85~265V AC Input LED Constant Current Driver

■ General Description

The LN2543 is a high voltage buck control IC for constant LED current regulation. The LN2543 operates constant off-time mode. It allow efficient operation of High Brightness (HB) LEDs from voltage sources ranging from 8VDC up to 450VDC or 12VAC~265VAC.

LN2543 is available by SOT23-6 packages.

■ Applications

- DC/DC or AC/DC LED driver applications
- RGB backlighting LED driver
- General purpose constant current source
- Signal and decorative LED lighting

■ Features

- Switch mode controller for single switch LED Drivers
- Open loop peak current controller
- Wide Input range from 8VDC~450VDC or 12VAC~265VAC
- Application from a few mA to more than 1A output
- Up to hundreds of LEDs
- Constant off-time operation
- Requires few external components for operation

■ Package

- SOT23-6

■ Typical Application Circuit
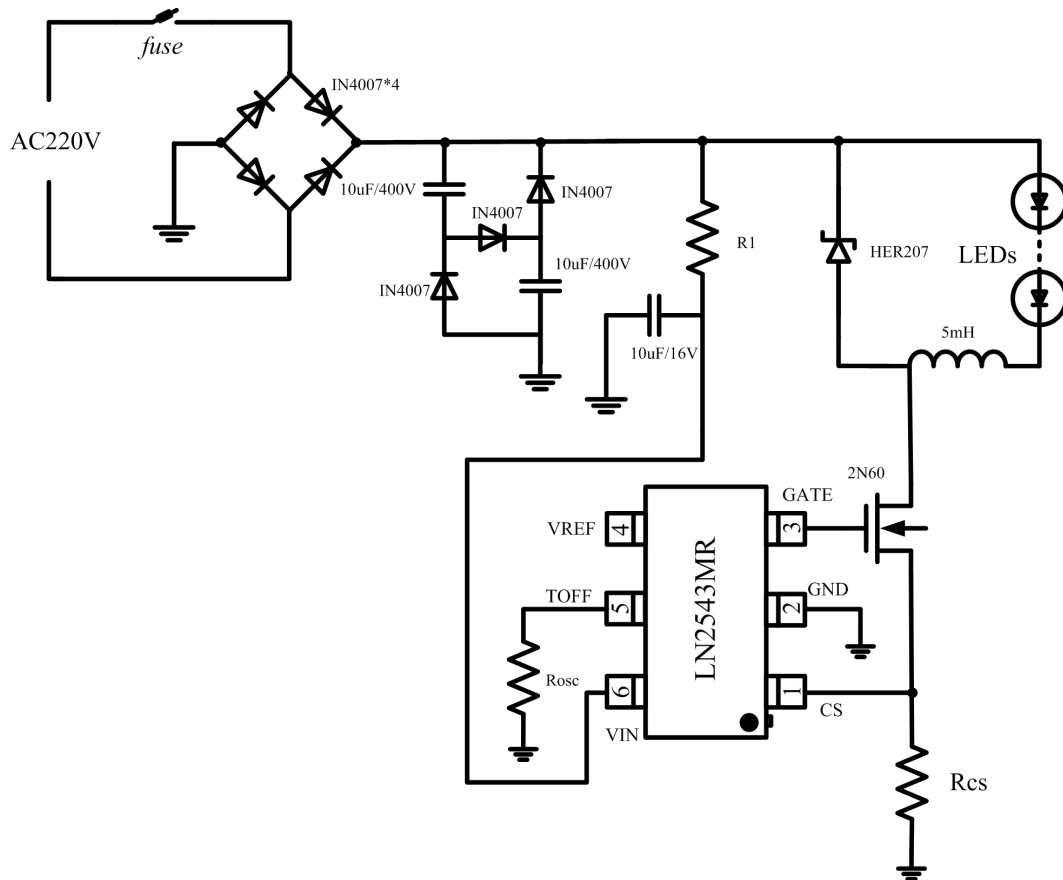
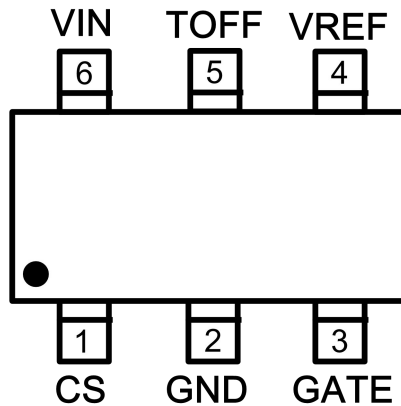Note： 1、The Rcs depends on the number of LED in parallel.

2、VREF floating。
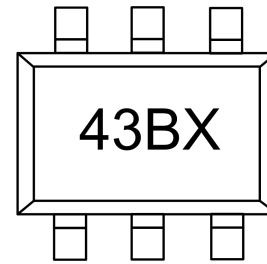
■ Ordering Information

LN2543 ①②

Designator	Symbol	Description
①		Package
	M	SOT23-6
②		Device Orientation
	R	Embossed Tape: Standard Feed
	L	Embossed Tape: Reverse Feed

■ Functional Pin Description And Marking

SOT23-6
(Top View)

MARKING

VIN TOFF VREF
6   5   4

1   2   3
CS   GND   GATE

43BX

43----LN2543MR
B-----die code
X-----process code

Pin NO.	Pin Name	Function
2	GND	Ground.
3	GATE	This pin is the output gate driver for an external N-channel power MOSFET.
1	CS	This pin is the current sense pin used to sense the FET current by means of an external sense resistor.
5	TOFF	This pin sets the off time of the power mos and this chip operates in constant off time mode. It can be floating with the internal set off time 510ns. When a resistor is connected between TOFF and GND, the off time is increased.
6	VIN	This pin is the input of an 8V – 450V voltage supply through a resistor, it must be bypassed with a capacitor to GND.
4	VREF	The internal reference voltage is 1.25V and the normal application can be suspension.

■ **Function Block Diagram**
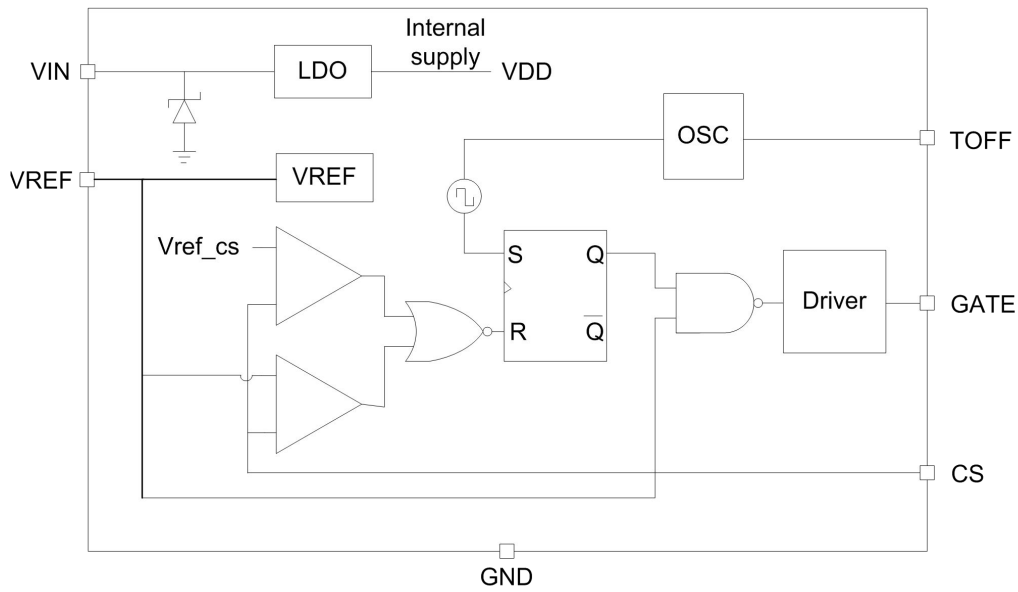
■ **Absolute Maximum Ratings**

Parameter	Symbol	Maximum Rating	Unit
VIN pin voltage to GND	Vin	-0.3—14	V
CS, TOFF pin voltage to GND		-0.3—6	V
GATE pin to GND	V_{GATE}	-0.3—12	V
VIN pin Input Current Range	I_{VIN}	1—20	mA
Storage temperature range	T_{STG}	-40—150	℃
Operating junction temperature	T_J	-40—150	℃
ESD Human Model		4000	V

■ Electrical Characteristics

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{INDC}	Input DC supply voltage range		8		450	V
V_{IN_clamp}	VIN clamp voltage		5.5	6.5	7.5	
I_{IN}	Operation current range	VIN=5.5V GATE floating		0.4	1	mA
UVLO	Under voltage lockout threshold	VIN rising		5.5		V
△UVLO	Under voltage lockout hysteresis	VIN falling		700		mV
V_{CSTH}	Current sense pull-in threshold voltage			500		mV
T_{OFF}	Off time	R_{OSC}=200K		6		uS
VREF	The Internal Reference Voltage	VIN=6.0V		1.2		V

■ Application Information

The LN2543 is optimized to drive buck LED drivers using open-loop peak current mode control. This method of control enables fairly accurate LED current control without the need for high side current sensing or the design of any closed loop controllers. The IC uses very few external components and enables both Linear and PWM dimming of the LED current.

A capacitor connected to the Toff pin programs the off-time. The oscillator produces pulses at regular intervals. These pulses set the SR flip-flop in the LN2543 which causes the GATE driver to turn on. When the FET turns on, the current through the inductor starts ramping up. This current flows through the external sense resistor RCS and produces a ramp voltage at the CS pin. The comparators are constantly comparing the CS pin voltage to both the voltage at the LD pin and the internal 500mV. Once the blanking timer is complete, the output of these comparators is allowed to reset the flip flop. When the output of either one of the two comparators goes high, the flip flop is reset and the GATE output goes low. The GATE goes low until the SR flip flop is set by the oscillator. Assuming a 30% ripple in the inductor, the current sense resistor RCS can be set using:

$$R_{CS} = \frac{0.5V}{(1 + 0.3/2) * I_{LIMT}} \approx \frac{0.43}{I_{LIMT}}$$

A constant off-time peak current control scheme can easily operate at duty cycles greater than 0.5 and also gives inherent input voltage rejection making the LED current almost insensitive to input voltage variations.

● **Input Voltage Regulator**

When a voltage is applied at the decent resistor, the LN2543 maintains a constant 6.5V at the VIN pin. This voltage is used to power the IC and any external resistor dividers needed to control the IC. The VIN pin must be bypassed by a low ESR capacitor to provide a low impedance path for the high frequency current of the output GATE driver.

The input current draw from the VIN pin is a sum of the 1.0mA current draw by the internal circuit and the current drawn by the GATE driver (which in turn depends on the switching frequency and the GATE charge of the external FET).

The ic is allowed of input maximum current draw from the VIN pin is about 20mA, so the resistor between VIN pin and VIN input can be set using:

$$R_{max} = \frac{V_{DC\,min} - 6.5V}{1mA}; \quad R_{min} = \frac{V_{DC\,max} - 6.5V}{20mA}$$
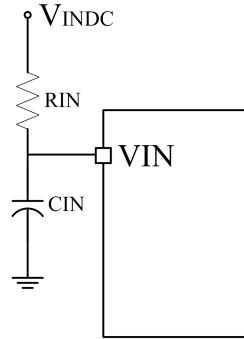
The RIN's value must be between Rmax and Rmin.

● **Current Sense**

The current sense input of the LN2543 goes to the noninverting inputs of two comparators. The inverting terminal of one comparator is tied to an reference from DIM pin whereas the inverting terminal of the other comparator is connected to the RNTC pin. The outputs of both these comparators are fed into an OR GATE and the output of the OR GATE is fed into the reset pin of the flip-flop. Thus, the comparator which has the lowest voltage at the inverting terminal determines when the GATE output is turned off.

The outputs of the comparators also include a 50-280ns blanking time which prevents spurious turn-offs of the external FET due to the turn-on spike normally present in peak current mode control. In rare cases, this internal blanking might not be enough to filter out the turn-on spike. In these cases, an external RC filter needs to be added between the external sense resistor (RCS) and the CS pin.

Please note that the comparators are fast (with a typical 80ns response time). A proper layout minimizing external inductances will prevent false triggering of these comparators.

● **Oscillator**

The oscillator in the LN2543 is controlled by a single resistor connected at the Toff pin. The equation governing the Toff-time of oscillation period is given by:

$$T_{OFF-TIME} = 45 \times 10^{-12} \times R_{OSC}$$

■ Package Information

- SOT23-6

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°