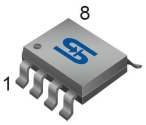
TS19460

AC/DC WLED Driver with External MOSFET Universal High Brightness

SOP-8



Pin Definition:

1. VIN	8. RT
2. CS	7. LD
3. GND	6. VDD
4. Gate	5. PWMD

General Description

The TS19460 is an average current mode control LED driver IC. It can be programmed to operate in either a constant frequency or constant off-time mode. And therefore greatly improves accuracy, line and load regulation of the LED current without any need for loop compensation or high-side current sensing. The output LED current accuracy is at +/-3%, and it is equipped with current limit comparator for hiccup mode output short circuit protection.

The TS19460 is includes an 8V~450V linear regulator which allows it to work from a wide range of input voltages without the need for an external low voltage supply. It also includes a PWM dimming input that can accept an external control TTL compatible signal. The output current can be programmed by an internal 250mV reference, or controlled externally through a 0~1.5V dimming input. The TS19460 is ideally suited for buck LED drivers and is requires only free external components (apart from the power stage) to produce a controlled LED current making it and ideal solution for low cost LED drivers.

Features

- Switch mode controller LED drivers
- Fast average current controller
- Internal 8V~450V linear regulator
- Constant frequency or constant off-time operation
- Linear and PWM dimming capability
- Requires few external components for operation
- Output short circuit protection with skip mode

Application

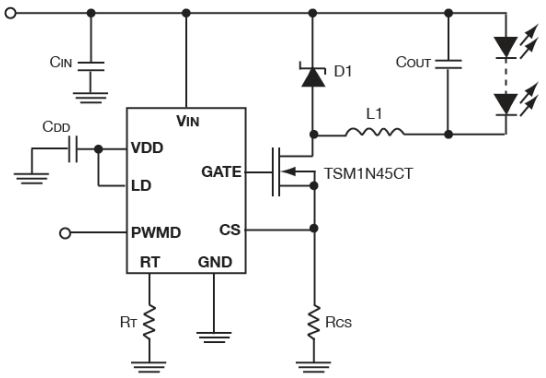
- DC/DC or AC/DC LED driver applications
- RGB backlighting LED driver
- Back lighting of flat panel displays
- General purpose constant current source
- Signage and decorative LED lighting
- LED street lighting

Ordering Information

Part No.	Package	Packing
TS19460CS RLG	SOP-8	2.5Kpcs / 13” Reel

Note: “G” denote for Halogen Free Product

Typical Application Circuit



Absolute Maximum Rating

Parameter	Symbol	Limit	Unit
Input Voltage Range	V_{IN} to GND	-0.5 ~ +470	V
Internal Regulated Voltage	V_{DD} to GND	12	V
CS, LD, PWMD, Gate, RT to GND		-0.3 ~ (V_{DD}+0.3)	V
Continuous Power Dissipation	P_D	650	mW
Storage Temperature Range	T_A	-65 to +150	°C
Junction Temperature Range	T_J	-40 to +150	°C
Thermal Resistance – Junction to Ambient	$R\theta_{JA}$	128	°C/W

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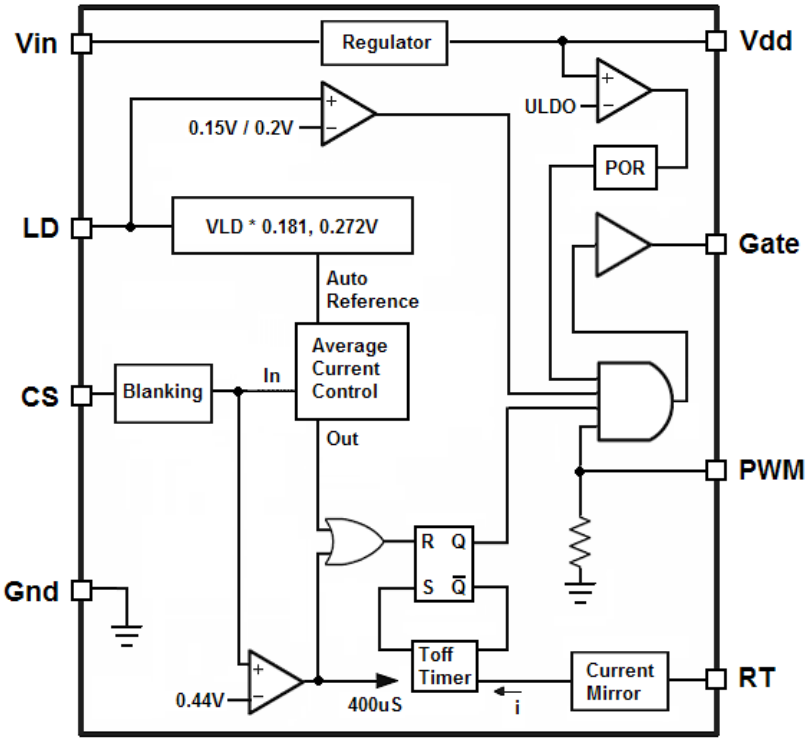
Universal High Brightness

Electrical Specifications (T_A= 25°C, V_{IN}= 12V, V_{LD}=PWM=V_{DD}, unless otherwise noted)

Function Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Input						
DC Input Voltage Range	V_{INDC}	DC input voltage	8.0	--	450	V
Shut-down Mode Supply Current	I_{INSD}	Pin PWMD to GND	--	0.5	1.0	mA
Internal Regulator						
Internally Regulated Voltage	V_{DD}	V_{IN}=8V, $I_{DD(EXT)}$=0 500pF at Gate, R_T=226kΩ	7.25	7.5	7.75	V
Line Regulation of V_{DD}	ΔV_{DDLine}	V_{IN}=8~450V, $I_{DD(EXT)}$=0 500pF at Gate, R_T=226kΩ	0	--	1.0	V
Load Regulation of V_{DD}	ΔV_{DDLoad}	$I_{DD(EXT)}$= 0 ~ 1mA 500pF at Gate, R_T=226kΩ	0	--	100	mV
Undervoltage Lockout Threshold	UVLO	V_{DD} rising	6.45	6.7	6.95	V
Undervoltage Lockout Hysteresis	ΔUVLO	V_{DD} falling	--	500	--	mV
Maximum Input Current	$I_{IN\ (MAX)}$	V_{IN}=8V	3.5	--	--	mA
Dimming						
PWMD Input Low Voltage	V_{ENL}	V_{IN}=8V~450V	--	--	0.8	V
PWMD Input High Voltage	V_{ENH}	V_{IN}=8V~450V	2.0	--	--	V
PWMD Pull-down resistance at PWMD	R_{EN}	V_{PWMD}=5V	50	100	150	kΩ
Average Current Sense Logic						
Current Sense Reference Voltage	V_{CS}		238	250	262	mV
LD to Current Sense Ratio	$Av_{(LD)}$	T_A < +125ºC	--	0.18	--	
LD input Voltage Shutdown	$V_{LD(OFF)}$	V_{LD} falling	--	150	--	mV
LD input Voltage Enable	$\Delta V_{LD(OFF)}$	V_{LD} rising	--	200	--	mV
Current Sense Blanking Interval	T_{BLANK}		150	--	280	nS
Minimum On-Time	$T_{ON(min)}$	V_{CS}= V_{CS} + 30mV	--	--	1	uS
Off Time	T_{OFF}	R_T=1MΩ	32	--	48	uS
		R_T=226kΩ	8	--	12	
Max. Steady-State Duty Cycle	D_{MAX}		75	--	--	%
Short Circuit Protection						
Hiccup Threshold Voltage	V_{CS}		410	--	470	mV
Current Limit Delay CS to Gate	T_{DELAY}	V_{CS}= V_{CS} + 30mV	--	--	150	nS
Short Circuit Hiccup Time	T_{HICCUP}		330	--	460	uS
Minimum On-Time (Short Circuit)	$T_{ON(min)}$	V_{CS}= VDD	--	--	430	nS
Gate Driver						
Gate Sourcing Current	I_{SOURCE}	V_{GATE}=0V, V_{DD}=7.5V	165	--	--	mA
Gate Sinking Current	I_{SINK}	V_{GATE}=V_{DD}, V_{DD}=7.5V	165	--	--	mA
Gate output Rise Time	T_{RISE}	C_{GATE}=500pF, V_{DD}=7.5V	--	30	50	nS
Gate Output Fall Time	T_{FALL}	C_{GATE}=500pF, V_{DD}=7.5V	--	30	50	nS

Note 1: Limited by package power dissipation, whichever is lower

Block Diagram



Pin Description

Pin	Function	Description
1	VIN	This pin is the input of 8V~450V linear regulator
2	CS	This pin is the current sense pin used to sense the MOSFET current by means of an external sense resistor.
3	GND	Ground return for all internal circuitry. This pin must be electrically connected to the ground of the power train.
4	GATE	This pin is the output GATE driver for an external N-CH Power MOSFET
5	PWMD	This is the PWM 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.
6	VDD	This is the power supply pin for all internal circuits. It must be bypassed with a low ESR capacitor to GND (≥0.1μF)
7	LD	This pin is the linear dimming input and sets the current sense threshold as long as the voltage at the pin is less than 1.5V, The Gate output is disable when LD voltage <150mV(typ.) and recovery when LD voltage >200mV (typ.)
8	RT	A resistor is connected between RT and GND to program the Gate off-time within the range of 30kohm

Application Information

The TS19460 is optimized to drive buck LED drivers using average 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 resistor connected to the RT pin programs the frequency of operation (or the off-time). Constant frequency of average current mode control is used for stability and to improve the LED current regulation over a wide range of input voltages.

The current through the switching MOSFET source is averaged and used to give constant-current feedback. This current is detected from a sense resistor at the CS pin, the feedback operates is a fast open-loop mode, there are no compensation is required, the output current is programmed as

$$\mathbf{I_{LED} = 0.25V / R_{CS}}$$

When the Voltage at the LD input >1.5V, otherwise

$$\mathbf{I_{LED} = (V_{LD} * 0.181) / R_{CS}}$$

When application to design the inductor witching ripple current in it is 40% of average peak to peak, full load current, the inductance can be calculated as follow:

$$\mathbf{L_{OUT} = (V_{OUT(max)} * T_{OFF}) / (0.4 * I_{OUT})}$$

The duty cycle range of current control feedback is limited to <0.75%, when the LED string voltage is greater than 75% of input voltage, the LED current will be reduced.

When output LED voltage is below $V_{OUT(MIN)} = V_{IN} * D_{(MIN)}$, where $D_{(MIN)} = 1uS / (T_{OFF} + 1uS)$, it also occurred the loss of regulation of LED current. This condition will cause an increase in LED current and can be possible to trip the short circuit protection comparator when the voltage at CS exceeds 0.44V, the Gate off time (T_{HICCUP} = 400uS) is generated to prevent stair casing of inductor current. the leading edge blanking delay is provide at CS to prevent false triggering of current feedback and short circuit protection, both of output open or short condition is required to recycle the V_{DD} to restore to operate in normally.

Input Voltage Regulator

The TS19460 can be powered directly from its VIN pin and can work from 8.0V~450VDC at its VIN pin. When a voltage is applied at the VIN pin, the TS19460 maintains a constant 7.5V at the VDD pin. This voltage is used to power the IC and any external resistor dividers needed to control the IC. The VDD 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 TS19460 can be also operated by supplying a voltage at the VDD pin greater than the internally regulated voltage. Please note that this external voltage at the VDD pin should not exceed 12V.

Although the VIN pin of the TS19460 is rated up to 450V, the actual maximum voltage that can be applied is limited by the power dissipation in the IC. For example, if an SOP-8 (junction to ambient thermal resistance $R\theta_{JA}$ = 128℃/W) TS19460 draws about I_{IN} = 2.0mA from the VIN pin, and has a maximum allowable temperature rise of the junction temperature limited to about the maximum voltage at the VIN pin would be:

$$\mathbf{V_{IN(MAX)} = (T_{J(MAX)} - T_A) / (R\theta_{JA} * I_{IN}) = 390V}$$

In these cases, to operate the TS19460 from higher input voltages, a Zener diode can be added in series with the VIN pin to divert some of the power loss from the TS19460 to the Zener diode. In the above example, using a 100V zener diode will allow the circuit to easily work up to 490V.

Application Information (Continue)

The input current drawn from the VIN pin is a sum of the 1.0mA current drawn 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

$$I_{IN} \approx 1mA + Q_G \times f_S$$

In the above equation, f_S is the switching frequency and Q_G is the GATE charge of the external MOSFET (which can be obtained from the datasheet of the MOSFET).

Oscillator

The oscillator in the TS19460 is controlled by a single resistor connected at the RT pin. The equation governing the oscillator time period t_{OSC} is given by:

$$T_{OFF(uS)} = (RT_{(K\Omega)} / 25) + 0.3$$

Linear Dimming

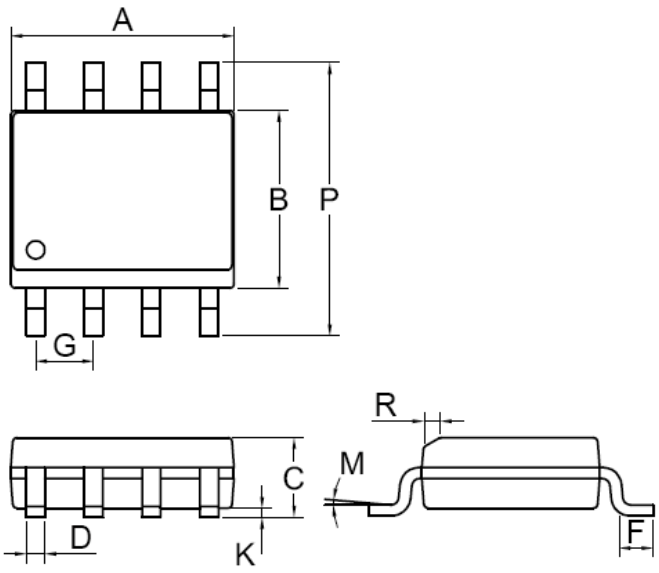
The Linear Dimming pin is used to control the LED current, when voltage at LD is fall below 1.5V, the internal reference voltage (250mV) to the constant current feedback become over ridden by VLD * 0.181, and the current in the inductor remain continuous, the LED current is given by $I_{LED} = (V_{LD} * 0.181) / R_{CS}$, The Gate output is disable when LD voltage <150mV(typ.) and recovery when LD voltage >200mV (typ.)

The Linear Dimming input could also be used for mixed-mode dimming to expand the dimming ratio, in this kind of application condition, the pulse-width modulated signal of a measured amplitude below 1.5V should be applied at LD.

PWM Dimming

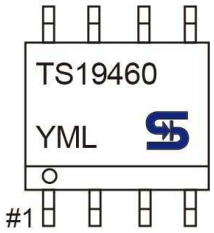
PWM Dimming can be achieved by driving the PWMD pin with a square wave signal. The rising and falling edges are limited by current slew rate in inductor, the first switching cycle is terminated upon reaching the level (250mV) at CS, the circuit is further reaching its steady state within 3~5 switching cycle regardless of the switching frequency.

SOP-8 Mechanical Drawing



SOP-8 DIMENSION				
DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX.
A	4.80	5.00	0.189	0.196
B	3.80	4.00	0.150	0.157
C	1.35	1.75	0.054	0.068
D	0.35	0.49	0.014	0.019
F	0.40	1.25	0.016	0.049
G	1.27BSC		0.05BSC	
K	0.10	0.25	0.004	0.009
M	0º	7º	0º	7º
P	5.80	6.20	0.229	0.244
R	0.25	0.50	0.010	0.019

Marking Diagram



Y = Year Code
M = Month Code for Halogen Free Product
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L = Lot Code

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