



晶丰明源半导体

BP2866XJ

Non-isolated Buck Offline LED Driver

Description

BP2866XJ is a high precision Buck constant current LED driver. The device operates in critical conduction mode and is suitable for 85Vac~265Vac universal input offline LED lighting.

The BP2866XJ integrates a 500V power MOSFET, with proprietary MOSFET driving technique. It doesn't need VCC capacitor and startup resistor. It can achieve excellent constant current performance with very few external components, so the system cost and size are minimized.

BP2866XJ operates in critical conduction mode, it can achieve precise output current and excellent line regulation. The driver output current does not change with the inductance and output voltage.

The BP2866XJ offers protections to improve the system reliability, including LED short circuit protection, and thermal regulation function.

Features

- No VCC Capacitor and Startup Resistor
- Integrated HV JFET for IC Power Supply
- Internal 500V Power MOSFET
- Critical Conduction Mode Operation
- $\pm 5\%$ LED Output Current Accuracy
- Configurable OVP by Rovp resistor
- LED Short Protection
- Thermal Regulation Function
- Available in SOP7 Package

Applications

- LED Bulb
- LED Tube
- Other LED Lighting

Typical Application

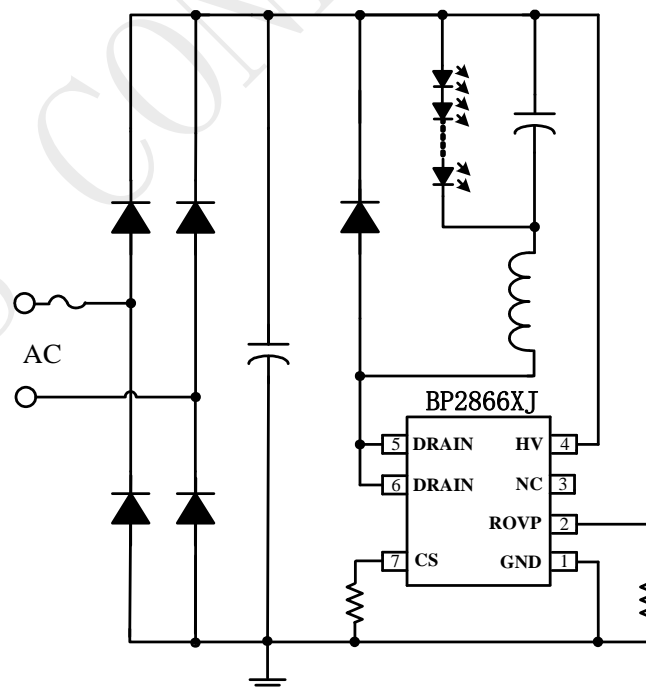


Figure 1. Typical application circuit for BP2866XJ

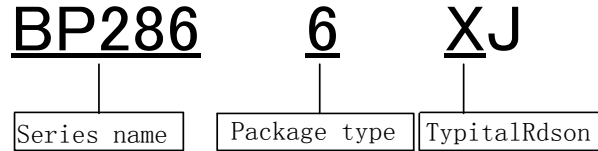


晶丰明源半导体

BP2866XJ

Non-isolated Buck Offline LED Driver

Naming rules



Ordering Information

Part Number	Package	Operating Temperature	Packing Method	Marking
BP2866XJ	SOP7	-40 °C to 105 °C	Tape 4000Pcs/Reel	BP2866X XXXXXXY WXXYYJ

Pin Configuration and Marking Information

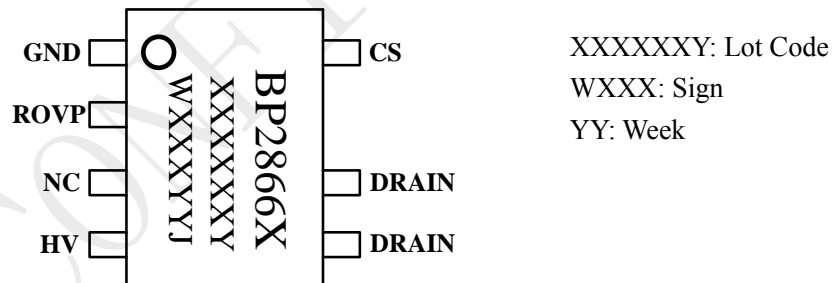


Figure 2. Pin configuration

Pin Definition

Pin No.	Name	Description
1	GND	Ground
2	Rovp	OVP configure by a resistor between this pin and GND Pin
3	NC	Not connect
4	HV	High voltage power supply Pin
5,6	DRAIN	Internal HV Power MOSFET Drain.
7	CS	Current Sense Pin. Connect a sense resistor between this pin and GND pin.



晶丰明源半导体

BP2866XJ

Non-isolated Buck Offline LED Driver

Absolute Maximum Ratings (note1)

Symbol	Parameters	Range						Units
HV	500V High voltage supply Pin	-0.3~500						V
DRAIN	Internal HV MOSFET drain voltage	-0.3~500						V
CS	Current sense pin input voltage	-0.3~8						V
Rovp		-0.3~8						V
I _{DMAX}	Maximum drain current @ T _J =100℃	A	B	C	D	F	G	mA
		500	650	900	1000	1100	1500	
P _{DMAX}	Power dissipation (note 2)	0.45						W
θ _{JA}	Thermal resistance (Junction to Ambient)	145						℃/W
T _J	Operating junction temperature	-40 to 150						℃
T _{STG}	Storage temperature range	-55 to 150						℃
	ESD (note 3)	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.

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) / θ_{JA} and the number listed in the maximum table.

Note 3: Human Body mode, 100pF capacitor discharge on 1.5KΩ resistor

Recommended Operation Conditions

Symbol	Parameter	Range						Unit
I _{LED}	Output LED current @ V _{out} =72V (Input voltage 176V~265V)	A	B	C	D	F	G	mA
		160	220	250	280	350	380	
I _{LED max}	Maximum Output LED current	A	B	C	D	F	G	mA
		240	300	400	450	500	550	
V _{LED min}	Minimum LED Loading Voltage	>20	>15					V



晶丰明源半导体

BP2866XJ

Non-isolated Buck Offline LED Driver

Electrical Characteristics (Notes 4, 5) (Unless otherwise specified, $T_A=25^\circ\text{C}$)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Supply Voltage Section						
I _{CC}	Operating current	F _{OP} =4kHz		230		uA
Current Sense Section						
V _{CS_TH}	Threshold Voltage for Peak Current Limit		362	373	384	mV
T _{LEB}	Leading Edge Blanking Time for Current Sense			500		ns
T _{DELAY}	Switch Off Delay Time			200		ns
Rovp						
V _{EN}	OVP Pin enable threshold			0.3		V
I _{OVP}	OVP Pin output current			35		uA
Internal Time Control Section						
T _{OFF_MIN}	Minimum OFF Time			2.5		us
T _{OFF_MAX}	Maximum OFF Time			250		us
T _{ON_MAX}	Maximum On Time			40		us
T _{OVP_RST}	OVP reset time			8		ms
MOSFET Section						
BV _{DSS}	Drain-Source Breakdown Voltage	V _{GS} =0V/I _{DS} =250uA	500			V
I _{DSS}	Power MOSFET leakage current	V _{GS} =0V/ V _{GS} =500V			1	uA
AJ R _{DS_ON}	MOSFET conductor resistance	V _{GS} =10V/I _{DS} =0. 1A		15		Ω
BJ R _{DS_ON}				8. 5		
CJ R _{DS_ON}				5. 8		
DJ R _{DS_ON}				4. 8		
FJ R _{DS_ON}				3		
GJ R _{DS_ON}				2		
Thermal Regulation Section						
T _{REG}	Thermal Regulation Temperature			140		℃

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

Internal Block Diagram

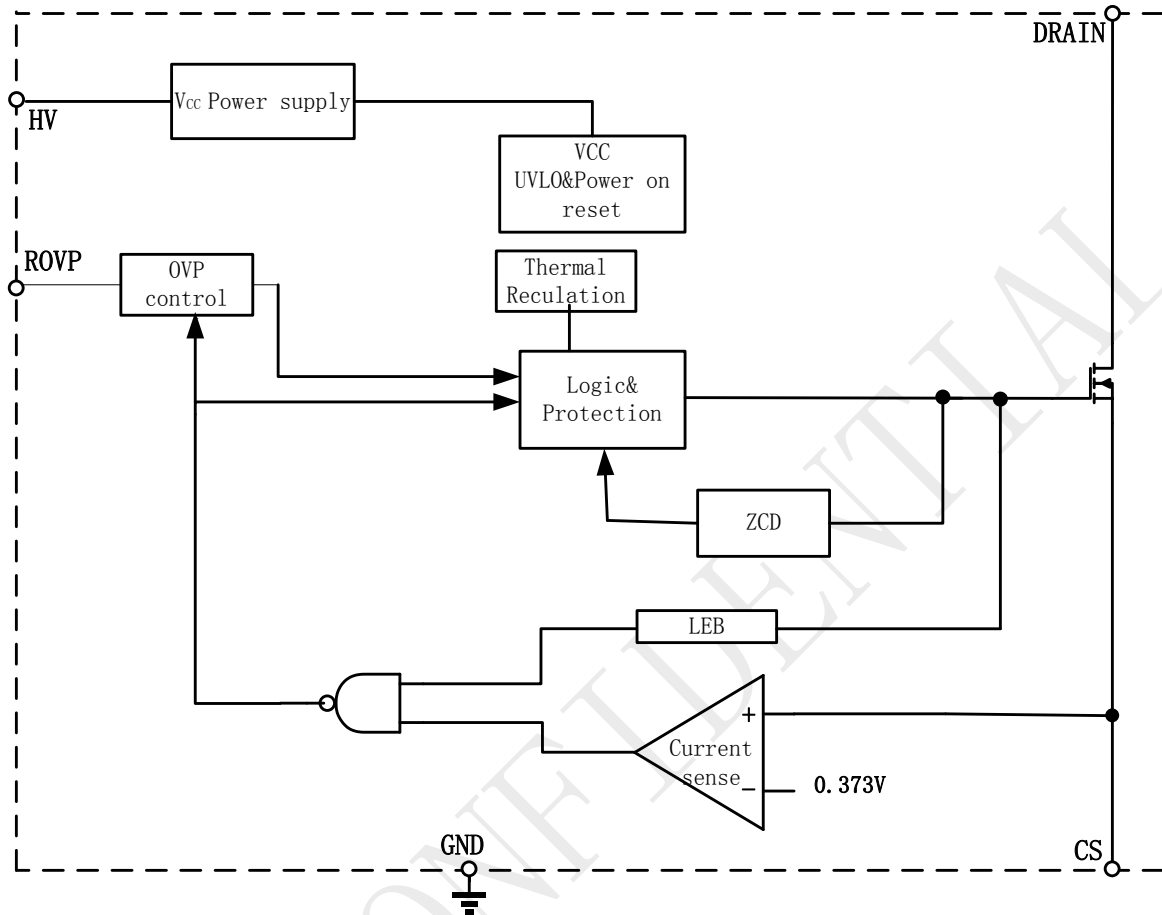


Figure 3. BP2866XJ Internal Block Diagram

Application Information

The BP2866XJ is a high performance non-isolated Buck converter specially designed for LED lighting. The device integrates a 500V power MOSFET. With very few external components, the converter achieves excellent constant current control. And it can save VCC capacitor and startup resistor. So the system size and cost is greatly reduced.

Start Up

When the system powered on, the HV pin supply the power to the IC. Then the IC start working. After the chip operates normally, the HV JFET supplies the working current also.

Constant Current Control

Cycle by Cycle current sense is adopted in BP2866XJ, the CS pin is connected to the internal current sense comparator, and the voltage on CS pin is compared with the internal 0.373V reference voltage. The MOSFET will be switched off when the voltage on CS pin reaches the threshold. The CS comparator includes a 500ns leading edge blanking time.

The peak inductor current is given by:

$$I_{PK} = \frac{373}{R_{CS}}$$

Where, R_{CS} is the current sense resistor value.



晶 丰 明 源 半 导 体

BP2866XJ

Non-isolated Buck Offline LED Driver

The current in LED can be given by:

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

Where, I_{PK} is the peak current of the inductor.

Inductor Selection

The BP2866XJ works under inductor current critical conduction mode. When the power MOFET is switched on, the current in the inductor rises up from zero, the on time of the MOSFET is given by:

$$t_{on} = \frac{L \times I_{PK}}{V_{IN} - V_{LED}}$$

Where,

L is the inductor value

V_{IN} is the DC bus voltage after the rectifier bridge

V_{LED} is the voltage on the LED

After the power MOSFET is switched off, the current in the inductor decreases. When the inductor current reaches zero, the power MOSFET is turned on again by IC internal logic. The off time of the MOSFET is given by:

$$t_{off} = \frac{L \times I_{PK}}{V_{LED}}$$

The inductance can be given by:

$$L = \frac{V_{LED} \times (V_{IN} - V_{LED})}{f \times I_{PK} \times V_{IN}}$$

The f is the system switching frequency, which is proportional to the input voltage. So the minimum switching frequency is set at lowest input voltage, and the maximum switching frequency is set at highest input voltage.

The minimum and maximum off time of BP2866XJ are 2.5us and 250us, respectively. Referring to the equation of T_{off} calculation, if the inductance is too low, the T_{off} may be lower than the minimum off time,

system will operate in discontinuous current mode and the output current will be lower than the designed value. If the inductance is too large, the T_{off} may be higher than the maximum off time, the system will operate in continuous conduction mode and the output current will be higher than the designed value. So it is important to choose a proper inductance.

ROVP Resistor Value calculate

The OVP voltage is set by the resistor which connects the ROVP Pin. The current out of the ROVP Pin is 35uA.

When the LED load is open, the output voltage becomes higher and the Toff becomes lower. So we can get the Tovp by the needed OVP voltage. The Tovp is given by:

$$T_{ovp} \approx \frac{L \times V_{cs}}{R_{cs} \times V_{ovp}}$$

where,

V_{cs} is CS reference voltage (373mV)

V_{ovp} is the needed OVP

Then we can get the Rovp resistor value by the Tovp. The Rovp is given by:

$$R_{ovp} \approx \frac{150}{T_{ovp}} * 10^{-3}$$

Noted: the Rovp Pin has the enable function. When the ROVP Pin voltage is lower 0.3V, the IC is disabled and the system has no output. So we suggest the ROVP resistor will be higher 15kΩ. If you needn't OVP function you can disconnect the ROVP Pin.

Protection Function

The BP2866XJ offers rich protection functions to improve the system reliability, including LED short protection, thermal regulation.

When the LED short circuit is detected, the system works at low frequency (4kHz), so the system power



晶 丰 明 源 半 导 体

BP2866XJ

Non-isolated Buck Offline LED Driver

consumption is very low.

The BP2866XJ integrates thermal regulation function. When the system is over temperature, the output current is gradually reduced, so the output power dissipation and thermal are also reduced. The system temperature is regulated and the system reliability is improved. The thermal regulation temperature is set to 140°C internally.

PCB Layout

The PCB designing rules should be followed in BP2866XJ PCB layout:

CS resistor

The current sense resistor should be short to the bus capacitor ground. And it is separated from other signal ground. Another the bigger copper area of the CS Pin is better for thermal dissipation.

HV Pin

HV trace should be far away from the CS pin trace and other low voltage pin.

The Area of Power Loop

The area of main current loop should be as small as possible to reduce EMI radiation, such as the inductor, the power MOSFET, the output diode and the bus capacitor loop.

Drain Pin

To increase the copper area of DRAIN pin for better thermal dissipation. However too large copper area may compromise EMI performance.

Physical Dimensions

