TS19310A/B

Single-Stage PFC
TRIAC Dimmable LED Driver

SOT-26

Pin Definition:

1. COM
2. GND
3. CS
4. OUT
5. V_{CC}
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 ±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_{AC} ~ 135 V_{AC}
  TS19310BCX6: 180 V_{AC} ~ 264 V_{AC}
- Active Power Factor Correction Technique
- Constant Output Current Control LED Driver
- Open-LED Protection on DMG Pin
- Over-Voltage Protection on V_{CC} 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 (Note 1)

Parameter	Symbol	Range	Unit
Power Supply Pin	V_{CC}	40	V
DMG Voltage to GND	V_{DMG}	-0.3 to 40	V
OUT Voltage to GND	V_{OUT}	-0.3 to 40	V
CS Voltage to GND	V_{CS}	-0.3 to 5.5	V
COM Voltage to GND	V_{COM}	-0.3 to 5.5	V
Junction Temperature Range	T_J	-40 to +150	°C
Storage Temperature Range	T_{STG}	-65 to +150	°C
Lead Temperature (soldering 10 s)	T_{LEAD}	260	°C
Power Dissipation @ T_A=25°C	P_D	0.3	W
ESD Rating (Human Body Mode) (Note 2)	HBM	2	kV

Thermal Information

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

Recommended Operating Conditions (Note 4)

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°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}=17V, at V_{CC} off	--	30	50	μA
Quiescent Current 2	I_{Q2}	Start up at 4.5 kHz	--	600	800	μA
Operation Supply Current	I_{CC}		--	2.5	3.0	mA
Protection						
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 (Note 5)	V_{O_STR}		--	3	--	V
Oscillator						
Start-up Timer	t_{STR}		--	222	--	μs
GM Amplifier						
Transconductance	g_m		--	60	--	μS
Source Current	I_{COMP_SOU}		--	20	--	μA

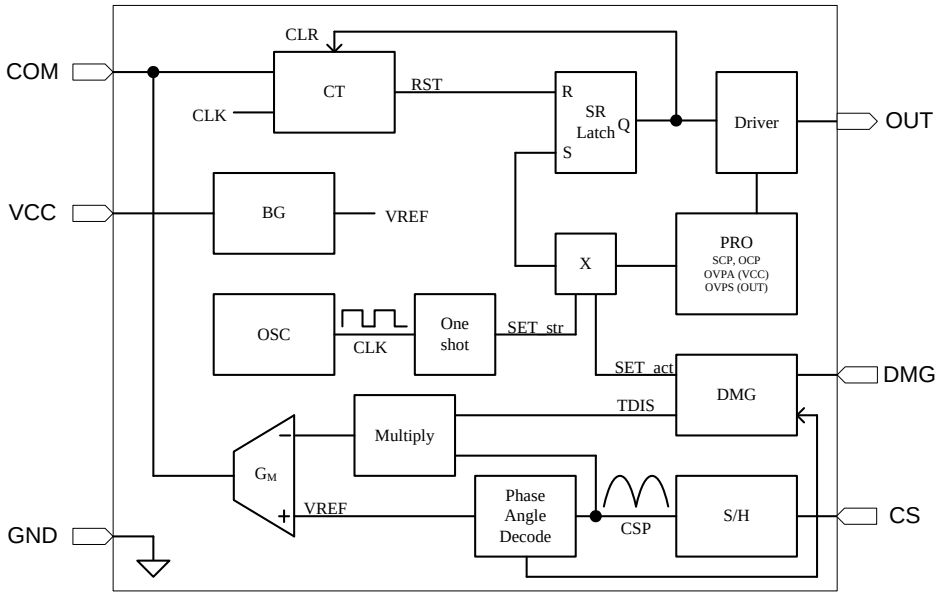
Electrical Characteristics (T_A= 25°C, unless otherwise specified.)

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Driver						
Dropout Voltage	V_{OH}	V_{CC}=33V, I_O = 10mA	--	1.2	1.5	V
	V_{OL}	V_{CC}=33V, I_O = -10mA	--	0.12	--	V
Rise Time	t_{RISE}	V_{CC}=20V, C_O =1nF	--	40	--	ns
Fall Time	t_{FALL}	V_{CC}=20V, C_O =1nF	--	80	--	ns
Output Clamp Voltage	V_{O_CLAMP}		--	--	19	V
Leading Edge Blanking Time	t_{LEB}		--	500	--	ns
Over Temperature Protection (Note 6)						
OTP Trip Point			--	150	--	°C
OTP Release Point			--	115	--	°C
OTP Threshold Hysteresis			--	35	--	°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°C.
4. The device is not guaranteed to function outside its operating conditions.
5. Guaranteed by design.
6. Auto recovery type.

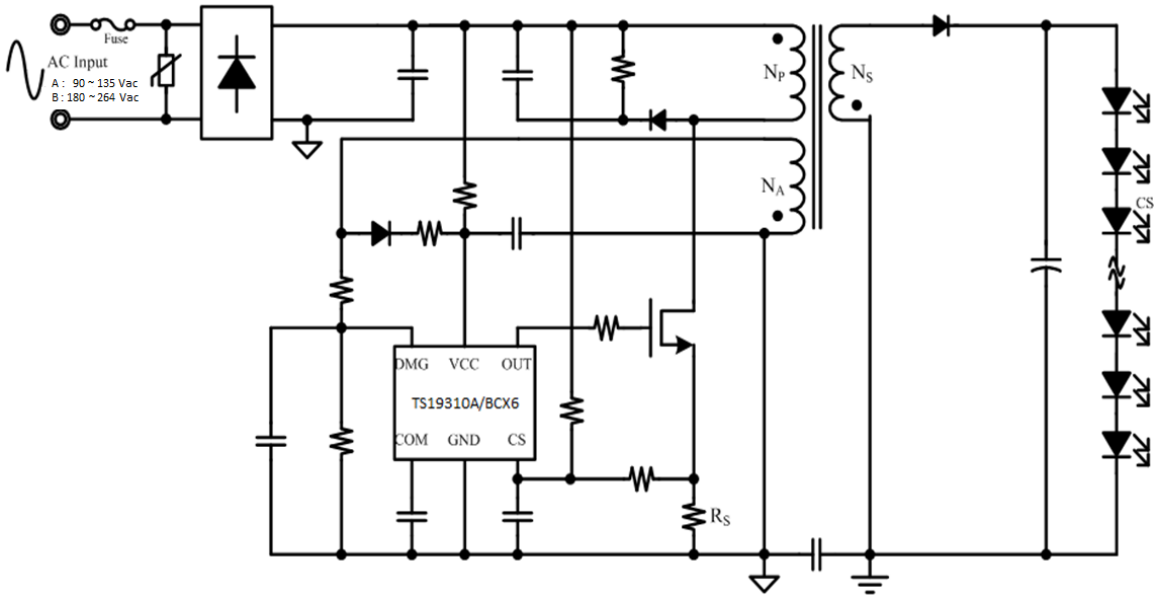
Function Block



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_{CC}	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
- η 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_{CC}

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

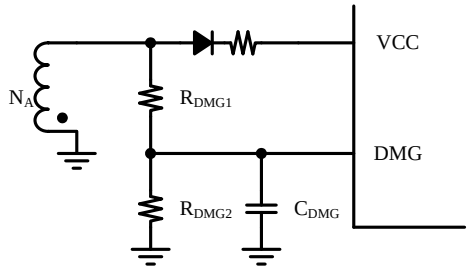
The TS19310 performs VCC over voltage protection though VCC pin. Once VCC pin exceeds 32V, TS19310 turns off and latches the MOSFET until VCC goes below VCC_OFF.

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_{CC} goes below V_{CC_OFF}.



OVP Protection (by DMG)

$$V_{DMG\_OVP} = \frac{N_S}{N_A} \times V_{OVPS} \times \frac{R_{DGM1} + R_{DGM2}}{R_{DMG2}}$$

OVP Protection (by V_{CC})

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

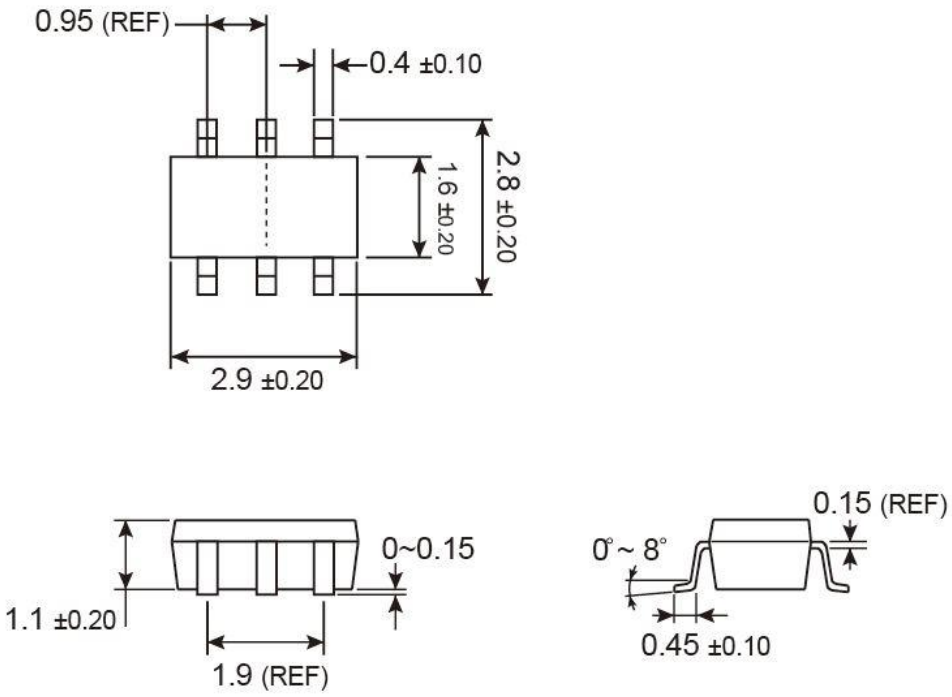
Short Circuit Protection

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

Where:

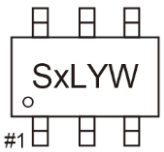
- V_{DMG_OVP} is the output-over-voltage protection point
- V_{OVPS} is the over voltage protection signal
- V_{O_STR} is the start-up timer
- N_A is the number of auxiliary-winding turns
- N_S is the number of secondary-winding turns

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

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