BP2371XG

Non-isolated APFC Buck LED Driver

Description

BP2371XG is a high precision non-isolated APFC buck LED driver, specially designed for universal mains with constant current control. BP2371XG operates in Critical Conduction Mode to reduce the switching loss and optimize the EMI.

BP2371XG remove the VCC capacitor, COMP capacitor and R_{CS} resistor to simplify the external BOM. And it utilizes specific current detection, with few external components, it achieves high precision output current, excellent line regulation and load regulation.

BP2371XG offers full of protection functions to improve the system reliability, including LED load short protection. The system reliability is further improved by the thermal and input overvoltage regulation function . The output current is reduced when the driver is in condition of over temperature or input overvoltage.

Features

■ Active-PFC for High PF and Low THD

■ No VCC and COMP capacitor

■ Integrated current sense resister

■ Integrated 800V rectifier bridge

■ Integrated 650V superfast recovery diode

■ Critical Conduction Mode Operation

■ LED Short Protection

■ Cycle by Cycle Current Limit

■ Thermal Regulation Function

■ Input Overvoltage Regulation Function

■ Available in ASOP7 Package

Applications

■ LED Bulb

■ LED Tube
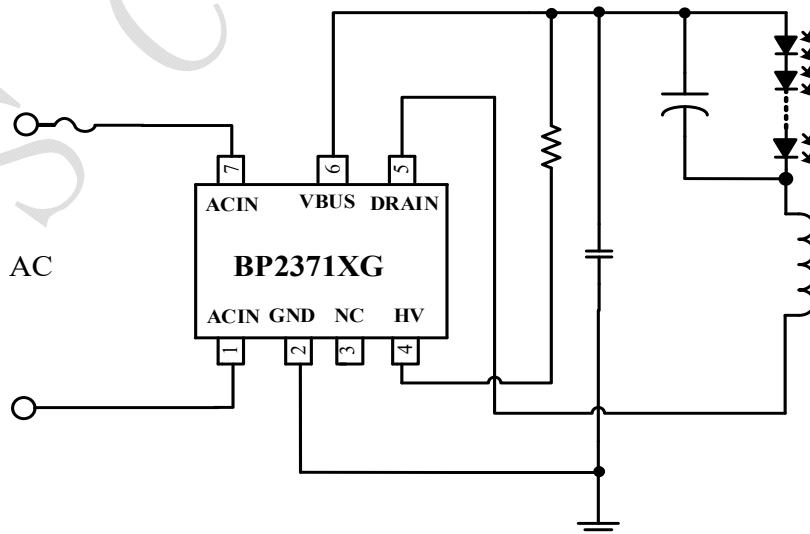
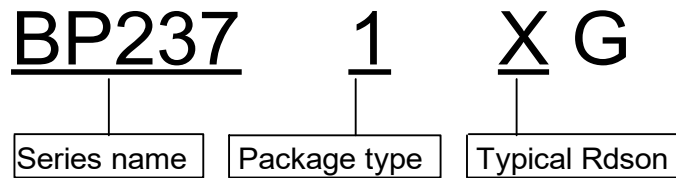■ Other LED Lighting

ASOP7

Typical Application

Figure 1 Typical application circuit for BP2371XG

Naming rules

BP237   1   X G

| Series name | Package type | Typical Rdson |

Ordering Information

Part Number	Package	Package Method	Marking
BP2371XG	ASOP7	Tape 5,000 pcs/Reel	BP2371 XXXXXYX ZZZZWWG

Pin Configuration and Marking Information
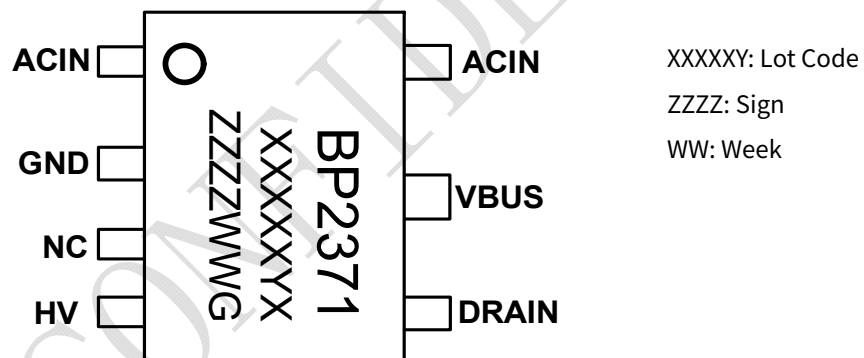
Figure 2. Pin configuration

XXXXXY: Lot Code

ZZZZ: Sign

WW: Week

Pin Definition

Pin No.	Name	Description
1,7	ACIN	Input Voltage.
2	GND	Ground.
3	NC	No Connection.
4	HV	High Voltage startup and power supply.
5	DRAIN	Internal High Voltage Power MOSFET Drain.
6	VBUS	Built-in diode negative

Absolute Maximum Ratings (note1)

Symbol	Parameters	Range	Units
DRAIN	Internal HV MOSFET drain voltage	-0.3~650	V
HV	IC high voltage power supply	-0.3~650	V
VBUS	Built-in diode negative	-0.3~650	V
ACIN	Input Voltage.	-0.3~800	V
P_{DMAX}	Power dissipation (note2)	0.5	W
T_J	Operating junction temperature	-40 to 150	℃
T_{STG}	Storage temperature range	-55 to 150	℃

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.

Electrical Characteristics (Notes 3, 4) (Unless otherwise specified, HV=100V and T_A=25 ℃)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
High Voltage Power Supply (HV)						
I_{CC}	IC Operating Current	No switching		0.4	0.6	mA
Output LED Current (CS)						
I_{LED_D}	Default LED Current	L=2mH,Vo=80V, Vin=220Vac		94.5		mA
Internal Timing Control						
T_{ON_MAX}	Maximum On Time			6.4		µs
T_{OFF_MAX}	Maximum Off Time			160		µs
Current Sense Section						
V_{CS_LIMIT}	CS Peak Voltage Limitation			1.8		V
T_{LEB_CS}	Leading Edge Blanking Time for Current Sense			300		ns
T_{DELAY}	Switch off Delay Time			200		ns
V_{REF}	Internal Reference Voltage			280		mV
Built-in diode						
V_R	Breakdown Voltage	IR=10uA	650			V
$I_{F(AV)}$	Max Average Forward Rectified Current	Tj≤150°C		0.5		A
V_F	Forward Voltage Drop	IF=0.5A			1.8	V
T_{rr}	Reverse Recovery Time	IF=0.5A, IR=1A, I_{rr}=0.25A			35	ns
OVP Control						
V_{OVP}	Shutdown voltage	L=2mH，Vo=80V Vin=220Vac		126		V
T_{OVP_RST}	OVP recovery Time			140		mS
K	OVP Constant			1.5		
Power MOSFET						
AG R_{DS_ON}	Static Drain-source On-resistance	V_{GS}=10V/I_{DS}=0.4A		13		Ω
BG R_{DS_ON}				9		Ω

BV$_{DSS}$	Drain-Source Breakdown Voltage	V$_{GS}$=0V/I$_{DS}$=250uA	650			V
I$_{DSS}$	Power MOSFET Drain Leakage Current	V$_{GS}$=0V/V$_{DS}$=650V			1	uA
Thermal Regulation						
T$_{REG}$	Thermal Regulation Temperature	IC Surface		140		°C

Note 3: *production testing of the chip is performed at 25°C.*

Note 4: *the maximum and minimum parameters specified are guaranteed by test, the typical values are guaranteed by design, characterization and statistical analysis*
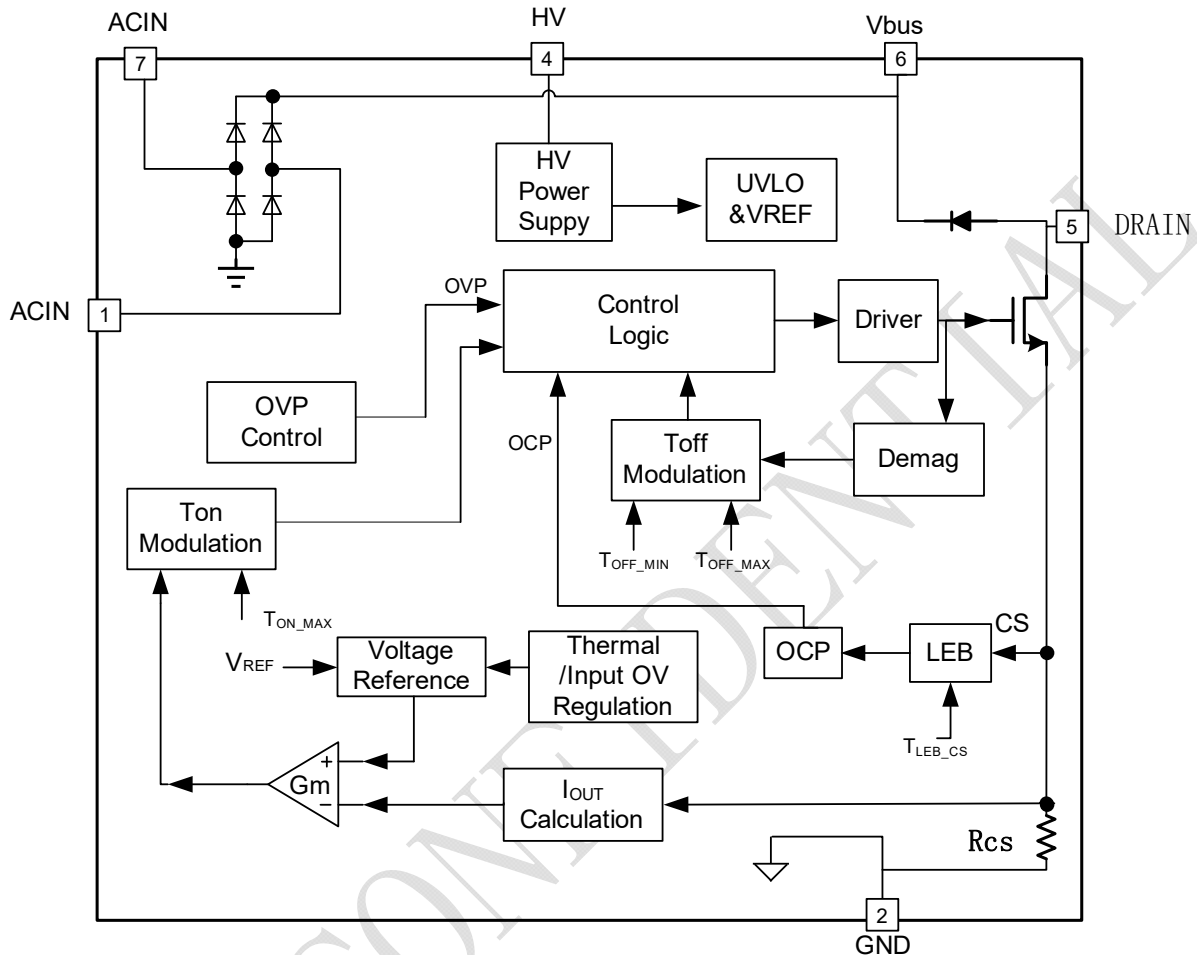
Internal Block Diagram

Figure 3. BP2371XG Internal Block Diagram

Application Information

BP2371XG is a high precision non-isolated APFC buck LED driver, specially designed for universal mains with constant current control. The driver with on-chip PFC circuit achieves high power factor, low THD and high efficiency.

1 Startup

After system is powered on, the system starts switching very quickly, and the output voltage rises up gradually, and the inductor peak current also rises up. The LED current hence achieves a soft start without overshoot.

2 Constant Current Control

The BP2371XG samples the peak current of the inductor cycle by cycle. Compared with the internal reference, it realizes closed-loop control and realizes high-precision constant current output. The chip integrates LED current detection resistor. The internal current of the LED defaults to 94.5mA.

3 Thermal / Input overvoltage Regulation

BP2371XG integrates thermal/input overvoltage regulation function. When the system is over temperature or input overvoltage, the output current is gradually reduced; the output power and thermal dissipation are also reduced. The system temperature is regulated and the system reliability is improved.

4 Protection Functions

To improve the system reliability, BP2371XG offers protection functions:

When the LED is shorted circuit, the switching frequency will work under 5 kHz.

When the output is shorted or the inductor is saturated, the CS peak voltage will be relatively high. When CS voltage reaches the internal limitation (1.8V), the power MOSFET will be turned off instantaneously. This cycle by cycle current limitation can help protecting power MOSFET, inductor and output diode.

The R_{OVP} function is also integrated in the IC, the LED open protection voltage is default with 126V, with L=2mH. I_{LED}=94.5mA. The V_{OVP} is given by:

$$Vovp \approx \frac{L(mH) \times I_{LED} (mA)}{K}$$

where，
L is the inductor value
K is constant is 1.5

5 PCB Layouts

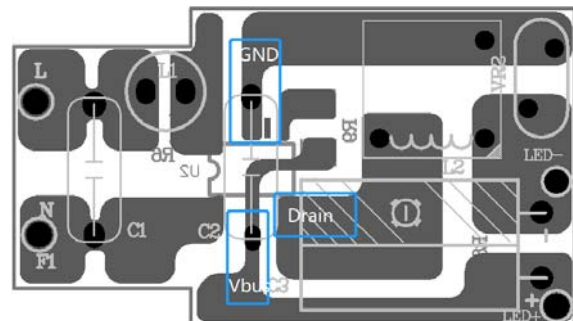The following guidelines should be followed in BP2371XG PCB layout:

Ground VB Path

Try to increase GND, copper area of VB pin to improve chip heat dissipation.

Drain Path

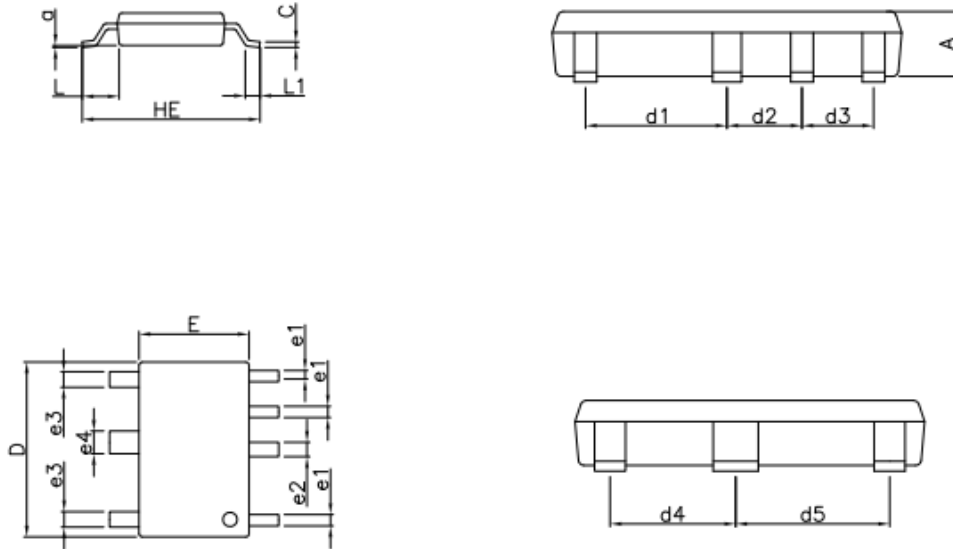Keep a short and wide ground path for current sense resistor.

The Area of Power Loop

The area of main current loop should be as small as possible to reduce EMI radiation.

PCB LAYOUT

Package (ASOP7)

Unit	mm			Unit	mm		
/	min	typ	max	/	min	typ	max
A	1.05	1.15	1.25	d1	2.46	2.51	2.56
C	0.15	0.20	0.22	d2	1.28	1.33	1.38
D	6.0	6.2	6.4	d3	1.22	1.27	1.32
E	3.70	3.9	4.1	d4	2.18	2.23	2.28
HE	5.9	6.0	6.1	d5	2.68	2.73	2.78
L	0.95	1.05	1.15	e1	0.35	0.40	0.45
L1	0.40	/	0.80	e2	0.46	0.51	0.56
a	0.2 (ref)			e3	0.50	0.55	0.60
				e4	0.75	0.80	0.85

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