

### SOT-26



### Pin Definition:

1. COM
2. GND
3. CS
4. OUT
5. V<sub>CC</sub>
6. DMG

## Description

TS19310 is a buck/boost control IC with phase angle decoding circuit and hold current adjusting function for TRIAC dimming LED lighting. TS19310 achieves high power factor and low total harmonic distortion (THD) operation by boundary conduction mode (BCM). The line and load regulation of LED current is about  $\pm 3\%$ , based on particular control method.

## Features

- Built-in Phase Angle Decoding
- TRIAC Hold Current Management Technique
- PSR and Buck/Boost Control
- Universal Input Voltage Range  
TS19310ACX6: 90 V<sub>AC</sub> ~ 135 V<sub>AC</sub>  
TS19310BCX6: 180 V<sub>AC</sub> ~ 264 V<sub>AC</sub>
- Active Power Factor Correction Technique
- Constant Output Current Control LED Driver
- Open-LED Protection on DMG Pin
- Over-Voltage Protection on V<sub>CC</sub> Pin
- Short-LED Protection
- Cycle by Cycle Over-Current Protection on CS Pin
- Over-Temperature Protection
- Gate Driving Voltage Clamping

## Applications

- LED Lighting
  - Down Light
  - Tube Lamp
  - PAR Lamp
  - Bulb

## Ordering Information

Part No.	Package	Packing
TS19310ACX6 RFG	SOT-26	3kpcs/7" Reel
TS19310BCX6 RFG	SOT-26	3kpcs/7" Reel

**Note:** "G" denotes for Halogen- and Antimony-free as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds

## Absolute Maximum Ratings <sup>(Note 1)</sup>

Parameter	Symbol	Range	Unit
Power Supply Pin	V <sub>CC</sub>	40	V
DMG Voltage to GND	V <sub>DMG</sub>	-0.3 to 40	V
OUT Voltage to GND	V <sub>OUT</sub>	-0.3 to 40	V
CS Voltage to GND	V <sub>CS</sub>	-0.3 to 5.5	V
COM Voltage to GND	V <sub>COM</sub>	-0.3 to 5.5	V
Junction Temperature Range	T <sub>J</sub>	-40 to +150	°C
Storage Temperature Range	T <sub>STG</sub>	-65 to +150	°C
Lead Temperature (soldering 10 s)	T <sub>LEAD</sub>	260	°C
Power Dissipation @ T <sub>A</sub> =25°C	P <sub>D</sub>	0.3	W
ESD Rating (Human Body Mode) <sup>(Note 2)</sup>	HBM	2	kV

## Thermal Information

Parameter	Symbol	Range	Unit
Thermal Resistance Junction to Ambient <sup>(Note 3)</sup>	$R_{\theta JA}$	220	°C/W
Thermal Resistance Junction to Case	$R_{\theta JC}$	106.6	°C/W

## Recommended Operating Conditions <sup>(Note 4)</sup>

Parameter	Symbol	Conditions	Unit
Power Supply Pin	$V_{CC}$	34.5	V
DMG Voltage to GND	$V_{DMG}$	-0.3 to 11.2	V
OUT Voltage to GND	$V_{OUT}$	-0.3 to 19	V
CS Voltage to GND	$V_{CS}$	-0.3 to 5	V
COM Voltage to GND	$V_{COM}$	-0.3 to 5	V
Operating Junction Temperature Range	$T_J$	-40 to +125	°C
Operating Ambient Temperature Range	$T_{OPA}$	-40 to +85	°C

## Electrical Characteristics ( $T_A = 25^\circ\text{C}$ , unless otherwise specified.)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Turn-on Voltage	$V_{CC\_ON}$		17	18	19	V
Turn-off Voltage	$V_{CC\_OFF}$		8.5	9.5	10	V
Quiescent Current 1	$I_{Q1}$	$V_{CC}=17\text{V}$ , at $V_{CC}$ off	--	30	50	$\mu\text{A}$
Quiescent Current 2	$I_{Q2}$	Start up at 4.5 kHz	--	600	800	$\mu\text{A}$
Operation Supply Current	$I_{CC}$		--	2.5	3.0	mA
<b>Protection</b>						
VCC Voltage Protection	$V_{OVPA}$		31	32	34	V
Output Voltage Protection	$V_{OVPS}$		10	10.5	11	V
CS Limit Voltage	$V_{OCP}$		1.15	1.25	1.35	V
Short Circuit Protection <sup>(Note 5)</sup>	$V_{O\_STR}$		--	3	--	V
<b>Oscillator</b>						
Start-up Timer	$t_{STR}$		--	222	--	$\mu\text{s}$
<b>GM Amplifier</b>						
Transconductance	$g_m$		--	60	--	$\mu\text{S}$
Source Current	$I_{COMP\_SOU}$		--	20	--	$\mu\text{A}$

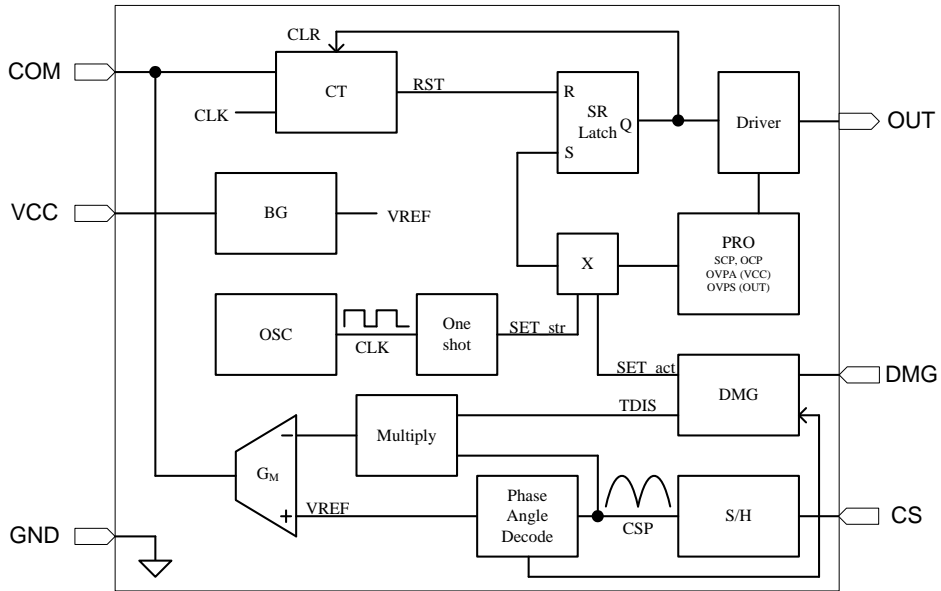
**Electrical Characteristics** ( $T_A = 25^\circ\text{C}$ , unless otherwise specified.)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
<b>Driver</b>						
Dropout Voltage	$V_{OH}$	$V_{CC}=33\text{V}, I_O = 10\text{mA}$	--	1.2	1.5	V
	$V_{OL}$	$V_{CC}=33\text{V}, I_O = -10\text{mA}$	--	0.12	--	V
Rise Time	$t_{RISE}$	$V_{CC}=20\text{V}, C_O = 1\text{nF}$	--	40	--	ns
Fall Time	$t_{FALL}$	$V_{CC}=20\text{V}, C_O = 1\text{nF}$	--	80	--	ns
Output Clamp Voltage	$V_{O\_CLAMP}$		--	--	19	V
Leading Edge Blanking Time	$t_{LEB}$		--	500	--	ns
<b>Over Temperature Protection</b> <small>(Note 6)</small>						
OTP Trip Point			--	150	--	$^\circ\text{C}$
OTP Release Point			--	115	--	$^\circ\text{C}$
OTP Threshold Hysteresis			--	35	--	$^\circ\text{C}$

**Notes:**

1. Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. Functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may remain possibility to affect device reliability.
2. Devices are ESD sensitive. Handling precaution recommended.
3. Thermal Resistance is specified with the component mounted on a low effective thermal conductivity test board in free air at  $T_A=25^\circ\text{C}$ .
4. The device is not guaranteed to function outside its operating conditions.
5. Guaranteed by design.
6. Auto recovery type.

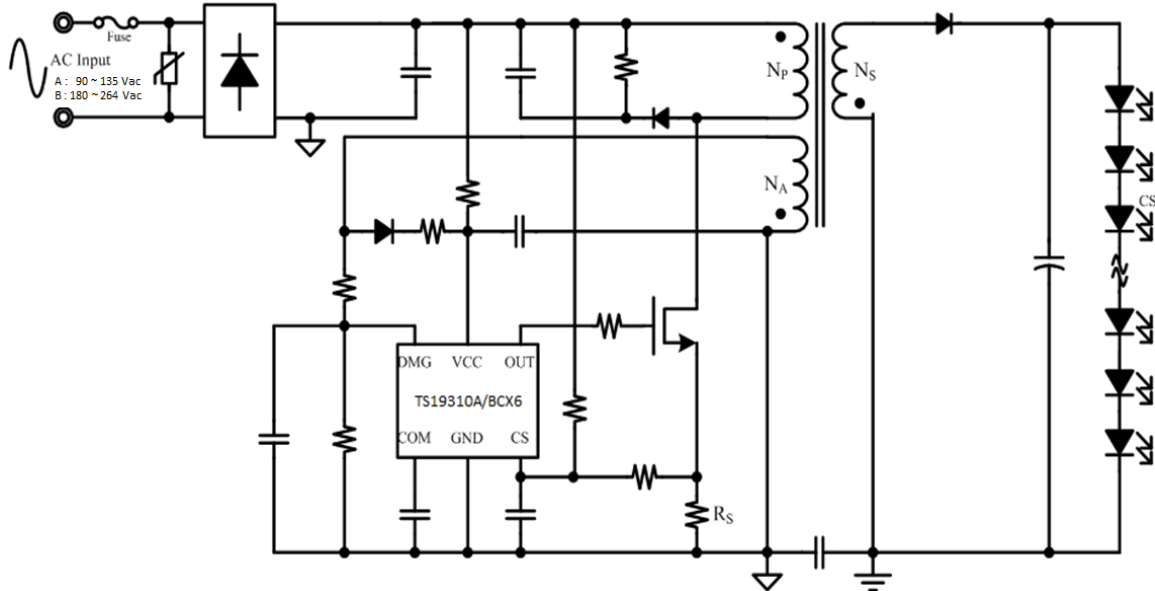
**Function Block**



**Pin Description**

Pin No.	Name	Function
1	COM	Output pin of error amplifier.
2	GND	Ground return for all internal circuitry.
3	CS	Input current sense pin.
4	OUT	Power MOSFET output pin.
5	V <sub>CC</sub>	Power supply pin for all internal circuitry.
6	DMG	Zero current demagnetization sensing.

**Typical Application Circuit**



**Application Information**

**Function Description**

The TS19310 is boundary conduction mode (BCM) operation with constant on time based regulator design to achieve high power factor performance. The TS19310 has built-in functions of phase dimmable, and included protection function related  $V_{CC}$  over-voltage protection, open-LED protection, short-LED protection, over-temperature protection, primary side current limit, and gate clamp is within. The TS19310 is the sense switch current from CS voltage multiplier by test data input signal (TDIS) to get the output current information by system close loop feedback.

The average output current can express by below formula.

$$I_{OUT} = \frac{N_P}{N_S} \times \frac{0.333 * \eta}{2 \times R_S}$$

Where:

- $I_{OUT}$  is the average output current
- $N_P$  is the primary-side turn ratio
- $N_S$  is the secondary-side turn ratio
- 0.333 is the reference potential setting of IC
- 2 is the reference potential setting of IC
- $\eta$  is the efficiency
- $R_S$  is the sensing resistor connected between the MOSFET source and the GND

**Pin Detail**

**Pin 1: Compensation**

This is the output of the  $g_m$  amplifier. Connect with a suitable RC network to ground.

**Pin 2: Ground**

GND is the reference node of internal circuit.

### Pin 3: Current Sense

MOSFET current signal sensing for multiply, phase angle decode and current limit setting function.

$$I_{CS(Limit)} = \frac{1.25}{R_s}$$

Where:

- $I_{CS}$  is the input current sense
- IC internal CS Pin 1.25V Over voltage level
- $R_s$  is the sensing resistor connected between the MOSFET source and GND

### Pin 4: Output

Gate drive for external MOSFET switch and has built-in gate clamp function.

### Pin 5: V<sub>CC</sub>

Power supply for the controller during normal operation. The controller will start up when V<sub>CC</sub> reaches 18V (typical) and will shut-down when V<sub>CC</sub> voltage is below 9.5V (typical). A decoupling capacitor should be connected between the V<sub>CC</sub> and GND pin as close as possible.

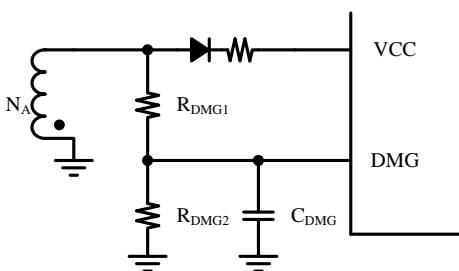
The TS19310 performs V<sub>CC</sub> over voltage protection though V<sub>CC</sub> pin. Once V<sub>CC</sub> pin exceeds 32V, TS19310 turns off and latches the MOSFET until V<sub>CC</sub> goes below V<sub>CC\_OFF</sub>.

### Pin 6: DMG

The Output voltage is reflected by the auxiliary winding ( $N_A$ ) voltage of Flyback transformer, the DMG pin can sense output information to depart from start up voltage ( $V_{O\_STR}$ ) and protection voltage ( $V_{O\_OVP}$ ).

When DMG sense voltage under  $V_{O\_STR}$ , the circuit will work on short circuit protection,  $f_{STR}=1/t_{STR}$ .

When DMG sense voltage over  $V_{O\_OVP}$ , the circuit will work on over voltage protection, it will latch out off until V<sub>CC</sub> goes below V<sub>CC\_OFF</sub>.



OVP Protection (by DMG)

$$V_{DMG\_OVP} = \frac{N_s}{N_A} \times V_{OVPS} \times \frac{R_{DMG1} + R_{DMG2}}{R_{DMG2}}$$

OVP Protection (by V<sub>CC</sub>)

$$V_{VCC\_OVP} = \frac{N_s}{N_A} \times V_{OVPA}$$

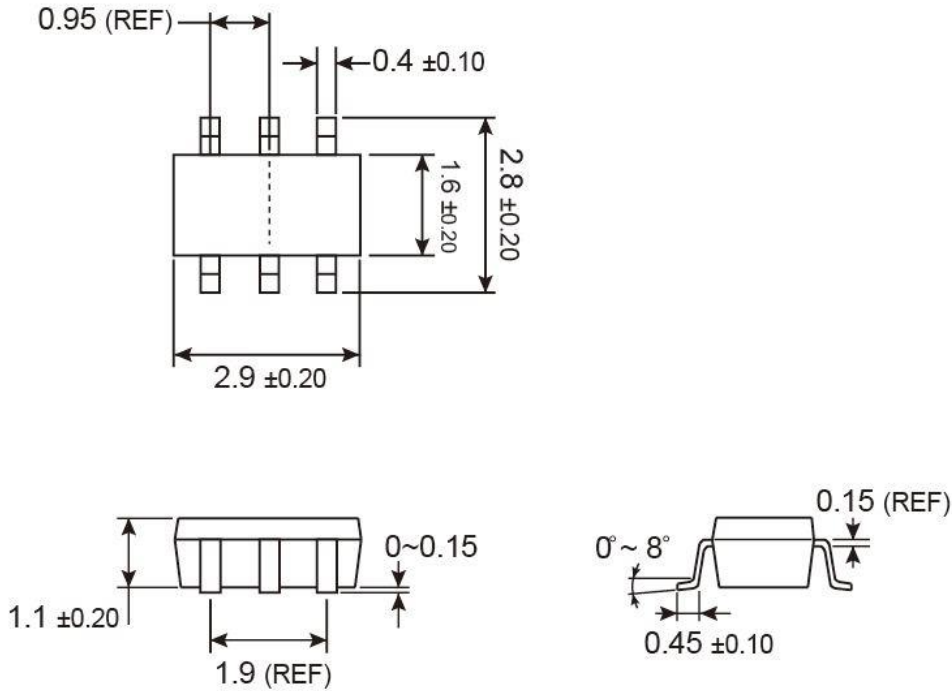
Short Circuit Protection

$$V_{O\_Short} = \frac{N_s}{N_A} \times V_{O\_STR} \times \frac{R_{DMG1} + R_{DMG2}}{R_{DMG2}}$$

Where:

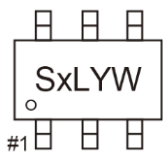
- $V_{DMG\_OVP}$  is the output-over-voltage protection point
- $V_{OVPS}$  is the over voltage protection signal
- $V_{O\_STR}$  is the start-up timer
- $N_A$  is the number of auxiliary-winding turns
- $N_s$  is the number of secondary-winding turns

**SOT-26 Mechanical Drawing**



Unit: Millimeters

**Marking Diagram**



- SM** = TS19310CXA Device Code
- SN** = TS19310CXB Device Code
- L** = Lot Code A~Z
- Y** = Year Code  
(**D**=2014, **E**=2015, **F**=2016, **G**=2017, **H**=2018, **J**=2019, **K**=2020)
- W** = Week Code  
A~Z = wk1~wk26  
A~Z = wk27~wk52

## Notice

Specifications of the products displayed herein are subject to change without notice. TSC or anyone on its behalf, assumes no responsibility or liability for any errors or inaccuracies.

Information contained herein is intended to provide a product description only. No license, express or implied, to any intellectual property rights is granted by this document. Except as provided in TSC's terms and conditions of sale for such products, TSC assumes no liability whatsoever, and disclaims any express or implied warranty, relating to sale and/or use of TSC products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright, or other intellectual property right.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify TSC for any damages resulting from such improper use or sale.