

CS8906 Application Note

General Description

The CS8906 is a non-isolation LED buck controller and integrated. It provides a simple circuit to get higher power factor, higher efficiency and meet the accuracy average LED current, reduce the cost of LED power supply. CS8906 can use the DIM pin control the LED current dimming and OTP Protection.

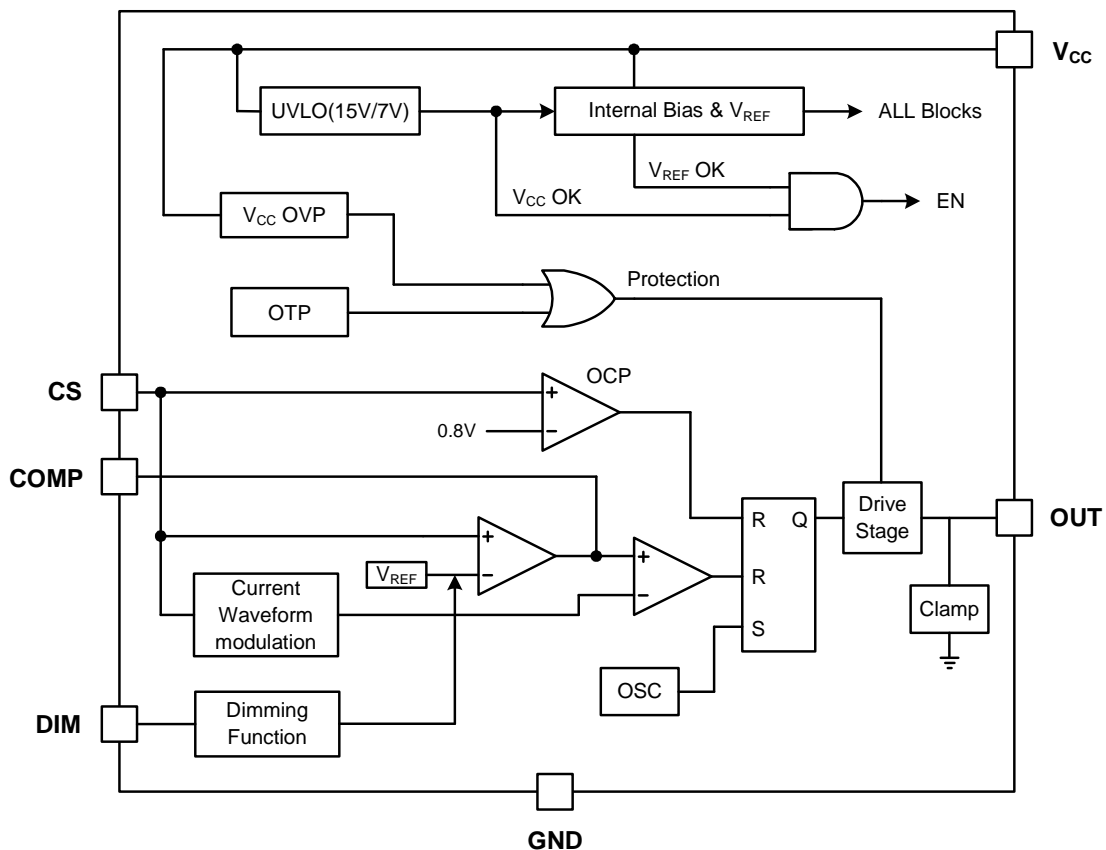
The COMP pin controls the duty by connected an RC compensation network to ground and forming the closed loop feedback control, Constant current output with a resistor to complete the set.

Application E26 / E27 or T5 / T8 LED Lamp.

Features

- Low BOM Cost
- High Power Factor $PF > 0.9$
- Accuracy Constant Current ($\pm 3\%$)
- Internal OTP Protection
- LED Open Protection (OVP)
- LED Short Protection (SCP)
- Over Current Protection (OCP)

Functional Block Diagram



Application Information

Start-up Current

The V_{CC} pin of CS8906 is connected to the line input through a resistor. The typical start-up current is around 8μA. A large value startup resistor can be used to minimize the power loss in application because the start current of CS8906 is very low.

A hysteresis UVLO comparator is implemented in CS8906, then the turn-on and turn-off thresholds level are fixed at 15V and 7V respectively.

The CS8906 is implemented an OVP function on V_{CC} Pin to protect LED power system. When the V_{CC} voltage is higher than the OVP threshold voltage 31.5V, the output gate driver circuit will be shut down immediately to stop the switching of power MOSFET, until the V_{CC} voltage drops below the UVLO threshold, then start again. The CS8906 is working in an auto-recovery mode
IC power supply is provided by the output of the LED lamp voltage, V_{CC} voltage can be obtained by:

$$V_{CC} = V_{LED} - V_Z - V_F$$

Gate Clamp/Soft Driving

The operating frequency of CS8906 is fixed at 45kHz and the maximum duty-cycle is up to 90% for driving high LED voltage string. It has a wide output voltage range for LED lighting application.

Driver output voltage is clamped to 15V by an internal clamping circuit to protect the power circuit. Those damages usually come from undesired over-voltage OUT signals.

In order to reduce EMI interference, CS8906 is built in soft driving function. It helps designer save EMI components and cost.

Over Temperature Protection/Dimming Function

The NTC thermistor is setting as an external OTP protection at DIM pin.

In this DIM pin, there is one comparator for Output Minimum Pulse mode protection.

The application of DIM pin is as below:

1. Output Minimum Pulse mode protection is less than 0.3V.
2. The linear Dimming is between 0.3V and 3V.
3. The normal operating area is higher than 3.0V.
4. User can open this Dimming Pin when the Output Minimum Pulse mode and the linear Dimming are not required.

COMP Pin Compensation Network

It is easy to compensate the loop stability for the CS8906's application in LED driving.

Compensation network only contains a capacitor between COMP pin and GND.

The best criterion to optimize the loop compensation is by inspecting the transient response and adjusting the compensation network.

The most simple compensation network is use a 1μF~4.7μF capacitor to construct an integrator.

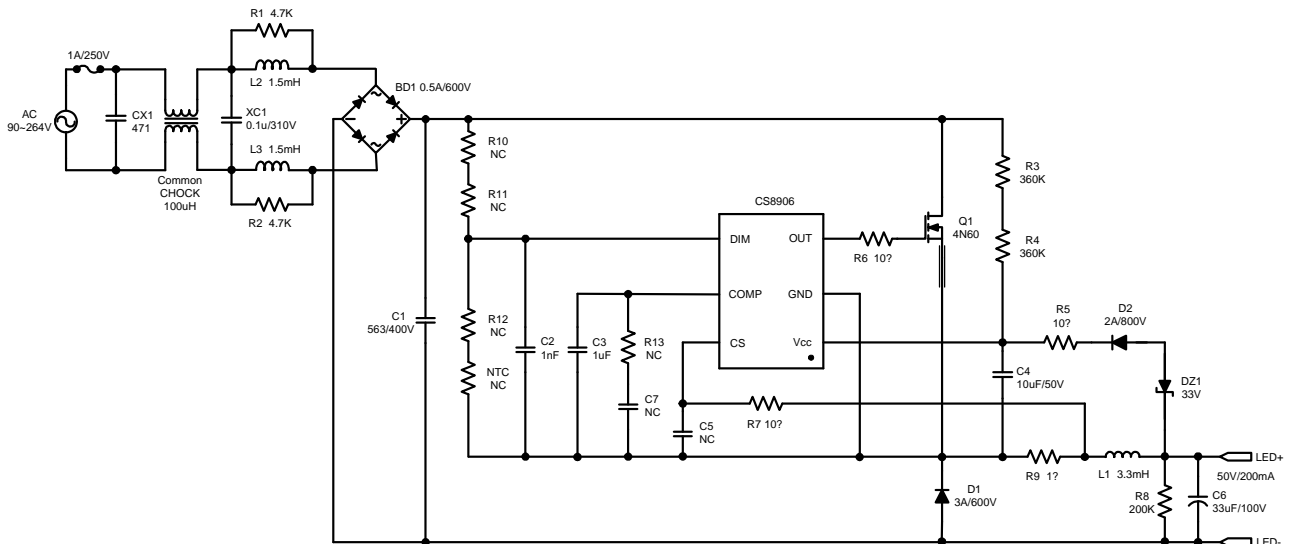
CS Pin Compensation Network

CS8906 constant current output control by CS pin R_{SENSE} voltage to achieve a constant current function.

Output current can be obtained by:

$$I_{LED} = 0.2V / R_{SENSE}$$

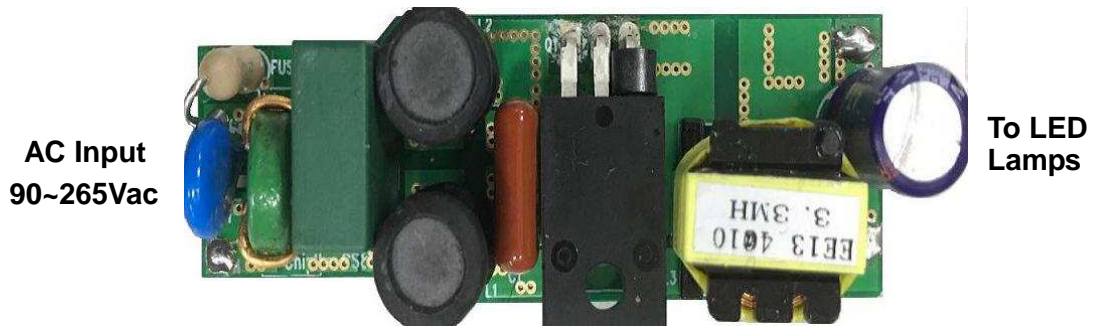
Typical Application Circuit



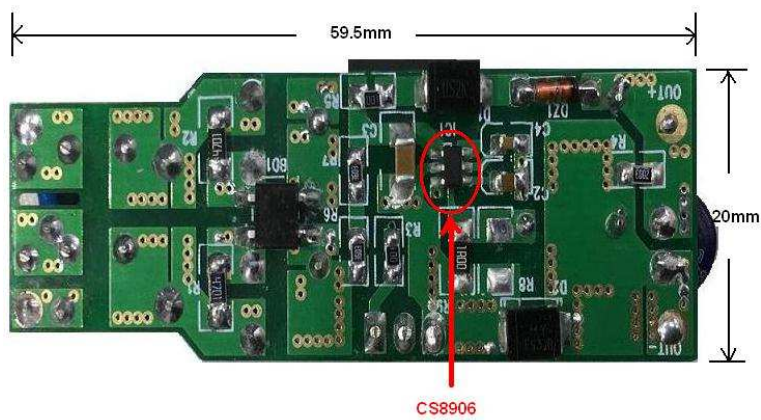
Bill of Material

Manufacturer	Description	Package	Qty	Reference
Chiplus	CS8906	SOT-23-6	1	IC1
	SMD 1206 4.7K Ω 5% 1/4W	SMD 1206	2	R1,R2
	SMD 1206 360K Ω 5% 1/4W	SMD 1206	2	R3,R4
	SMD 0805 10 Ω 1/10W	SMD 0805	3	R5,R6,R7
	SMD 1206 200K Ω 5% 1/4W	SMD 1206	1	R8
	SMD 1206 1 Ω 1% 1/4W	SMD 1206	1	R9
	Capacitor 563/400V 105 $^{\circ}$ C 10%		1	C1
	SMD 0805 102/50V 5% X7R	SMD 0805	1	C2
	SMD 0805 104/25V 10% X7R	SMD 0805	1	C3
AVX	SMD 1210 10 μ F/50V 5% Y5V	SMD 1210	1	C4
STONE	33 μ F 200V 105 $^{\circ}$ C		1	C6
VISHAY	Bridge Diode 0.5A/600V MD5S	MD-S	1	BD1
	SUPER FAST DIODE ES3J 3A/600V	DO-214AA	1	D1
DIODES	ULTRA FAST DIODE US2K 2A/800V	SMA	1	D2
VISHAY	ZENER DIODE 33V 1/2W 5%	DO-41	1	DZ1
BOURNS	Capacitor-X 471K 10%		1	CX1
CT	Capacitor 0.1 μ F/310V 110 $^{\circ}$ C		1	XC1
ST	MOSFET 4N60 4A/600V	TO-220F	1	Q1
	EE13-3.3mH Φ 0.2mm \times 240T		1	L1
	DRUM CHOKE ψ 8x10 1.5mH 10%		2	L2,L3
	Common Chock 100 μ H		1	L4
	1A/250V		1	Fuse

Circuit Board Photograph



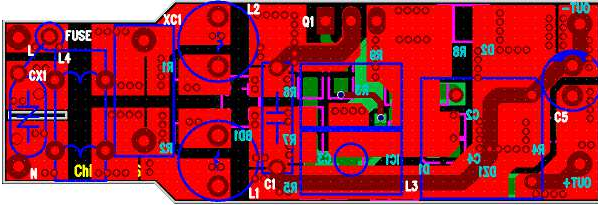
Top side



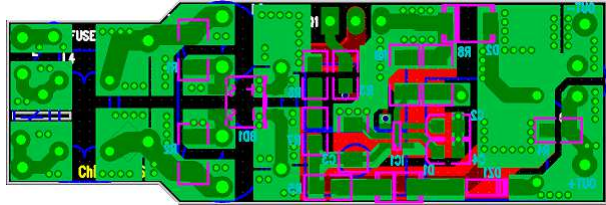
Bottom side

PCB Layout

59.5mmx20mm

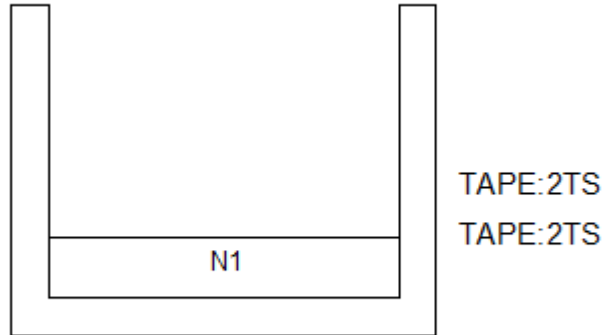
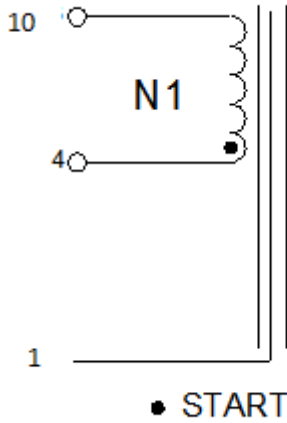


PCB Top



PCB Bottom

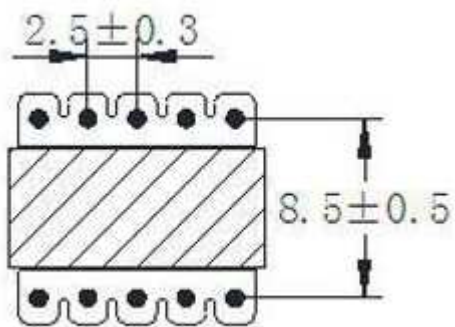
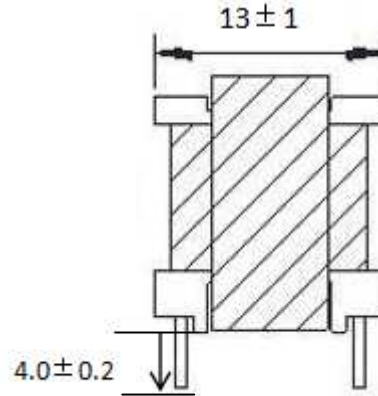
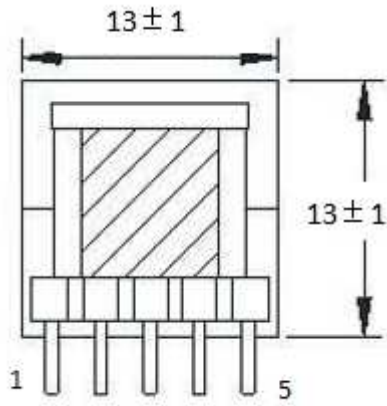
Transformer drawing



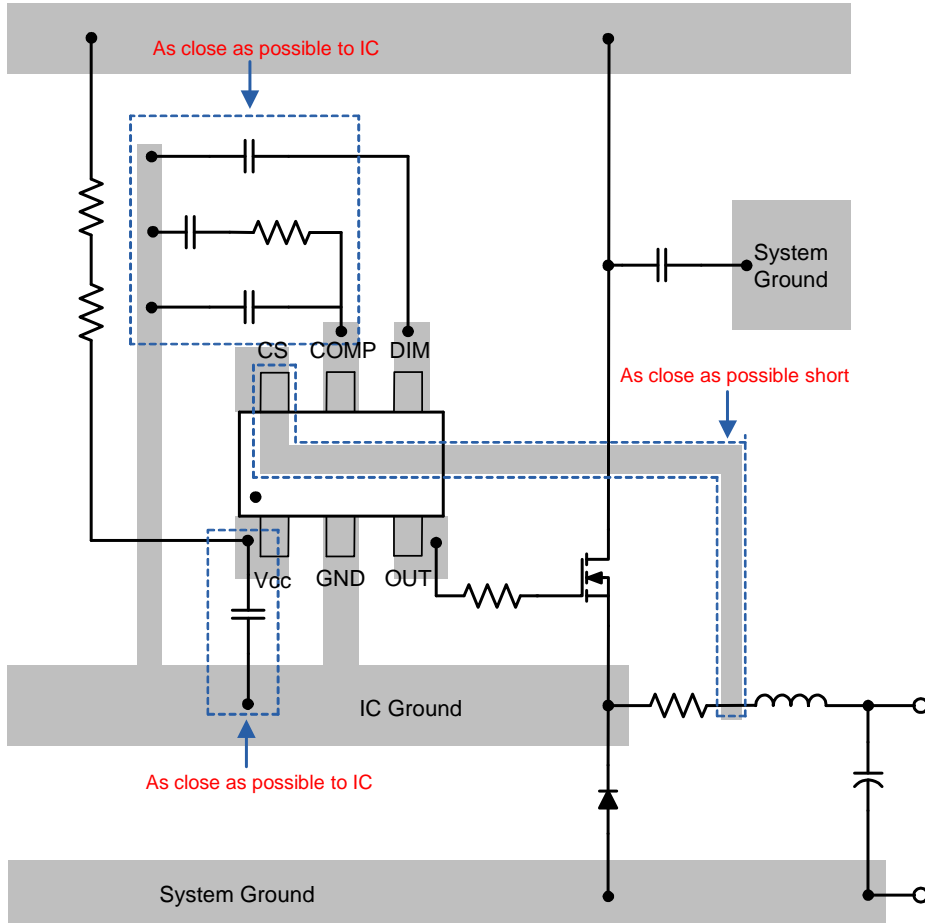
Electrical Specifications: Ta=25°C	
1.	Inductance(Lp)= 3.3mH ±7% @1KHz 0.25V
2.	Insulation resistance ≥100MΩ @DC500V
Voltage test:	
1.	AC200V 5mA 3SEC
2.	AC1000V 5mA 3SEC

No	Product Specifications	Type	Materials
1	Core	EE-13	PC40
2	Bobbin	EE-13 vertical	T375J
3	Magnet wires	0.2	UEW/U(MW75-C)
4	triple insulated wires		YH-B
5	Layer insulation tape	0.025*8	CT-280B
6	varnish		468-2(X)
7	Solder		LCD-D9800C

Transformer Bobbin Dimensions



PCB Layout Note



Recommend Application

Parameter	Specification
Input Voltage Range	90~265V _{AC} , 50/60Hz
Output Power	10W
Output Voltage	50V
Output Current	200mA
Power Factor	> 0.9
Efficiency	> 85%
Ambient Temperature	25 °C

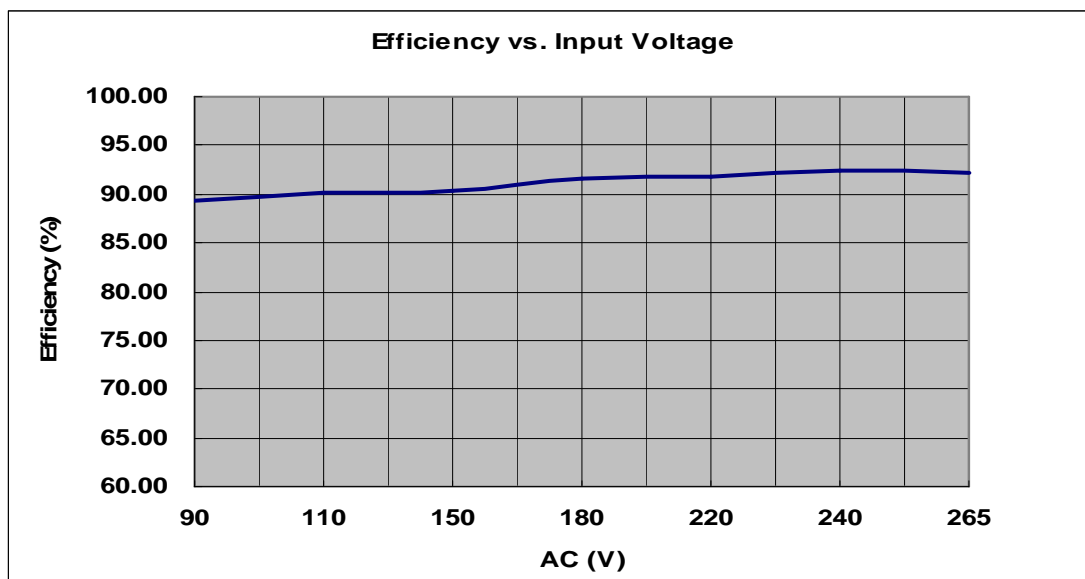
Test Results

Efficiency

Test condition

Input Voltage : 90V,110V,150V,180V,220V,240V,265V

AC	90V	110V	150V	180V	220V	240V	265V
Efficiency (%)	89.26	90.06	90.44	91.58	91.82	92.41	92.22



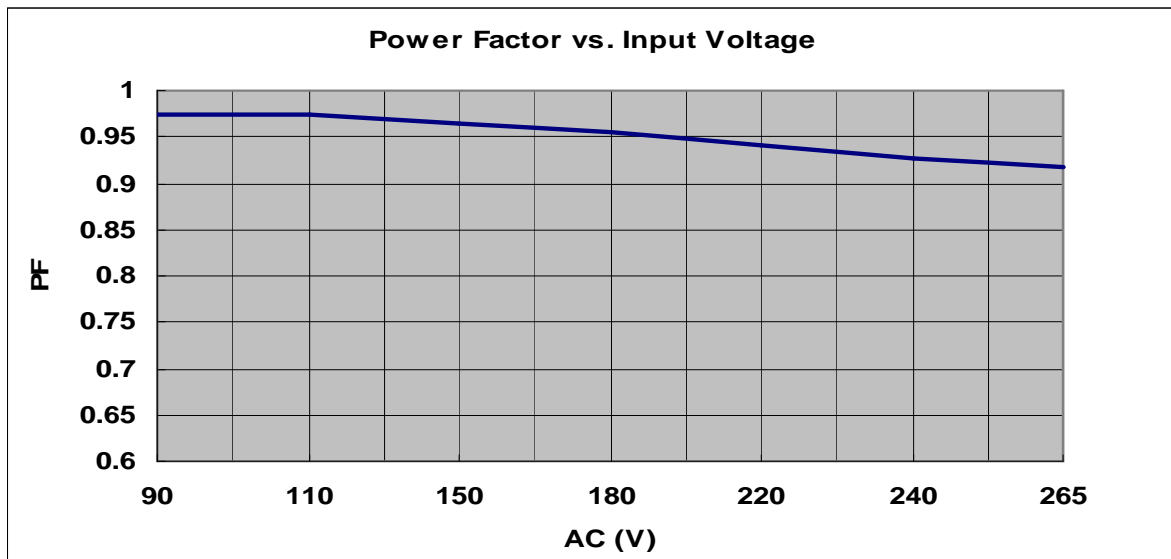


Power Factor

Test condition

Input Voltage : 90V,110V,150V,180V,220V,240V,265V

AC	90V	110V	150V	180V	220V	240V	265V
PF	0.974	0.975	0.964	0.955	0.942	0.928	0.917





Output Current

Test condition

Input Voltage : 90V,110V,150V,180V,220V,240V,265V

AC	90V	110V	150V	180V	220V	240V	265V
Io	200.3	200.9	201.4	201.5	201.7	201.7	201.7

