

## Controller for LED Current Ripple Removing Circuit

### Features

- Current filter for single stage LED driver to eliminate current ripple
- No external COMP capacitor
- Built-in soft-start
- Output current high to 300mA
- Over temperature protection
- Operating temperature range from -40°C to 135°C

### Description

The WS9931 is an adaptive linear current regulator to eliminate low frequency current ripple targeting at LED lighting applications. It adopts an adaptive control scheme and no additional electrical design is needed. It can realize the function of LED light filtering with very few external components, so the system cost and size are minimized. The WS9931 is mainly applied in panel lights and tube lights, sharing the Board with LED lamps.

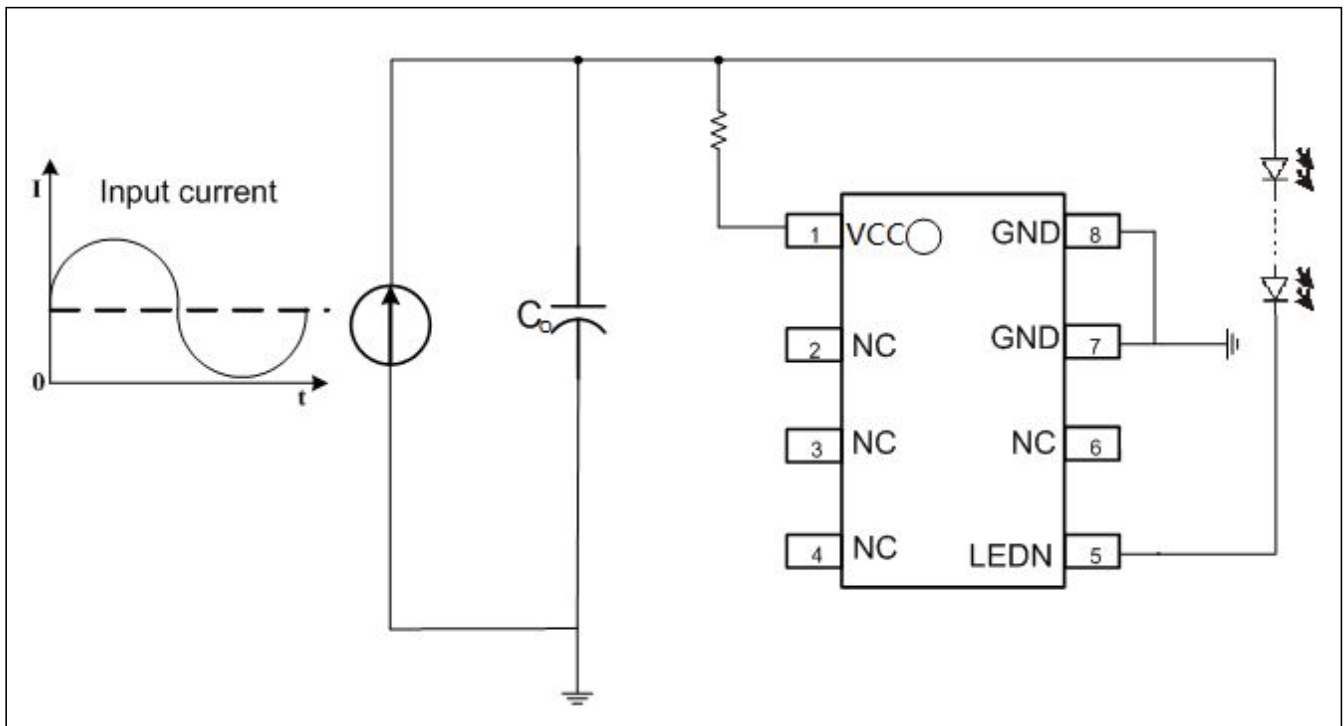
The operating temperature range of the WS9931 is from -40°C to 135°C.

The WS9931 is available in ESOP8 Package.

### Applications

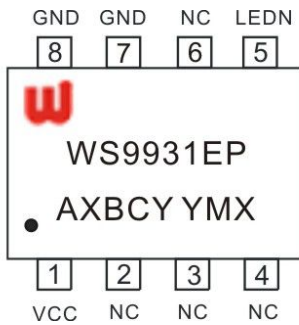
- LED Tube Lights
- LED Panel Lights

### Typical Application Circuit



**Pin Configuration and Marking Information**

The WS9931 is available in ESOP-8 Package. The top marking is shown as below:

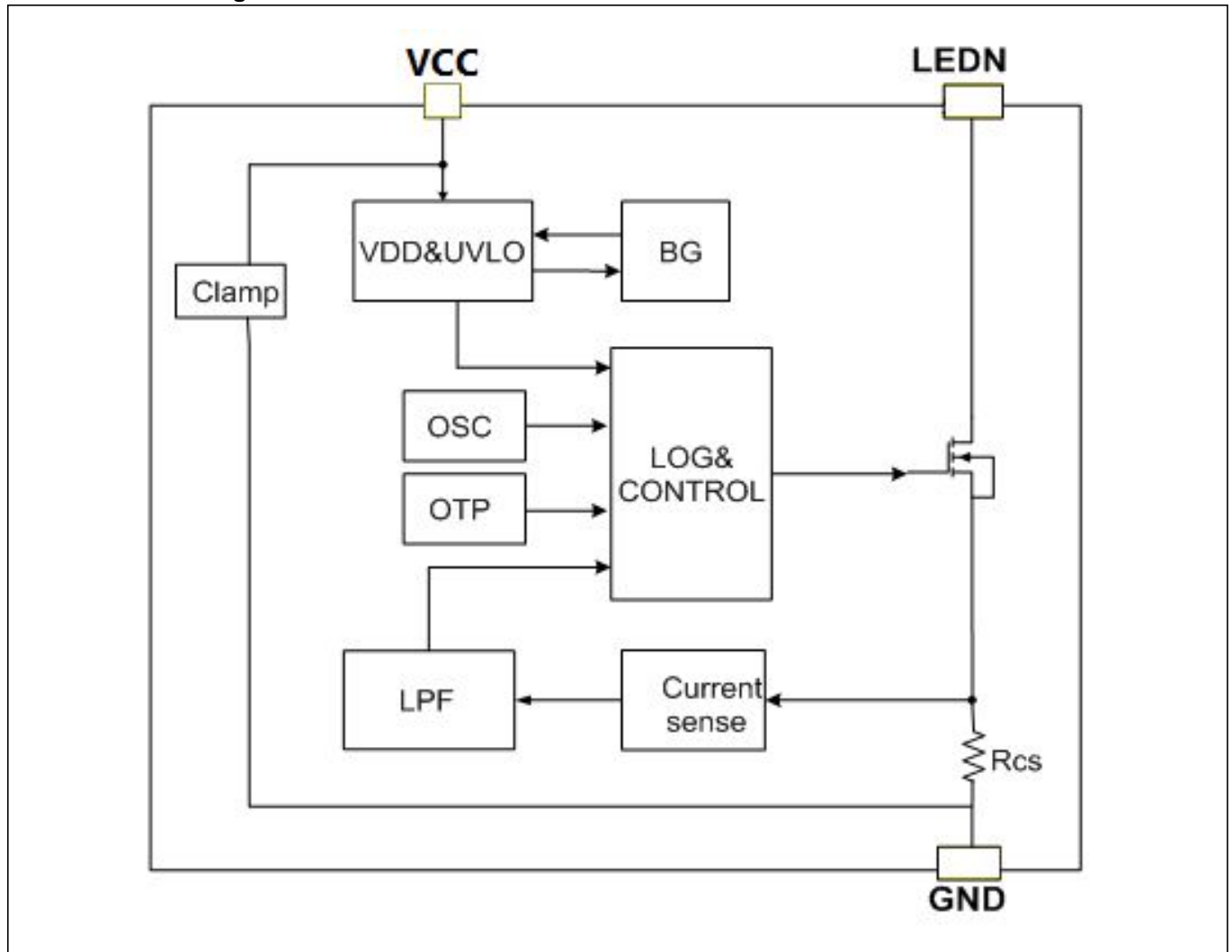


WS9931EP: Product Code  
 A: Product Code  
 X: Internal Code  
 BCY: Internal Code for QC  
 YMX: D/C

**Pin Definition** (Note: the heat sink at the bottom is connected to Pin 5.)

Name	Pin No.	Description
VCC	1	Power Supply
NC	2/3/4/6	NA
LEDN	5	Cathode of LED string
GND	7/8	Ground Pin

**Internal Block Diagram**



## Ordering Information

Package	Marking	Part Number
8-Pin ESOP8,Pb-free	WS9931EP	WS9931EP

## Absolute Maximum Ratings

Parameter	Range	unit
V <sub>IN</sub>	-0.3~6	V
LEDN	-0.3~60	V
Junction Temperature	-40~150	°C
Lead Temperature (Soldering, 10 sec.)	260	°C
Storage Temperature	-55~150	°C

**Note** : Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## Electrical Characteristics

V<sub>IN</sub>=5V and T=25°C, unless otherwise stated.

Symbol	Parameter	Test condition	Min	Typ	Max	Unit
<b>Supply Voltage Section</b>						
V <sub>IN</sub>	V <sub>IN</sub> clamp voltage		4.8	5	5.2	V
I <sub>OP</sub>	V <sub>IN</sub> operation current		400	500	600	uA
V <sub>OVP-V<sub>O</sub>_MIN</sub>	Differential between maximum OVP voltage and minimum on-load voltage			50	60	V
I <sub>O</sub>	Adaptive output current		100	240	300	mA
<b>Thermal Section</b>						
T <sub>TC</sub>	Thermal Regulation Temperature			120		°C
T <sub>SD</sub>	Thermal Shutdown Temperature			135		°C
T <sub>HYS</sub>	Thermal Hysteresis Temperature			18		°C

## Application Information

The WS9931 is an adaptive linear current regulator to eliminate low frequency current ripple targeting at LED lighting applications. It adopts adaptive control scheme and integrates MOS and current sense resistor. No additional electrical design is needed to eliminate ripple.

The maximum output current of the WS9931 can be high to 300mA, and the value of  $V_{OVP}-V_{O\_MIN}$  should be lower than 60V.

## Theory of Current Ripple Removing

The WS9931 acquires the signals of sense voltages through sampling the output currents signal from the load, and makes the signals filter. Then it magnifies the error between sense voltage signals and filter voltage signals, and outputs the signal of error compensation to regulate output current signals. The WS9931 drives MOSFET to transfer the LED current ripple to voltage ripple on MOSFET, and ensures the constant voltage across LED string and the current flow through LED string, thus eliminating current ripple.

## Start Up

The WS9931 integrates soft-start function and is supplied by the front-end system. When  $V_{IN}$  rises up over 5V, the WS9931 starts to work. At first, it has 350ms blanking time without current filter function to build up stable reference internally. Then the LED current ripple is decreased by WS9931 gradually.

The typical value of the startup current is 500uA. And the startup resistor can be calculated by the equation:

$$R_{ST} < \frac{V_O - V_{IN\_MAX}}{I_{VIN\_TYP}} \approx \frac{V_O - 5.2V}{500\mu A}$$

Where,

$V_O$  is the on-load voltage in practical application;  
 $V_{IN\_MAX}$  is the maximum clamp voltage, about 5.2V;  
 $I_{VIN\_TYP}$  is the operating current, about 500uA.

## Over Thermal Protection

The WS9931 monitors operation temperature. When the temperature is up to 120 °C , the temperature compensation is turned on to increase LED current ripple and reduce the maximum voltage of LEDN. When the temperature is high to 135°C, over thermal protection starts. And the MOSFET will be On-State all the time, it no longer suppresses ripple.

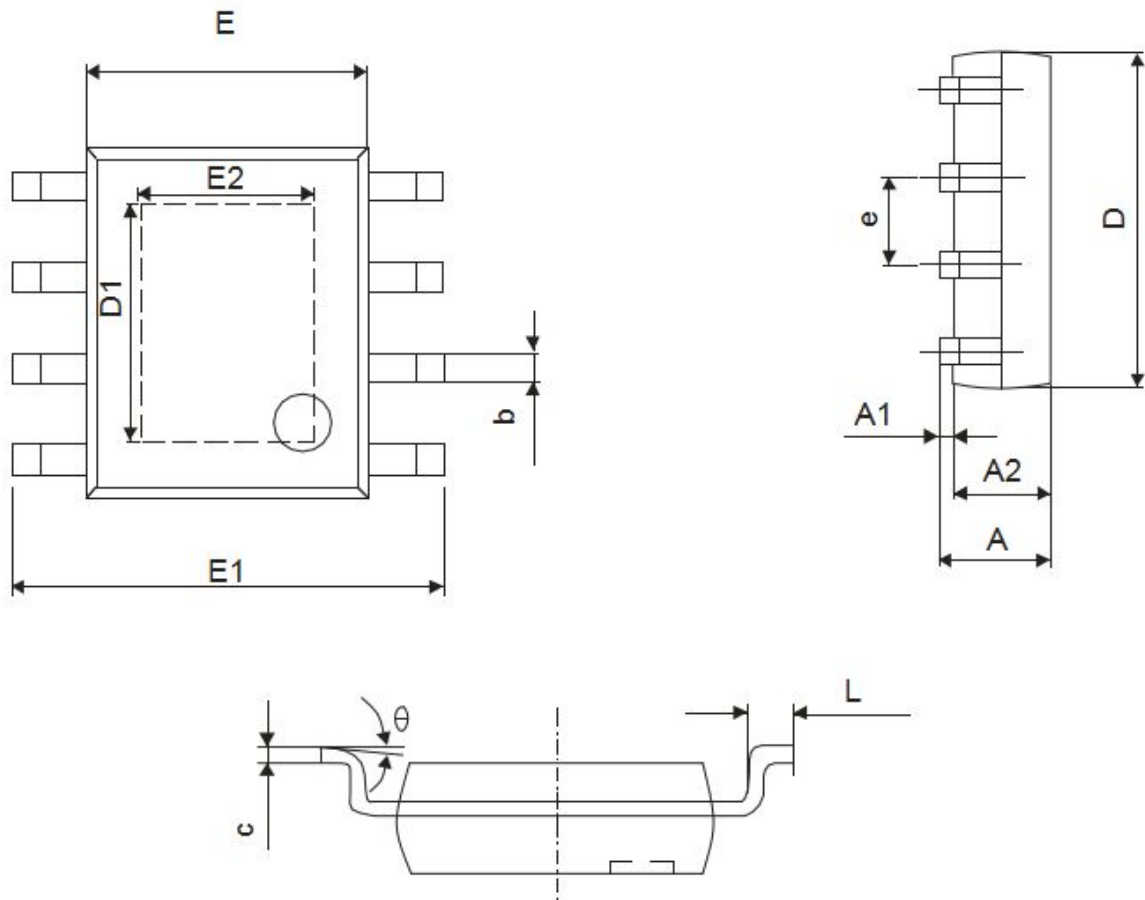
## PCB Layouts

The following rules should be followed in WS9931 PCB layout:

**IC Layout:** The IC should be away from MOSFET, freewheeling diodes, inductors and other heating devices.

**LEDN Pin:** To increase the copper area of LEDN pin or to connect to other NC pins for better thermal dissipation.

**Package Information**  
**ESOP8 Package Outline Dimensions**



Symbol	Winsemi			
	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.050	0.150	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
D1	3.202	3.402	0.126	0.134
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
E2	2.313	2.513	0.091	0.099
e	1.270(BSC)		0.050(BSC)	
L	0.400	1.270	0.016	0.050
theta	0°	8°	0°	8°

**NOTE:**

- 1.We strongly recommend customers check carefully on the trademark when buying our product, if there is any question, please don't be hesitate to contact us.
- 2.Please do not exceed the absolute maximum ratings of the device when circuit designing.
- 3.Winsemi Microelectronics Co., Ltd reserved the right to make changes in this specification sheet and is subject to change without prior notice.

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