



## The primary side feedback single-stage active PFC constant current LED driver

### Description

D8063A is a single-stage, with the active power factor correction, high-precision primary side feedback LED constant current control IC, which can be applied to 85Vac-265Vac universal input voltage flyback isolated LED constant current power. D8063A integrates active power factor correction circuit, which can achieve high power factor and low total harmonic distortion. Due to operating in inductor current critical continuous mode, power MOS transistor is at zero current turn on condition, the switching loss can be reduced, while the utilization of transformer can be increased.

D8063A adopts proprietary current sampling mechanism, operating in primary side feedback mode, without secondary feedback circuit, achieve high precision constant current control. The system size and cost are optimized, as well as the system reliability.

D8063A utilizes advanced line voltage and load compensation method to achieve excellent line voltage and load regulation rate. And the line voltage compensation factor can also be tuned externally for flexibility.

D8063A offers rich protection functions to improve the system reliability, including LED open circuit protection, LED short circuit protection, VCC over voltage protection, VCC under voltage protection, CS resistor open protection and cycle by cycle current limit, etc. All the protection functions are auto-recovery.

### Feature

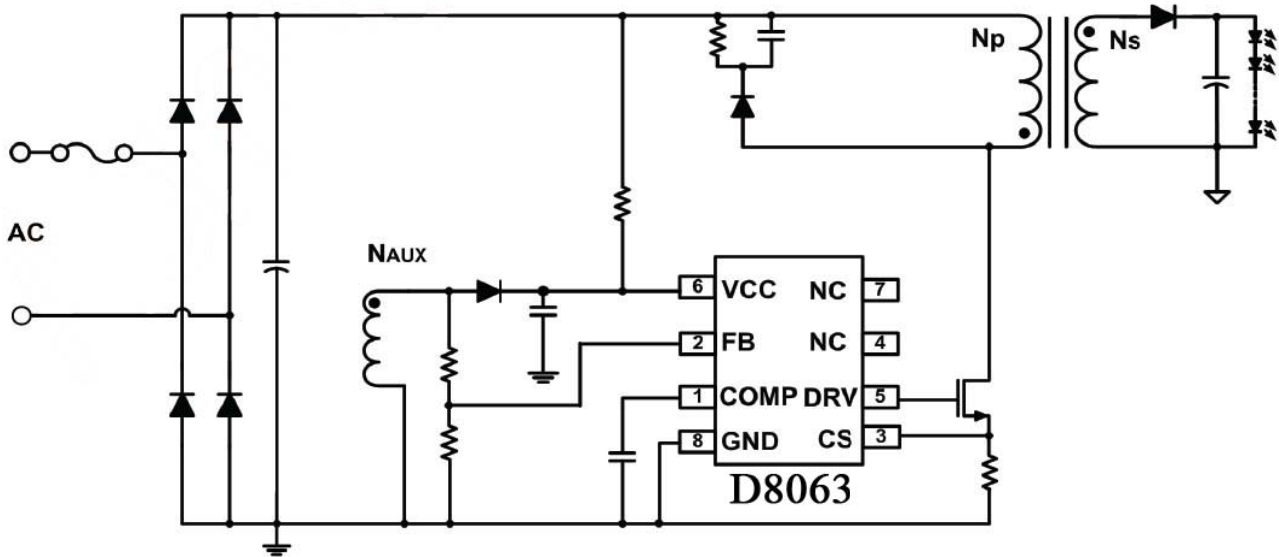
- Single-stage active high power factor correction, high PF value, and Low THD
- Primary side feedback constant current control, without secondary feedback circuit
- $\pm 3\%$  LED output current precision
- Excellent Line Voltage and Load Regulation rate
- Inductor current operate in critical conduction mode
- Ultra-Low (10uA) startup current
- FB feedback resistor is higher, and the power consumption is lower
- LED open and short circuit protection
- CS resistor open circuit protection
- Cycle-by-cycle current limit
- VCC over-voltage and under-voltage protection
- Auto fault recovery
- Available in SOP-8 package

### Applications

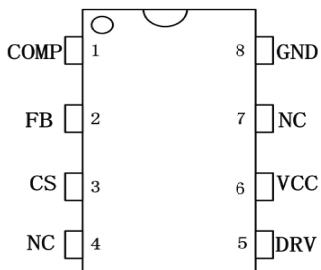
- GU10/E27 LED Bulb, Spot Light
- LED PAR30, PAR38 LED Light
- LED Tube Light
- Other LED Lighting



## Typical Application



## PIN Configuration



## PIN Definition

Pin No.	Name	Description
1	COMP	Loop Compensation Node
2	FB	Feedback signal feedback pin.
3	CS	Current sense Pin. Connect a resistor to GND.
4, 7	NC	Float
5	DRV	Connect this pin to the gate of external power MOSFET.
6	VCC	Power Supply Pin.
8	GND	Chip signal and power MOSFET ground.



## Absolute Maximum Ratings (note1)

Symbol	Parameters	Range	Units
V <sub>CC</sub>	VCC pin input voltage	-0.3~35	V
I <sub>CC_MAX</sub>	VCC pin maximum clamp current	5	mA
COMP	Compensation pin in loop circuit	-0.3~6	V
FB	Auxiliary winding feedback pin	-0.3~6	V
CS	Current sense pin input voltage	-0.3~6	V
DRV	External MOSFET gate driver pin voltage	-0.3~25	V
P <sub>DMAX</sub>	Power dissipation (note2)	0.45	W
θ <sub>JA</sub>	PN Thermal resistance (Junction to Ambient)	145	°C/W
T <sub>J</sub>	Operating junction temperature	-40 to 150	°C
T <sub>STG</sub>	Storage temperature range	-55 to 150	°C
	ESD	2	KV

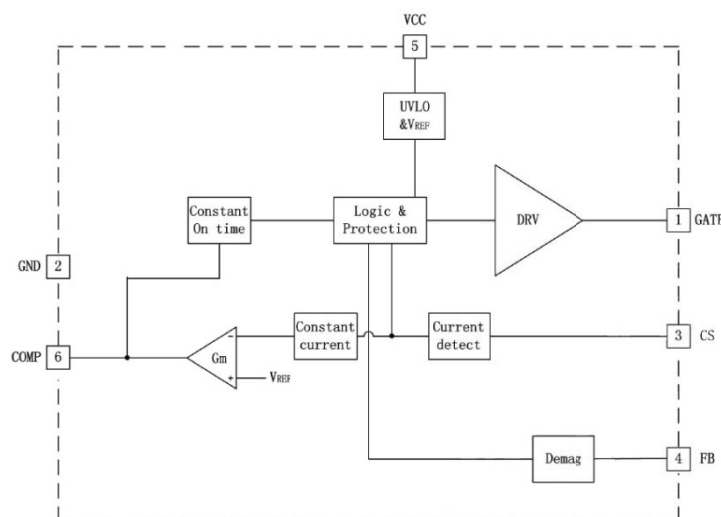
Note 1: Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. Under “recommended operating conditions” the device operation is assured, but some particular parameter may not be achieved. The electrical characteristics table defines the operation range of the device, the electrical characteristics is assured on DC and AC voltage by test program. For the parameters without minimum and maximum value in the EC table, the typical value defines the operation range, the accuracy is not guaranteed by spec. value in the EC table, the typical value defines the operation range, the accuracy is not guaranteed by spec.

Note 2: The maximum power dissipation decrease if temperature rise, it is decided by T<sub>JMAX</sub>, θ<sub>JA</sub>, and environment temperature (T<sub>A</sub>). The maximum power dissipation is the lower one between P<sub>DMAX</sub> = (T<sub>JMAX</sub> - T<sub>A</sub>) / θ<sub>JA</sub> and the number listed in the maximum table.

## Recommended Operating Conditions

Symbol	Parameter	Range	Unit
V <sub>CC</sub>	Power supply voltage	8.5~18	V

## Internal Block Diagram





## Electrical Characteristics

(Notes 4, 5) (Unless otherwise specified, VCC=15V and TA =25°C)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
<b>Supply Voltage Section</b>						
V <sub>CC_CLAMP</sub>	V <sub>CC</sub> Clamp Voltage			23		V
V <sub>CC_ON</sub>	V <sub>CC</sub> Turn On Threshold	V <sub>CC</sub> Rising		16.7		V
V <sub>CC_UVLO</sub>	V <sub>CC</sub> Turn Off Threshold	V <sub>CC</sub> Falling		7.5		V
V <sub>CC_OVP</sub>	V <sub>CC</sub> Over Voltage Protection threshold			19		V
I <sub>CC_UVLO</sub>	V <sub>CC</sub> Startup Current	V <sub>CC</sub> Rising V <sub>CC</sub> = V <sub>CC_ON</sub> - 1V		33	50	uA
I <sub>CC</sub>	V <sub>CC</sub> Operating Current	Fop =10KHz Load=100pF		0.5		mA
<b>FB Feedback Section</b>						
V <sub>FB_FALL</sub>	FB Drop threshold voltage	FB Drop		0.1		V
V <sub>FB_HYS</sub>	FB 迟滞电压	FB Rising		0.08		V
V <sub>FB_OVP</sub>	FB Over Voltage Protection threshold			1.6		V
T <sub>ON_MAX</sub>	Maximum On Time			25		us
T <sub>OFF_MIN</sub>	Minimum Off Time			4.5		us
T <sub>OFF_MAX</sub>	Maximum Off Time			100		us
<b>Current Sense Section</b>						
V <sub>CS_LIMT</sub>	CS Peak Voltage Limitation			1		V
T <sub>LEB_CS</sub>	Leading Edge Blanking Time			350		ns
T <sub>DELAY</sub>	Turn off Delay Time			200		ns
<b>Compensation Section</b>						
V <sub>REF</sub>	Internal Reference Voltage		0.194	0.200	0.206	V
V <sub>COMP_LO</sub>	COMP Low Clamp Voltage			1.5		V
V <sub>COMP</sub>	COMP Linear Operating Voltage Range		1.5		3.5	V
V <sub>COMP_OVP</sub>	COMP Protection Threshold			3.6		V
<b>Driver Section</b>						
I <sub>SOURCE_MAX</sub>	GATE pin Maximum Drive pull-up Current		200			mA
I <sub>SINK_MAX</sub>	GATE pin Maximum Pull-down Current		600			mA
<b>Thermal Regulation Section</b>						
T <sub>REG</sub>	Thermal Regulation		150			°C



	Temperature					
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**Note 4:** production testing of the chip is performed at 25°C.

**Note 5:** the maximum and minimum parameters specified are guaranteed by test, the typical value are guaranteed by design, characterization and statistical analysis

## Application Information

D8063A is a primary-side feedback single stage active power factor correction controller for constant current LED lighting; Operating in inductor current critical conduction mode, the controller achieves high power factor, low total harmonic distortion and high efficiency.

### 1. Start Up

After system powered up, the bus voltage is charged up by the  $V_{CC}$  pin capacitor the startup resistor. When the  $V_{CC}$  pin voltage reaches the turn on threshold, the internal circuits start operating. The COMP pin voltage is pulled up to 1.5V quickly, and then the D8063A starts output pulse signal. The system operates at 10 kHz frequency at the beginning, the COMP voltage rises up gradually from 1.5V, and the transformer primary peak current also rises up. The LED current hence achieves a soft start, and prevent output current overshoot. After the output voltage is built up, the  $V_{CC}$  voltage is supplied by the auxiliary winding, thus the power consumption of the system can be lower.

### 2. Constant Current Control, Output Current Setting

D8063A adopts proprietary current sensing mechanism. It operates in primary side feedback mode, without secondary feedback circuit, achieve to control the high precision constant current output.

The current in LED can be calculated by the equation:

$$I_{out} = \frac{V_{ref}}{2 \times R_{cs}} \cdot \frac{N_p}{N_s}$$

$V_{REF}$ : Internal reference voltage

$N_p$ : Primary winding turns of transformer

$N_s$ : Secondary winding turns of transformer

$R_{cs}$ : The current sensing resistor value

### 3. Feedback Network

D8063A senses the output current zero crossing information through the feedback network, FB the threshold voltage is set at 0.1V, and the hysteresis voltage is 0.08V. The FB pin is also used to detect output over voltage protect (OVP), the threshold voltage is 1.6V.

FB upper / lower divide resistor to can be set as:

$$\frac{R_{FBL}}{R_{FBL} + R_{FBH}} = \frac{1.6V}{V_{OVP\_FB}} \times \frac{N_s}{N_A}$$

$R_{FBL}$ : The lower divide resistor of the feedback network

$R_{FBH}$ : The upper divide resistor of the feedback network

$V_{OVP\_FB}$ : Output over voltage setting point

$N_s$ : Secondary winding turns of transformer

$N_A$ : Auxiliary winding turns of transformer



The FB upper resistor can be set to around 300K $\Omega$  to improve the system efficiency. It is also used for fine tuning the LED current line voltage compensation.

#### 4. Over temperature adjustment function

D8063AA has the function of over temperature adjustment, the output current is gradually reduced when the driving power is over heat, to control the output power and temperature rise, so the power supply temperature is maintained at the set value, so as to improve the system reliability. Chip internal setting temperature is 150°C.

#### 5. Protection Functions

D8063A offers rich protection functions to improve the system reliability

When the LED is open circuit, the output voltage will gradually rise up,  $V_{CC}$  voltage rises up with it. When  $V_{CC}$  rise up to 19V OVP threshold value, will trigger the logic protection and stop driver operating. If there is an accident, the  $V_{CC}$  voltage will continue to rise, the chip has a clamp circuit, the  $V_{CC}$  voltage limit in 23V, so as to improve the reliability of the system.

When the LED is shorted circuit, the system operates at low frequency of 10KHZ. The output voltage is too low and the auxiliary winding cannot charge the  $V_{CC}$ . So the  $V_{CC}$  voltage will gradually decrease and finally reaches the UVLO threshold.

After the system enters into fault condition, the  $V_{CC}$  voltage will decrease until it reaches UVLO threshold, then the system will re-start again. If the fault condition is removed, the system will resume normal operation.

When the output is short circuit or the transformer is saturated, the CS peak voltage will be relatively high. When CS voltage reaches the internal limitation (1V), the power MOSFET will be turned off instantaneously. This cycle by cycle current limitation can help protecting the power MOSFET, the transformer and the output rectifying diode.

#### 6. PCB Layouts

The following guidelines should be followed in D8063A PCB layout:

##### Bypass Capacitor

The bypass capacitor on  $V_{CC}$  pin should be as close as possible to the  $V_{CC}$  and GND pins.

##### Ground wire

The power ground path for current sense resistor should be wide, and it should be as close as possible to the IC ground (Pin 8), to ensure the current sampling, otherwise the LED output current accuracy maybe affected. The IC signal ground should be connected to the IC GND pin separate.

##### The Area of Power Loop

The area of main current loop should be as small as possible to reduce EMI radiation, such as the transformer primary, MOSFET and absorb network of the loop area, and the transformer secondary, secondary diode, output capacitance loop area, to reduce EMI radiation.

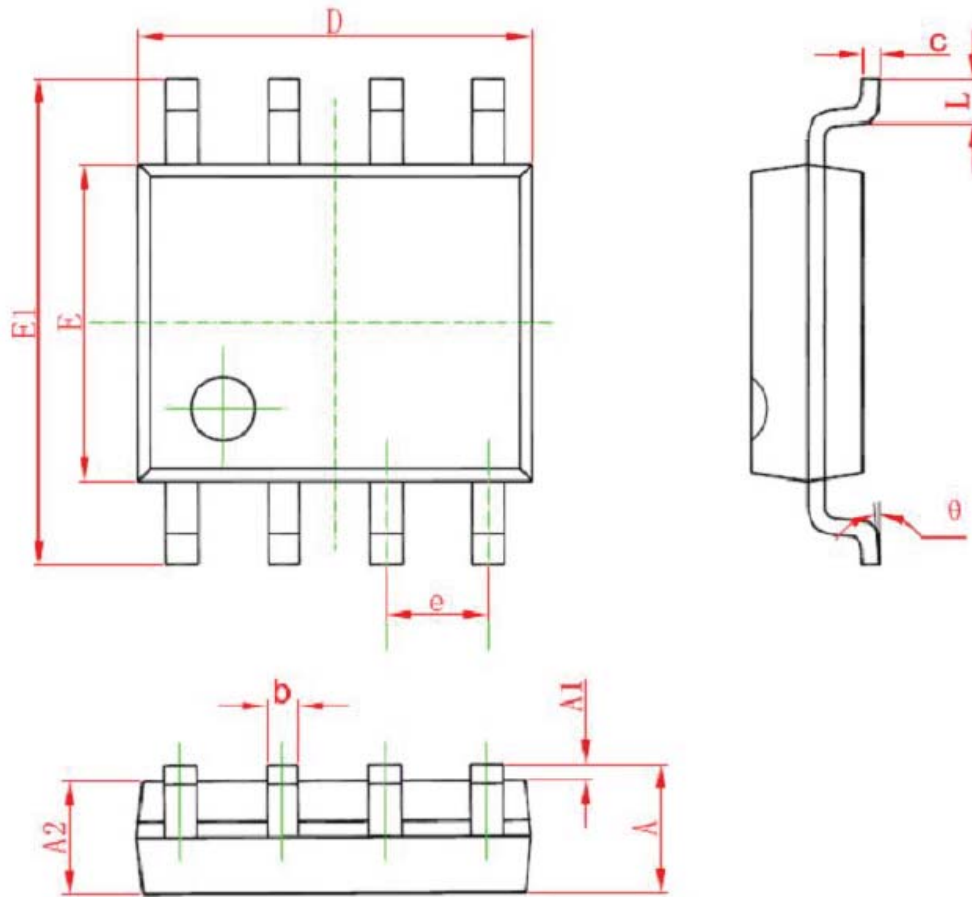
##### FB Pin

The feedback divider resistor should be as close as possible to the FB pin, and the trace must keeps away from dynamic node of the transformer, otherwise the FB pin OVP function might have risk to be mis-triggered by the system noise.



## Package Dimensions

### SOP-8



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	0.020
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°



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2015-12-09	A0_J	/	Jasper	/	Active