85~265V AC Input LED Constant Current Driver

■ General Description

The LN2542 is a high voltage buck control IC for constant LED current regulation. The LN2542 operates constant off-time mode. It allow efficient operation of High Brightness (HB) LEDs from voltage sources ranging from 8VDC up to 450VDC or 110VAC/220VAC.

The LN2542 includes a PWM dimming input that can accept an external control signal with a duty ratio of 0 - 100% and a frequency of up to a few kilohertz, and the dimming also accept a 0-1.2V linear input signal. The RNTC pin can accept a 0-250mV Line Dimming input witch be used for temperature compensation of the LED current. LN2542 is available by SOP-8 packages.

■ Applications

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

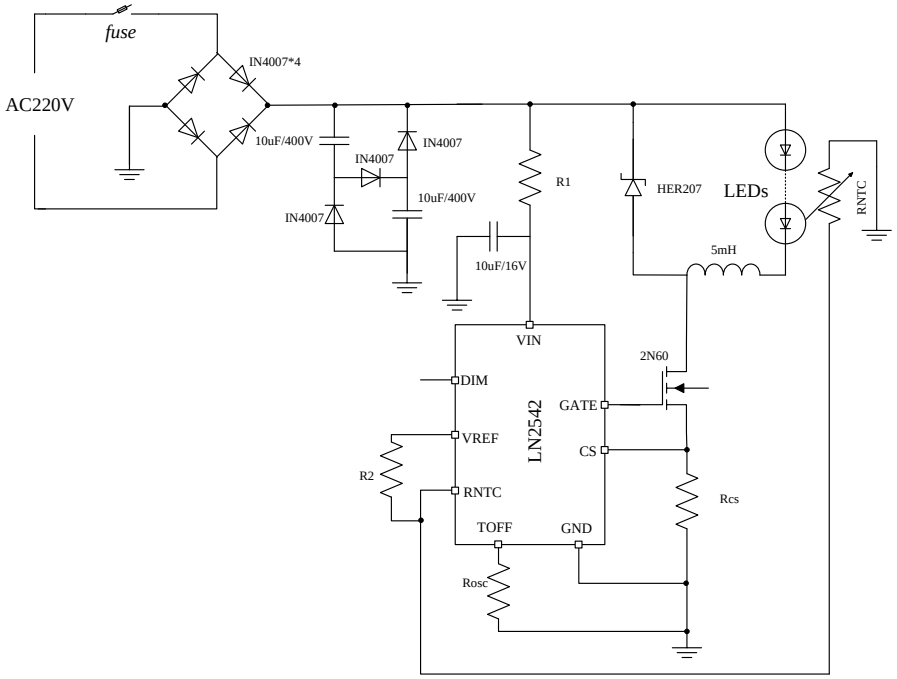
■ Features

- Switch mode controller for single switch LED Drivers
- Open loop peak current controller
- Wide Input range from 8VDC~450VDC or 110VAC/220AC
- Application from a few mA to more than 1A output
- Up to hundreds of LEDs
- Constant off-time operation
- Linear and PWM dimming capability
- Requires few external components for operation
- Temperature compensation to regulate LED current

■ Package

- SOP-8

■ Typical Application Circuit



Note： 1、R1 is based on the value of the Input voltage.

2、R2 and RNTC are used as temperature compensation threshold voltage.

3、The Rcs depends on the number of LED in parallel.

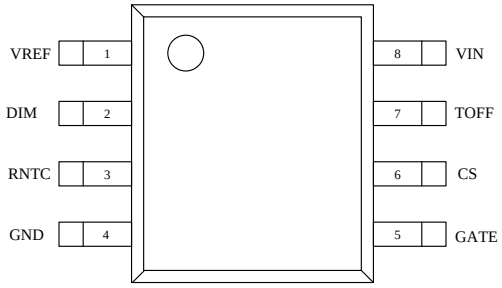
■ Ordering Information

LN2542 ①②

Designator	Symbol	Description
①		Package
	S	SOP-8
②		Device Orientation
	R	Embossed Tape: Standard Feed
	L	Embossed Tape: Reverse Feed

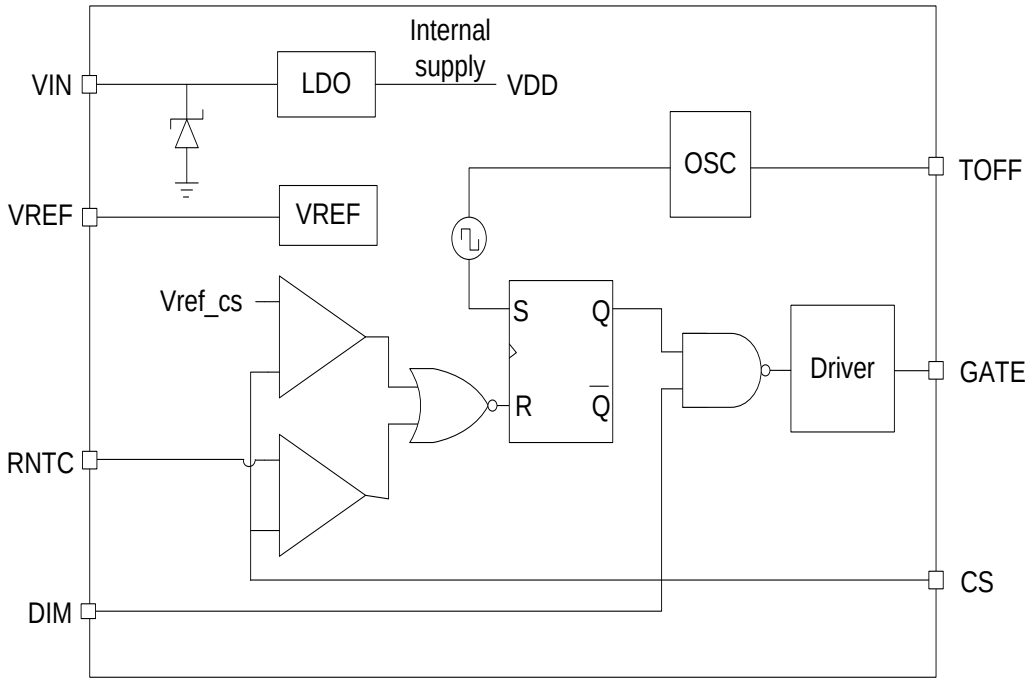
■ Functional Pin Description

SOP-8
(TOP VIEW)



Pin NO.	Pin Name	Function
1	VREF	This pin provides reference voltage about 1.25V, no bypass capacitor is needed.
2	DIM	This is the PWM and linear dimming input of the IC. When this pin is pulled to GND, the gate driver is turned off. When the pin is pulled high, the gate driver operates normally.
3	RNTC	This is used as temperature compensation threshold voltage.
4	GND	Ground.
5	GATE	This pin is the output gate driver for an external N-channel power MOSFET.
6	CS	This pin is the current sense pin used to sense the FET current by means of an external sense resistor.
7	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.
8	VIN	This pin is the input of an 8V – 450V voltage supply through a resistor, it must be bypassed with a capacitor to GND.

■ Function Block Diagram



■ Absolute Maximum Ratings

Parameter	Symbol	Maximum Rating	Unit
VIN pin voltage to GND	Vin	-0.3—14	V
CS, RNTC, DIM, TOFF, VREF 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		6.0	6.5	7.0	
I_{IN}	Operation current range	VIN=10.5V 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_{DIM}	External control voltage range on DIM pin for dc brightness control		0.3		1.2	V
V_{DIMoff}	DC voltage on DIM pin to switch device from active(on) state to quiescent(off) state		0.15	0.2	0.25	V
V_{DIMon}	DC voltage on DIM pin to switch device from quiescent(off) state to active(on) state		0.20	0.25	0.3	V
R_{DIM}	Resistance between DIM and Internal Power			200K		Ω
V_{CSTH}	Current sense pull-in threshold voltage			500		mV
V_{RNTC}	RNTC pin voltage voltage range		0.05		0.25	V
T_{OFF}	Off time	T_{OFF} pin Floating		510		ns
V_{REF}	VREF pin voltage			1.2		V
I_{REF}	Reference output current range		0.15		2	mA

■ Application Information

The LN2542 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 LN2542 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 200mV. 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 then 0.5 and also gives inherent input voltage rejection making the LED current almost insensitive to input voltage variations.

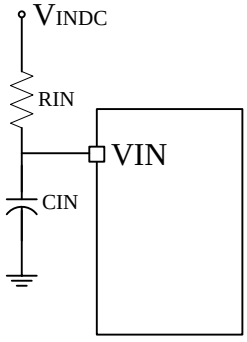
- **Input Voltage Regulator**

When a voltage is applied at the decent resistor, the LN2542 maintains a constant 10.5V 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 LN2542 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 LN2542 is controlled by a single resistor connected at the Toff pin. The equation governing the Toff-time of oscillation period is given by:

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

- **Linear Dimming**

The Linear Dimming pin is used to control the LED current. There are two cases when it may be necessary to use the Linear Dimming pin.

In some cases, it may not be possible to find the exact RCS value required to obtain the LED current when the internal 200mV is used. In these cases, an external voltage divider from the VDD pin can be connected to the DIM pin to obtain a voltage (less than 1.2V) corresponding to the desired voltage across RCS.

Linear dimming may be desired to adjust the current level to reduce the intensity of the LEDs. In these cases, an external 0-1.2V voltage can be connected to the DIM pin to adjust the LED current during operation.

To use the internal 200mV, the DIM pin can be connected to VDD or be Floating.

- **PWM Dimming**

PWM Dimming can be achieved by driving the PWMD pin with a low frequency square wave signal. When the PWM signal is zero, the GATE driver is turned off and when the PWMD signal is high, the GATE driver is enabled. Since the PWM signal does not turn off the other parts of the IC, the response of the LN2542 to the PWM signal is almost instantaneous. The rate of rise and fall of the LED current is thus determined solely by the rise and fall times of the inductor current.

To disable PWM dimming and enable the LN2542 permanently, connect the DIM pin to VDD or floating.

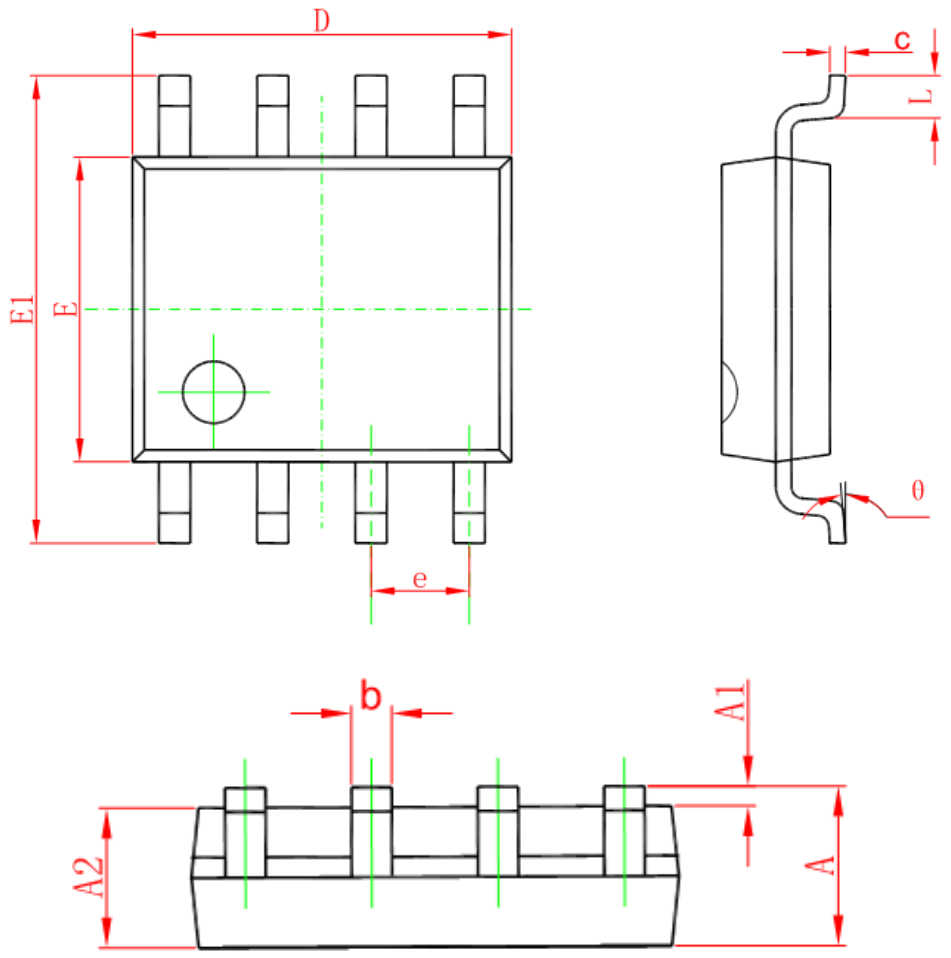
- **Thermal Compensation**

Refer to application figure, applying a decent NTC resistor close to the LEDs string will realize the temperature compensation of LEDs current. If the temperature of LEDs rises above a threshold as the current increases, the value of NTC will fall and the voltage of LD pin will fall below 0.25V.Then the current of LEDs will decrease according to the Linear Dimming section.

Make sure the value of R1 is more the 1K.

■ Package Information

- SOP-8



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°