Single-Stage PFC Buck Current Control LED Driver With High Voltage MOSFET Integrated

DESCRIPTION

TS19721D a very efficient constant current controller for driving LED lamps in non-dimmable lighting applications. The IC provides a high power factor correction and constant current accuracy with boundary conduction mode (BCM) operation in a single stage buck topology. The TS19721D controller is easy to integrate with a small BOM and includes an internal high voltage power MOSFET for PWM control. Total harmonic distortion (THD) and efficiency are optimized by an external resistor. The line and load regulation of LED current are easily maintained to within ±2.5%. TS19721D also provides V_{CC} over-voltage protection, and output open/short circuit protection.

FEATURES

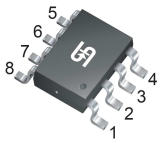
- Integrated 600V Power MOSFET
- Low THD <20% (Option)
- Constant current accuracy within ±2.5%
- High Power Factor Correction >0.9
- Boundary Current Mode control
- LED open protection & short protection
- Over current protection (OCP)
- Over temperature protection (OTP)
- Compliant to RoHS directive 2011/65/EU and in accordance to WEEE 2002/96/EC.
- Halogen-free according to IEC 61249-2-21 definition.

APPLICATION

- LED lighting system

Pb-Free RoHS COMPLIANT HALOGEN FREE

SOP-8



Pin Definition:
1. CS
2. COM
3. N/C
4. Drain
5. RT
6. GND
7. V_{CC}
8. CS

Notes: Moisture sensitivity level: level 3. Per J-STD-020

ABSOLUTE MAXIMUM RATINGS (T_A = 25°C unless otherwise specified) (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
DRAIN Voltage to GND	V_{OUT}	-0.3 to 620	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 sec)	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
ESD Rating (Machine Mode) (Note 2)	MM	200	V

THERMAL PERFORMANCE (Note 3)			
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

RECOMMENDED OPERATING CONDITION (T_A = 25°C unless otherwise specified) (Note 4)			
PARAMETER	**SYMBOL**	**LIMIT**	**UNIT**
Power Supply Pin	V_{CC}	33	V
RT Voltage to GND	V_{RT}	-0.3 to 5	V
DRAIN Voltage to GND	V_{OUT}	-0.3 to 620	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 +150	°C
Operating Ambient Temperature Range	T_{OPA}	-40 to +85	°C

ELECTRICAL SPECIFICATIONS (T_A = 25°C unless otherwise specified)						
PARAMETER	**SYMBOL**	**CONDITION**	**MIN**	**TYP**	**MAX**	**UNIT**
Supply Voltage						
Start-up Current	$V_{CC(ST)}$	V_{CC}= $V_{UVLO(on)}$ -1V	--	45	--	μA
Operating Current	I_{OPA}	With 1nF load on out pin	--	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
Voltage Feedback						
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
Current Sensing						
CS Limit Voltage	V_{OCP}		--	1.4	--	V
Open Loop Voltage	V_{OLP}	CS Pin Open	--	5	--	V
Leading-Edge Blanking Time	LEB_t		--	400	--	ns
Delay to Output			--	100	--	ns
Switching Frequency						
Start Frequency	f_{STR}		3	4.5	6	kHz
Maximum On Time	$T_{ON(MAX)}$		14	--	--	μs
Thermal Section (Note 5, 6)						
Thermal Shutdown			--	150	--	°C
Thermal Shutdown Release			--	120	--	°C

ELECTRICAL SPECIFICATIONS (T_A = 25°C unless otherwise specified)						
PARAMETER	**SYMBOL**	**CONDITION**	**MIN**	**TYP**	**MAX**	**UNIT**
MOSFET Section (Note 7)						
Drain-Source Breakdown Voltage	BV_{DS}	V_{GS} = 0V, I_D = 250μA	600	--	--	V
Zero Gate Voltage Drain Current	I_{DSS}	V_{DS} = 600V, V_{GS} = 0V	--	--	10	μA
MOSFET Section (Note 8,9)						
Continuous Drain Current	I_D	T_C=25 °C	--	--	2	A
Pulsed Drain Current	I_{DM}		--	--	8	A
Drain-Source On-Resistance	$R_{DS(ON)}$	V_{GS} = 10V, I_D = 1A	--	--	4.4	Ω
Single Pulse Avalanche Energy	E_{AS}	V_{DD}=50V, I_{AS}=2A, L=25mH, R_G =25Ω	--	--	55	mJ
Input Capacitance	C_{ISS}	V_{DS} = 25V, V_{GS} = 0V, f = 1.0MHz	--	249	--	pF
Output Capacitance	C_{OSS}		--	30.7	--	
Reverse Transfer Capacitance	C_{RSS}		--	5	--	
Turn-On Delay Time	$t_{d(on)}$	V_{GS} = 10V, I_D = 2A, V_{DD} = 300V, R_G =25Ω	--	9.1	--	ns
Turn-On Rise Time	t_r		--	9.8	--	
Turn-Off Delay Time	$t_{d(off)}$		--	17.4	--	
Turn-Off Fall Time	t_f		--	12.4	--	

Note:

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. Handing 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.
7. Pulse test: PW ≤ 300μs, duty cycle ≤ 2%
8. For DESIGN AID ONLY. Limited by maximum junction temperature.
9. Switching time is essentially independent of operating temperature.

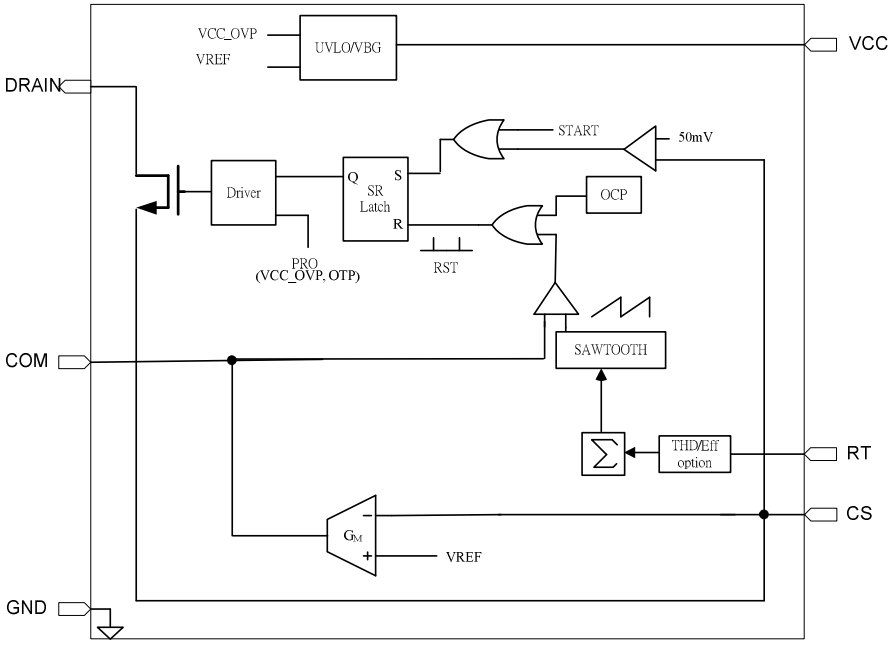
ORDERING INFORMATION

PART NO.	PACKAGE	PACKING
TS19721DCS RLG	SOP-8	2,500pcs / 13” Reel

Note:

1. Compliant to RoHS Directive 2011/65/EU and in accordance to WEEE 2002/96/EC.
2. Halogen-free according to IEC 61249-2-21 definition.

Function Block



PIN DESCRIPTION

PIN NO.	NAME	FUNCTION
1,8	CS	Input current sense pin.
2	COM	Output pin of error amplifier.
3	N/C	No Connect.
4	Drain	Drain of internal HV MOS.
5	RT	Efficiency / THD option pin.
6	GND	Ground return for all internal circuitry.
7	V_{CC}	Power supply pin for all internal circuitry.

APPLICATION INFORMATION

Start-up Current

The typical start-up current is around 45μA. The very low start-up current allows the PWM controller to operate with a high value start-up resistor and reduce overall power dissipation.

UVLO(Under Voltage Lockout)

A hysteretic UVLO comparator is implemented in TS19721D. The turn-on and turn-off thresholds level are fixed at 17.5V and 8V respectively. This hysteresis shown in Fig.1 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 & capacitor needs to optimize for application.

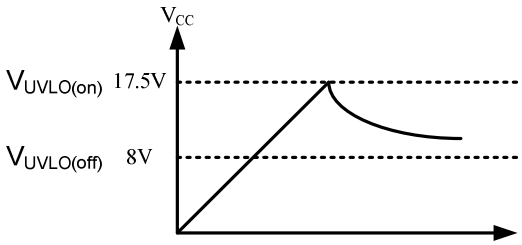


Fig. 1

LEB(Leading-Edge Blanking)

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

OCP(Over Current Protection)

The TS19721D has built-in cycle-by-cycle over-current protection functions available at the CS pin. When the CS pin voltage is larger than V_{OCP} (1.4V), the gate output will be turned off immediately to avoid over temperature damage.

OVP (Over Voltage Protection) on V_{CC}

To prevent the LED driver from being damaged, the TS19721D has an integrated OVP on V_{CC}. When the V_{CC} voltage is higher than the V_{OVP} (31V), the output MOSFET will be shut down immediately. The OVP on the V_{CC} pin will automatically recover.. If the OVP triggers, the output PWM pulses will be stopped until the V_{CC} pin voltage returns to the UVLO off level when the TS19721D will automatically recover as shown in Fig. 2.

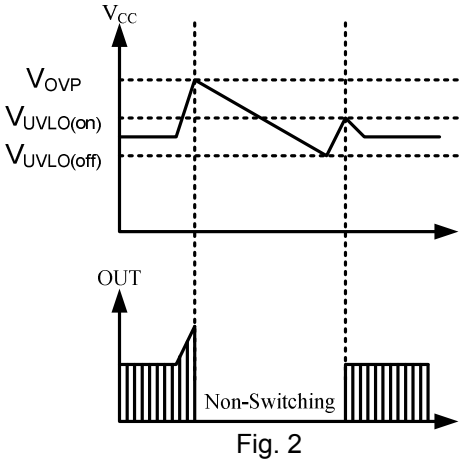
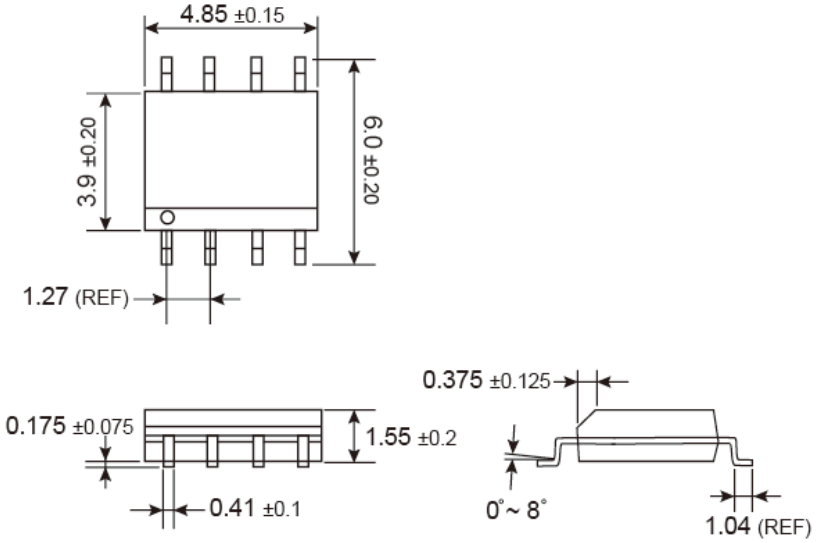


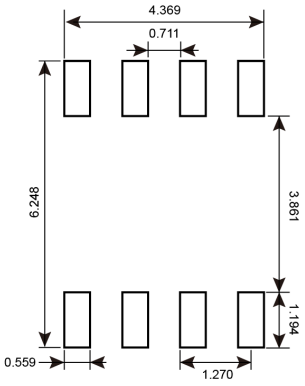
Fig. 2

PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)

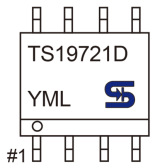
SOP-8



SUGGESTED PAD LAYOUT (Unit: Millimeters)



MARKING DIAGRAM



x = Series code
Y = Year Code
M = Month Code for Halogen Free Product

O	=Jan	**P**	=Feb	**Q**	=Mar	**R**	=Apr
S	=May	**T**	=Jun	**U**	=Jul	**V**	=Aug
W	=Sep	**X**	=Oct	**Y**	=Nov	**Z**	=Dec

L = Lot Code (1~9, A~Z)

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