

## High Efficiency LED Buck Controller

### Features

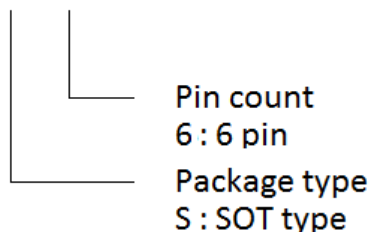
- Non-Isolation LED driver
- SOT-23-6 package
- Lower BOM Cost
- High Power Factor by One Cycle Control
- Lower THD Performance
- Accuracy Constant Current
- Linear Dimming on DIM Pin
- 45kHz of fixed Frequency Control
- Gate Output Voltage Clamp
- LED Open Protection (OVP) with auto recovery
- LED Short-Circuit Protection (SCP) with auto recovery
- Over Current Protection (OCP) with auto recovery
- Internal OTP Protection with auto recovery
- 300mA Driving Capability for GATE Pin

### Application

- E26/27, T8 LED Tube
- Others LED Lighting Applications

### Ordering information

ZA8606 – □ □



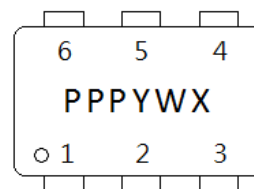
### Description

The ZA8606 is a non-isolation LED buck controller and integrated in SOT-23-6 package. It provides a simple circuit to get higher power factor, higher efficiency and accurate constant current; hence It can meet LED lighting requirements and reduce the cost of LED power supply. It has a 45kHz fixed frequency oscillator, an internal 200mV precision reference, and a PWM comparator with latching logic. The accurate output current is achieved by an averaging current feedback loop and the LED current dimming can be easily controlled via the Dim pin. The ZA8606 also has multiple features to protect the controller and system from fault conditions, including :

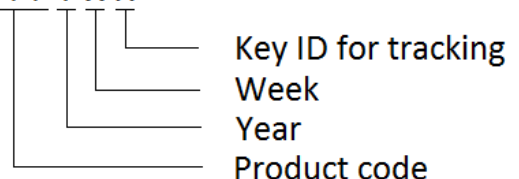
Under Voltage Lockout (UVLO), Over Current Protection (OCP) and Over Voltage Protection (OVP). Additionally, to ensure the system reliability, ZA8606 is built with the thermal protection function(OTP).

### Marking Information

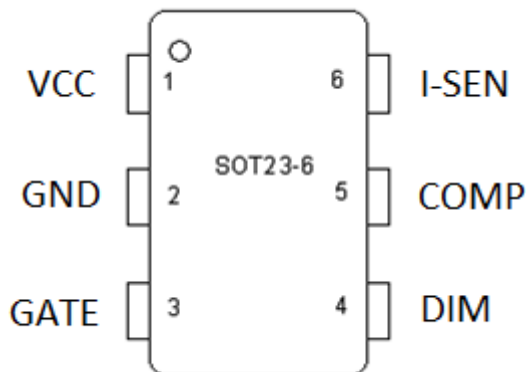
SOT-23-6



PPPYWX



## Pin Configuration (Top View)



## Absolute Maximum Ratings

Parameter	Value
Supply Voltage VCC	30V
DIM, COMP, I-SEN	-0.3 to 7V
GATE	30V
Junction Temperature	150°C
Operating Ambient Temperature	-20°C~85°C
Storage Temperature Range	-65°C~150 °C
SOT-23-6 Package Thermal Resistance (junction to ambient)	320°C/W
Power Dissipation (SOT-23-6, at ambient temperature = 85°C)	250mW
Lead Temperature (All Pb free packages, soldering, 10 sec)	260°C
ESD voltage protection, machine model	200V
ESD voltage protection, human body model	2KV

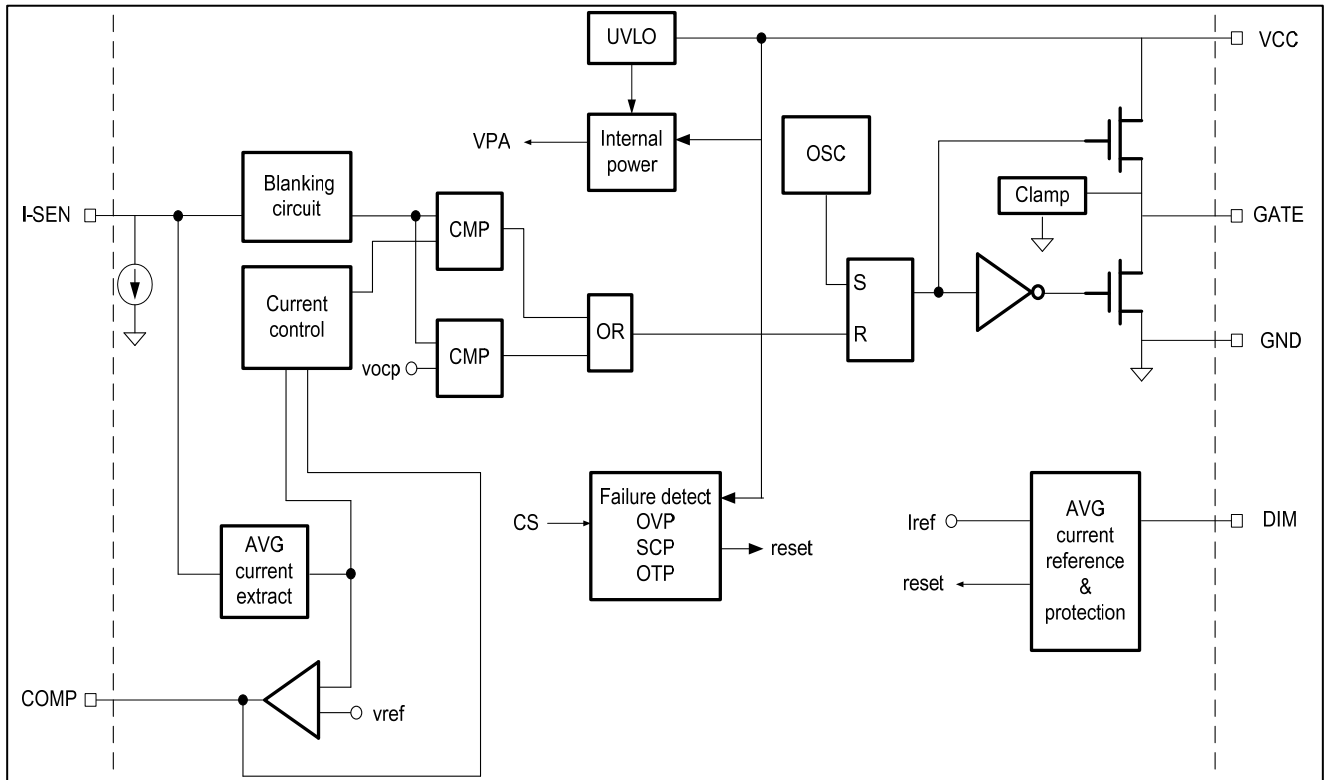
## Pin Description

Pin No.	Name	Function
1	VCC	Power Supply Pin
2	GND	Ground Pin
3	GATE	The Output Driver for Driving The External MOSFET
4	DIM	Dimming Control Pin by Input a DC Voltage
5	COMP	Feedback Compensation Network
6	I-SEN	Current Sense Pin, Connect to Sense The MOSFET Current

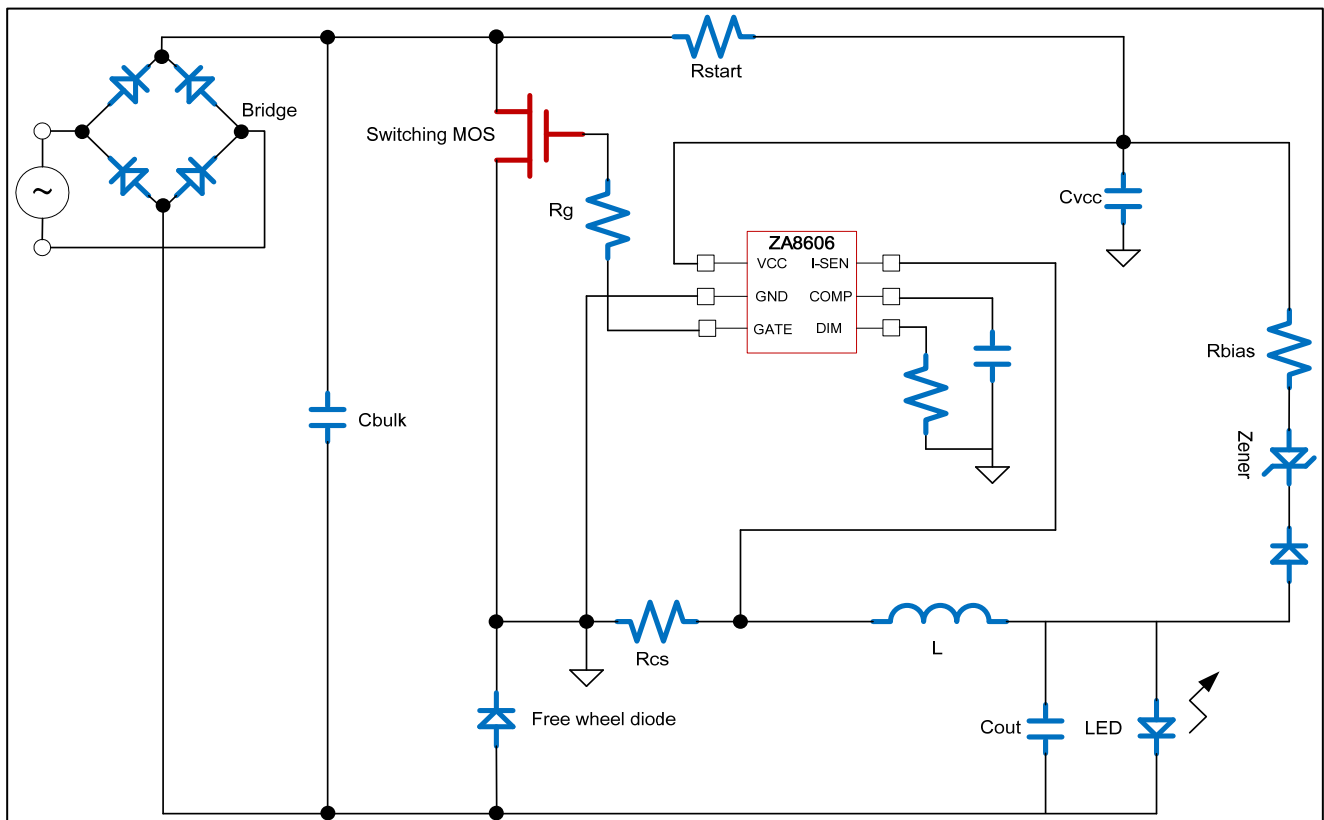
## Recommended Operating Condition

Symbol	Parameter	Min/Max	Unit
VCC	VCC Supply Voltage	12 to 29	V
TA	Operating Ambient Temperature	-20 to 85	°C

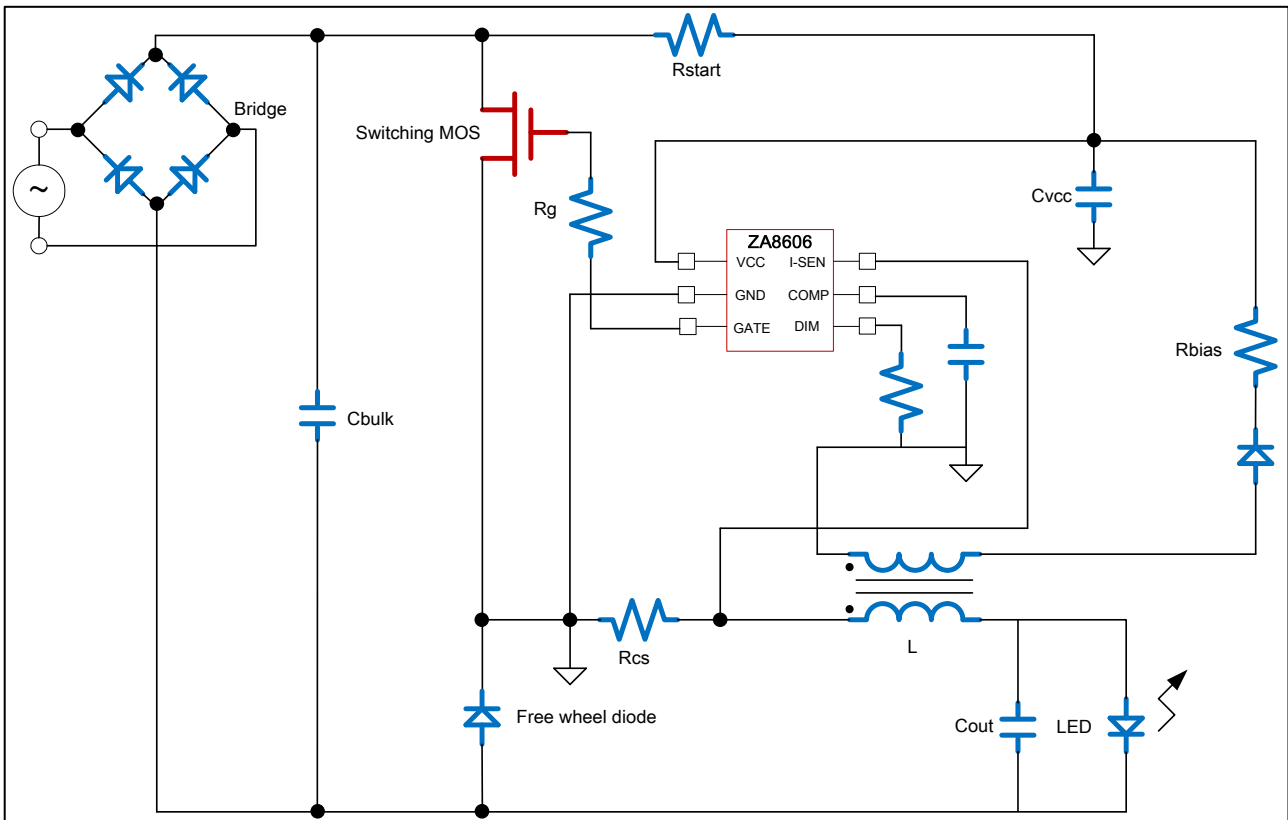
Function Block



Application Circuit (1) Vcc is from Zener diode



Application Circuit (2) Vcc is from Aux-winding



**Electrical Characteristics (VCC = 15.0V & TA = +25°C, unless otherwise specified.)**

Parameters	Pin	Min.	Typ.	Max.	Unit
<b>SUPPLY VOLTAGE</b>					
Startup Current (VCC=UVLO on -1V)	1		25	35	uA
Operating Current (with 1nF load on OUT pin)	1		2	3	mA
Operating Current (with 1nF load on OUT pin) The protection is triggered	1		1	1.5	mA
UVLO(off)	1		8		V
UVLO(on)	1		19		V
OVP Level on VCC Pin (ZA8606)	1	30	32	34	V
<b>VOLTAGE FEEDBACK</b>					
Output Sink Current	5		30		uA
Output Source Current	5		30		uA
<b>CURRENT SENSING</b>					
Feedback Reference Voltage	6	0.196	0.2	0.204	V
Over Current Protection Threshold	6	0.7	0.8	0.9	V
Leading-Edge Blanking Time	6		430		nS
<b>SWITCHING FREQUENCY</b>					
Switching Frequency	-	42	45	48	KHz
Maximum Duty	-	80	90		%
Frequency Jitter Range			+/-5		%
Temp. Stability (-40°C ~ 125°C)	-			6	%
Voltage Stability (VCC = 11V~25V)	-			1	%
<b>GATE DRIVER OUTPUT</b>					
Rising Time, Load Capacitance = 1000pF	3		200		nS
Falling Time, Load Capacitance = 1000pF	3		100		nS
VGATE-Clamp (VCC = 25V )	3			17	V
<b>DIM INPUT SECTION</b>					
Saturation Threshold Voltage	4	3			V
Linear Dimming Range	4	0.5		3	V
LED Current off Threshold Voltage	4		0.5		V
Current Source	4	270	300	330	uA
<b>OTP SECTION</b>					
OTP Trip Point	-		150		°C
Release temperature			70		°C
OTP De-bounce Time	-		40		uS

## Application Information

### Start-up

When the power supply is first powered from the mains outlet, the start-up current begins to charge up the VCC capacitor. When the voltage on this VCC capacitor reaches the  $UVLO_{(ON)}$  level (typically 19 V), at this time, the VCC capacitor only supplies the controller before VCC collapses below  $UVLO_{(OFF)}$ .

For quickly startup the LED driver, the start-up resistor should be chosen smaller resistor value to match with the startup capacitor, but it leads to bigger power loss in start-up resistor.

Once the power supply has been started, the VCC shall be constrained below 29 V, which is the maximum rating on VCC pin.

### Oscillator

The operating frequency of ZA8606 is fixed at 45kHz and the maximum duty-cycle is up to 90%. It has a wide output voltage range for LED lighting application.

### Gate Clamp/Soft Driving

In order to reduce EMI interference, ZA8606 is built in soft driving function. It helps designer save EMI components and cost. Driver output voltage is clamped to 17V by an internal clamping circuit to protect the power circuit.

### LEB (Leading-Edge Blanking)

A 430ns leading-edge blanking (LEB) time is included in I-SEN pin to prevent the false-trigger from the current spike. Hence, RC filter can be omitted. The current limit comparator is disabled and cannot turn off the external MOSFET during the blanking period.

### Over Current Protection

Cycle-by-Cycle current limiting is offered in ZA8606. The switch current is detected by a sense resistor into the sense pin,

when the current is larger than a OCP level, the gate output will keep on low level. When VCC is lower than  $UVLO_{(OFF)}$  level, the controller resets again. This OCP protection mode is auto-recovery type.

### Over Voltage Protection

It is implemented an OVP function on VCC Pin to protect LED power system. When the VCC voltage exceeds 32V due to abnormal conditions, PWM pulses are disabled until the VCC voltage drops below the  $UVLO$  threshold, then start again. This protection mode is auto-recovery. Over-voltage condition is usually caused by LED open.

### Over Temperature Protection Function

When the junction temperature of the IC exceeds approximately  $150^{\circ}\text{C}$ , the switching cycle is turned off until the junction temperature drops to or below approximately  $70^{\circ}\text{C}$ . ZA8606 will re-start again.

### Dimming Function

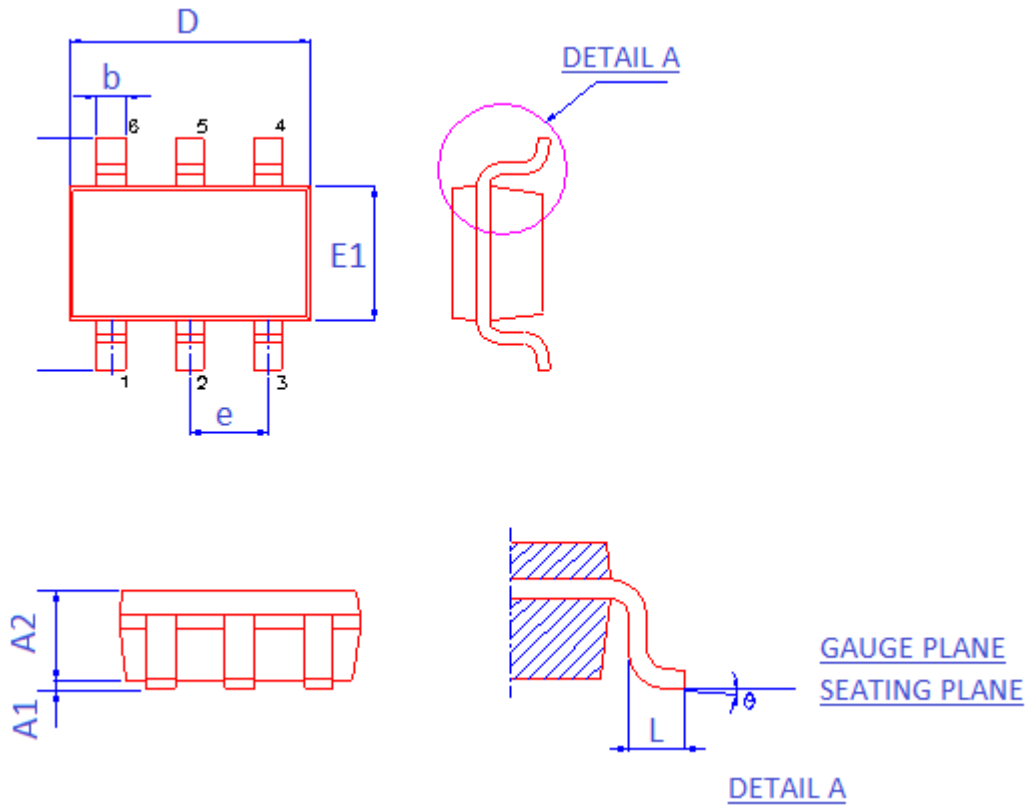
DIM pin provides multi-function including latch-off mode protection, linear Dimming function and normal operating area. In this DIM pin, there is one comparator for latch-off mode protection. While the voltage on this pin is lower than 0.5V, it will shut down. When the voltage is in the range of 0.5 to 3.0V, it is operating on the linear dimming range. While the voltage is higher than 3.0V, it operates on the normal status.

The application of DIM pin is as below:

1. Latch-off mode protection is less than 0.5V
2. The linear Dimming is between 0.5V and 3V.
3. The normal operating area is higher than 3.0V
4. User can open this Dimming Pin when the latch mode and the linear Dimming are not required

## Package Information

### SOT-23-6 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		
	Min.	NOM.	Max.
A	-	-	1.45
A1	0.000	-	0.15
A2	0.90	1.15	1.30
b	0.30	-	0.50
D	2.90 BSC		
E	2.80 BSC		
E1	1.60 BSC		
e	0.95 BSC		
L	0.30	0.46	0.60
$\theta$	0°	4°	8°