



Non-isolated Buck Type LED Driver

Description

D8077B 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. D8077B 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.

D8077B internal integrated 600V power MOSFET, only a few peripheral devices are needed to achieve excellent constant current characteristics.

D8077B is sampling for inductor current in full cycle, to achieve high precision output constant current control, and excellent line voltage regulation and load regulation.

D8077B 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, D8077B 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

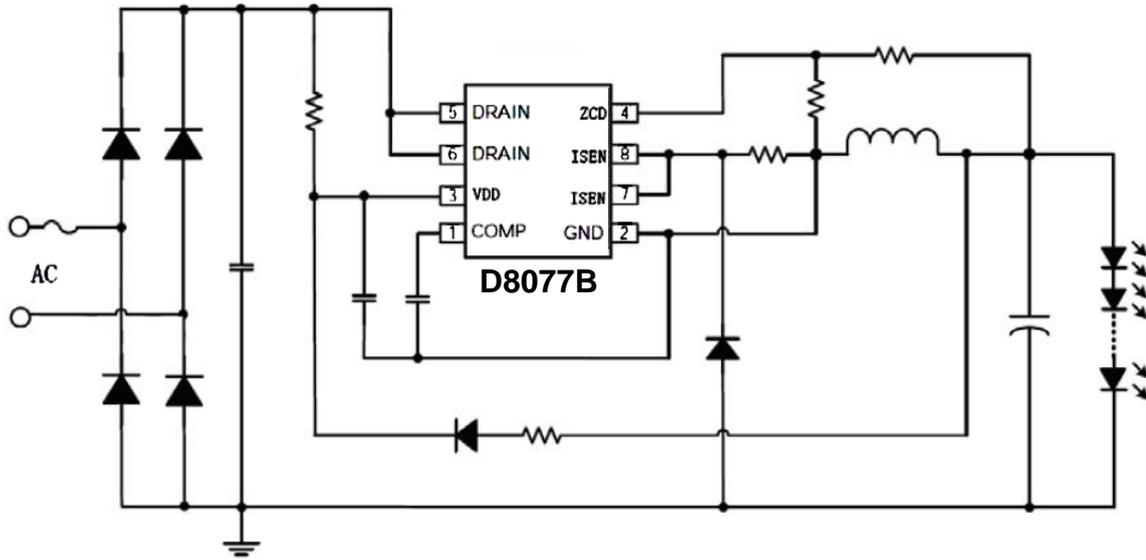
- Single stage, with active power factor correct, high PF, low THD
- Internal 600V power MOSFET
- $\pm 3\%$ LED output current precision
- Excellent line voltage regulation rate and loading regulation rate
- Critical continuous mode of inductor current
- Ultra low (33uA) starting current
- System efficiency 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
- DIP-8 package

Application

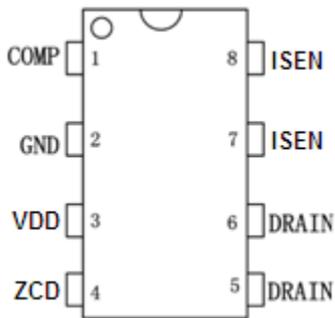
- LED driving power



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. |
| 7,8 | ISEN | Current sampling pin, connected with the sampling resistor to ground. |



Absolute Maximum Ratings(Notes 1)

| Symbol | Range | Units |
|-----------------------------|----------|-------|
| V_{DRAIN} TO GND | -0.3~600 | 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 | °C |
| Storage temperature | -55~155 | °C |

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

Electrical Characteristics (Notes 4, 5) (Unless otherwise specified, $V_{DD} = 17V$, $T_A = 25$ °C)

| 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 |



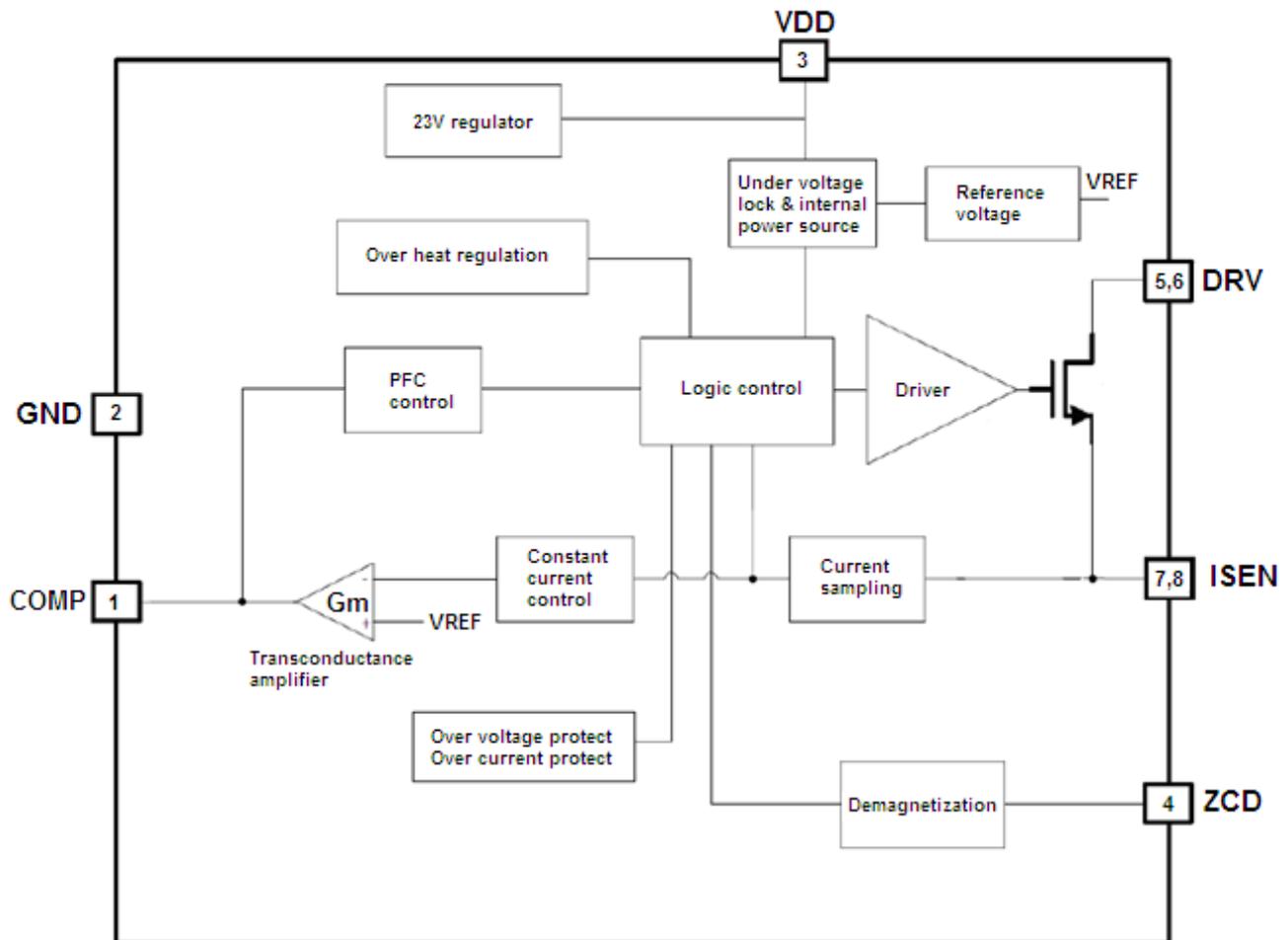
| | | | | | | |
|-------------------|-------------------------------------|----------------------------------|-----|-----|-----|-------------|
| V_{ISEN_LIMIT} | ISEN peak voltage limit | | | 1 | | V |
| T_{LEB} | Current sampling edge blanking time | | | 350 | | ns |
| T_{DELAY} | Chip turn off delay | | | 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 | | | 2.5 | | Ω |
| BV_{DSS} | Power MOSFET breakdown voltage | $V_{GS}=0V$ $I_{DS}=250\mu A$ | 600 | | | V |
| I_{DSS} | Power MOSFET drain current | $V_{GS}=0V$ $V_{DS}=600V$ | | | 10 | μA |
| T_{REG} | Overheating temperature regulation | | | 150 | | $^{\circ}C$ |

Note 4: The typical parameters values is tested under typical parameters, in 25 $^{\circ}C$.

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



Internal structure diagram



Application information

D8077B is a active power factor correction LED constant current control chip, integrate an internal 600V 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 D8077B 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

D8077B 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:
$$I_{out} = \frac{V_{ref}}{R_{ISEN}}$$

V_{REF} is the internal reference voltage

R_{ISEN} is a current sampling resistor value

Zero-crossing detector

D8077B 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 $5K\Omega$ - $10K\Omega$.

Over heat regulation

D8077B has the function of over heat 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 $150^{\circ}C$.

Protection function

D8077B 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 D8077B 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.

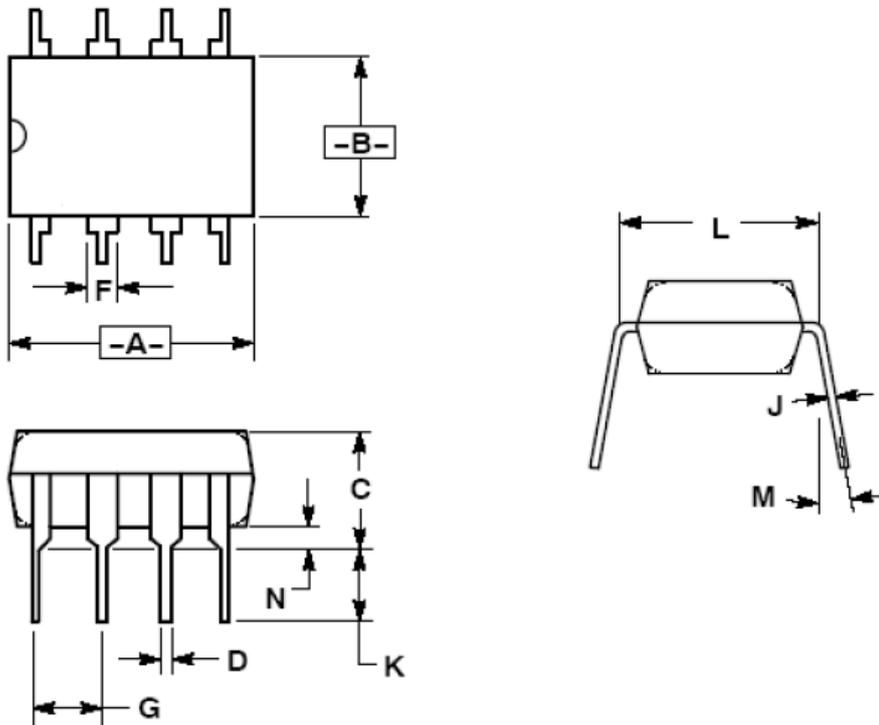
DRAIN pin

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



Package Dimensions

DIP-8



| Symbol | MIN | TYP | MAX |
|--------|---------|------|------|
| A | 9.05 | 9.25 | 9.45 |
| B | 6.15 | 6.35 | 6.55 |
| C | 3.6 | 3.8 | 4 |
| D | 0.44 | | 0.53 |
| F | 1.52BSC | | |
| G | 2.54BSC | | |
| J | 0.25 | | 0.31 |
| K | 3.0 | | |
| L | 7.62BSC | | |
| M | 0 | | 0.84 |
| N | 0.51 | | |



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