# 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
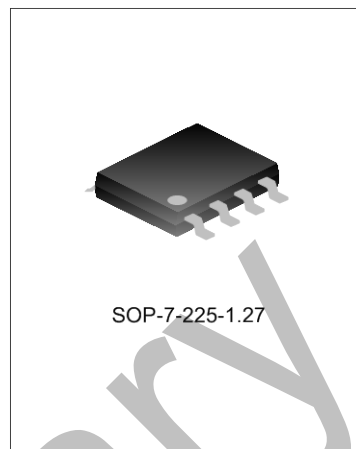
APPLICATION

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

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

ORDERING INFORMATION

Part No.	Package	Marking	Material	Packing
SD6901STR	SOP-7-225-1.27	SD6901S	Halogen free	Tape&Reel
SD6902STR	SOP-7-225-1.27	SD6902S	Halogen free	Tape&Reel
SD6904STR	SOP-7-225-1.27	SD6904S	Halogen free	Tape&Reel

BLOCK DIAGRAM
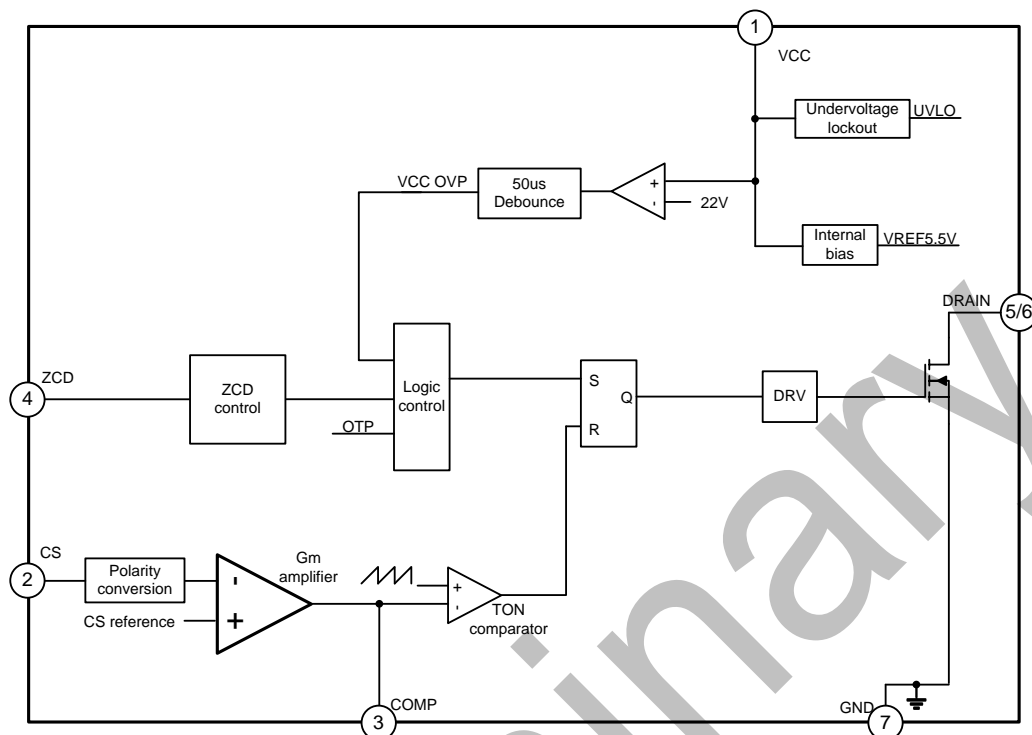
ABSOLUTE MAXIMUM RATINGS

Characteristics	Symbol	Rating	Unit
Supply voltage	V_{CC}	-0.3~22	V
Feedback voltage	V_{ZCD}	-0.3~6.5	V
Sample 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
Junction temperature Range	T_j	-40~125	°C
Storage temperature Range	T_S	-65~150	°C

ELECTRICAL CHARACTERISTICS (Unless otherwise stated, V_{CC}=16V, T_{amb}=25°C)

Characteristics	Symbol	Test condition	Min.	Typ.	Max.	Unit
Operating voltage	V_{CC}	After start	10	16	18	V
UVLO VH	$UVLO_H$		15	16	17	V
UVLO VL	$UVLO_L$		7.5	8.5	9.5	V
VCC OVP	VCC_{OVP}		20.5	22	23	V
Start-up current	I_{START}	Before start, V_{CC}=15V	0	4	10	µA
Quiescent current	I_{VCC}	No switching waveform after start-up	800	950	1100	µA

Characteristics	Symbol	Test condition	Min.	Typ.	Max.	Unit
Voltage feedback						
ZCD OVP voltage	ZCD$_{OVP}$	Increase ZCD to the threshold value	4.1	4.25	4.4	V
ZCD OVP delay			--	900	--	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$_{REF}$		165	170	175	mV
Transconductance of transconductance Amplifier	Gm		--	270	--	μA/V
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	--	0.4	--	μs
Max. off time	T$_{OFF,MAX}$		--	38	--	μs
Min. off time	T$_{OFF,MIN}$		--	3.2	--	μs
Max. switching frequency	F$_{MAX}$		--	120	--	KHz
High-voltage MOSFET						
On resistance	SD6901S R$_{DSON}$	V$_{CC}$=16V	--	10	--	Ω
	SD6902S R$_{DSON}$	V$_{CC}$=16V	--	4	--	Ω
	SD6904S R$_{DSON}$	V$_{CC}$=16V	--	2	--	Ω
Drain-Source voltage	V$_{DS}$	I$_D$=50uA	--	600	--	V
Temperature characteristics						
Over temperature protection threshold value	T$_{SD}$		--	150	--	°C
Over temperature protection release point			--	130	--	°C

PIN CONFIGURATIONS

```
          ┌─────────────────┐
        1 │ VCC       GND  │ 7
          │                 │
        2 │ CS        S      │
          │           D      │
        3 │ COMP  6  DRAIN  │ 6
          │       9          │
          │       0          │
        4 │ ZCD   X   DRAIN │ 5
          │       S          │
          └─────────────────┘
```
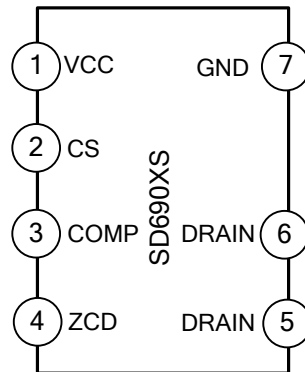
PIN DESCRIPTION

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 0.17V 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.

Gate driver

GATE Pin is connected to gate of external MOSFET for controlling its on/off. Too weak driving of GATE will increase power dissipation on MOSFET and too strong driving will bring EMI. A good tradeoff is achieved through the totem pole gate drive design with appropriate output ability and dead time control.

Output high level of GATE is clamped at 15V to protect external MOSFET.

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 4.25V, protection occurs, MOSFET is off and the system will restart.
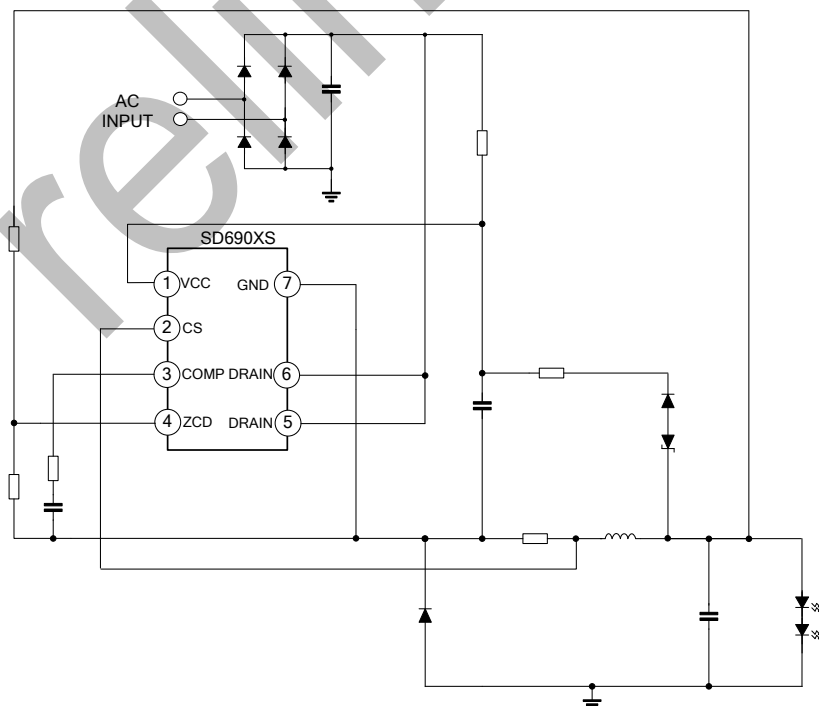
Output short circuit protection

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
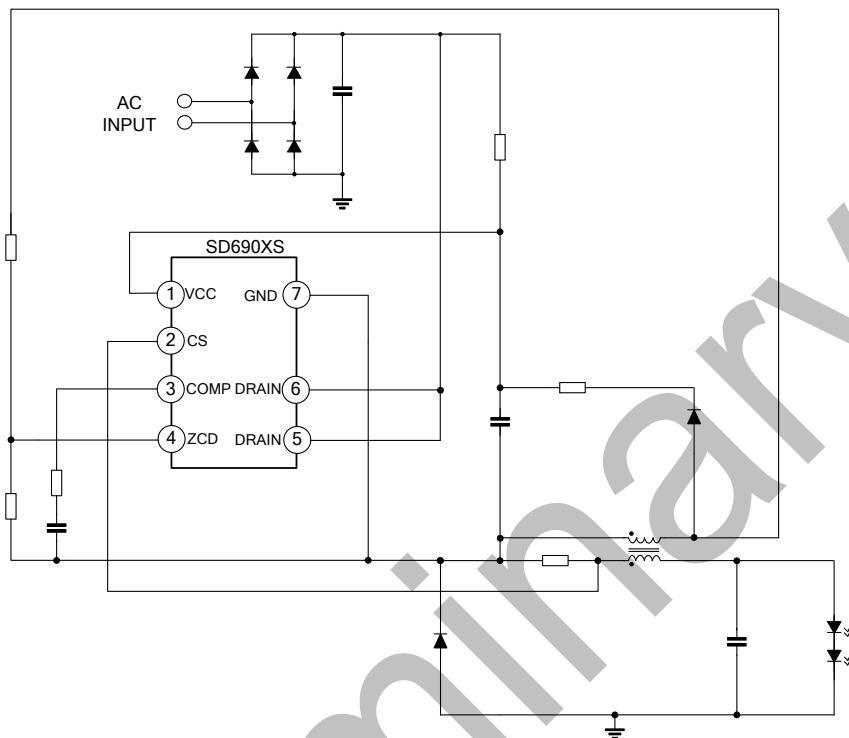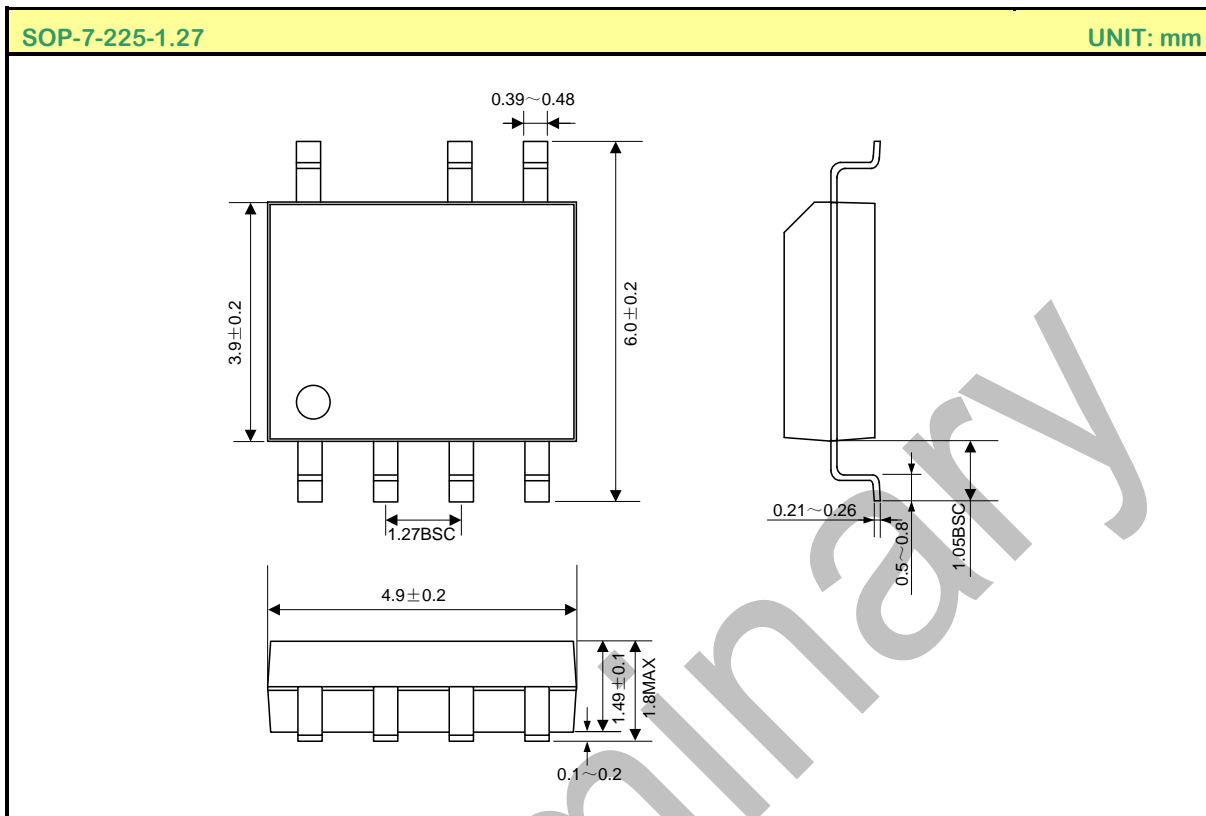

VCC is powered by Zener diode

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.

Disclaimer :

- Silan reserves the right to make changes to the information herein for the improvement of the design and performance without further notice! Customers should obtain the latest relevant information before placing orders and should verify that such information is complete and current.
- All semiconductor products malfunction or fail with some probability under special conditions. When using Silan products in system design or complete machine manufacturing, it is the responsibility of the buyer to comply with the safety standards strictly and take essential measures to avoid situations in which a malfunction or failure of such Silan products could cause loss of body injury or damage to property.
- Silan will supply the best possible product for customers!