## General Description

OC6711 is a highly integrated and cost effective Light Emitting Diode (LED) DC-DC optimized for LCD monitor and LCD TV backlighting application. It provides a high performance LED backlight solution with minimized BOM count.

The OC6711 contains a PWM boost driver which uses current mode control and fixed frequency operation to regulate the LED current. The LED current is sensed through an external current sense resistor. The voltage across the sensing resistor is compared with reference level of 400mV, the error is amplified to control the pulse width of the power switch thus to regulate the current flowing the LED.

The OC6711 offers PWM to analog dimming method for a wide range of dimming control.

The OC6711 offers comprehensive protection such as power MOSFET over current protection (OCP), output over voltage protection (OVP), Diode & Inductor short protection, IC power supply under voltage lockout (UVLO), and LED open protection.

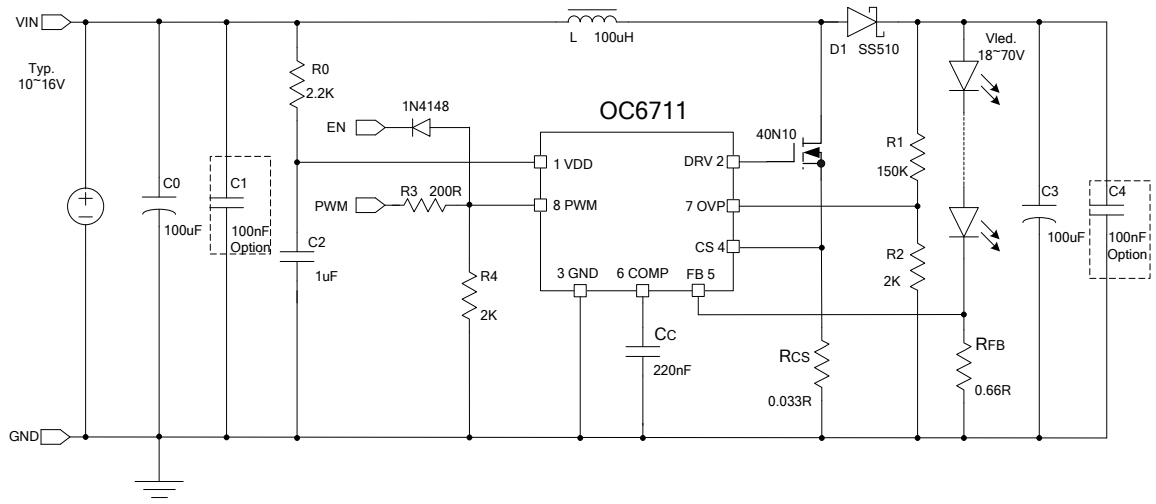
## Features

- Current Mode PWM Control With Good Dynamic Response
- 2.6V to 100V Input Voltage Range
- PWM to analog Dimming Mode
- Over Voltage Protection
- Over Current Protection
- Under Voltage Lockout (UVLO)
- Thermal Protection
- Diode & Inductor Short Protection
- Standby mode when PWM=L last for 20ms
- SOP-8 Package

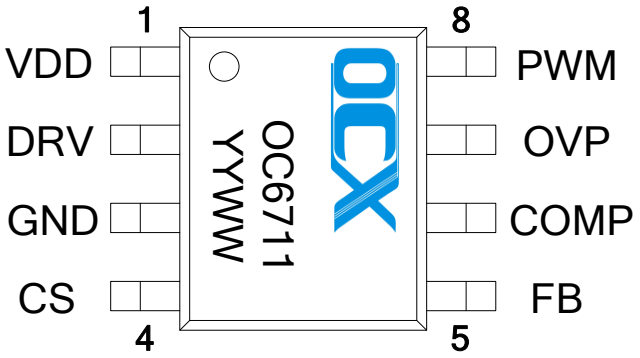
## Application

- LCD Monitor\LCD TV
- Flat panel display
- Desk lamp, Fan lamp, Electric drying rack

## Typical Applicaion Schematic



## pin configuration



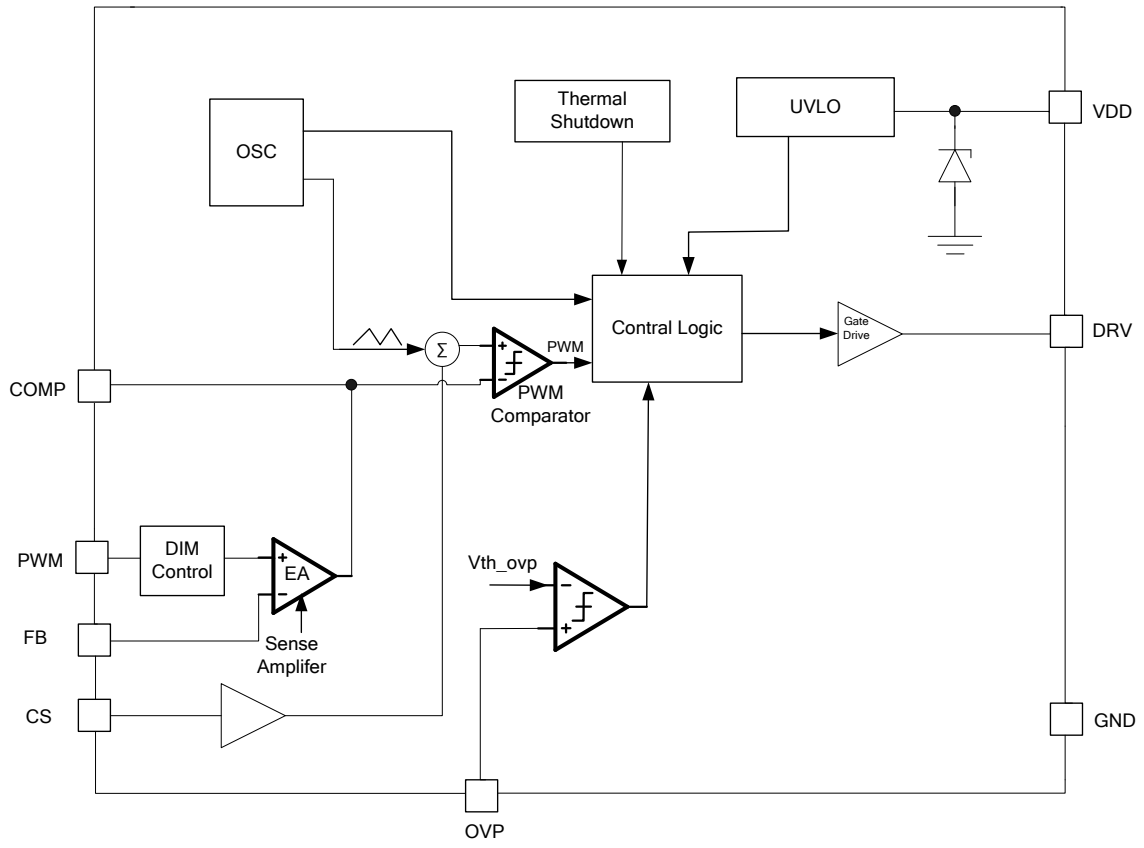

## Pin functions

| No. | Name | I/O | Pin Function |
|---|---|---|---|
| 1 | VDD | Power | Power supply input with build-in clamp diode. |
| 2 | DRV | I/O | Gate of outer NMOS |
| 3 | GND | GND | Ground |
| 4 | CS | I/O | Current sense input |
| 5 | FB | I/O | LED current feedback input |
| 6 | COMP | I/O | Boost controller loop compensation pin |
| 7 | OVP | I/O | Over voltage protection sense input |
| 8 | PWM | I/O | PWM signal input pin for analog dimming control<br>Standby mode control. When floating, pull-up to VDD |

## Recommended Operating Conditions

| Symbol | Description | MIN | MAX | UNIT |
|---|---|---|---|---|
| $T_J$ | Operating Junction Temperature Range | -40 | 125 | ℃ |
| $T_A$ | Operating Temperature Range | -40 | 85 | ℃ |
| $f_{PWM}$ | PWM to analog Dimming Frequency | 5 | 50 | kHz |

## Functional block diagram




## Absolute maximum ratings

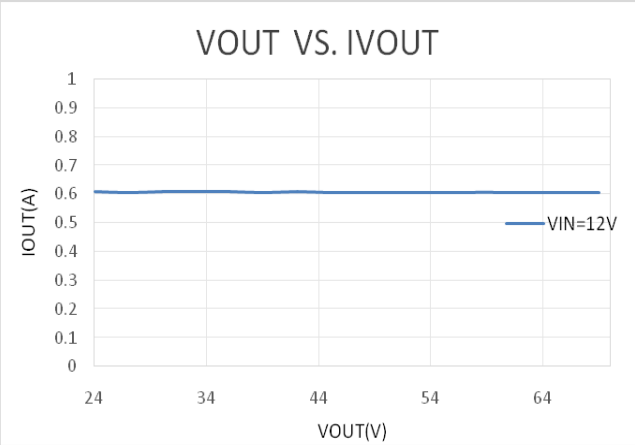
| Parameter | Value |
|---|---|
| VDD,OVP,CS,FB,COMP,PWM,DRV to GND | -0.3V to 7V |
| Maximum Power Consumption (SOP) | 1W |
| Operating Ambient Temp. $T_A$ | -40℃ ~ 85℃ |
| Operating Junction Temp. $T_J$ | -40℃~ 150℃ |
| Min/Max Storage Temp. $T_{STG}$ | -55℃ ~150℃ |
| Lead Temp. (10 Sec) | 260℃ |

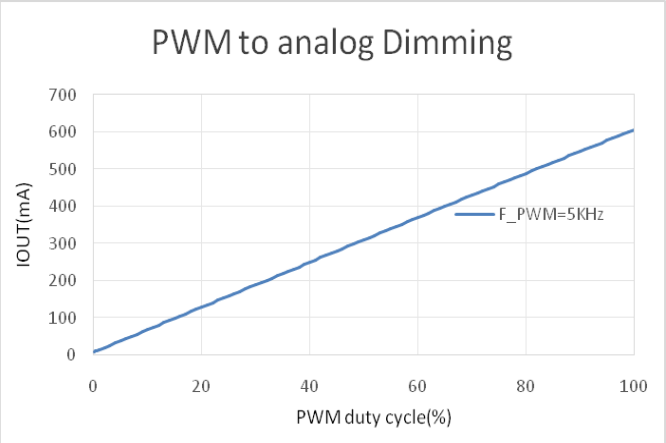
**Note1:** Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, functional operation of the device at these or any other conditions beyond those indicated "recommended operating conditions" is not implied. Exposure to absolute maximum-rated conditions for extended periods may affect device reliability.

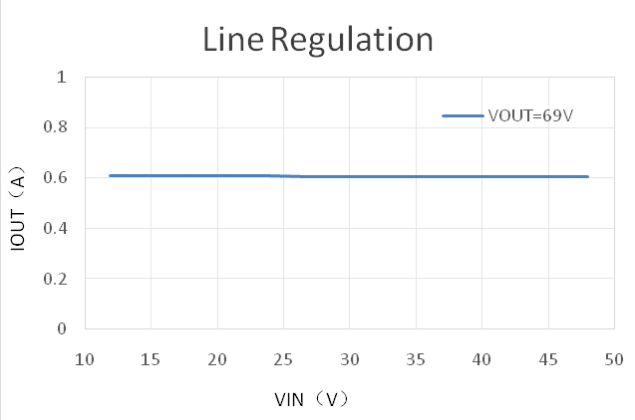
## Electrical characteristics(VIN=12V,PWM=5V, $T_A$=25℃, if not otherwise noted)

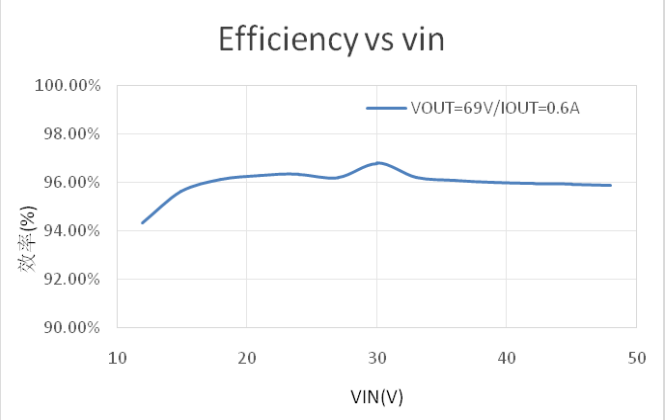
| Parameter | Symbol | Conditions | Min | Typical | Max | Units |
|---|---|---|---|---|---|---|
| **Current Consumption** | | | | | | |
| VDD Clamp Voltage | $VDD$ | | | 5.45 | | V |
| VDD Clamp Current | $I_{VDDCLAMP}$ | | | | 10 | mA |
| Operating supply current | $I_{VDD}$ | VDD=5V,PWM=5V | 1.1 | 1.4 | 1.8 | mA |
| Stand by current | $I_{VDD\_STB}$ | PWM low >20ms sleep mode | 15 | 28 | 40 | uA |
| **VDD UVLO** | | | | | | |
| UVLO | UVLO(OFF) | | | 2.61 | | V |
| UVLO Hysteresis | UVLO(Hys) | | | 120 | | mV |
| **Soft start** | | | | | | |
| Soft start slope | $I_{sst\_slop}$ | | | 0.7 | | mV/ms |
| **PWM Control** | | | | | | |
| Operating frequency | $F_{OSC}$ | | | 130 | 145 | KHz |
| Max duty cycle | $D_{max}$ | | | 94 | | % |
| **FB reference** | | | | | | |
| Reference voltage | Vref _ ea | PWM Duty=100% | 388 | 400 | 412 | mV |
| | | PWM Duty=50% | | 200 | | mV |
| **PWM to analog Dimming Control** | | | | | | |
| PWM duty | | | 0 | | 100 | % |
| PWM Logic input level | high | | 1.5 | | | V |
| | low | | | | 0.9 | V |
| **Protection Threshold** | | | | | | |
| OVP | $V_{OVP\ OV}$ | Threshold of output over voltage | | 1 | | V |
| OCP | $V_{th\_OCP}$ | Threshold of over current protection | | 200 | | mV |
| OTP ON | $T_{OTP\_ON}$ | | | 140 | | ℃ |
| CS high protection threshold | $V_{TH\_CS}$ | Diode or Inductor short | | 0.9 | | V |
| **DRV Capability** | | | | | | |
| DRV rising time | $T_{RISE}$ | Drive 500pf capacity | | | 50 | ns |
| DRV falling time | $T_{FALL}$ | Drive 500pf capacity | | | 50 | ns |

## TYPICAL PERFORMANCE CHARACTERISTICS



# Detail Description

## General Operation

The OC6711 is a boost DC-DC in a constant frequency mode . The OC6711 implements a peak current mode control scheme and an internal transconductance amplifier to accurately control the output current over a wide input and load conditions.

Low frequency PWM dimming input that can accept an external control signal with a duty ratio of 1%-100%.

OC6711 offers comprehensive protection features to protect the system in various fault conditions such as LED open protection, output over voltage protection (OVP), Diode & Inductor short protection(CS high). The cycle-by-cycle current limit function limits the maximum current flowing through the build-in MOSFET. The over temperature protection ensures that the system will not run into condition of thermal runaway and blow up.

## Startup

OC6711 is enabled by applying a voltage of greater than approximately 1.5V to PWM pin. An on-chip internal 500KΩ pull up resistor is inserted between PWM pin and ground. When the first rising edge is applied to PWM input, the OC6711 will power up immediately, and remains power up until the PWM input is lower than 0.9V for at least 20ms(typical), at this time the chip will enter standby mode. At standby mode, the power of the OC6711 will be lower than 28uA (typical).

Once OC6711 is enabled the internal 5V regulator will be activated and clamped to 5.45V, and the maximum clamp current is 10mA.

When PWM is active high, the OC6711 checks the topology connection first. The OC6711 will check faults (UVLO, CS high, CMP high, FB high, OCP and OTP), if there is no fault, then the boost controller will boost up the output with the internal soft start.

## UVLO

An under-voltage lockout protection feature with a hysteresis of about 120mv is provided for VIN. When the voltage at this pin exceeds a threshold of approximately 2.73V (typical), the IC starts the normal operation. If the voltage at this pin drops below a threshold of approximately 2.61V (typical), the IC stops switching operation. The IC resumes switching operation when the voltage at pin VIN increases to a voltage above 2.73V (typical).

## LED Current Regulation

The LED current is sensed by current sense resistors connected between pin FB and GND.

The sensed error signal is amplified and compared to the CS pin sensing current signal plus the slope compensation to determine the on-time of the switching MOSFET. The error amplifier sources or sinks the current to the COMP pin to adjust the required inductor current as the load changes. The slope-compensation signal is added to the current-sense signal to improve the stability at high duty cycles.

The error amplifier reference is set by internal reference voltage and the PWM duty cycle at PWM pin.

The average LED current is approximated by the following equation:

$$I_{LED}[mA] = \frac{400 * Duty_{PWM}[mV]}{R_{FB}[\Omega]}$$

## Dimming Control

The LED brightness is controlled by the PWM signal at PWM pin which has different duty cycle. OC6711 can accept an external PWM signal to PWM pin in the range of 5KHz to 50KHz with a swing voltage of 0V to a level greater than 1.5V.

A internal square wave whose duty cycle is

the same as the duty cycle of the external PWM signal to PWM pin is filtered to provide reference voltage of EA input which determines the FB reference.

When PWM=L last for 20ms, the OC6711 will enter standby mode for low power consumption.

## Slope Compensation

The OC6711 uses a current mode control scheme. The main advantages of current mode control are inherent cycle-by-cycle current limit for the switch and simpler control loop characteristics. However, current mode control has an inherent instability for duty cycles greater than 50%, which is also called sub-harmonic oscillation. The OC6711 has a build-in slope compensation to avoid sub-harmonic oscillation.

## LED open Protection and OVP Setting

The OC6711 monitors through Pin OVP, and the controller is shut down if the output voltage exceeds the predetermined level. The output OVP voltage is approximated by the following equation:

$$V_{OUT\_OVP}[V] = \frac{V_{OVP} * (R_1 + R_2)[k\Omega]}{R_2[k\Omega]}$$

Where $V_{OVP}$=1V.

## Diode & Inductor Short Protection

When the Schottky diode or the inductor shorts, the current of the build-in MOSFET increasing significantly, which will cause the MOSFET permanent damage if the IC is continuously working. OC6711 will monitor the voltage on CS pin voltage cycle by cycle, if the voltage on CS pin is greater than 0.9V (typical), the OC6711 will latch shutdown for continuous 177us to prevent the MOSFET from permanent damage.

## RCS setting

The resistance value of the RCS resistor must be set appropriately to prevent output power limitation due to input current limiting under normal load conditions.

$$R_{CS} \le \frac{0.2}{\frac{V_{OUT} * I_{LED}}{\eta * V_{IN}} + \frac{(V_{OUT} - V_{IN}) * V_{IN}}{2L * V_{OUT} * fosc}}$$

where η represents the conversion efficiency, which is typically taken as 90%. The RCS value should be calculated at the lowest input voltage.

The maximum peak current IPK of the system is limited by the resistance RCS:

$$I_{PK} \le \frac{0.2}{R_{CS}}$$

## MOSFET selection

First, the voltage withstand capability of the MOSFET must be considered, typically requiring the MOSFET's voltage rating to exceed 1.5 times the maximum output voltage. Second, the IDS current of the MOSFET should be selected based on the driving current for the LEDs and the maximum peak current of the inductor. Generally, the maximum IDS current of the MOSFET should be at least twice the maximum peak current of the inductor. Additionally, the on-resistance ($R_{DSON}$) of the MOSFET should be low, as lower $R_{DSON}$ results in reduced power loss in the MOSFET and higher system conversion efficiency.

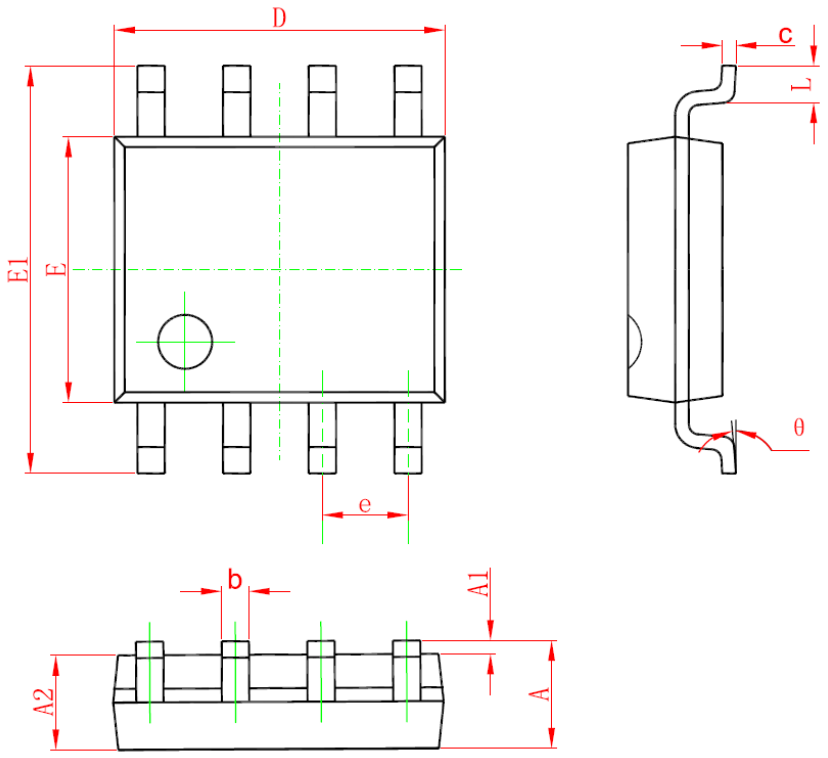
Additionally, when applying high voltage, it is important to select MOSFETs with a threshold voltage of 2.5V or less. The operating power supply voltage of the chip determines the DRV driving voltage. Typically, the chip's driving voltage is 5.45V, so the MOSFET should ensure a sufficiently low on-resistance when the VGS voltage equals 5.45V.

## Thermal Protection

The OC6711 includes a thermal protection circuit. When the junction temperature exceeds 140℃ (typical), the OC6711 will decrease the output current to ensure that the system will not run into condition of thermal runaway and blow up.

## 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° |

## Version Information

1、V01，Initial version.