

## Single-Stage PFC Buck Current Control LED Driver

### DESCRIPTION

The TS19720 is a high power factor and high accuracy constant current PWM controller. It is able to control total harmonic distortion (THD) and efficiency optimization by an external resistor. TS19720 achieves high power factor and high efficiency by boundary conduction mode (BCM). The line and load regulation of LED current are within  $\pm 2.5\%$ . TS19720 also provides gate driving voltage clamping,  $V_{CC}$  over-voltage protection, and system output open/short circuit protection to increase IC performance.

### FEATURES

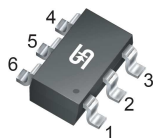
- Low THD <15%
- Constant Current Accuracy within  $\pm 2.5\%$
- High Power Factor >0.9
- Low BOM Cost
- Boundary Conduction Mode Control
- Gate Output Voltage Clamp
- LED Open Protection
- LED Short Protection
- Over Current Protection (OCP)
- Over Thermal Protection (OTP)
- Compliant to RoHS Directive 2011/65/EU and in accordance to WEEE 2002/96/EC.
- Halogen-free according to IEC 61249-2-21

### APPLICATION

- LED lighting
- Down lights, Tube lamps, PAR Lamps, Bulbs



**SOT-26**



#### Pin Definition:

1.  $V_{CC}$
2. GND
3. OUT
4. RT
5. COM
6. CS

**Note:** MSL 3 (Moisture Sensitivity Level) per J-STD-020

### ABSOLUTE MAXIMUM RATINGS (Note 1)

| PARAMETER                                  | SYMBOL     | LIMIT       | UNIT             |
|--------------------------------------------|------------|-------------|------------------|
| Power Supply Pin                           | $V_{CC}$   | 40          | V                |
| RT Voltage to GND                          | $V_{RT}$   | -0.3 to 5.5 | 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                |
| Power Dissipation @ $T_A=25^\circ\text{C}$ | $P_D$      | 0.3         | W                |
| ESD Rating (Human Body Mode) (Note 2)      | HBM        | 2           | kV               |
| ESD Rating (Machine Mode)                  | MM         | 200         | V                |
| Lead Temperature (Soldering 10 sec)        | $T_{LEAD}$ | 260         | $^\circ\text{C}$ |
| Junction Temperature Range                 | $T_J$      | -40 to +150 | $^\circ\text{C}$ |
| Storage Temperature Range                  | $T_{STG}$  | -65 to +150 | $^\circ\text{C}$ |

**THERMAL PERFORMANCE**

| PARAMETER                                | SYMBOL          | LIMIT | UNIT |
|------------------------------------------|-----------------|-------|------|
| Thermal Resistance - Junction to Case    | $R_{\theta JC}$ | 106.6 | °C/W |
| Thermal Resistance - Junction to Ambient | $R_{\theta JA}$ | 220   | °C/W |

**Note:**  $R_{\theta JA}$  is the sum of the junction-to-case and case-to-ambient thermal resistances. The case thermal reference is defined at the solder mounting surface of the drain pins.  $R_{\theta JA}$  is guaranteed by design while  $R_{\theta CA}$  is determined by the user's board design.  $R_{\theta JA}$  shown below for single device operation on FR-4 PCB in still air. Thermal Resistance is specified with the component mounted on a low effective thermal conductivity test board in free air at  $T_A=25^{\circ}\text{C}$ .

**RECOMMENDED OPERATING CONDITIONS** (Note 3)

| PARAMETER                            | SYMBOL    | CONDITIONS  | UNIT |
|--------------------------------------|-----------|-------------|------|
| Power Supply Pin                     | $V_{CC}$  | 33          | V    |
| RT Voltage to GND                    | $V_{RT}$  | -0.3 to 5   | 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 SPECIFICATIONS** ( $V_{CC} = 18\text{V}$ ,  $T_A = 25^{\circ}\text{C}$  unless otherwise noted)

| PARAMETER                  | CONDITIONS                          | SYMBOL          | MIN   | TYP  | MAX   | UNIT |
|----------------------------|-------------------------------------|-----------------|-------|------|-------|------|
| <b>Supply Voltage</b>      |                                     |                 |       |      |       |      |
| Start-up Current           | $V_{CC} = V_{UVLO(on)} - 1\text{V}$ | $V_{CC(ST)}$    | --    | 45   | --    | μA   |
| Operating Current          | With 1nF load on out pin            | $I_{OPA}$       | --    | 2.1  | 2.6   | mA   |
| UVLO(off)                  |                                     | $V_{UVLO(off)}$ | 7     | 8    | 9     | V    |
| UVLO(on)                   |                                     | $V_{UVLO(on)}$  | 16    | 17.5 | 19    | V    |
| OVP Level on $V_{CC}$ Pin  |                                     | $V_{OVP}$       | 29    | 31   | 33    | V    |
| <b>Voltage Feedback</b>    |                                     |                 |       |      |       |      |
| Feedback Reference Voltage |                                     | $V_{FB}$        | 0.196 | 0.2  | 0.204 | V    |
| Transconductance           |                                     | $G_M$           | --    | 58   | --    | μS   |
| Output Sink Current        |                                     | $I_{O-SINK}$    | --    | 5.8  | --    | μA   |
| Output Source Current      |                                     | $I_{O-SOURCE}$  | --    | 5.8  | --    | μA   |
| <b>Current Sensing</b>     |                                     |                 |       |      |       |      |
| CS Limit Voltage           |                                     | $V_{OCP}$       | --    | 1.4  | --    | V    |
| Open Loop Voltage          | CS Pin Open                         | $V_{OLP}$       | --    | 5    | --    | V    |
| Leading-Edge Blanking Time |                                     | $LEB_t$         | --    | 400  | --    | ns   |
| Delay to Output            |                                     |                 | --    | 100  | --    | ns   |
| <b>Switching Frequency</b> |                                     |                 |       |      |       |      |
| Start Frequency            |                                     | $f_{STR}$       | 3     | 4.5  | 6     | kHz  |

| <b>ELECTRICAL SPECIFICATIONS</b> ( $V_{CC} = 18V$ , $T_A = 25^{\circ}C$ unless otherwise noted) |                       |            |     |      |     |             |
|-------------------------------------------------------------------------------------------------|-----------------------|------------|-----|------|-----|-------------|
| PARAMETER                                                                                       | CONDITIONS            | SYMBOL     | MIN | TYP  | MAX | UNIT        |
| <b>Gate Driver Output</b>                                                                       |                       |            |     |      |     |             |
| Rising Time                                                                                     | Load Capacitance =1nF | $t_{RISE}$ | --  | 90   | --  | ns          |
| Falling Time                                                                                    | Load Capacitance =1nF | $t_{FALL}$ | --  | 40   | --  | ns          |
| VGATE-Clamp                                                                                     |                       | $V_{GATE}$ | --  | 12.5 | 15  | V           |
| <b>Thermal Section</b>                                                                          |                       |            |     |      |     |             |
| Thermal Shutdown <sup>(Note 4)</sup>                                                            |                       |            | --  | 150  | --  | $^{\circ}C$ |
| Thermal Shutdown Release <sup>(Note 5)</sup>                                                    |                       |            | --  | 120  | --  | $^{\circ}C$ |

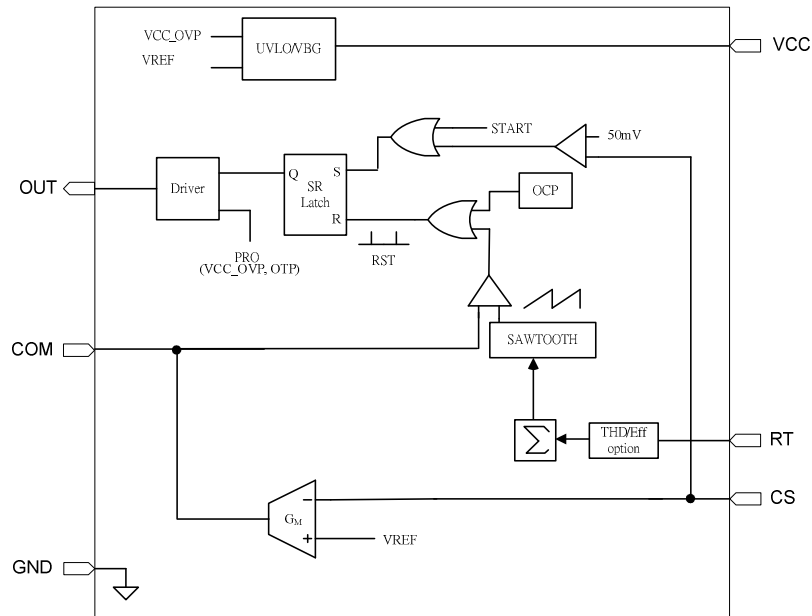
**Notes:**

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. The device is not guaranteed to function outside its operating conditions.
4. Guaranteed by design.
5. Auto Recovery Type.

## ORDERING INFORMATION

| PART NO.       | PACKAGE | PACKING            |
|----------------|---------|--------------------|
| TS19720CX6 RFG | SOT-26  | 3,000pcs / 7" Reel |

## BLOCK DIAGRAM



## PIN DESCRIPTION

| PIN NO. | NAME            | FUNCTION                                    |
|---------|-----------------|---------------------------------------------|
| 1       | V <sub>CC</sub> | Power supply pin for all internal circuitry |
| 2       | GND             | Ground return for all internal circuitry    |
| 3       | OUT             | Gate driver output                          |
| 4       | RT              | Efficiency / THD option pin                 |
| 5       | COM             | Output pin of error amplifier               |
| 6       | CS              | Input current sense pin                     |

## APPLICATION INFORMATION

### Start-up Current

The typical start-up current is around 45 $\mu$ A. Very low start-up current allows the PWM controller to increase the value of start-up resistor and then reduce the power dissipation.

### Under Voltage Lockout (UVLO)

A hysteresis UVLO comparator is implemented in TS19720. The turn-on and turn-off thresholds level are fixed at 17.5V and 8V respectively. This hysteresis shown in Fig.3 ensures that the start-up capacitor will be adequate to supply the chip during start-up. For quick start-up of the LED driver, the start-up resistor should be matched with the start-up capacitor.

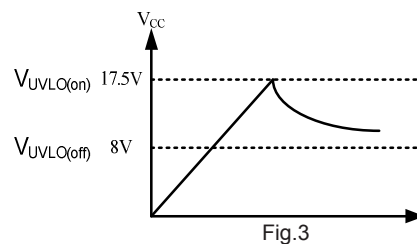


Fig.3

### Leading-Edge Blanking (LEB)

Each time the power MOSFET is switched on, a turn-on spike will inevitably occur at the sense resistor. To avoid fault trigger, a 400ns leading-edge blanking time is built in. Conventional RC filtering can therefore be omitted. During this blanking period, the current-limit comparator is disabled and cannot switch off the gate driver.

### Gate Clamp

Driver is clamped to 12.5V by an internal clamping circuit to avoid the Gate of MOSFET to get damaged.

### Over Current Protection (OCP)

The TS19720 has built-in cycle by cycle over current protection function on CS pin. As the CS pin voltage is larger than  $V_{OCP}$  (1.4V), the gate output will be turned off immediately to avoid the driver board to be burned out.

### Over Voltage Protection (OVP) on $V_{CC}$

To prevent the LED driver from being damaged, the TS19720 has an implemented OVP function on  $V_{CC}$ . When the  $V_{CC}$  voltage is higher than the  $V_{OVP}$  (31V), the output gate driver circuit will be shut down immediately to stop the switching of power MOSFET. The  $V_{CC}$  pin OVP function is an auto recovery type protection. If the OVP condition happens, the pulses will be stopped until the  $V_{CC}$  pin voltage is down to the UVLO off level. The TS19720 is working in an auto-recovery mode as shown in Fig. 4.

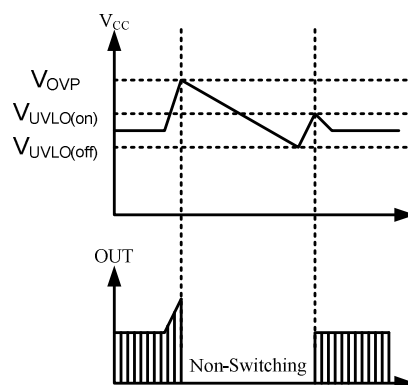
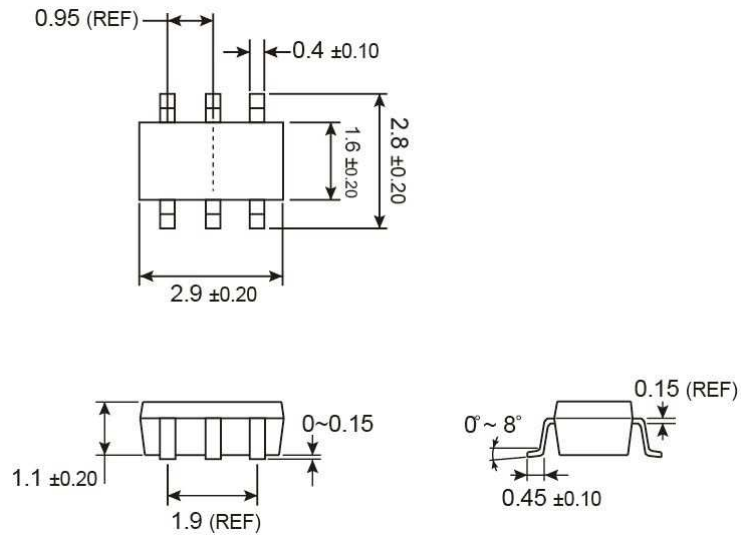


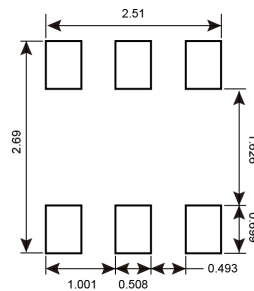
Fig. 4

**PACKAGE OUTLINE DIMENSIONS** (Unit: Millimeters)

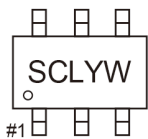
**SOT-26**



**SUGGESTED PAD LAYOUT** (Unit: Millimeters)



**MARKING DIAGRAM**



**SC** = Device Code

**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

**L** = Lot Code A~Z

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