STG}	Storage temperature range	−55 to 150	℃
	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 $P_{DMAX} = (T_{JMAX} - T_A)/\theta_{JA}$ and the number listed in the maximum table.*

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

Electrical Characteristics (Notes 4, 5) (Unless otherwise specified, V_{CC}=14V and T_A=25℃)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Supply Voltage Section						
V_{CC_CLAMP}	V_{CC} Clamp Voltage	1mA		15		V
V_{CC_ON}	V_{CC} Turn On Threshold	V_{CC} Rising	12.9	14.0	15.1	V
V_{CC_UVLO}	V_{CC} Turn Off Threshold	V_{CC} Falling	7.0	8.0	9.0	V
I_{CC_ST}	V_{CC} Startup Current	V_{CC}= V_{CC_ON} - 1V		40	80	uA
I_{OP}	V_{CC} Operating Current			110	200	uA
Current Sense Section						
V_{COMP}	COMP Linear Operating Voltage Range		0		4	V
I_{COMP}	COMP Pull Up Current			6		uA
V_{CS_LOW}	LED Open Circuit Detect Voltage			24		mV
Driver Section						
I_{SOURCE_MAX}	Maximum Sourcing Current			4		mA
I_{SINK_MAX}	Maximum Sinking Current			5		mA
Thermal Protection Section						
T_{REG}	Thermal Protection Temperature			140		℃

Note 4: *production testing of the chip is performed at 25℃.*

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

Application Information

The BP5609 is a LED current ripple remover, working with single-stage active PFC LED driver to remove the low frequency LED current ripple and the low frequency flicker.

1 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.
The startup resistor can be set as:

$$R_{START} \le (V_{LED} - 16V) * 1000$$

The startup resistor should be adjusted according to the LED voltage, the minimum LED voltage should be used to calculate the startup resistor value.

2 Current Sensing Resistor

The current sensing resistor can be calculated by the equation:

$$Rcs \approx \frac{0.2V}{Iout}$$

Where,

Rcs: The current sensing resistor value
Iout: The LED output current

The BP5609 can automatically control the LED current to make it equal to the APFC stage output current. The current sensing resistor is not required to be very accurate.

3 Input Capacitor Selection

Sufficient input capacitor is needed to store the input current ripple energy. The input capacitor value is recommended as:

$$C_{IN} > 1 \times I_{LED}(mA) uF$$

4 Power MOSFET Selection

The power MOSFET breakdown voltage should be higher than the open voltage of the previous APFC LED driver with sufficient margin.

The smaller the power MOSFET Rdson is, the less the system power loss would be. However, keep decreasing the power MOSFET Rdson will not reduce the power loss infinitely. Proper MOSFET rating should be chosen to balance the cost and the system loss.

The power MOSFET should be chosen with a good power dissipation package.

6 PCB Layouts

The following guidelines should be followed in BP5609 PCB layout:

COMP Capacitor

The COMP capacitor should be as close as possible to the COMP and GND pins.

Ground Path

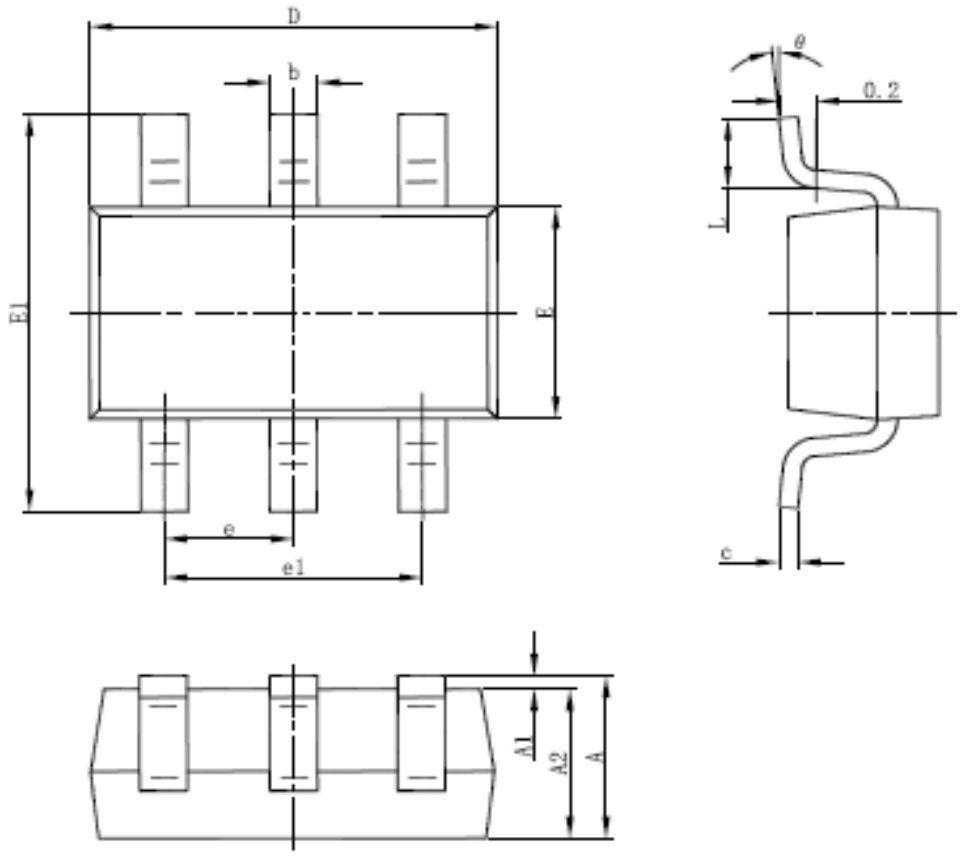
The power ground path for current sense resistor should be short and wide, and it should be as close as possible to the IC ground.

Power MOSFET

The power MOSFET should be placed as close as possible to the BP5609. The copper area of the power MOSFET should be as large as possible for better thermal dissipation.

Physical Dimensions

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°