DESCRIPTION

SM2097 is a high precision step-down constant current LED driver chips. Chip inductor current critical work in continuous mode for 85Vac ~ 265Vac input voltage full range of non-isolated buck LED constant current power supply. SM2097 chip integrated 500V power switch, power detection and no auxiliary winding, making it easier to peripheral devices, saving the cost and size of the system.

SM2097 chip with high-precision current sampling circuit, high accuracy LED constant current output and excellent line voltage regulation. Chip inductor current critical work mode, output current with inductance and LED operating voltage changes varied to achieve excellent load regulation.

SM2097 has multiple protection features including LED short circuit protection, under-voltage protection, the chip overheating adjustment function. SM2097 use SOT23-3 package.

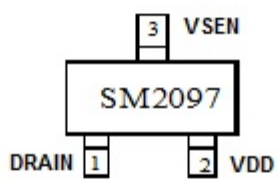
FEATURES

- Integrated 500V power MOSFET
- Inductor Critical Continuous Current Mode
- Low operating current without auxiliary power winding
- Wide input voltage range
- ± 5% LED current accuracy
- LED open-circuit protection
- LED short-circuit protection
- Chip supply voltage protection
- Over temperature protection
- System is small, low cost BOM
- Use SOT23-3 package

APPLICATION

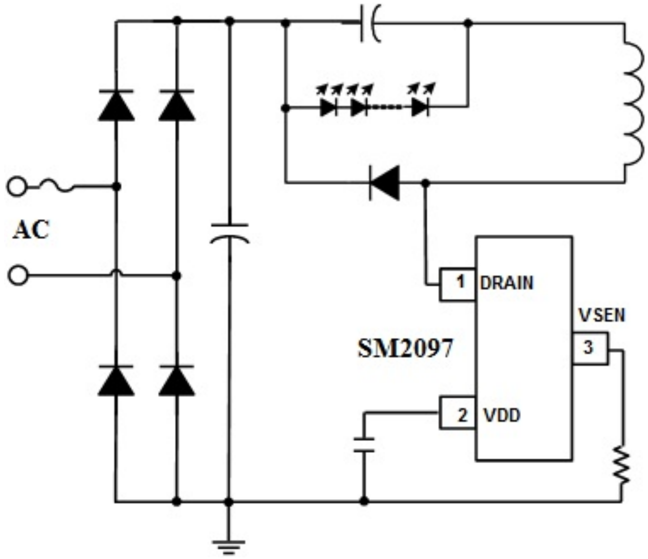
- GU10 LED Spotlight
- E17 / E27 LED candle light
- LED Bulb
- Other LED Lighting

PIN OUT



SOT23-3

TYPICAL APPLICATION CIRCUIT



PIN DESCRIPTION

Pin #	Name	Description
1	DRN	Internal high-voltage power MOSFET drain
2	VDD	Power supply
3	VSEN	Transformer primary winding peak current detection terminal connected to ground resistance

RECOMMENDED PARAMETERS (NOTE 1)

Parameter	Value	Unit
VCC, SW Voltage to GND	-0.3~+8.5	V
DRN Voltage to GND	-0.3~+500	V
PN junction to ambient thermal resistance	240	°C/W
Power Loss	0.3	W
Storage Temperature	-50~+150	°C
Operating junction Temperature	-40~150	°C
ESD (HBM)	2000	V
ESD (MM)	200	V

Note 1: Absolute Maximum Ratings indicate limits beyond which the device may be damaged. Recommended operating range is the range within which the device is functional, but not completely guarantee specific performance limits. Electrical parameters of the device are defined in the operating range and DC and AC electrical specifications under particular assurance of performance test conditions. For the parameter is not given upper and lower limits, the specification does not guarantee its accuracy, but its typical good indication of device performance.
Note 2: The temperature maximum power dissipation must be reduced, which also made *TJMAX, θJA,* and the ambient temperature TA of the decision. The maximum allowable power dissipation is *PDMAX = (TJMAX - TA)* the value of the digital / θJA or the limits given relatively low.
Note 3: The human body model, 100pF capacitor discharge through 1.5KΩ resistor.

ELECTRICAL PARAMETERS

(Normal Operation，Ta=25°C，VCC=7V)

Symbol	Parameter	Test Condition	Min	Typ	Max	Unit
Power Up						
V_{ST}	Start up voltage for VCC	V_{VCC} rise		6.6		V
V_{UV}	Under voltage lockout for VCC	V_{VCC} fall		5.7		V
V_{DD}	Operating voltage for VCC	Drain=100V		7.3		V
I_{ST}	Startup current for VCC	V_{VCC}= V_{ST} -1V		1	2	mA
I_{CC}	Operating current for VCC			180	300	μA
Current Control						
V_{SEN_TH}	Current detection threshold		580	600	620	mV
T_{LEB}	Current detecting leading edge blanking time			500		ns
T_{DELAY}	Switch off delay			200		ns
Timing Control						
T_{OFF_MIN}	Minimum OFF time			2.5		μs
T_{OFF_MAX}	Maximum OFF time			300		μs
T_{ON_MAX}	Maximum ON time			40		μs
MOSFET						
R_{ON}	Drain source resistance	V_{GS}=7V/ I_{DS}=0.1A		12		Ω
B_{VDSS}	Breakdown voltage	V_{GS}=0V/ I_{DS}=250μA	500			V
Over Temperature protection						
T_{REG}	Super-heat temperature protection			140		°C

Note 4: Typical parameters of the standard parameter value measured at 25˚C.
Note 5: The minimum specifications, the maximum specifications are guaranteed by test, typical values are guaranteed by design, test, or statistical analysis.

APPLICATION NOTES

SM2097 is a dedicated LED lighting constant current driver chips, used in non-isolated buck LED driver power supply. Chip integrated 500V power switch, requires minimal external components can achieve excellent constant current characteristic, and no auxiliary power winding and testing, the system costs low.

Boot Process

After the system bus voltage through the high voltage JFET chip capacitor is charged to VDD when VDD voltage reaches the turn-on threshold chip, chip Internal control circuit to work. When the chip is working properly, the current is still needed to work through the internal JFET its offer.

Output current setting

Chip-by-cycle peak current of the inductor is detected, VSEN terminal is connected to the input of the peak current comparator inside, the internal 600mV threshold voltage is compared, when the voltage reaches the internal VSEN detection threshold, the power transistor is turned off.

Inductor peak current is calculated as follows:

$$I_{PK} = \frac{V_{REF}}{R_{SEN}} = \frac{600}{R_{SEN}}(mA)$$

Wherein, RSEN for the current sampling resistor.
VSEN output of the comparator also includes a 500ns leading-edge blanking time.
LED output current is calculated as:

$$I_{LED} = \frac{I_{PK}}{2}(mA)$$

Wherein, I_{PK} is the peak inductor current.

$$I_{S\_PK} = I_{P\_PK} \times \frac{N_P}{N_S}$$

Primary Inductance Calculation

SM2097 in critical mode inductor current when the power MOSFET, current flow through the inductor increased from zero, the conduction time is:

$$t_{ON} = \frac{L\ x\ I_{PK}}{V_{IN} + V_{LED}}$$

Where, L is the inductance; I_{PK} is the peak inductor current; V_{IN} is the bus voltage after rectification; V_{LED} is the voltage on the output of the LED.

When the power transistor is turned off when the inductor current to flow down from the peak beginning, when the inductor current falls to zero, the internal logic chip again
The Power MOSFET opening. Turn-off time of the power MOSFET is:

$$t_{OFF} = \frac{LL\ x\ I_{PK}}{V_{LED}}$$

Inductor is calculated as following:

$$L = \frac{V_{LED}\ x\ (V_{IN} - V_{LED})}{f\ x\ I_{PK}\ x\ V_{IN}}$$

Wherein, f is the operating frequency of the system. When the system operating frequency and input voltage is proportional to the SM2097, SM2097 system operating frequency setting, select when the input voltage lowest operating frequency settings for the system, and when the input voltage is the highest system frequency is highest.

SM2097 sets the minimum and maximum system demagnetization time period, respectively 2.5us and 300us. Known by the formula TOFF, if the inductance is small, TOFF is likely to be less than the minimum chip demagnetization time, the system will enter discontinuous inductor current mode, LED output current will deviate from the design value; and when the inductance is large, TOFF and may exceed the maximum demagnetization time chip, then the system will enter continuous inductor current mode, the output of the LED current will also deviate from the design value. So choose the appropriate inductor value is important.

Protection

SM2097 built a variety of protection features including LED short circuit protection, VDD under-voltage protection, the chip overheating regulation. When LED short circuit, the system works in 3KHz low frequency, power consumption is very low.

Temperature Regulation

SM2097 overheating regulation, when the driving power of overheating decreases output current to control the output power and temperature, power supply temperature is maintained at the set value, to improve system reliability. Chip set superheat temperature control point is 140 ° C.

PCB Layout

SM2097 PCB design, you need to follow these guidelines:
1) VDD bypass capacitor
2) VDD bypass capacitor should be as close chip VDD

pin.
3) VSEN sampling resistor
4) Copper connection between VSEN sampling resistor and VDD bypass capacitor should be as short as possible.
5) Increasing VSEN pin copper area to improve chip cooling.
6) Power loop area:
Reducing the power loop area such as power inductors, power MOSFET, bus capacitance loop area, and a power inductor, freewheeling diode, output capacitor loop area to reduce EMI radiation.

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