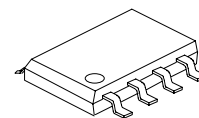


## 1A WHITE LED DRIVER

### DESCRIPTION

The SD42509 is a step-down PWM control LED driver with a built-in internal power MOSFET. It achieves 1A continuous output current over a wide input supply range. It provides thermal shutdown circuit, current limiting circuit.

SD42509 adopts current mode control. Current mode operation provides fast transient response and simple loop stabilization design. SD42509 has high efficiency up to more than 90%, and has excellent constant current characteristic when the input/output voltage changed, with the excellent current accuracy within  $\pm 1\%$ .



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### FEATURES

- \* Maximum 1A output current
- \* 0.25 $\Omega$  built-in power MOSFET
- \* 280kHz fixed frequency
- \* Excellent constant current accuracy  $\pm 1\%$
- \* High efficiency up to 90%
- \* Thermal shutdown
- \* Cycle-by-cycle over current protection
- \* 6-20V input voltage range
- \* Drive LED string

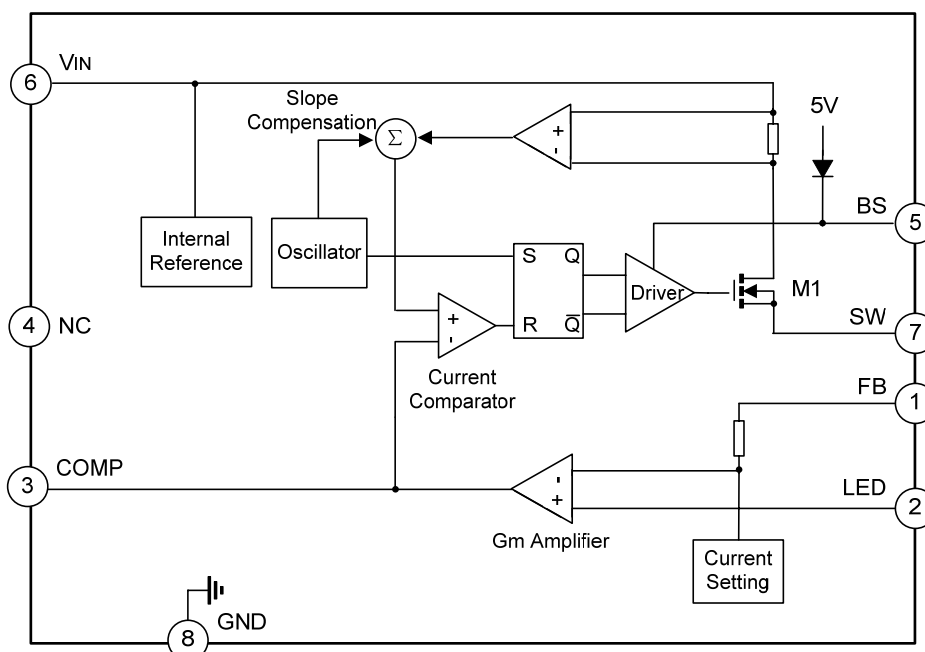
### ORDERING INFORMATION

Device	Package
SD42509	SOP-8-225-1.27

### APPLICATIONS

- \* Power LED driver

### BLOCK DIAGRAM



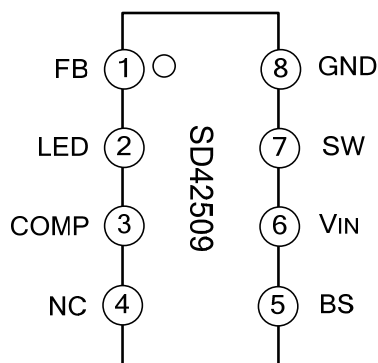
## ABSOLUTE MAXIMUM RATING

Characteristics	Symbol	Ratings	Unit
Supply Voltage	V <sub>IN</sub>	22	V
Switch Voltage	V <sub>SW</sub>	-1~V <sub>IN</sub> +1	V
Boost Voltage	V <sub>BS</sub>	V <sub>SW</sub> +6	V
Feedback Voltage	V <sub>FB</sub>	-0.3~V <sub>IN</sub>	V
Comp Voltage	V <sub>COMP</sub>	-0.3~6	V
LED Voltage	V <sub>LED</sub>	-0.3~V <sub>IN</sub>	V
Junction Temperature	T <sub>j</sub>	150	°C
Lead Temperature	T <sub>L</sub>	260	°C
Storage Temperature	T <sub>STG</sub>	-65~150	°C
Input Voltage	V <sub>IN</sub>	6~20	V
Operating Temperature	T <sub>OPR</sub>	-40~125	°C

## ELECTRICAL CHARACTERISTICS (Unless otherwise specified, V<sub>IN</sub>=12V, T<sub>amb</sub>=25°C)

Characteristics	Symbol	Test Condition	Min.	Typ.	Max.	Unit
Operating Current	I <sub>IN</sub>	V <sub>FB</sub> ≥3.5V		2.0	2.3	mA
Upper Switch Leakage	I <sub>L</sub>	V <sub>SW</sub> =0V		0	10	μA
Current Limit	I <sub>LIM</sub>		1.3	1.6	2.0	A
Maximum Duty Cycle	D <sub>max</sub>	V <sub>FB</sub> =0V	--	93	--	%
Oscillator Frequency	f <sub>osc</sub>		250	280	310	kHz
COMP Clamp Voltage	V <sub>COMP</sub>	Open without load	1.9	2.2	2.5	V
Switch Transistor on Resistance	R <sub>ONH</sub>		--	0.25	--	Ω
Sampling Voltage Threshold	V <sub>FB</sub> —V <sub>LED</sub>		--	88	--	mV

## PIN CONFIGURATION



**PIN DESCRIPTIONS**

Pin No.	Pin Name	I/O	Description
1	FB	I	Current sense pin ,connect inductance and sense resistor.
2	LED	O	LED positive connecting end, the other end connects to the sense resistor.
3	COMP	I/O	Compensation pin, connects to external capacitor
4	NC	-	No Connected.
5	BS	I	Bootstrap pin, used to increase the power MOSFET voltage
6	VIN	I	Input supply voltage.
7	SW	O	Power output.
8	GND	-	Ground.

**FUNCTION DESCRIPTION**

The SD42509 is a current mode LED driver. The voltage on compensation pin COMP is proportional to the current delivered to the load.

At the beginning of a cycle: the upper transistor M1 is off; the COMP pin voltage is higher than the current sense amplifier output; and the current comparator's output is low. The rising edge of the 280KHz CLK signal sets the RS Flip-Flop. Its output turns on M1 thus connecting the SW pin and inductor to the input supply. The inductor current is sensed and amplified by the current sense amplifier. Ramp compensation is summed to current sense amplifier output and compared to the Gm amplifier output by the current comparator. When the current sense amplifier plus ramp compensation signal exceeds the comp pin voltage, the RS Flip-Flop is reset and the chip reverts to its initial M1 off state. If the current sense amplifier plus slope compensation signal does not exceed the comp voltage, then the falling edge of the CLK resets the Flip-Flop.

The Gm amplifier compares the output current to the threshold current (threshold current is set by internal). When the output current is higher than threshold current, the COMP pin's voltage is lower down. Since the COMP pin's voltage is proportional to the peak inductor current a decrease in its voltage decreases current delivered to the output. When the output current is lower than threshold current, the COMP pin's voltage is up while the output current increases. The output current is stable at the set value by the adjusting of the loop.

**1. Output Current Setting**

The output current is determined by the sampling resistor and setting voltage. The sampling voltage of VFB-VLED is 88mV, and adjust the output current by adjusting the sampling resistor Rs (refer to Typical Application Circuit).

$$I_{out} = \frac{V_{FB} - V_{LED}}{R_s}$$

**2. Bootstrap Circuit**

SD42509 has Bootstrap circuit, which provides grid drive voltage to power MOSFET; the chip has diode to charge the bootstrap capacitor by 5V standard voltage.

**3. Current Limiting Function**

SD42509 has internal current limiting function, and the voltage on COMP is clamped at about 2.2V, the output current of the power MOSFET is limited at about 1.6A by current comparator.

## COMPONENTS SELECTION

### 1. Input Capacitor Selection

The input capacitor provides the pulse current when the power MOSFET is on, and charge the capacitor when the power MOSFET is off, thus to keep the stability of the input voltage. The input capacitor is recommended to be more than 10 $\mu$ F, which can reduce the peak current drawn from input source and the switch noise. The input capacitor should be near to the input pin when in real routing.

### 2. Output Capacitor Selection

Parallel connecting a capacitor between the two ends of LED can reduce the output voltage ripple accordingly reduce the ripple current of LED, while this capacitor will not effect the operating frequency and efficiency, but the start time will be longer by reducing the rising speed of the voltage on LED. The larger the output capacitor is, the smaller the current ripple on LED is. It is recommend use the capacitor of 4.7 $\mu$ F or larger.

### 3. Inductance Selection

The inductance is used to keep the output current constant, the bigger the inductance is, the smaller the output current ripple is; while the bigger the physical size is, the bigger the series-wound resistor is. The selected effective current (RMS current rating) of inductance current should be bigger than the maximum output current, and the saturation current should be 30% bigger than maximum output current. In order to improve the efficiency, the series-wound resistor (DCR) of inductance should be smaller than 0.2 $\Omega$ .

The relation between inductance and ripple:

$$L = V_{OUT} * \frac{V_{IN} - V_{OUT}}{V_{IN} * f * \Delta I}$$

Where: L: Inductance value

F: Oscillator frequency

$\Delta I$  is ripple current

When select inductance, you should consider the combination of various factors to select suitable inductance. When output current is 1A, 47 $\mu$ H inductance is recommended.

### 4. Diode Selection

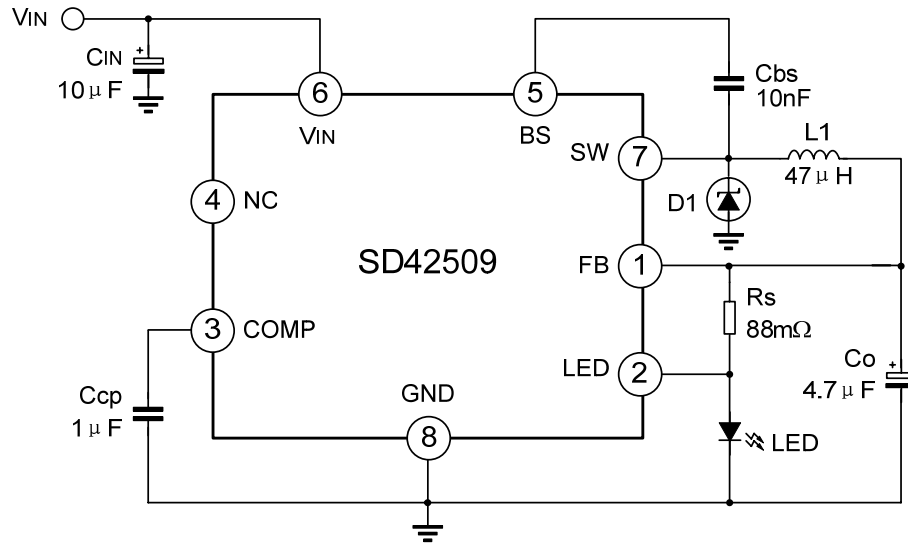
SD42509 is a non-synchronous step-down adjuster, so the diode should provide continuous current when the power MOSFET is off. Because the forward voltage of Schottky diode is small, and the reverse continuous current time is short, so it is usually used for continuous current. During the power MOSFET is conducting, the diode will withstand high voltage, so the reverse voltage of selected diode should be bigger than the input voltage.

The average current through the diode is  $I_D$ :

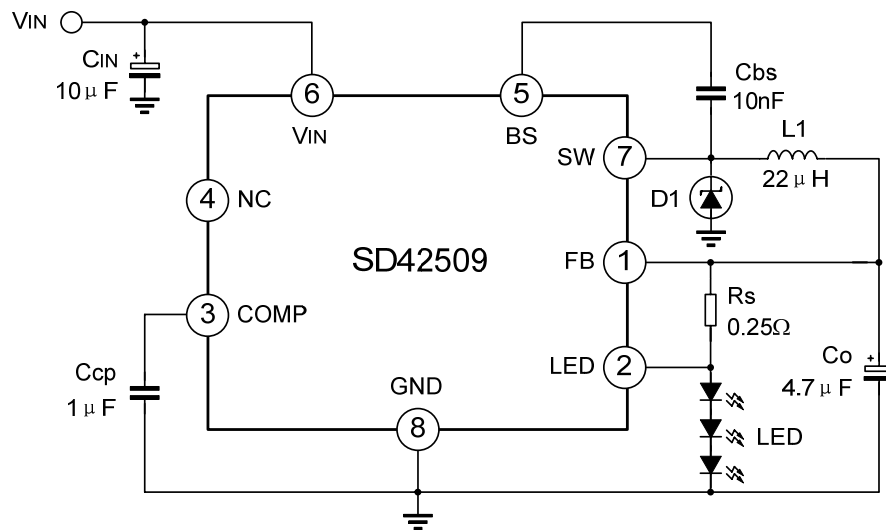
$$I_D = (1-D) * I_{LED} \quad I_{LED} \text{ is the current of LED}$$

When the input voltage is high with a small duty,  $I_D$  increases, so the selected maximum continuous current diode should be bigger than the output current.

**TYPICAL APPLICATION CIRCUIT**



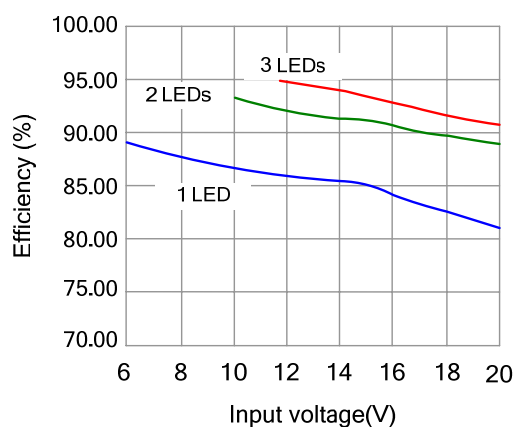
6~20V input voltage, 1A output LED driver



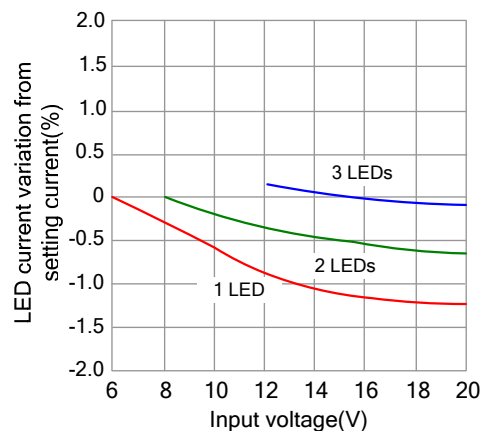
12V input voltage, 350mA output three strings of LED driver

Note: The circuit and parameters are reference only, please set the parameters of the real application circuit based on the real test .

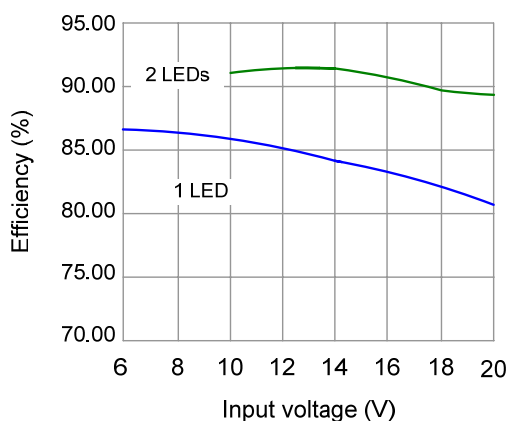
## ELECTRICAL CHARACTERISTICS CURVE



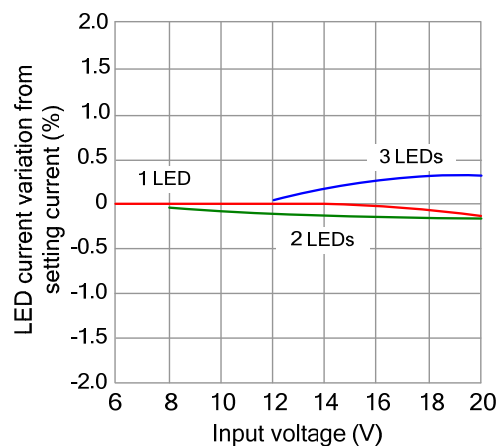
Output 350mA efficiency changed with input voltage



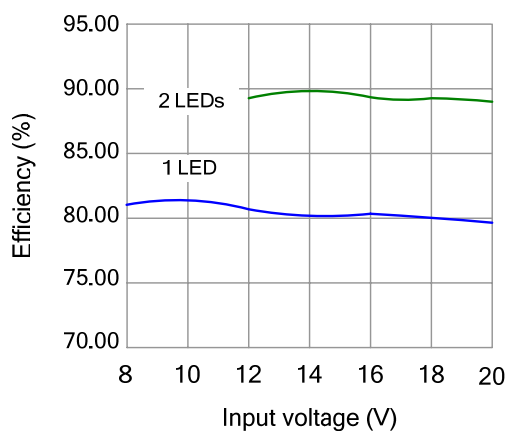
Output 350mA current changed with the rate of input voltage change



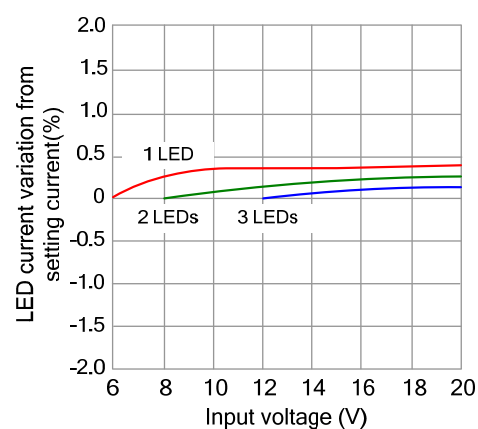
Output 700mA efficiency changed with input voltage



Output 700mA current changed with the rate of input voltage change



Output 1A efficiency changed with input voltage

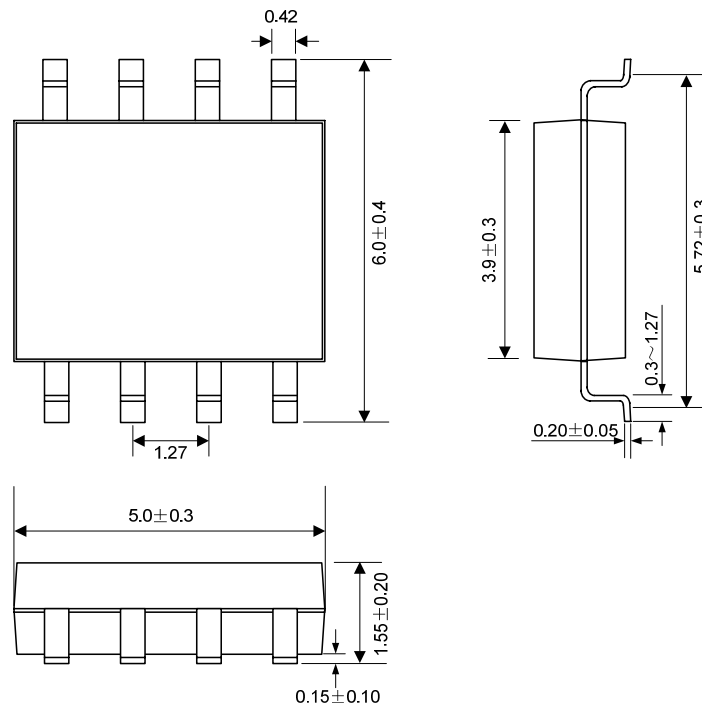


Output 1A current changed with the rate of voltage change

## PACKAGE OUTLINE

SOP-8-225-1.27

UNIT: mm



### MOS DEVICES OPERATE NOTES:

Electrostatic charges may exist in many things. Please take following preventive measures to prevent effectively the MOS electric circuit as a result of the damage which is caused by discharge:

- The operator must put on wrist strap which should be earthed to against electrostatic.
- Equipment cases should be earthed.
- All tools used during assembly, including soldering tools and solder baths, must be earthed.
- MOS devices should be packed in antistatic/conductive containers for transportation.

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