



Primary Side Feedback Single-stage Active PFC LED Driver IC

Description

D8061A 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. This controller 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 MOSFET is at zero current turn on condition, the switching loss can be reduced, while the utilization of transformer can be increased.

D8061A uses a proprietary current sampling system with the primary feedback mode, which can achieve high precision output constant current control without secondary feedback circuit, so it can not only save the cost and bulk, but also improve the system reliability. In order to achieve the low loss of primary side driver and the ultrafast power system and LED start-up, the IC uses the especial sourced driving technology and an internal rapid charge circuit.

D8061A use the especial linear voltage compensation technology and load voltage compensation technology, which can achieve excellent linear voltage regulation and load voltage regulation. Moreover, linear voltage compensation factor can also be flexible adjustment of the external device.

D8061A has multi-protection functions, to increase the system reliability. It concludes open circuit protection, short circuit protection, over voltage protection, under voltage protection, open circuit protection, short circuit protection of current sampling resistor, by-cycle current limiting, and over temperature protection. All protection status has the automatic restart function.

Features

- Single stage, active power factor correction, high PF value, low THD
- Primary feedback constant current control, no need secondly feedback circuit
- LED start-up ultrafast (<200ms @85Vac)
- $\pm 3\%$ LED output constant current precision
- Excellent linear voltage adjust rate and load voltage adjust rate
- Inductance current critical continue mode
- Source drive mode
- Very low (20uA) start up current
- Very low (600uA) operating current
- FB feedback resistance value is high, low power
- LED short / open circuit protection
- Current samples collect resistance short / open protect
- Transformer saturation protect
- By-cycle primary side current limiting
- IC provide voltage over / under voltage protect
- Over temperature protection
- Automatic restart function
- Available in SOP-8 package

Application

- GU10 / E27 LED bulb lamp, searchlight
- LED PAR30, PAR38 lamp
- LED day light lamp
- Others LED light



Typical Application

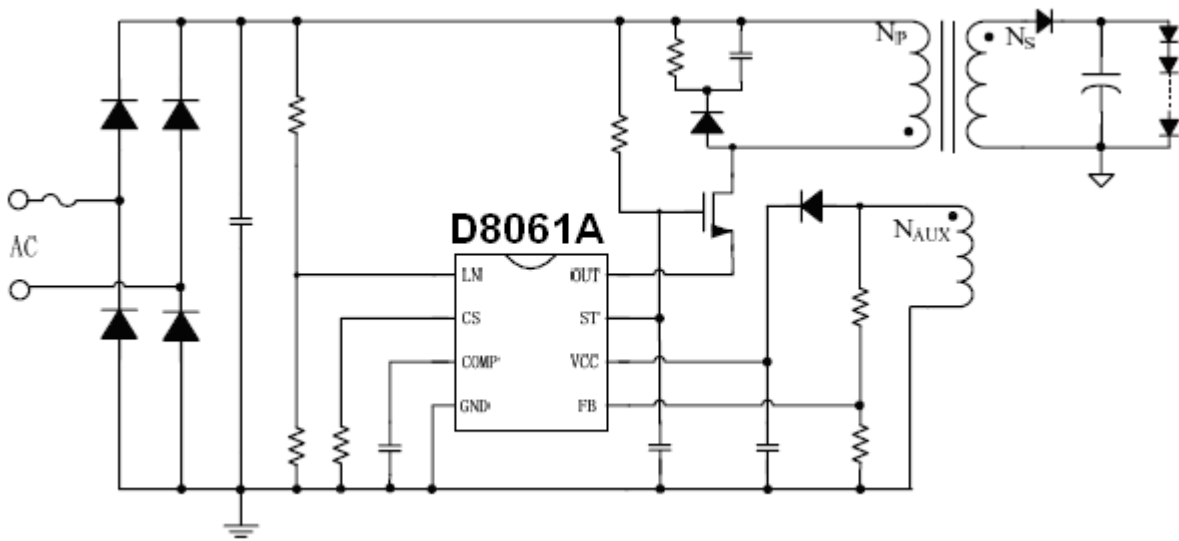


Figure1 D8061A typical application figure

Pins Configuration

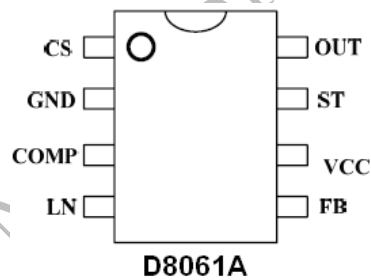


Figure 2 pins figure

Pin Definition

Pin NO.	Pin name	Description
1	CS	Current samples collect, collecting resistance connect to CS and GND
2	GND	IC ground
3	COMP	Loop compensate point
4	LN	Linear voltage sample collect input pin
5	FB	Auxiliary winding feedback pin
6	VCC	IC power supply
7	ST	IC start up pin. In application, it connect with outside power MOSFET gate
8	OUT	Pulse output pin, connect the outside power MOSFET source



Absolute Maximum Ratings (note 1)

Symbol	Parameter	Range	Unit
V _{CC}	Power voltage	-0.3 to 22	V
CS	Current sample collect point	-0.3 to 6	V
COMP	Loop compensation point	-0.3 to 6	V
LN	Linear voltage sample collect input point	-0.3 to 6	
FB	Auxiliary winding feedback point	-0.3 to 6	
I _{ST_MAS}	ST pin max power current	5	Ma
OUT	Outside power MOS drive point	-0.3 to 18	V
I _{OUT}	Inside drive power MOS max operating current	3	A
P _{DMAX}	Power waste (note 2)	0.45	W
θ _{JA}	PN junction to the environment hot resistance	145	°C/W
T _J	Operating junction temperature range	-40 to 150	°C
T _{STG}	Conservation temperature range	-55 to 150	°C
	ESD (note 3)	2000	V

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.

Note 2: The maximum power dissipation decrease if temperature rise, it is decided by T_{JMAX} , θ_{JA} , and environment temperature (T_A). The maximum power dissipation is the lower one between $P_{DMAX} = (T_{JMAX} - T_A) / \theta_{JA}$ and the number listed in the maximum table.

Note 3, Human mode 100pF capacitance electric 1.5KΩ resistance releasing the electricity.

Recommended Operating Range

Symbol	Parameter	Range	Unit
V _{CC}	Power supply	8-18	V

Electrical Characteristics (notes 4 , 5)

(V_{CC}=14V, T_A=25°C , unless otherwise specified)

Symbol	Parameter description	Condition	Min	Type	Max	Unit
Start-up voltage						
V _{ST_ON}	V _{ST} start-up current	1mA, V _{CC} =10V	16	17	18	V
V _{ST_HYS}	V _{ST} the hysteresis voltage	V _{CC} =14V		2		V
I _{ST_ON}	ST start up current	V _{CC} =10V		20	35	uA
I _{ST_OP}	ST operating current	V _{CC} =14V		35	60	uA
Power voltage						
V _{CC_ON}	V _{CC} start up voltage	V _{CC} up	10	11	12	V



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V _{CC_UVLO}	V _{CC} under voltage protect threshold	V _{CC} down	5.5	6.0	6.5	V
V _{CC_HOLD}	keep up the voltage	V _{CC} down	7	7.5	8	V
I _{CC_UVLO}	V _{CC} shutdown current	V _{CC} up, V _{CC} = 10V		40	70	uA
I _Q	V _{CC} static current	No any switch action V _{CC} =14V		320	600	uA
I _{CC}	V _{CC} typical operation current	F _{op} =60kHz		600		uA
V _{CC_OVP}	V _{CC} over voltage protection threshold			20		V
FB feedback						
V _{FB_FALL}	FB decrease threshold	FB drop		0.4		V
V _{FB_HYS}	FB hysteresis voltage	FB rise		0.6		V
V _{FB_OVP}	FB over voltage protect threshold			5.5		V
T _{OFF_MIN}	Min shut off time			4.0		us
T _{OFF_MAX}	Max shut off time			150		us
Current sampling						
T _{LEB_CS}	Current sampling, the time to leading edge blanking			350		ns
T _{DELAY}	IC shut off the delay			180		ns
Loop circuit compensation						
V _{REF}	Internal reference voltage		0.295	0.300	0.305	V
V _{COMP_LO}	Clamp voltage of COMP			1.5		V
V _{COMP}	COMP linear voltage range		1.5		3.5	V
V _{COMP_OVP}	Output short, COMP check threshold			4.5		V
Linear voltage sampling						
V _{LN}	LN linear operating range		0		2.5	V
Driver						
R _{DS_ON}	Internal drive MOSFET electric resistance	V _{CC} =14V				mΩ
Over temperature protect						
T _{SD}	Over temperature shut off temperature			150		°C



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T_{SD_HYS}	Over temperature protect delay			30		°C
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Note 4, type parameter value is test in 25°C,

Note 5, the maximum and minimum in the spec are confirmed by the test. The type value is confirmed by the design, test and statistical analyses.

Internal Structure Diagram

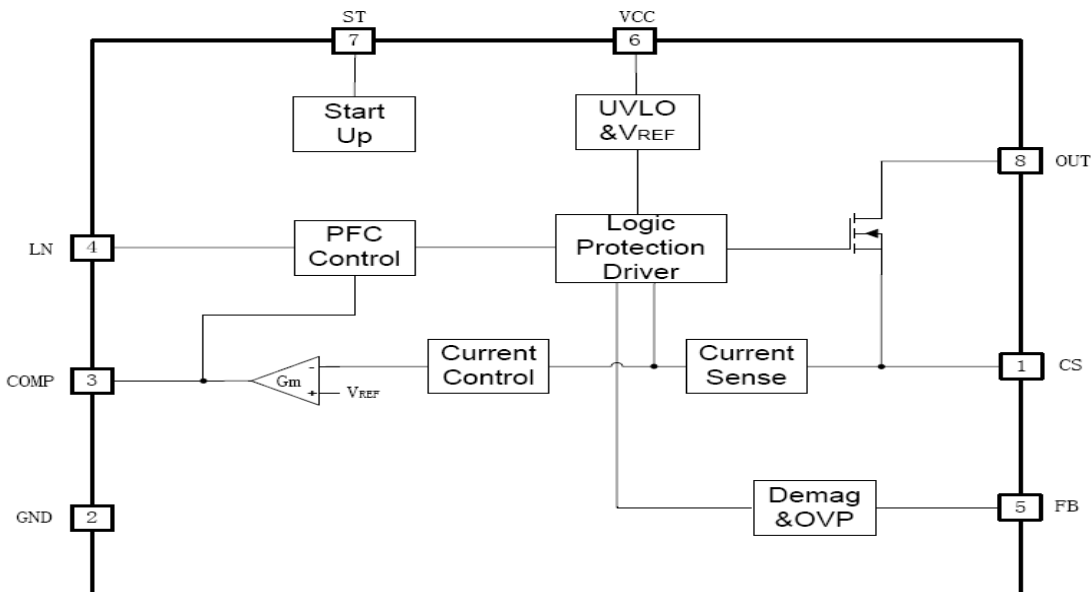


Figure3 D8061A Internal Structure Diagram

Application information

D8061A is a high precision primary feedback, single stage, with a active power factor correction, and LED constant current control IC. Since it operates at the inductance current critical continue mode, the IC can operate at a very high power factor and very low total harmonic distortion and high efficiency.

1, start-up

After power the system, generatrix voltage charge the ST pin inductance by the start up resistor. And the V_{CC} voltage follows up the ST pin voltage to rise. D8061A use the source drive and especial internal charge circuit. And V_{CC} voltage can electrify fast, when the system do not loss any frequency.

After the V_{CC} rise to make the start up threshold voltage, D8061A begin to output pulse signal. And internal charge circuit will be shut off. Auxiliary winding resistor suppls the power to the V_{CC} . When the system just begins to operate at 7 KHz switch frequency, the LED will begin the soft start up, to prevent the current overshoot. At 85Vac condition, even if use the 1 MΩ start up resistance, it need 200ms from system electrify to LED electrify.

In the normal operating time, if connect output pin's LED quantity is too less to make the output voltage very low, it will make the auxiliary winding can not supply the V_{CC} . And then, V_{CC} will level off at about 10V. This function make the system have a large range in LED used quantity and operating in



normal.

2, constant current control, output current set up

D8061A use a special current sampling mechanism. It operates in primary feedback mode. It do not need any secondly feedback circuit. And it can output a high precision constant current control.

LED output current calculator method

$$I_{OUT} \approx \frac{V_{REF}}{2 \times R_{CS}} \times \frac{NP}{NS}$$

VREF is an internal reference voltage.

NP is the number of turn of the transformer main winding.

NS is the number of turn of the transformer secondly winding.

3, feedback

D8061A use the FB to feedback the output current zero state. FB falling threshold voltage set up at 0.4V. And the hysteresis voltage is 0.6V. FB pin can be used in detecting over voltage protection (OVP). And the threshold value is 5.5V. The proportion of FB upper and lower divider resistor can be set up as follows:

$$\frac{R_{BL}}{R_{FBL} + R_{FBH}} = \frac{5.5V}{V_{OVP}} \times \frac{NS}{NA}$$

RFBL is upper and lower divider resistor of feedback network

VOVP is the set point of output over voltage protection.

NS is the number of turn of the transformer secondly winding.

NA is the number of turn of the transformer auxiliary winding.

For increase the system efficiency, FB upper and lower divider resistance can set up at about 300KΩ. And change this resistance, it can tiny adjust the linear voltage compensate to the LED output current.

4, protection function

D8061A has multi protection function to increase the system reliability. When the VCC voltage rise to 20V OVP threshold, and when the LED open, it will protect the logic and lock. And then, the system will be stopping the switch.

When the LED short, system operate at low frequency at 7KHz. So, the power is very low. And COMP pin voltage begins to increase, when it arrive 4.5V, it will be protect logic and lock. And then, the system stop switch. When the singularity condition happens, such as CS sampling resistance short, or transformer is saturation, IC detect the circuit fast, trigger the protect logic and lock out. And the system stops the switch operating in the same time.

D8061A over temperature protect check the IC junction temperature. When the junction temperature is more then 150°C threshold value, it will trigger the protect logic and lock, and the system will stop the switch operatng. After the junction temperature reduce 30°C, outside power MOSFET can back to operating.

When the system get into the protect state, VCC voltage will begin to reduce. When VCC arrive the under voltage threshold value, system will be reboot. And the system will continue to detect the loading state. Such as trouble shooting, system will begin to operating normal.



5, PCB design

When design the D8061A PCB board, need take care as below.

Bypass capacitor.

ST and VCC pin's bypass capacitor need close its IC pin.

Ground wire.

The power ground wire of the current sampling resistance need short (distance). And it need connect to the generatrix capacitor ground with IC ground wire and others small signal's ground.

Power loop area

Reduce the big current loop area, such as transformer main grade, power MOSFET, absorption of network loop area, transformer secondly grade, secondly diode, output capacitor loop area. It can reduce the EMI radiation.

FB pin

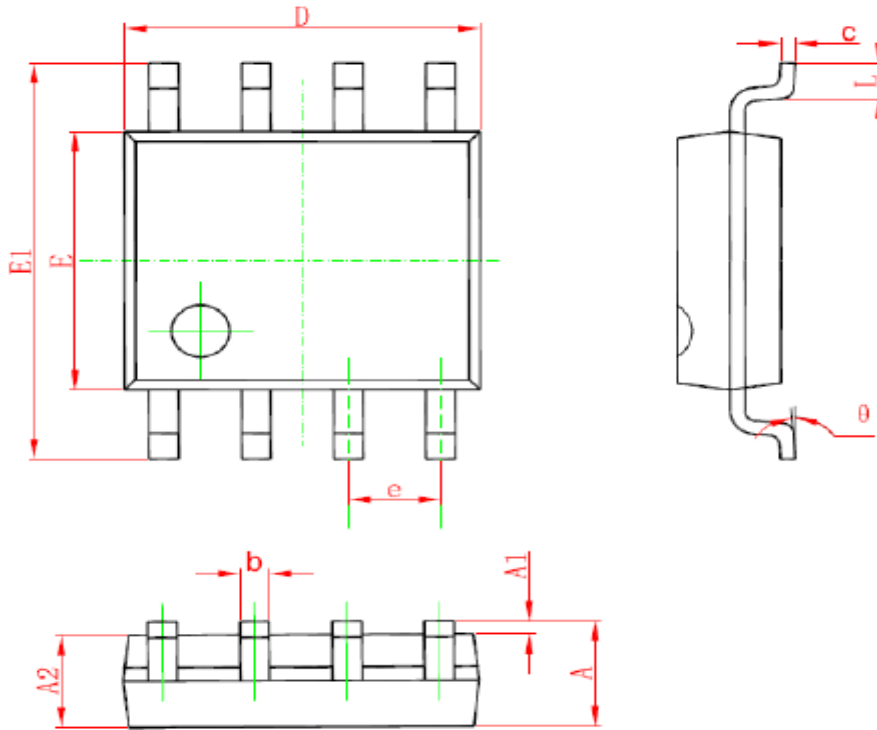
The divider resistance connecting FB, it must close to the FB pin. And the junction must far away from the point of the transformer.



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Physical 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	0.010
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°C	8°C	0°C	8°C



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日期 Date	版本 Version	说明 Description	排版 Typesetting	工程师 Engineer	状态 Status
2012-10-15	A0		W		Stop
2014-4-12	A1		E	林剑波	Stop
2015-2-5	A2-J	/	Jasper	/	Active