Bright Power Semiconductor

BP2861XK

Non-isolated buck typeledConstant current driver chip

Overview

BP2861XK is a buck LED constant current driver chip. The chip works in the critical continuous mode of inductor current and is suitable for non-isolated buck LED constant current power supply with full range input voltage of 85Vac~265Vac.

The BP2861XK chip integrates a 500V power switch, uses gate demagnetization detection technology and high-voltage JFET power supply technology, and does not require VCC capacitors and startup resistors, making its peripheral devices simpler and saving peripherals. cost and volume.

The BP2861XK chip uses a built-in high-precision current sampling circuit and constant current control technology to achieve high-precision LED constant current output and excellent line voltage regulation. The chip works in the inductor current critical mode. The output current does not change with the change of inductance and LED operating voltage, achieving excellent load regulation.

BP2861XK has multiple protection functions, including LED short circuit protection, chip temperature overheating regulation, etc.

BP2861XK adopts SOP7 package.

Features

- Pin compatible with BP2866X
- Integrated 600V ultra-fast recovery diode
- No VCC capacitor, no startup resistor
- Integrated high voltage power supply function
- No flashing at low bus voltage
- ±5% LED output current accuracy
- LED short circuit protection
- Overheat regulation function
- SOP7 package

application

- LED Candle Light
- LED Bulb
- Other LED lighting

Typical Applications

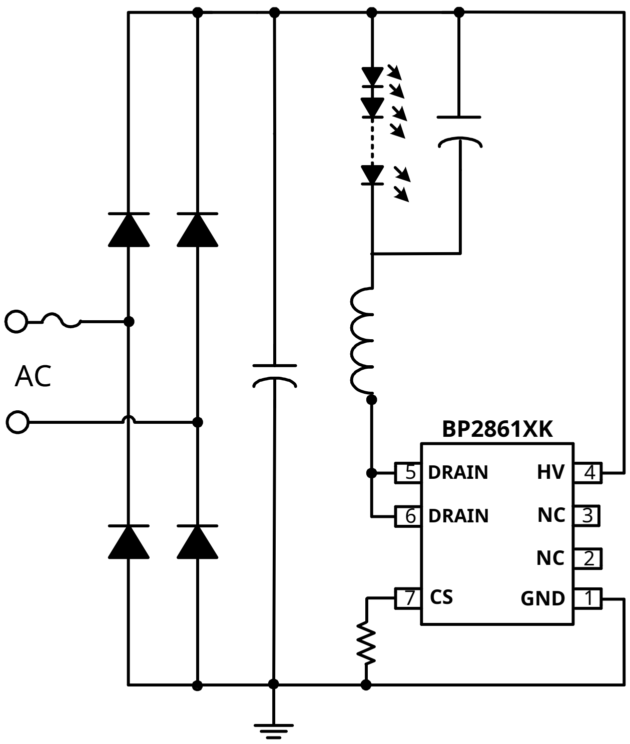
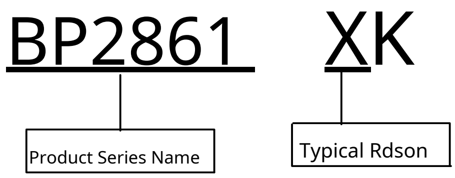


Figure 1 BP2861XK typical application diagram

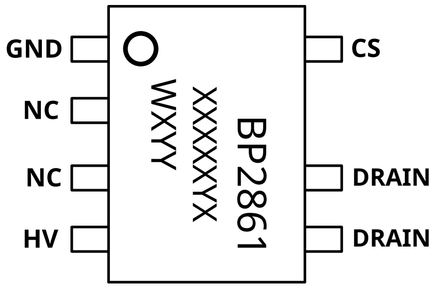
Chip Name



Ordering Information

Order model	Encapsulation	Temperature range	Packaging	Print
BP2861XK	SOP7	- 40℃ to 105℃	Taping 4,000 pcs/tray	BP2861 XXXXXYX WXYY

Pin package



XXXXXXY: lot code
WXXX: Mark
YY: Week number
X:S/A/B/C/D
(End of second line)

Figure 2 Pin package diagram

Pin Description

Pin Number	Pin Name	describe
1	GND	Chip Ground
2,3	NC	No connection
4	HV	Chip high voltage power supply
5,6	DRAIN	Internal high voltage power tube drain
7	CS	Current sampling terminal, the sampling resistor is connected between CS and GND terminals

Limit parameters(Note 1)

symbol	parameter	Parameter range					unit
HV	500V chip high voltage power supply interface	- 0.3~500					V
DRAIN	Internal high voltage power tube drain to source peak voltage	- 0.3~500					V
CS	Current sampling terminal	- 0.3~8					V
I_{DMAX}	Maximum drain current @ T_J=100℃	S	A	B	C	D	mA
		320	440	580	800	900	
P_{DMAX}	Power consumption (Note 2)	0.45					W
θ_{JA}	Thermal resistance from PN junction to ambient	145					℃/W
T_J	Operating junction temperature range	- 40 to 150					℃
T_{STG}	Storage temperature range	- 55 to 150					℃
	ESD (Note 3)	2					KV

Note 1: The maximum limit value means that the chip may be damaged if it exceeds this operating range. The recommended operating range means that within this range, the device functions normally, but it is not completely guaranteed to meet individual performance indicators. The electrical parameters define the DC and AC parameter specifications of the device within the operating range and under test conditions that guarantee specific performance indicators. For parameters without upper and lower limits, the specification does not guarantee their accuracy, but their typical values reasonably reflect the performance of the device.

Note 2: As the temperature rises, the maximum power consumption will definitely decrease, which is also determined by T_{JMAX}, θ_{JA}, and ambient temperature T_AThe maximum allowable power consumption is P_{DMAX}= (T_{JMAX}-T_A)/θ_{JA}Or the lower value among the numbers given in the limit range. **Note 3:**Human body model, 100pF capacitor discharged through 1.5KΩ resistor.

Working scope

symbol		Parameter range					unit
Vin=176Vac~265Vac, chamber temperature 60℃							
I_{LED} max Maximum output current		SK	AK	BK	CK	DK	mA
		160	220	260	310	380	
P_{OUT}max Maximum output power		SK	AK	BK	CK	DK	W
		16W	17W	19W	21W	24W	
Vin=176Vac~265Vac, chamber temperature 90℃							
I_{LED} max Maximum output current		SK	AK	BK	CK	DK	mA
		140	190	220	280	340	
P_{OUT}max Maximum output power		SK	AK	BK	CK	DK	W
		12W	13W	15W	17W	19W	
$V_{LED\ min}$	Minimum negative	SK	AK	BK	CK	DK	V
	Load voltage	> 20	> 10	> 15			

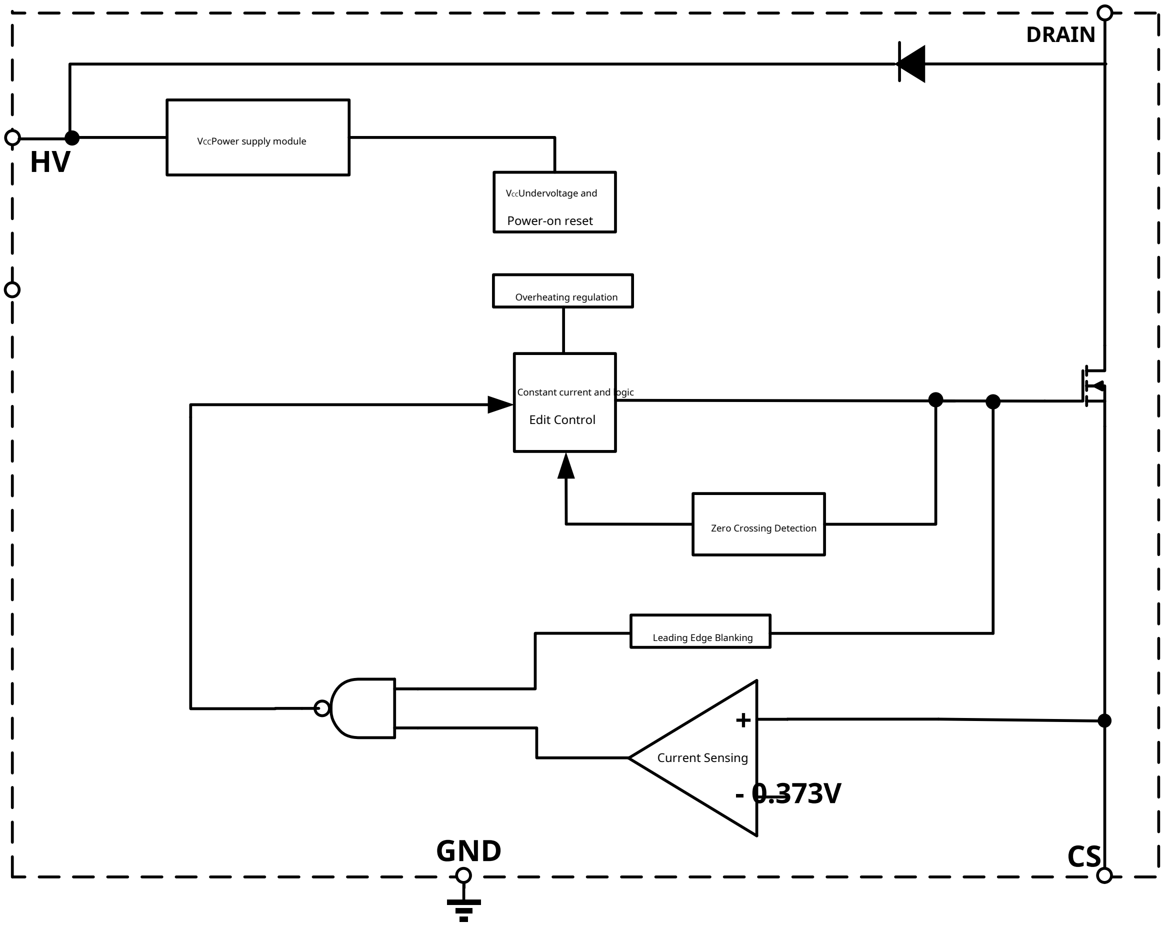
Electrical parameters(Note 4, 5) (Unless otherwise specified, T_A=25℃)

symbol	describe	condition	Minimum	Typical Value	Maximum	unit
Supply voltage						
I_{CC}	Chip operating current	F_{OP}=4kHz		230		uA
Current sampling						
V_{CS_TH}	Current detection threshold		360	373	386	mV
T_{LEB}	Leading edge blanking time			500		ns
T_{DELAY}	Chip shutdown delay			200		ns
Internal time control						
T_{OFF_MIN}	Minimum off time			1.3		us
T_{OFF_MAX}	Maximum off time			250		us
T_{ON_MAX}	Maximum opening time			40		us
Freewheeling diode						
Vb	Breakdown voltage	IR=5uA	600			V
VF	On-state voltage drop	IF=0.5A			1.8	V
IF(av)	Maximum average on-state current			0.5		A
Trr	Reverse recovery time	IF=0.5A IR=1A Irr=0.25A			35	ns
Power tube						
BV_{DSS}	Power tube breakdown voltage	V_{GS}=0V/I_{DS}=250uA	500			V
I_{DSS}	Power tube leakage current	V_{GS}=0V/V_{DS}=500V			1	uA
SK R_{DS_ON}	Power tube on-resistance	V_{GS}=10V/I_{DS}=0.1A		16.5		Ω
AK R_{DS_ON}				11		
BKR_{DS_ON}				8.5		
C K R_{DS_ON}				5.8		
D K_{DS_ON}				4.8		
Overheating regulation						
T_{REG}	Overheating adjustment temperature	IC Surface		120		℃

Note 4: Typical parameter values are those measured at 25 C.

Note 5: The minimum and maximum specification ranges in the data sheet are guaranteed by testing, and the typical values are guaranteed by design, testing or statistical analysis.

Internal structure diagram



picture3 BP2861XKInternal Block Diagram

Application Information

BP2861XK is a constant current driver chip dedicated to LED lighting, used in non-isolated buck LED driver power supply. It adopts gate demagnetization detection technology and high-voltage JFET power supply technology, without V_{CC}capacitor and startup resistor, making its peripheral devices simpler and saving peripheral

Cost and volume.

start up

After the system is powered on, the bus voltage supplies power to the chip through the HV pin. When the internal power supply voltage reaches the chip start threshold, the chip The control circuit starts working. When the chip is working normally, the required work

Current is still supplied to it through the internal JFET.

Constant current control, output current setting

The chip detects the peak current of the inductor cycle by cycle. The CS terminal is connected to the input of the internal peak current comparator and is compared with the internal 373mV threshold.

The value voltage is compared,When the CS voltage reaches the internal detection threshold, The power tube is turned off.

The formula for calculating the inductor peak current is:

$$I_{PK} = \frac{0.373}{R_{CS}}$$

Among them, $R_{CS}$is the resistance value of the current sampling resistor.

The output of the CS comparator also includes a 500ns leading edge blanking time.

The LED output current calculation formula is:

$$I_{led} = \frac{I_{PK}}{2}$$

Among them, $I_{PK}$is the peak current of the inductor.

Energy storage inductor

BP2861XK works in the critical mode of inductor current. When the power tube is turned on, the current flowing through the energy storage inductor starts to rise from zero.

The room is:

$$t_{on} = \frac{L \cdot I_{PK}}{V_{IN} - V_{led}}$$

Where, L is the inductance; I_{PK} is the peak value of the inductor current; V_{IN} is the bus voltage after rectification; V_{led} is the voltage across the output LED.

When the power tube is turned off, the current flowing through the energy storage inductor starts from the peak value.

When the inductor current drops to zero, the internal logic of the chip

Turn on the power tube again. The off time of the power tube is:

$$t_{off} = \frac{L \cdot I_{PK}}{V_{led}}$$

The calculation formula of energy storage inductance is:

$$L = \frac{V_{led} \cdot (V_{IN} - V_{led})}{f \cdot I_{PK} \cdot V_{IN}}$$

Where, f is the system operating frequency. The system operating frequency of BP2861XK is proportional to the input voltage. When setting the system operating frequency of BP2861XK, choose to set the system's maximum frequency when the input voltage is the lowest.

When the input voltage is the highest, the system operates at a low frequency.

The rate is also the highest.

BP2861XK sets the minimum off time and maximum off time of the system to 1.3us and 250us respectively.$_{OFF}$From the calculation formula, we can know that if the inductance is very small, t_{OFF}It is likely to be less than the minimum off time of the chip, and the system will enter the inductor current discontinuous mode.

When the inductance is large, the LED output current will deviate from the design value.$_{OFF}$The maximum off time of the chip may be exceeded, and the system will enter the inductor current continuous mode, and the output LED current will also deviate from the design value. Therefore, it is very important to choose the right inductor value.

important.

Protection function

BP2861XK has multiple built-in protection functions, including LED short circuit protection, chip temperature overheating regulation, etc.

When the LED is short-circuited, the system operates at a low frequency of 4kHz, so the power consumption

Very low.

BP2861XK detects the chip temperature through the over-temperature regulation circuit. When the chip temperature exceeds 120℃, the chip enters the over-temperature regulation state and gradually reduces the output current, thereby controlling the output power and temperature rise.

The chip temperature is controlled at a certain value to improve the reliability of the system.

PCB Design

When designing the BP2861XK PCB, the following guidelines need to be followed:

CS sampling resistor

The power ground wire of the current sampling resistor should be as short as possible and should be aligned with the chip.

The ground wire and other small signal ground wires are connected to the ground of the bus capacitor.

In addition, increasing the copper area of the CS pin can enhance chip heat dissipation.

HV Pin

When soldering is allowed, the HV pin should be kept as far away from the CS pin and other low-voltage pins as possible. When using, the copper area of the HV pin should be increased as much as possible to assist the built-in freewheeling diode in dissipating heat.

Power loop area

Reduce the area of the power loop, such as power inductors, power tubes, and busbars

The loop area of the capacitor, as well as the loop area of the power inductor and output capacitor

area to reduce EMI radiation.

DRAIN Pin

Increase the copper area of the DRAIN pin to improve chip heat dissipation, but too large a copper area will worsen EMI.

GND pin

The GND pin of the chip should be connected to the negative end of the bus capacitor, not directly to the negative end of the rectifier bridge. Increase the copper area of the GND pin to improve the heat dissipation of the chip.

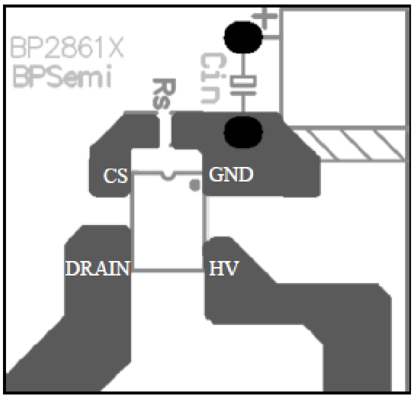
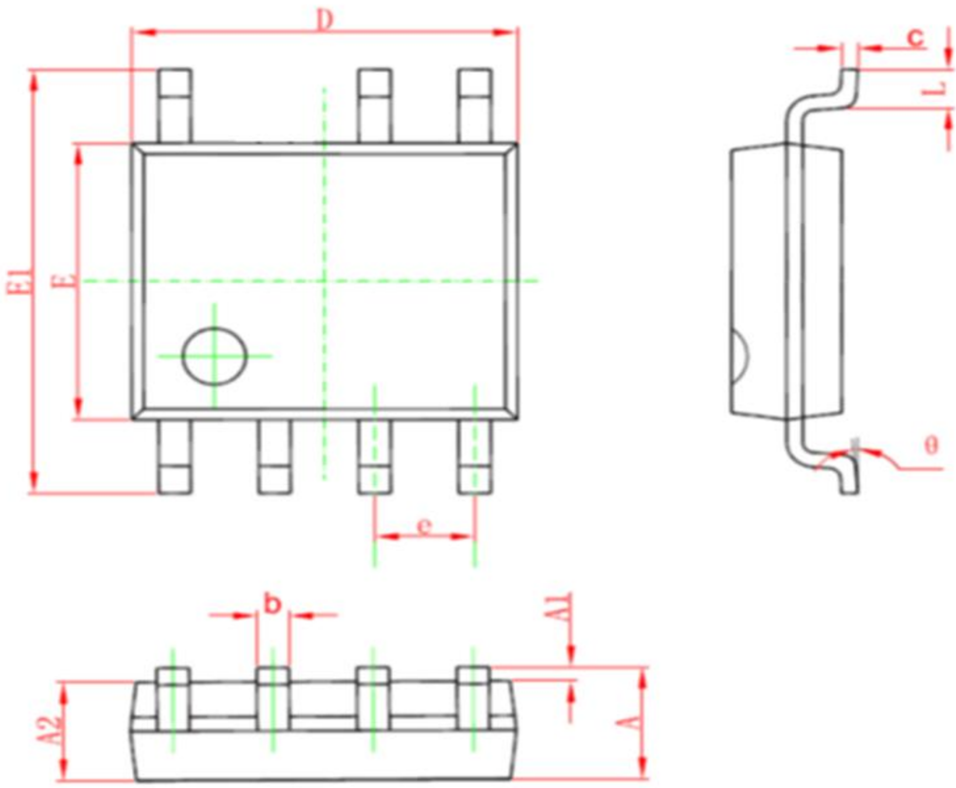


Figure 4 PCB copper area optimization diagram

Packaging information

SOP7 PACKAGE OUTLINE DIMENSIONS



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°	8°	0°	8°