Non-isolated Buck Type LED Driver

Description

D8078C is a high-precision buck type LED constant current IC, with the active power factor correction, which can be applied to 85Vac-265Vac universal input voltage non-isolated bulk type LED constant current power. D8078C integrate active power factor correct circuit, can achieve very high power factor and very low total harmonic distortion. Due to it operates in critical continuous mode of inductor current, the MOSFET is at zero current turn on station, the switch loss reduce, while the utilization rate of inductance is also higher.

D8078C internal integrated 500V power MOSFET, only a few peripheral devices are needed to achieve excellent constant current characteristics.

D8078C is sampling for inductor current in full cycle, to achieve high precision output constant current control, and excellent line voltage regulation and load regulation.

D8078C integrated multiple protection function to strengthen system reliability, including LED open circuit protection, LED short circuit protection, IC under voltage protection, current sampling resistor open circuit protection and cycle by cycle current limited, and so on. All the protection station is with automatic restart function. And, D8078C is with over heat regulation function, to reduce the output current when the driver power is too hot, to improve the reliability of the system.

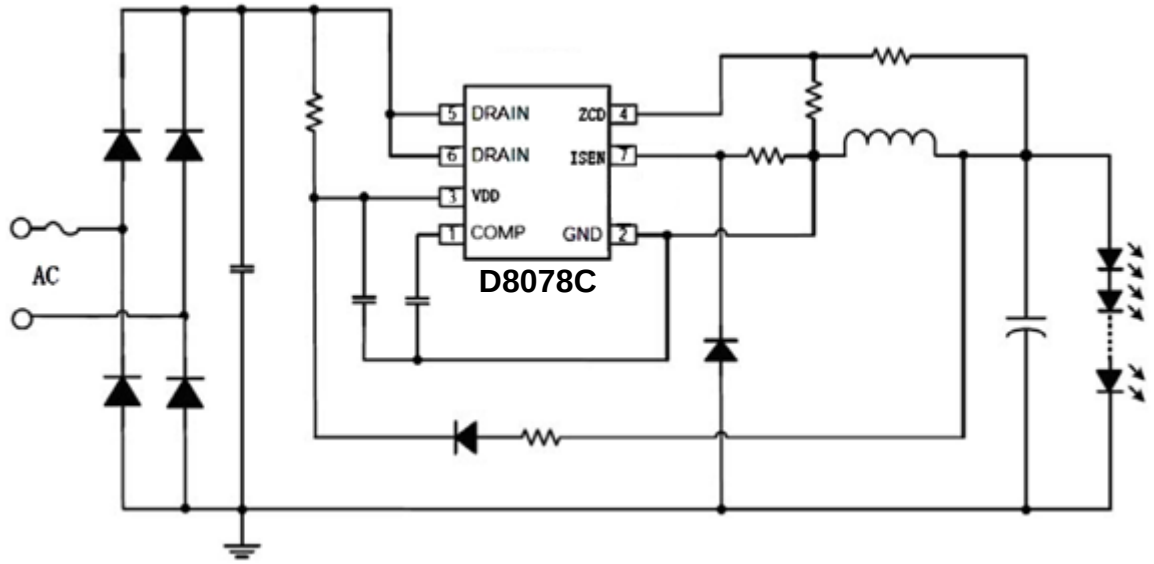
Feature

- Single stage, with active power factor correct, high PF, low THD
- Internal 500V power MOSFET
- ±3% LED output current precision
- Excellent line voltage regulation rate and loading regulation rate
- Critical continuous mode of inductor current
- Ultra low (33uA) start-up current
- System efficiency of up to 95%
- Ultra low (300uA) operating current
- LED open circuit / short circuit protection
- Open circuit protection for current sampling resistor
- Cycle by cycle current limiting
- Chip supply over voltage / under voltage protection
- Automatic reboot function
- Overheat regulation function
- SOP-7 package

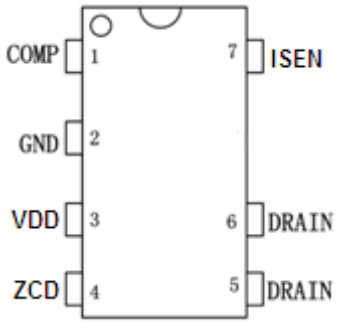
Application

- LED driving power

Typical Application



PIN Configuration



Pin Definition

Pin No.	Name	Description
1	COMP	Loop compensation point.
2	GND	Ground.
3	VDD	Power supply.
4	ZCD	Zero crossing detection, and over-voltage protection
5,6	DRAIN	Internal power MOSFET Drain drive.
7	ISEN	Current sampling pin, connected with the sampling resistor to ground.

Absolute Maximum Ratings(Note1)

Symbol	Range	Units
V_{DRAIN} TO GND	-0.3~500	V
ISEN TO GND	-0.3~6	V
COMP TO GND	-0.3~6	V
ZCD TO GND	-0.3~6	V
VDD maximum current	10	mA
Operating temperature range	-40~125	℃
Storage temperature	-55~155	℃

Note1: Absolute Maximum Ratings is beyond the operating range, the chip may damage.

Electrical Characteristics (Note 4, 5) （Unless otherwise specified, V_{DD} =17V, T_A =25 ℃）

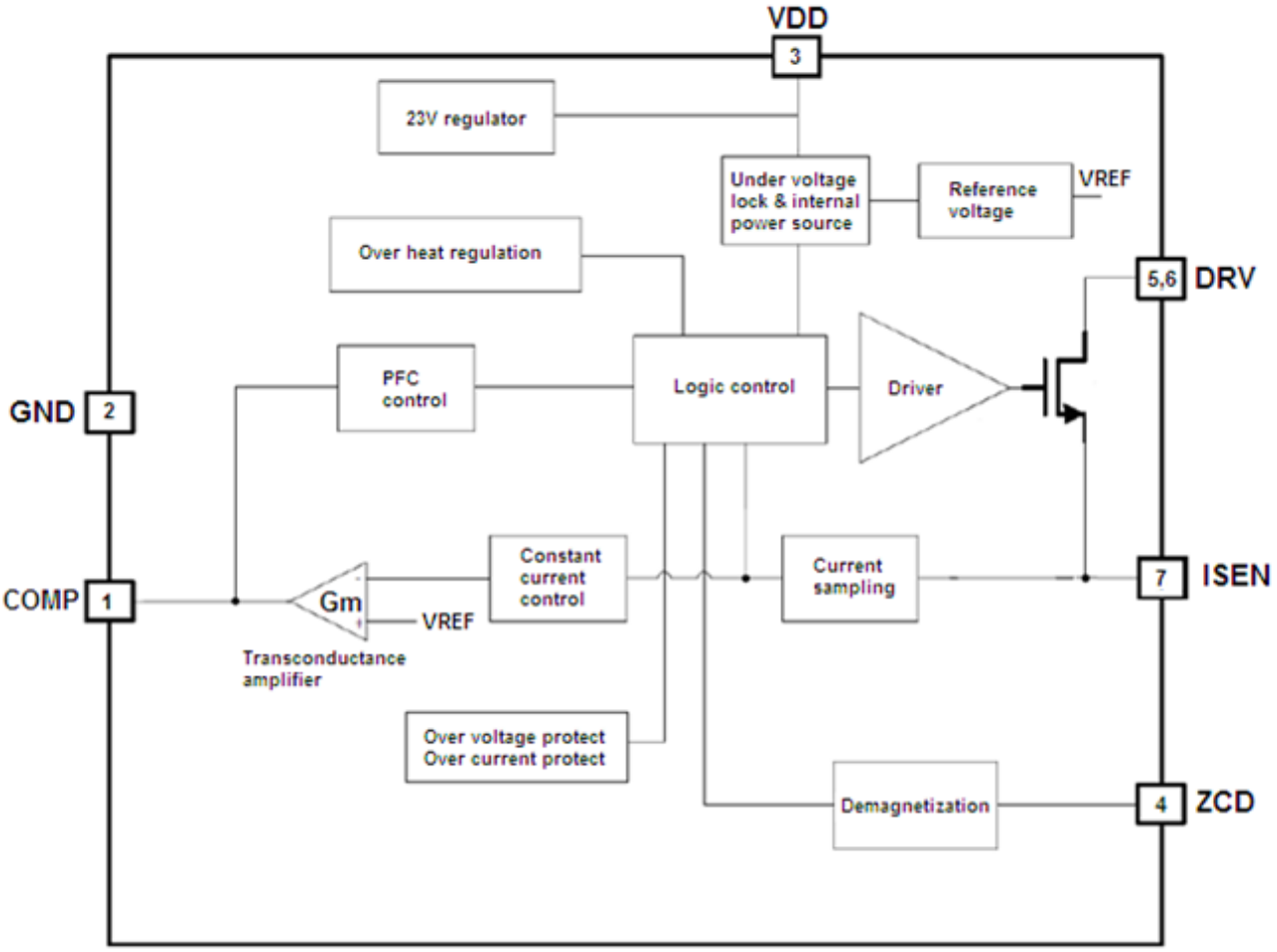
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{DD_ON}	V_{DD} startup voltage	V_{DD} rise		16.9		V
V_{DD_UVLO}	V_{DD} under voltage protection threshold	V_{DD} drop		7.8		V
I_{ST}	V_{DD} startup current	V_{DD} =V_{DD_ON} – 1V		33	50	uA
I_{OP}	V_{DD} operating current	F =10KHz		300	500	uA
V_{DD_CLAMP}	V_{DD} Clamp voltage protection threshold	1mA		20		V
V_{ZCD_FALL}	ZCD falling threshold voltage	ZCD drop		0.2		V
V_{ZCD_HYS}	ZCD hysteresis voltage	ZCD rise		0.15		V
V_{ZCD_OVP}	ZCD over voltage protection threshold			1.6		V
T_{OFF_MIN}	Minimum demagnetization time			3		us
T_{OFF_MAX}	Maximum demagnetization time			100		us
T_{ON_MAX}	Maximum opening time			20		us

V_{ISEN_LMIT}	ISEN peak voltage limit			1		V
T_{LEB}	Current sampling edge blanking time			350		ns
T_{DELAY}	Chip turn off delay			200		ns
V_{REF}	Internal reference voltage		194	200	206	mV
V_{COMP_LO}	Under voltage clamp			1.5		V
V_{COMP}	Linear operate range of COMP		1.5		3.9	V
V_{COMP_OVP}	COMP protection voltage			4		V
R_{DS-ON}	Power MOSFET on-resistance			2.1		Ω
BV_{DSS}	Power MOSFET breakdown voltage	V_{GS}=0V I_{DS}=250uA	500			V
I_{DSS}	Power MOSFET drain current	V_{GS}=0V V_{DS}=500V			1	uA
T_{REG}	Overheating temperature regulation			150		℃

Note 4: The typical parameters values is tested under typical parameters, in 25 ℃.

Note 5: Specifications, the maximum / minimum specification range ensure by testing, typical value ensure by test or statistical analysis.

Internal structure diagram



Application information

D8078C is a active power factor correction LED constant current control chip, integrate an internal 500V power MOSFET, suitable for non-isolated buck circuit, the system operates in the inductor current critical continuous mode, the chip can achieve high power factor and low total harmonic distortion, and high efficiency.

Start-up

In power system, the bus voltage through the startup resistor to charge the capacitor at the V_{DD} pin, when the voltage rises to start threshold voltage, the chip operate to start internal control circuit, COMP voltage is quickly pulled up to 1.5V. Then D8078C started the pulse signal output voltage, system begin to operate at 10KHZ switch frequency, COMP began to rise from the 1.5V, the inductor peak current increased following it, so as to realize the soft start-up of LED current output, prevents the output current overshoot effectively.

When the output voltage is established, the V_{DD} voltage is supplied by the output voltage through a diode, thereby reducing the power consumption of the system.

Constant current control, output current settings

D8078C adopts GND floating frame, the inductor current is sampling in complete period, operating in the inductor current critical continuous mode, can achieve high precision output constant current control.

Calculation method of LED output current: $$Iout = \frac{Vref}{R_{ISEN}}$$

V_{REF} is the internal reference voltage

R_{ISEN} is a current sampling resistor value

Zero-crossing detector

D8078C detects the output current zero state through the ZCD, ZCD the threshold voltage is set at 0.2V, and the hysteresis voltage is 0.15V, the ZCD pin can also be used to detect output over voltage protection (OVP), the threshold is 1.6V.

ZCD proportional of upper and lower pressure resistance can be set:

$$\frac{R_{ZCDL}}{R_{ZCDL}+R_{ZCDH}} = \frac{1.6V}{V_{OVP}}$$

R_{ZCDL} is the feedback lower divider resistance

R_{ZCDH} is the feedback upper divider resistance

V_{OVP} is the set point of protection of output voltage over voltage

Recommended ZCD lower divider resistor is in about 5KΩ-10KΩ.

Overheat regulation

D8078C has the function of overheat regulation, the output current is gradually reduced when the driving power is over heat, to control the output power and temperature rising, to keep the power temperature being at the setting value, so as to improve the system reliability. Chip internal setting temperature at 150℃.

Protection function

D8078C built-in multiple protection functions, to ensure the reliability of the system. When LED is open circuit, the output voltage rise gradually, the ZCD pin can detect output voltage when power MOSFET is shut off. When the output voltage is high to make ZCD

higher than 1.6V, will trigger the logic protection and stop switch function.

When the LED short circuit, the system operates at 10KHZ frequency, due to the output voltage is very low, it cannot supply power to V_{DD} through the diode, so the V_{DD} voltage gradually decreased until under voltage protection threshold. The system enters the protection state, V_{DD} voltage begins to drop, when V_{DD} reached the under voltage protection threshold, the system will reboot. At the same time, system state detection continuously, if trouble shooting, the system will reboot to operate normally.

When the output short circuit or transformer saturation, ISEN peak voltage will be higher. When the ISEN voltage rises to internal limit value (1V), the switch cycle will stop. The cycle by cycle current limiting function can protect the power MOSFET, transformer and an output fly-wheeling diode.

PCB Design

In the design of D8078C PCB, need to follow the guidelines:

Bypass capacitor

Bypass capacitor V_{DD} need to close to the chip V_{DD} and GND pins.

GND wire

The GND of power wire of current sampling resistor should be as thick as possible, and be close to the chip GND wire (Pin2), in order to ensure the precision of the current sampling, or may affect the output current regulation rate. In addition, signal GND requires a separate connection to the chip to GND pin.

The power loop area

To reduce the large current loop area, such as the transformer primary loop area, power MOSFET and loop area of absorption, and the secondary of the transformer, secondary diode, loop area of output capacitor, in order to reduce the EMI radiation.

ZCD pin

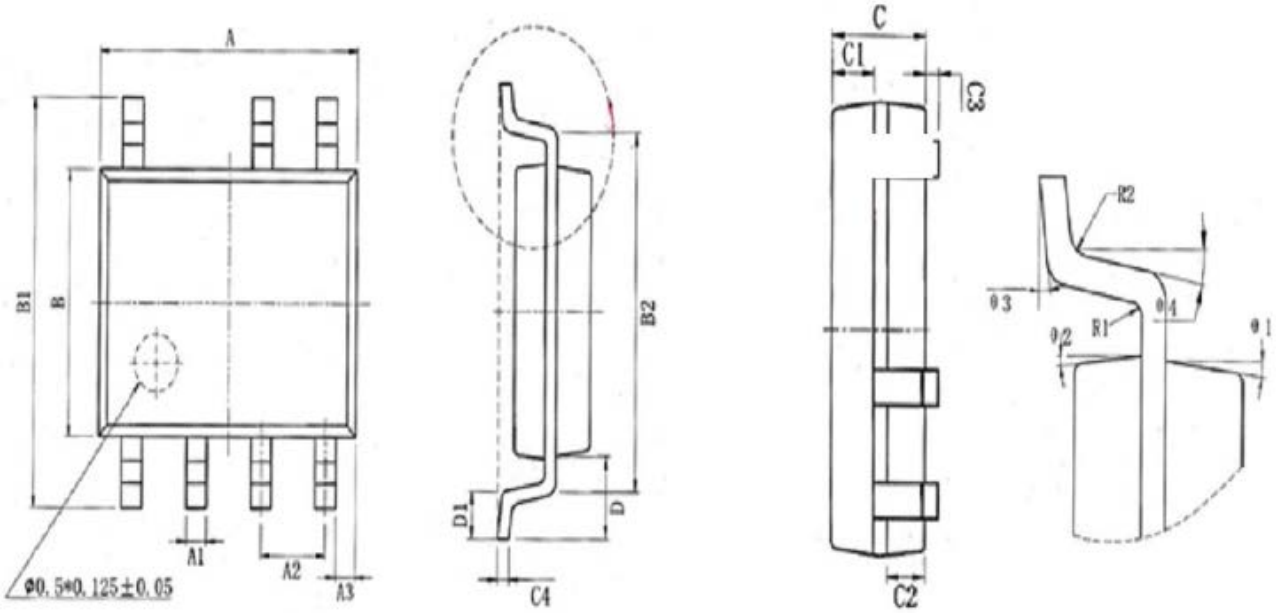
Divider resistor connected to ZCD must be close to the ZCD pin, and the junction to be away from the transformer moving point, otherwise the system noise prone to false triggering ZCD OVP protection function.

DRAIN pin

Appropriately increasing the copper area of DRAIN pin, in order to improve the chip cooling

Package Dimensions

SOP-7



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	4.8	5	0.189	0.1968
A1	0.356	0.456	0.014	0.018
A2	1.27(BSC)		0.05(BSC)	
A3	0.345(BSC)		0.0136(BSC)	
B	3.8	4	0.1496	0.1575
B1	5.8	6.2	0.2283	0.2441
B2	5(BSC)		0.1968(BSC)	
C	1.450	1.550	0.0571	0.061
C1	0.55	0.65	0.0217	0.0256
C2	0.55	0.65	0.0217	0.0256
C3	0.05	0.2	0.002	0.0079
C4	0.203	0.233	0.0080	0.0092
D	1.05(BSC)		0.041(BSC)	
D1	0.4	0.8	0.0157	0.0315
R1	0.2(BSC)		0.0079(BSC)	
R2	0.2(BSC)		0.0079(BSC)	
θ1	14^0(BSC)		14^0(BSC)	
θ2	13^0(BSC)		13^0(BSC)	
θ3	0^0	8^0	0^0	8^0
θ4	4^0	12^0	4^0	12^0

日期 Date	版本 Version	说明 Description	排版 Typesetting	工程师 Engineer	状态 Status
2015-9-15	A0_J	/	Jasper	/	Cancel
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