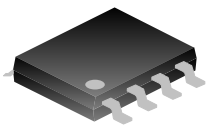
NON-ISOLATED LED LIGHTING DRIVE IC WITH BUILT-IN HIGH-VOLTAGE MOSFET, HIGH PFC AND HIGH CONSTANT CURRENT ACCURACY

DESCRIPTION

SD690XS is designed for non-isolated LED driving with floating Buck structure and built-in 600V MOSFET. With this structure, inductor current is sensed and closed-loop is formed with the internal error amplifier for high constant current accuracy and high input/output regulation rate. Also, high PF in full range is available as its own PFC control. Boundary Conduction mode is adopted for decreasing switching loss and improving the conversion efficiency.

SD690XS integrates various protections, such as output open circuit protection, output short circuit protection, cycle-by-cycle current limit protection, over temperature protection and VCC over voltage protection.

The start-up current and operating current are low and highlight LED can be driven with high efficiency in full range (85VAC~265VAC).



SOP-7-225-1.27

FEATURES

- Proprietary constant control method (Patent)
- Built-in 600V MOSFET
- Constant current with high accuracy for LED (<±3%)
- PF>0.9 in full voltage range
- Boundary-Conduction mode
- LED short circuit protection (Patent)
- LED open circuit protection
- VCC over/under voltage protection
- Over temperature protection
- Over current protection

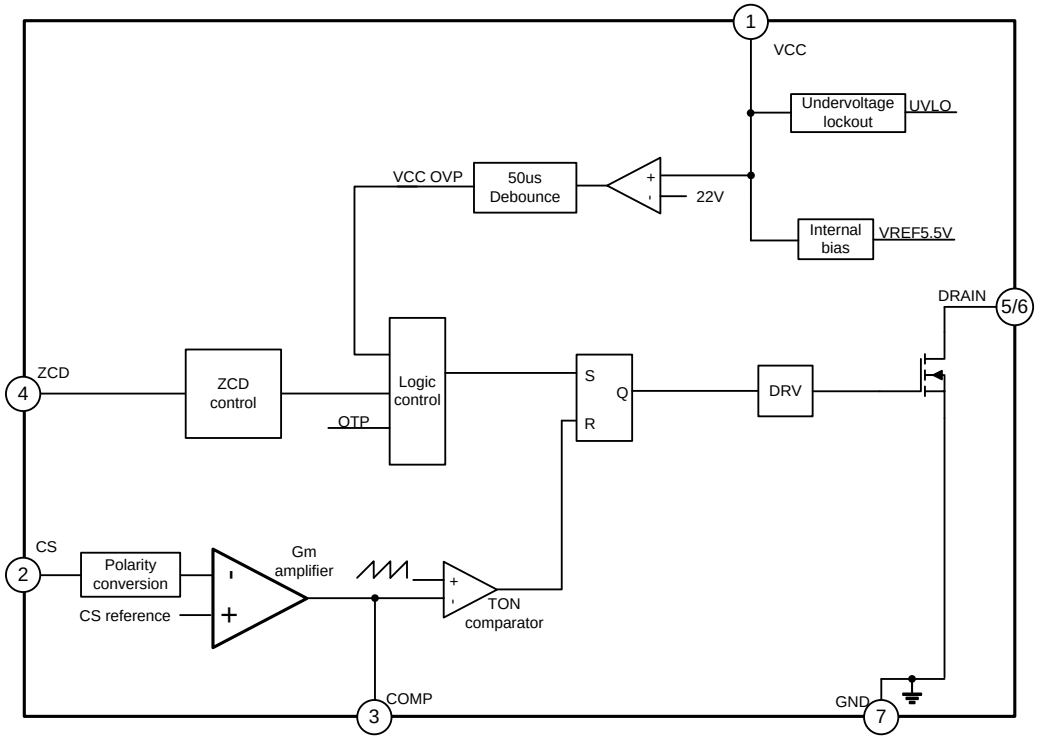
APPLICATION

- Bulb Lamp
- T5/T8 LED Lamp
- Various LED Lighting

ORDERING INFORMATION

Part No.	Package	Material	Packing
SD6901STR	SOP-7-225-1.27	Halogen free	Tape&Reel
SD6902STR	SOP-7-225-1.27	Halogen free	Tape&Reel
SD6904STR	SOP-7-225-1.27	Halogen free	Tape&Reel

Block diagram



ABSOLUTE MAXIMUM RATINGS

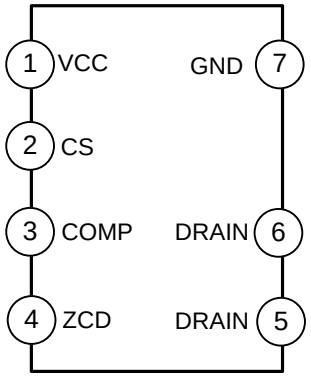
Characteristics		Symbol	Rating	Unit
Drain-Gate Voltage (R_{GS}=1MW)		V_{DGR}	600	V
Gate-Source Voltage		V_{GS}	±30	V
Drain Current Pulsed	SD6901S	I_{DM}	4.0	A
	SD6902S		8.0	
	SD6904S		12.0	
Drain Continuous Current (T_{amb}=25°C)	SD6901S	I_D	1.0	A
	SD6902S		2.0	
	SD6904S		3.0	
Single Pulsed Avalanche Energy	SD6901S	E_{AS}	52	mJ
	SD6902S		191	
	SD6904S		125	
Supply voltage		V_{CC}	-0.3~28	V
Feedback voltage		V_{ZCD}	-0.3~6.5	V
Sense voltage		V_{CS}	-6.5~6.5	V
COMP voltage		V_{COMP}	-0.3~6.5	V
DRAIN voltage		V_{DRAIN}	-0.3~600	V
Operation Junction Temperature Range		T_j	-40~150	°C
Storage Temperature Range		T_S	-55~150	°C

ELECTRICAL CHARACTERISTICS (Unless otherwise stated, V_{CC}=18V, T_{amb}=25°C)

Characteristics		Symbol	Test condition	Min.	Typ.	Max.	Unit
Operating voltage		V_{CC}	After start	10	16	18	V
VCC Clamp voltage		$V_{CCCLAMP}$	I_{VCC}=1mA	24	26	28	V
UVLO VH		$UVLO_H$		14.5	16	17.5	V
UVLO VL		$UVLO_L$		7.5	8.5	9.5	V
VCC OVP		VCC_{OVP}		20	21.5	23	V
Start-up current		I_{START}	Before start, VCC=15V	0	1	10	μA
Protection current		I_{PRO}	After start, no switching waveform	750	1050	1350	μA
Voltage feedback							
ZCD OVP voltage		ZCD_{OVP}	Increase ZCD to the threshold value	4	4.2	4.4	V
ZCD OVP delay				--	1400	--	ns
ZCD VL				--	0.1	--	V
ZCD VH				--	0.3	--	V
ZCD short circuit detect voltage		ZCD_{SL}		0.35	0.5	0.65	V
Operational amplifier							
Input reference voltage of transconductance Amplifier		CS_{REF}		162	167	172	mV
COMP high clamp voltage				--	3.5	--	V
CS peak protection voltage				--	1000	--	mV
Time parameter							
Max. on time		$T_{ON,MAX}$	V_{COMP}=3.5V	--	33	--	μs
Min. on time		$T_{ON,MIN}$	V_{COMP}=0V	650	900	1150	ns
Max. off time		$T_{OFF,MAX}$		--	38	--	μs
Min. off time		$T_{OFF,MIN}$		--	3	--	μs
Max. switching frequency		F_{MAX}		--	120	--	KHz
High-voltage MOSFET							
Static Drain-Source On State Resistance	SD6901S	RDS(ON)	V_{GS}=10V, I_D=0.1A	--	7.3	8.4	Ω
	SD6902S			--	4	4.7	
	SD6904S			--	1.8	2.2	
zero gate voltage drain current	SD6901S	I_{DSS}	V_{DS}=600V, V_{GS}=0V	--	--	1.0	μA
	SD6902S			--	--	1.0	
	SD6904S			--	--	1.0	
Gate-Source Leakage Current	SD6901S	I_{GSS}	V_{GS}=±30V, V_{DS}=0V	--	--	±100	nA
	SD6902S			--	--	±100	
	SD6904S			--	--	±100	

Characteristics		Symbol	Test condition	Min.	Typ.	Max.	Unit
Input capacitance	SD6901S	C_{ISS}	V_{GS}=0V, V_{DS}=25V, f=1MHz	--	139	--	pF
	SD6902S			--	236	--	
	SD6904S			--	150	--	
Output capacitance	SD6901S	C_{OSS}	V_{GS}=0V, V_{DS}=25V, f=1MHz	--	23.4	--	pF
	SD6902S			--	33	--	
	SD6904S			--	168.5	--	
Reverse Transfer Capacitance	SD6901S	C_{RSS}	V_{GS}=0V, V_{DS}=25V, f=1MHz	--	0.6	--	pF
	SD6902S			--	1.2	--	
	SD6904S			--	3.6	--	
Turn-on Delay Time	SD6901S	$T_{D(ON)}$	V_{DD}=0.5BV_{DSS}, I_D=25mA	--	6.1	--	ns
	SD6902S			--	6.8	--	
	SD6904S			--	6.4	--	
Rise Time	SD6901S	T_R	V_{DD}=0.5BV_{DSS}, I_D=25mA	--	11.9	--	ns
	SD6902S			--	20.87	--	
	SD6904S			--	22.27	--	
Turn-off Delay Time	SD6901S	$T_{D(OFF)}$	V_{DD}=0.5BV_{DSS}, I_D=25mA	--	8.3	--	ns
	SD6902S			--	11.87	--	
	SD6904S			--	13.2	--	
Fall Time	SD6901S	T_F	V_{DD}=0.5BV_{DSS}, I_D=25mA	--	15.3	--	ns
	SD6902S			--	22.87	--	
	SD6904S			--	22.53	--	
Total Gate Charge	SD6901S	Qg	V_{DD}=0.5BV_{DSS}, I_D=25mA	--	3.37	--	nC
	SD6902S			--	6.69	--	
	SD6904S			--	6.57	--	
Drain -Source Breakdown Voltage		BV_{DSS}	V_{GS}=0V, I_D=50uA	600	650	--	V
Temperature characteristics							
Over temperature protection threshold value		T_{SD}		--	150	--	°C
Over temperature protection release point		$T_{RECOVERY}$		--	130	--	°C

PIN CONFIGURATIONS



PIN DESCRIPTION

Pin No.	Pin Name	I/O	Description
1	VCC	POWER	Power supply
2	CS	I/O	current sense pin
3	COMP	O	Output of trans-conductance amplifier, connected to GND through a capacitor
4	ZCD	I	Inductor current zero-crossing detection pin
5,6	DRAIN	O	Drain output
7	GND	GND	Ground pin

FUNCTION DESCRIPTION

SD690XS is a non-isolated LED driver IC adopting BUCK structure. The function is described below.

Start control

Fast start-up is achieved due to very low start-up current. Large resistor can be used for external start-up resistor. It features undervoltage protection at VCC and the on/off threshold values are 16V and 8.5V. Hysteresis characteristics guarantees that IC can be powered by input capacitor during start-up. When the output voltage increases to a certain value after start, VCC will be charged by output through auxiliary winding or Zener Diode. $Vz=V_{LED}-V_{CC}$.

Boundary-conduction mode

Power MOSFET is turned on by inductor current zero-crossing detection. The zero-crossing of current can be detected by ZCD voltage which can be measured through auxiliary winding or resistance voltage divider.

When inductor current is zero crossing, voltage at pin ZCD drops rapidly, IC detects the falling edge and turns on Power MOSFET. Boundary-conduction mode provides low turn-on switching losses and high conversion efficiency.

Constant current accuracy control

IC senses the whole inductor current and forms the closed-loop with internal error amplifier to obtain high constant current accuracy and high regulation rate.

CS voltage and 167V reference voltage are the inputs of Gm amplifier, then the output is integrated through external Comp capacitor. The on time of MOSFET is controlled by Comp voltage for adjusting output current.

Current detection and LEB

With the cycle-by-cycle current limit function, Power MOSFET will be turned off if CS voltage exceeds a certain value. System still works and Power MOSFET is turned on in the next period.
During LEB, limit comparator stops, and MOSFET is on during this time.

VCC over voltage protection

Over voltage protection occurs if voltage at VCC is high, MOSFET is off and the system restarts automatically.

Output over voltage protection

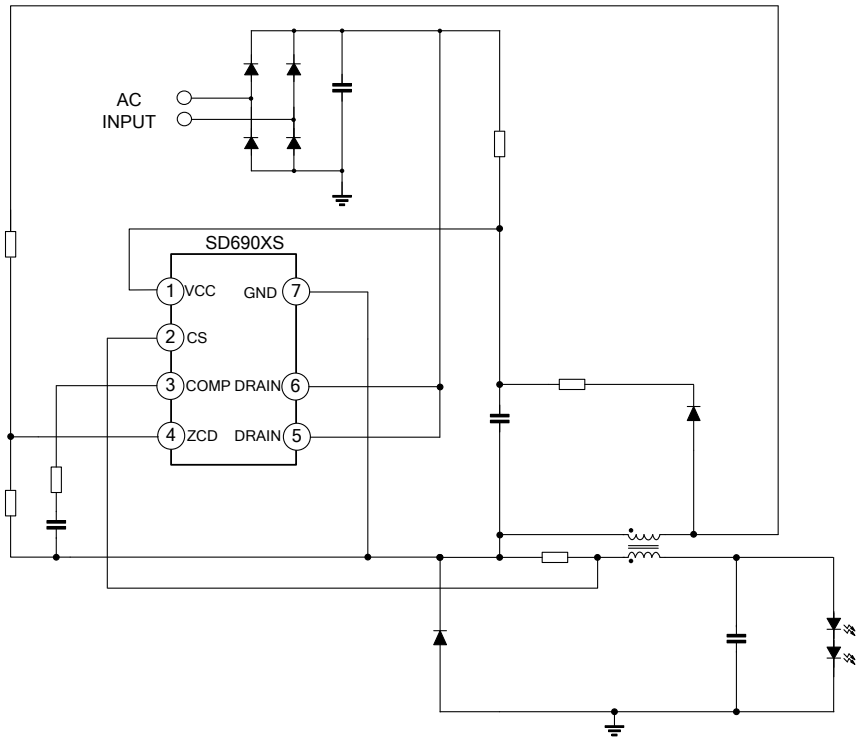
Output voltage is reflected to pin ZCD through resistor divider. When ZCD voltage is higher than the over voltage protection threshold value by 4.2V, protection occurs, MOSFET is off and the system will restart.

Output short circuit protection

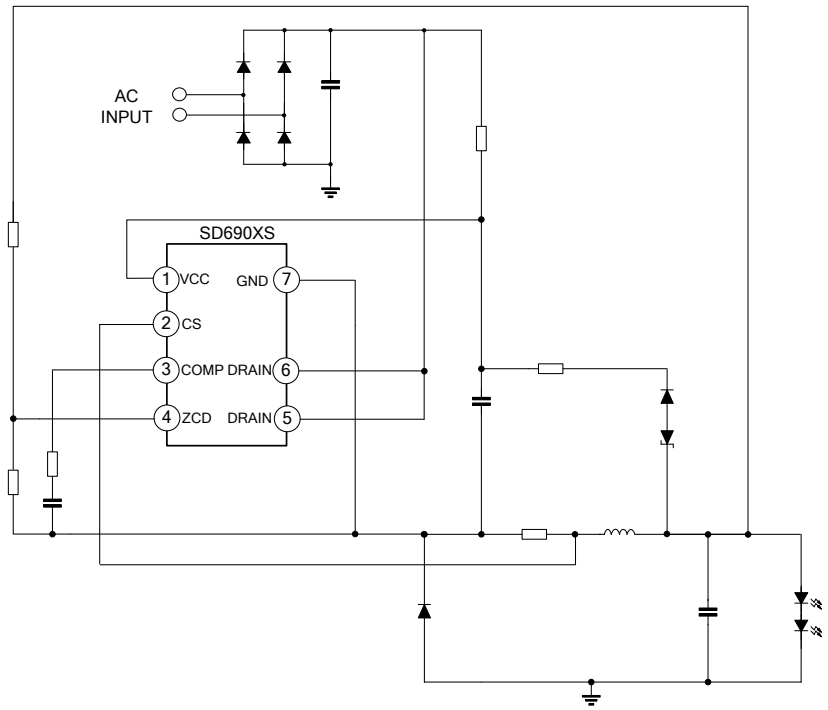
When ZCD voltage is lower than the short circuit protection threshold value by 0.5V, and kept for 448 switch periods, short circuit protection occurs, MOSFET is off and the system will restart.

TYPICAL APPLICATION CIRCUIT

VCC is powered by auxiliary winding



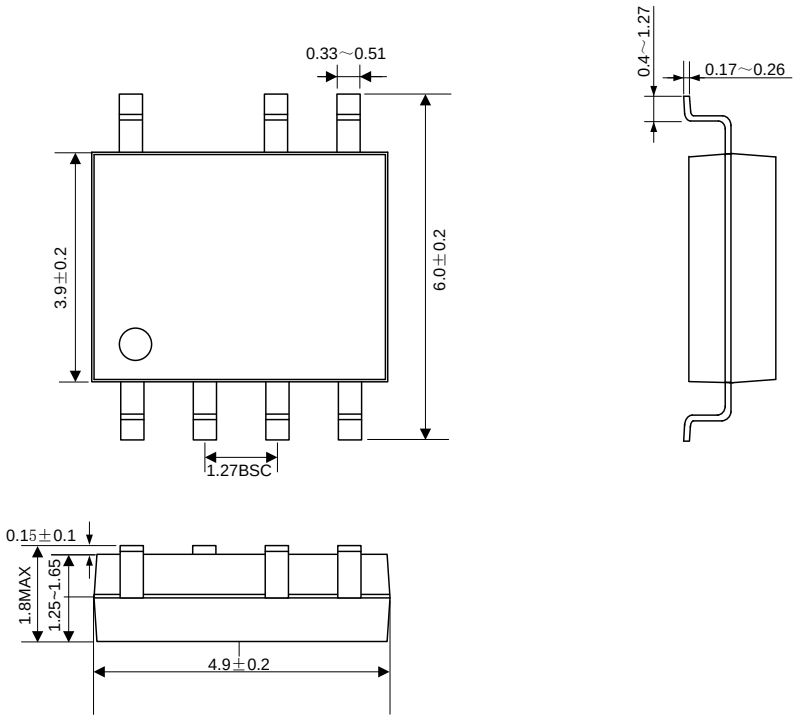
VCC is powered by Zener diode



Note: The circuit and parameters are for reference only; please set the parameters of the real application circuit based on the real test.

PACKAGE OUTLINE

SOP-7-225-1.27 **UNIT: mm**



MOS DEVICES OPERATE NOTES:

Electrostatic charges may exist in many things. Please take following preventive measures to prevent effectively the MOS electric circuit as a result of the damage which is caused by discharge:

- The operator must put on wrist strap which should be earthed to against electrostatic.
- Equipment cases should be earthed.
- All tools used during assembly, including soldering tools and solder baths, must be earthed.
- MOS devices should be packed in antistatic/conductive containers for transportation.

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Rev.:	1.5	Author:	Yao Feng

Revision History:

1. Modify the electrical characteristics

Rev.:	1.4	Author:	Yao Feng

Revision History:

1. Modify the electrical characteristics

Rev.:	1.3	Author:	Yao Feng

Revision History:

1. Modify the package outline of SOP-7

Rev.:	1.2	Author:	Yao Feng

Revision History:

1. Add the parameters of MOSFET

Rev.:	1.1	Author:	Yao Feng

Revision History:

1. Modify the electrical characteristics

Rev.:	1.0	Author:	Yao Feng

Revision History:

1. First release