# TS19705
## Single-Stage PFC
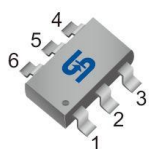## Primary-Side-Regulation LED Driver

**SOT-26**

**Pin Definition:**
1. Compensation
2. Ground
3. Current Sense
4. Output
5. $V_{CC}$
6. DMG

## Description

TS19705 is a primary-side-regulation with Fly-back control IC with active power factor correction function for LED lighting applications. The IC 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% because of particular control method.

TS19705 also provides gate driving voltage clamping, $V_{CC}$ overvoltage protection and system output open/short circuit protection to increase IC performance.

## Features

- Constant Current Accuracy within <±3%
- Primary-Side Feedback Control
- Application Voltage Range: 90~ 264$V_{AC}$
- Transition-Mode PFC Operating
- Built-in Active Power Factor Correction
- Constant Output Current Control
- Good Line and Load Regulation
- 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

- E27, T5, T8 LED Lighting
- LED Bulb
- LED Down Light
- LED Lighting Applications

## Ordering Information

| Part No. | Package | Packing |
|---|---|---|
| TS19705CX6 RFG | SOT-26 | 3kpcs / 7" Reel |

**Note:** "G" denote for Halogen Free Product

## Absolute Maximum Ratings ($T_A$ = 25$^o$C unless otherwise noted) (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 | V |
| Junction Temperature Range | $T_J$ | -40 to +150 | °C |
| Storage Temperature Range | $T_{STG}$ | -65 to +150 | °C |
| Power Dissipation @$T_A$=25 °C | $P_D$ | 0.3 | W |
| ESD Rating (Human Body Model) | ESD | 2 | kV |

## Thermal Information (Note 2)

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

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## Recommended Operating Conditions

| Parameter | Symbol | Conditions | Unit |
|---|---|---|---|
| Power supply pin | $V_{CC}$ | 38 | V |
| DMG voltage to GND | $V_{DMG}$ | -0.3 to 38 | V |
| OUT voltage to GND | $V_{OUT}$ | -0.3 to 38 | V |
| CS voltage to GND | $V_{CS}$ | -0.3 to 5 | V |
| COM voltage to GND | $V_{COM}$ | -0.3 to $V_{CC}$ | V |
| Operating Junction Temperature Range | $T_J$ | -40 to +125 | °C |
| Operating Ambient Temperature Range | $T_{OPA}$ | -40 to +85 | °C |

## Electrical Characteristics ($V_{CC}$=15 , $T_A$=25℃, 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, @ $V_{CC}$ off | -- | 30 | 50 | µA |
| Quiescent current 2 | $I_{Q2}$ | Start-up @ 4.5kHz | -- | 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 | $V_{SCP}$ | Guaranteed by design | -- | 3 | -- | V |
| **Oscillator** | | | | | | |
| Start-up timer | $t_{STR}$ | | -- | 220 | -- | µs |
| **GM Amplifier** | | | | | | |
| Transconductance | $g_m$ | | -- | 60 | -- | µA/V |
| Sink current | $I_{COMP\_SINK}$ | | -- | 20 | -- | µA |
| Source current | $I_{COMP\_SOU}$ | | -- | 20 | -- | µA |
| **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 |
| Rising time | $t_r$ | $V_{CC}$=20V, $C_O$ =1nF | -- | 40 | -- | ns |
| Falling time | $t_f$ | $V_{CC}$=20V, $C_O$ =1nF | -- | 80 | -- | ns |
| Output clamp voltage | $V_{O\_CLAMP}$ | | -- | -- | 19 | V |
| Leading edge blanking time | $LEB_t$ | | -- | 0.5 | -- | ns |

**Note:**

**1.** Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device.

**2.** Thermal Resistance is specified with the component mounted on a low effective thermal conductivity test board in free air at $T_A$=25°C.

## Function Block
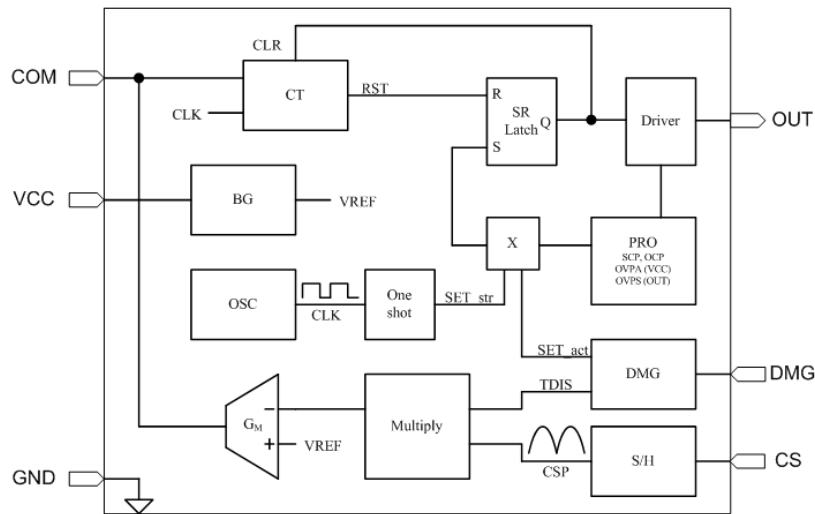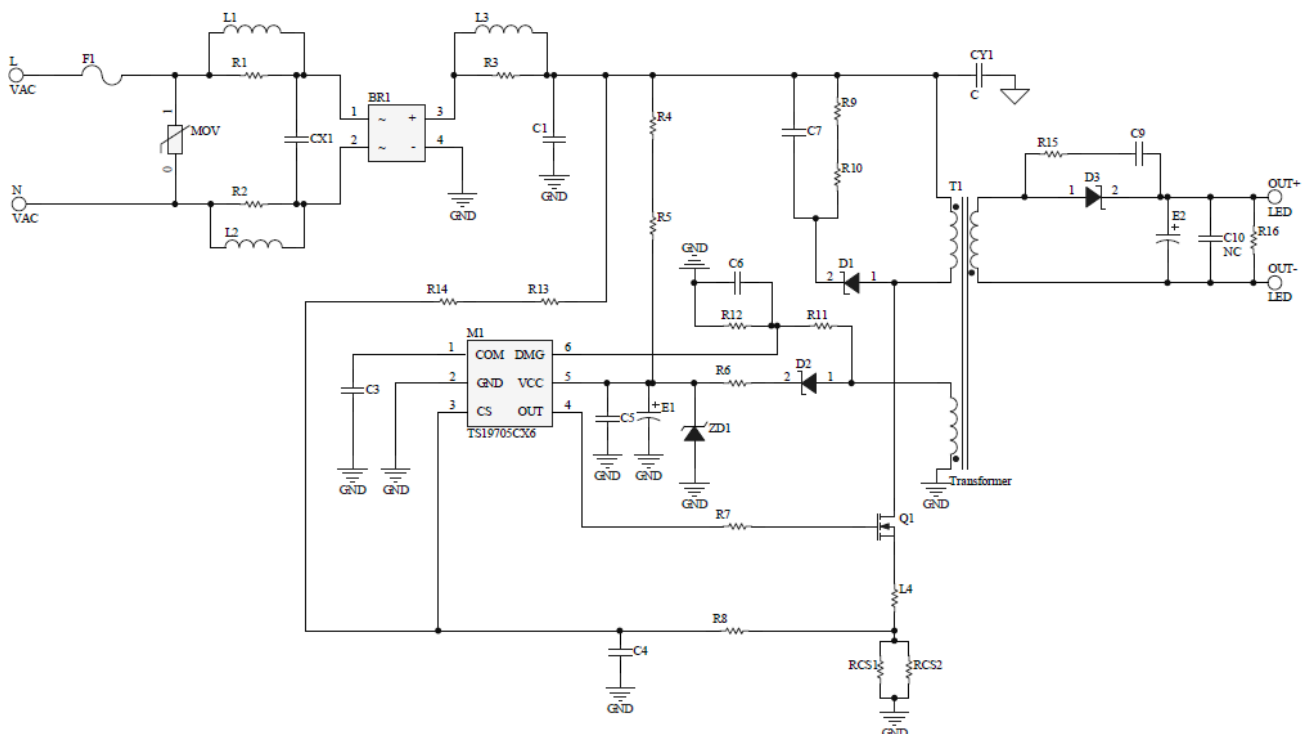


## Pin Description

| 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 MOS 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 TS19705 is a constant current Fly-back controller with primary side control and PFC function for LED lighting applications. The controller is Boundary Conduction Mode (BCM) operation with constant on time based regulator design to achieve high power factor performance.

The TS19705 has built-in $V_{CC}$ over voltage protection, open LED protection, short LED protection, over temperature protection, primary side current limit and gate clamp functions.

The average output current can be expressed as below.

$$I_O\_avg = \frac{N_P}{N_S} \times \frac{0.333 * \eta}{2 \times R_S}$$

Where :
- $I_{O\_avg}$ is the average output current
- $N_P$ is the primary-side turn ratio
- $N_S$ is the secondary-side turn ratio
- $R_S$ is the sensing resistor connected between the MOSFET source and the GND

### Pin Detail

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

**Ground**
GND is the reference node of internal circuit.

**Current Sense**
MOSFET current signal sensing for multiplication and current limit setting function.

$$I_{CS\,(LIMIT)} = \frac{1.25}{R_S}$$

Where :
- $I_{CS}$ is the input current sence
- $R_S$ is the sensing resistor connected between the MOSFET source and GND

**Output**
Gate drive for external MOSFET switch and is built-in gate clamp function.

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

The TS19705 performs $V_{CC}$ over voltage protection though $V_{CC}$ pin. Once $V_{CC}$ pin exceeds in 32V, TS19705 turns off and latchs out the MOSFET switcher until $V_{CC}$ goes below $V_{CC\_OFF}$.

## Application Information (Continue)

**DMG**

The Output voltage is reflected by the auxiliary winding ($N_{AUX}$) 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 latchs out until $V_{CC}$ goes below $V_{CC\_OFF}$.
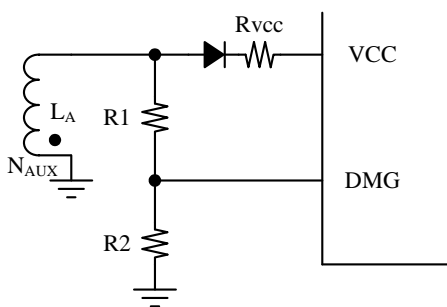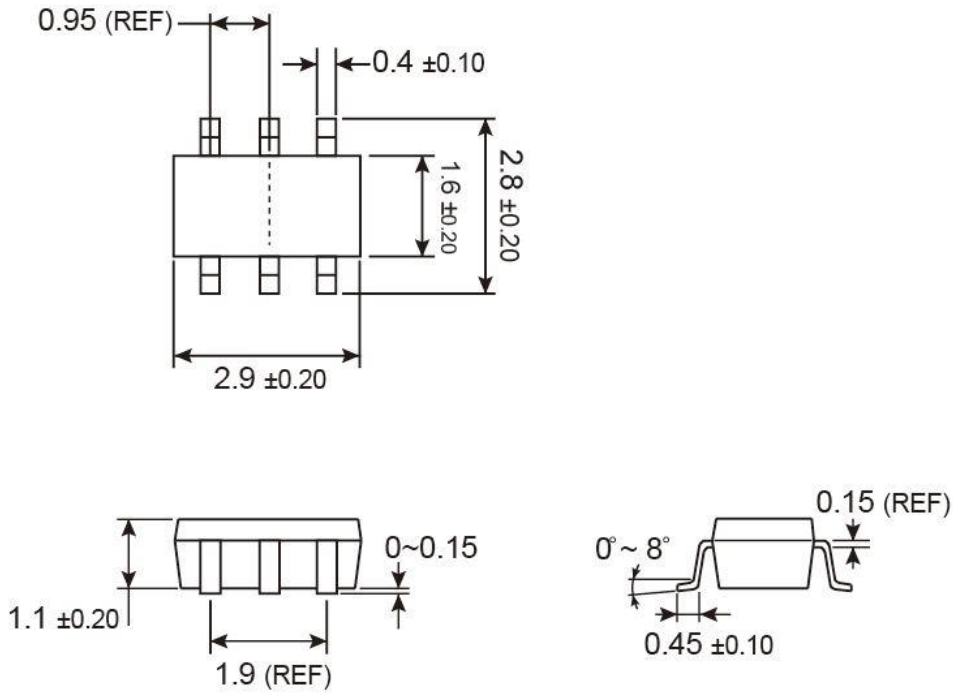


$$V_{O\_OVP} = \frac{N_{SEC}}{N_{AUX}} \times V_{OVPS} \times \frac{R_1 + R_2}{R_2}$$

$$V_{O\_STR} = \frac{N_{SEC}}{N_{AUX}} \times 3 \times \frac{R_1 + R_2}{R_2}$$
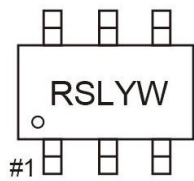
Where :
- $V_{OUT\_OVP}$ is the output-over-voltage protection point
- $V_{OVPS}$ is the over voltage protection signal
- $V_{O\_STR}$ is the start-up timer
- $N_{AUX}$ is the number of auxiliary-winding turns
- $N_{SEC}$ is the number of secondary-winding turns

RoHS COMPLIANCE

# SOT-26 Mechanical Drawing



Unit: Millimeters

## Marking Diagram



**RS** = 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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