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Description

OC6701 is a high efficient and precision boost LED constant current driver.

OC6701 has in-built high precision error amplifier, fix off-time control scheme and constant current (cc) control circuit, which can be used in high power or multiple high brightness LED series driver.

OC6701 adopts fixed turn off time control mode. The off-time can be adjusted by an external capacitor and resistor, thus the frequency can be changed according to the users' requirements.

OC6701 can be adjusted the external current sampling resistor to achieve the desired constant LED brightness. And LED dimming can be achieved by adding PWM signal to EN terminal.

VDD regulator, soft start and over-temperature protection circuit are integrated internally to reduce peripheral components and improve system reliability.

SOP-8 package is available.

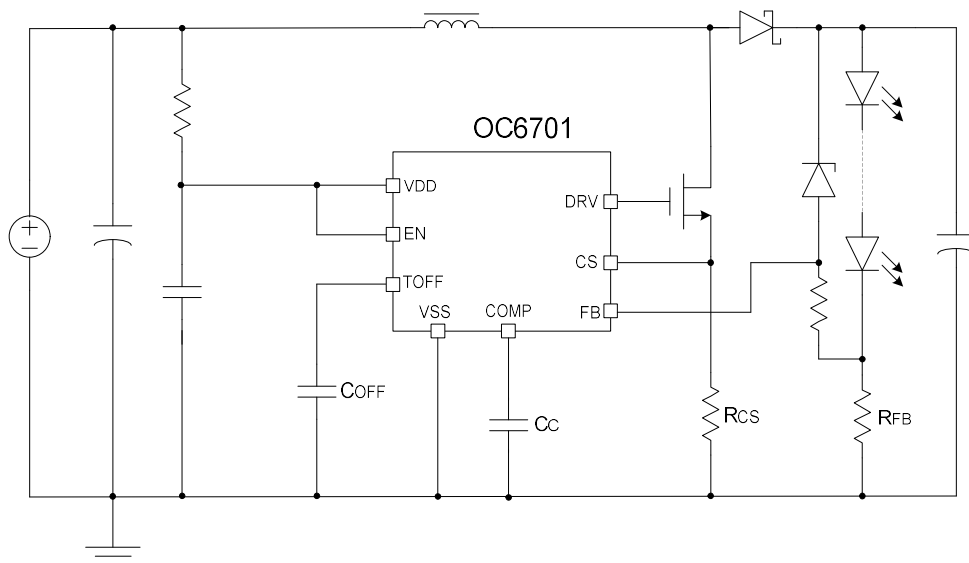
Features

- ◆ Wide input voltage range: 3.6V~100V
- ◆ High efficiency: up to 95%
- ◆ Maximum frequency: 1MHz
- ◆ CS current protect voltage: 250mV
- ◆ FB sampling voltage: 250mV
- ◆ UVLO voltage: 3.2V
- ◆ Off-time adjustable
- ◆ Intelligent OTP
- ◆ Soft-start circuit
- ◆ In-built VDD zener diode

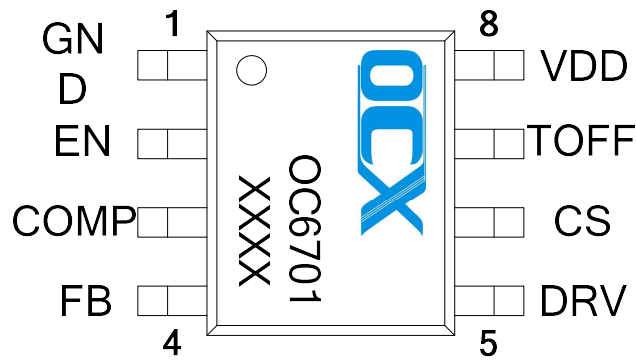
Applications

- ◆ LED lamps
- ◆ Battery power LED series.
- ◆ Flat backlight
- ◆ High power LED lighting

Typical applicaion schematic



Package and pin configuration



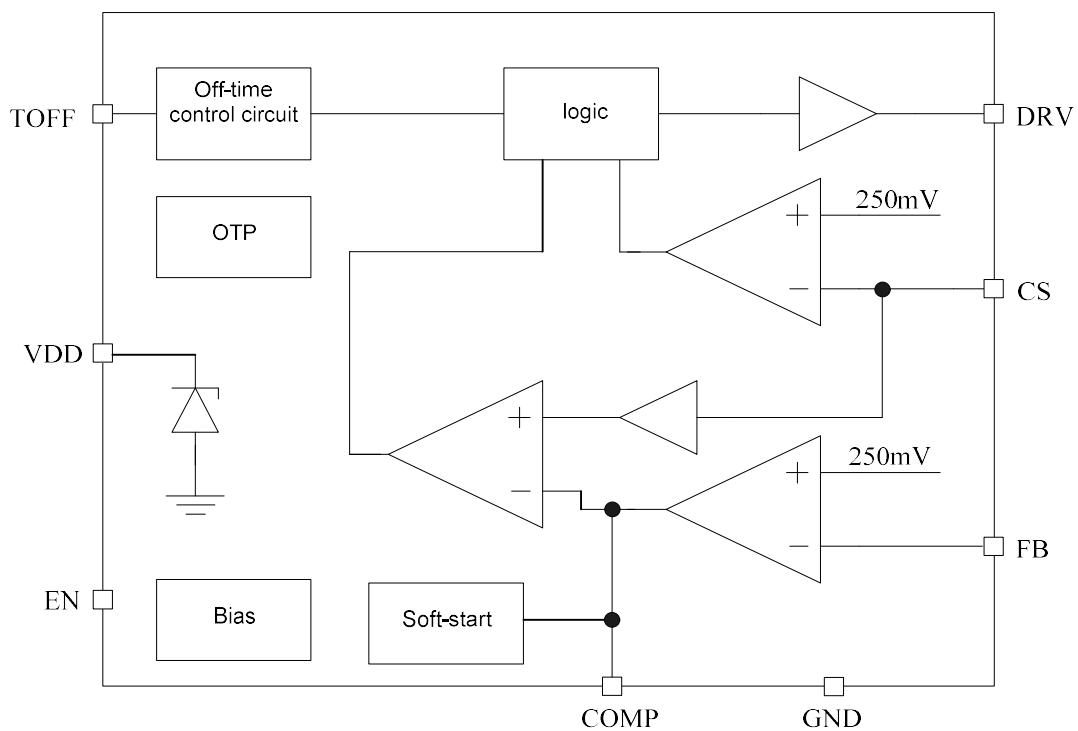
SOP8

Pin functions

pin	Pin name	Description
1	GND	Connect to system ground
2	EN	Chip enable, high level effective and PWM dimming
3	COMP	Frequency compensation
4	FB	Voltage feedback
5	DRV	Driver, connect to gate of outer NMOS
6	CS	Current sensing
7	TOFF	Off-time setting
8	VDD	Power supply

Absolute maximum rating

symbol	description	value	unit
VDD	Maximum voltage on VDD pin	5.5	V
V _{MAX}	Voltage range of EN,DRV,COMP,FB,TOFF and CS	-0.3~VDD+0.3	V
P _{SOP8}	Maximum power consumption of SOP8 package	0.8	W
T _A	Operation temperature range	-20~85	°C
T _{STG}	Storage temperature range	-40~120	°C
T _{SD}	Welding temp (less than 30sec.)	240	°C
V _{ESD}	ESD (HBM)	2000	V

Functional block diagram


Electrical characteristics($V_{DD}=5.5V$, $T_A=25^{\circ}C$ unless otherwise indicated)

Parameter	Symbol	Test Condition	Min	Typ.	Max	unit
Power Supply						
VDD clamping voltage	V_{DD}	$I_{VDD}<10mA$		5.5		V
UVLO voltage	V_{DD_UVLO}	V_{DD} 上升		3.2		V
UVLO hysteresis	V_{DD_HYS}			0.5		V
Power Current						
Operating current	I_{OP}	$F_{OP}=200KHz$		1.3		mA
Standby current	I_{INQ}	No load, EN is low level		200		uA
POWER MOS Over Current Protection						
OCP voltage	V_{CS_TH}		240	250	260	mV
OUTPUT Current Sampling						
FB feedback voltage	V_{FB}		240	250	260	mV
Off-time						
Minimum off time	T_{OFF_MIN}	TOFF no connection		620		ns
EN ENABLE						
EN high level			$0.4*V_{DD}$			V
EN low level					0.8	V
DRIVER						
DRV rising time	T_{RISE}	500pf cap on DRV pin			50	ns
DRV falling time	T_{FALL}	500pf cap on DRV pin			50	ns
OTP						
OTP	OTP_TH			135		$^{\circ}C$

Application Guide

Overview

OC6701 is a high power boost constant current LED driver, which uses fixed off-time and peak current detect control scheme.

The chip is composed of EA, PWM comparator, Inductor peak current detect, fixed off-time control, PWM logic, POWER MOS driving and bandgap circuit.

The chip samples the LED output current through the FB pin. When the system is in stable state, the voltage of FB is about 250mV. When the voltage of FB is lower than 250mV, the output voltage of EA will rise up to increase the peak current in on state, so the input power will increase, then the FB voltage will rise up, and vice versa.

OC6701 achieves peak current control by sampling the CS current and achieves OCP by limiting the maximum current to CS.

The system frequency can be set by off-time control, which is set by connecting a cap on TOFF pin.

COMP is the output of EA, compensation cap and resistor can be connected at the COMP pin to achieve frequency compensation.

OC6701 also has inbuilt VDD zener diode, soft start circuit and OTP circuit.

LED Current Setting

LED output current is setting by the resistor R_{FB} connected to FB pin:

$$I_{LED} = \frac{0.25}{R_{FB}}$$

T_{OFF} Setting

The off time is setting by C_{OFF} connected to Toff pin:

$$T_{OFF} = 0.51 * 150K\Omega * (C_{OFF} + 7.3 pF) + T_D$$

Where $T_D = 61ns$.

If there is no connection to T_{OFF}, OC6701 will set 620ns off time internally. For most applications, a 22~33pF or more capacitor is proposed.

System frequency F_S

The system frequency F_S is determined by:

$$F_S = \frac{V_{IN}}{V_{OUT} * T_{OFF}}$$

Where V_{IN} , V_{OUT} are input and output voltage.

The inductor L

The current ripple is relevant to the value of inductor L, when operating in CCM mode, the current ripple is determined by:

$$\Delta I_L = \frac{V_{OUT} - V_{IN}}{L} * T_{OFF}$$

Increasing L will decrease the current ripple, and vice versa.

The peak current in CCM mode is determined by:

$$I_{pk} = \frac{V_O * I_{LED}}{V_{IN} * \eta} + \frac{1}{2} \Delta I_L$$

The inductor L in BCM mode:

$$L_{cri} = \frac{V_{IN} * (V_{OUT} - V_{IN}) * T_{OFF}}{2V_{OUT} * I_{LED}}$$

When $L > L_{cri}$, the system is operating in CCM mode, when $L < L_{cri}$, then the system is operating in DCM mode.

When selecting inductor, make sure the peak current of the inductor do not trigger magnetic saturation. Actually, the saturation current should 1.5 times the peak current. Low ESR power inductor will get better system conversion efficiency.

R_{CS} Setting

Properly setting R_{CS} resistor, or the limited input current will limit the output power.

$$R_{CS} \leq \frac{0.2}{\frac{V_{OUT} * I_{LED}}{\eta * V_{IN}} + \frac{V_{OUT} - V_{IN}}{2L} * T_{OFF}}$$

Where η is conversion efficiency, typical value is 90%. R_{CS} should be calculated at the lowest input voltage.

The system peak current I_{PK} is determined by R_{CS}:

$$I_{PK} \leq \frac{0.25}{R_{CS}}$$

MOS Selection

Firstly, the most significant consideration of MOS selection is the voltage endurance; the voltage endurance should 1.5x larger than the maximum output voltage. Secondly, the selection of I_{DS} current of MOS should 2x larger than the peak current of inductor. Thirdly, the R_{DS(on)} of MOS should as small as possible, which is better for the system conversion efficiency.

Additionally, the threshold voltage of MOS should be smaller than 2.5v. the operating voltage

of OC6701 is 5.5V, so make sure the $R_{\text{DS(on)}}$ is low enough when the V_{GS} voltage is lower than 5.5V.

Power Resistor Selection

OC6701 is powered by R_{VDD} ,

$$R_{\text{VDD}} = \frac{V_{\text{IN}} - V_{\text{DD}}}{I_{\text{VDD}}}$$

Where VDD is 5.5V, the typical value of I_{VDD} is 2mA, V_{IN} is input voltage. When the system frequency is higher or the input capacitance of MOS is higher, the system operation current will be larger, so the R_{VDD} should be decreased.

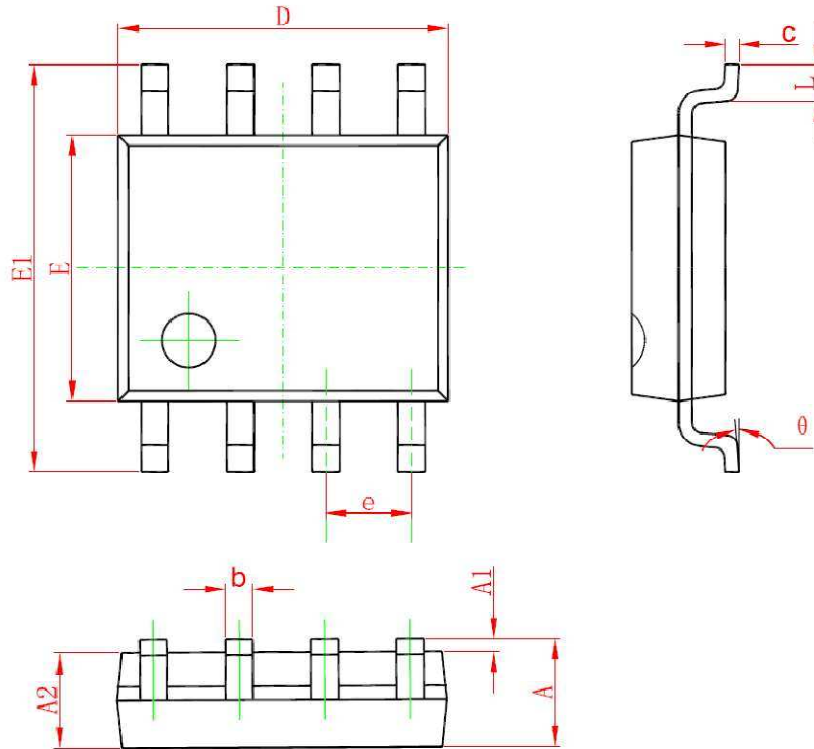
The clamping current of zener is 10mA in OC6701, so the value of R_{VDD} should not be too small. Larger VDD current should connect a zener diode at VDD pin.

OTP

When the temperature is too high, system will limit the input current. Typically, when the internal temperature of the chip exceeds 135 degrees, the OTP is starting to work. With the increase of temperature, the input peak current gradually decreases, thus limiting the input power and enhancing the reliability of the system.

Package Information

SOP8 package outline dimensions:



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.100	0.250	0.004	0.010
A2	1.350	1.550	0.053	0.061
b	0.330	0.510	0.013	0.020
c	0.170	0.250	0.006	0.010
D	4.700	5.100	0.185	0.200
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°