Cost Effective 100V StepUp LED Driver

General Descirption

OC6710 is a highly integrated and cost effective Light Emitting Diode (LED) driver optimized for LCD monitor and LCD TV backlighting application. It provides a high performance LED backlight solution with minimized BOM count.

The OC6710 build-in Power MOSFET and 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 OC6710 offers PWM to analog dimming method for a wide range of dimming control.

The OC6710 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.

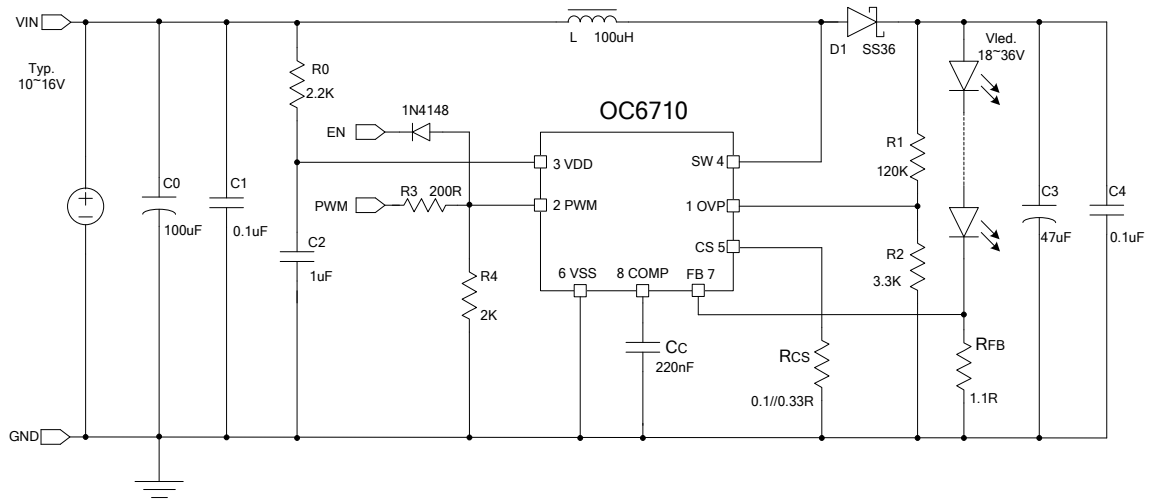
Features

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

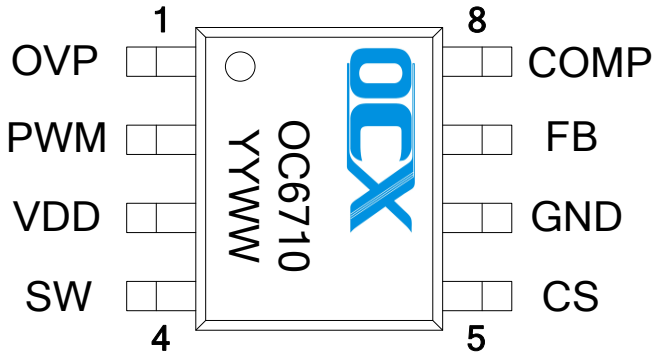
Application

- LCD Monitor
- Flat panel display
- LCD TV

Typical applicaion schematic



pin configuration



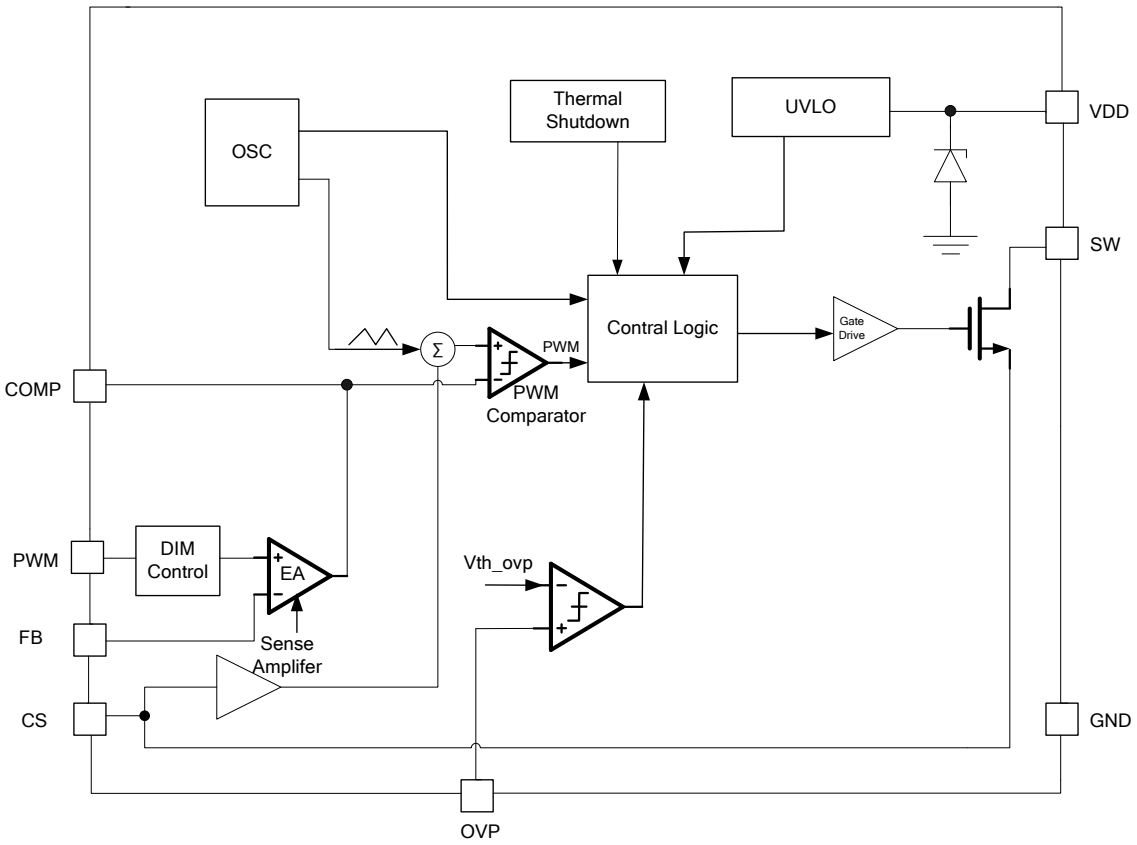
Pin functions

No.	Name	I/O	Pin Function
1	OVP	I/O	Over voltage protection sense input
2	PWM	I/O	PWM signal input pin for analog dimming control Standby mode control.
3	VDD	Power	Power supply input with inbuilt clamp diode.
4	SW	I/O	Built in MOS drain pin
5	CS	I/O	Current sense input
6	GND	GND	Ground
7	FB	I/O	LED current feedback input
8	COMP	I/O	Boost converter loop compensation pin

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

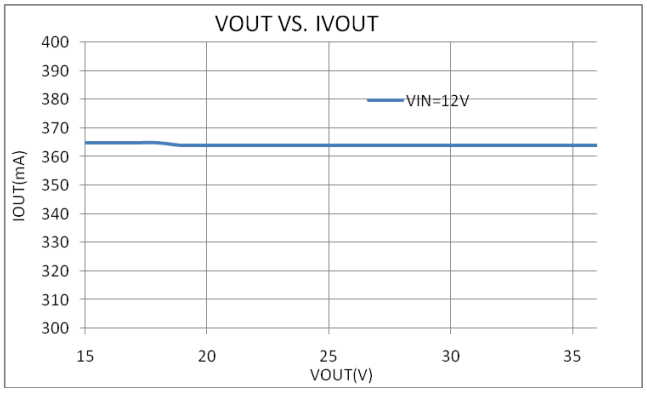
Parameter	Value
VDD,OVP to GND	-0.3V to 7V
CS,FB,COMP,PWM to GND	-0.3V to 7V
SW to GND (100V MOS)	-0.3V to 100V
Maximum Power Consumption (ESOP)	1.5W
Operating Ambient Temp. T_A	-40℃ ~ 85℃
Operating Junction Temp. T_J	-40℃~ 150℃
Min/Max Storage Temp. T_{STG}	-55℃ ~150℃
Lead Temp. (10 Sec)	260℃

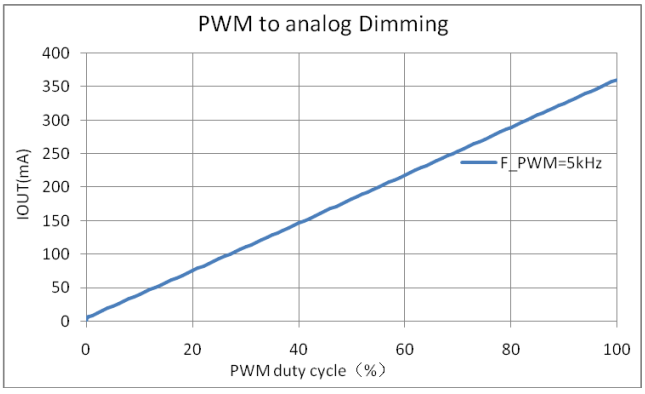
Note1: Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, functional operation of the device at these or any other conditions beyond those indicated "recommended operating conditions" is not implied. Exposure to absolute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

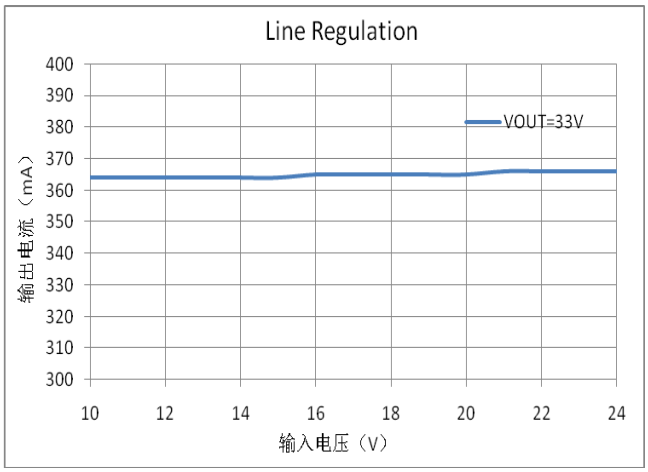
Electrical characteristics(VIN=12V,PWM=5V, T_A=25℃, if not otherwise noted)

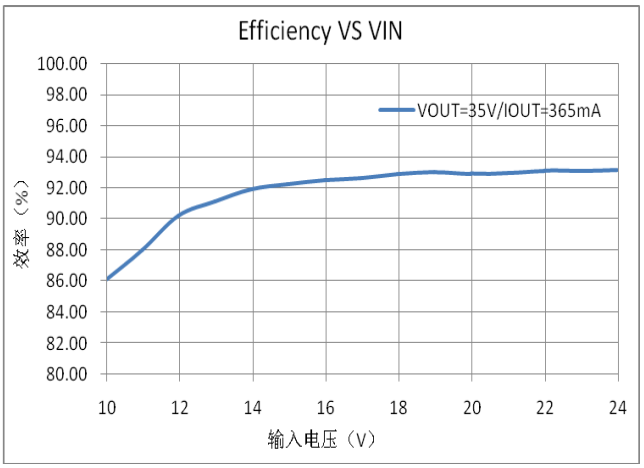
Parameter	Symbol	Conditions	Min	Typical	Max	Units
Current Consumption						
VDD Clamp Voltage	VDD			5.45		V
VDD Clamp Current	$I_{VDDCLAMP}$				10	mA
Operating supply current	I_{VDD}	VDD=5V,PWM=5V	1.1	1.4	1.8	mA
Stand by current	I_{VDD_STB}	PWM low >20ms sleep mode	15	28	40	uA
VDD UVLO						
UVLO	UVLO(OFF)			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	VTH_CS	Diode or Inductor short		0.9		V
Power MOSFET						
MOSFET Drain-Source Break -down Voltage	BVdss(V)		100			
On resistance (Id=4A)	Rds,on(mΩ)	VGS=4.5V		100		

TYPICAL PERFORMANCE CHARACTERISTICS









Detail Description

General Operation

The OC6710 is a build-in Power MOSFET for boost DC-DC converters in a constant frequency mode . The OC6710 implements a peak current mode control scheme and an internal trans-conductance 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%.

OC6710 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

OC6710 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 OC6710 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 OC6710 will be lower than 28uA (typical).

Once OC6710 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 OC6710 checks the topology connection first. The OC6710 will check faults (UVLO, CS high, CMP high, FB high, OCP and OTP), if there is no fault, then the boost converter 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. OC6710 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 OC6710 will enter standby mode for low power consumption.

Slope Compensation

The OC6710 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 OC6710 has a build-in slope compensation to avoid sub-harmonic oscillation.

LED open Protection and OVP Setting

The OC6710 monitors through Pin OVP, and the converter 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

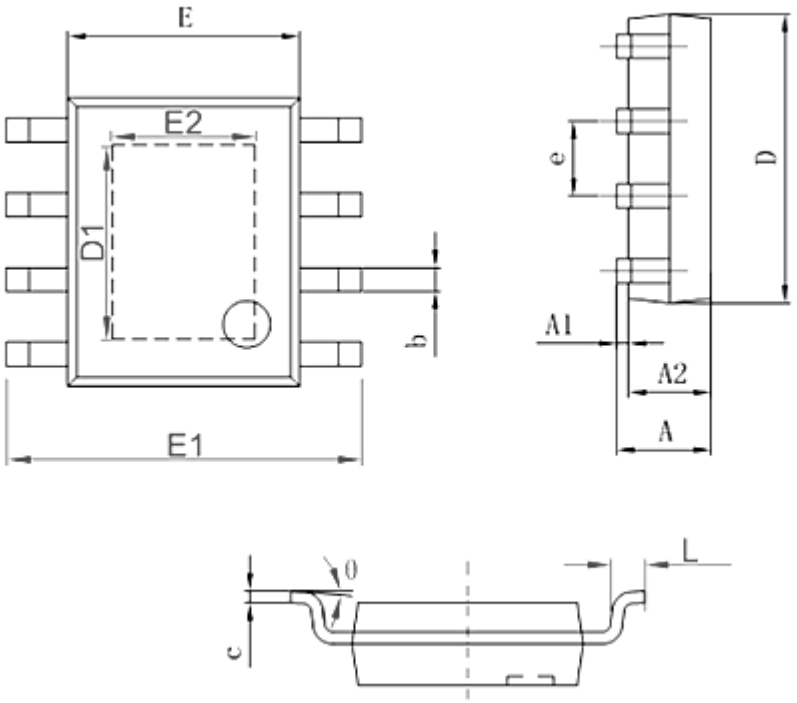
When the Schottky diode or the inductor shorts, the current of the build-in MOSFET increasing significantly, which will cause the MOSFET permanent damage if the IC is continuously working. OC6710 will monitor the voltage on CS pin voltage cycle by cycle, if the voltage on CS pin is greater than 0.9V (typical), the OC6710 will latch shutdown for continuous 177us to prevent the MOSFET from permanent damage.

Thermal Shut down

The OC6710 includes a thermal protection circuit. When the junction temperature exceeds 140℃ (typical), the OC6710 latch shut down.

Package Information

ESOP8 package outline dimensions：



字符	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.050	0.150	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
D1	3.202	3.402	0.126	0.134
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
E2	2.313	2.513	0.091	0.099
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.