

Description

BP2318 is a high precision non-isolated buck APFC 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. BP2318 operates in Critical Conduction Mode. Thanks for the Zero Current Switching, the switching loss is reduced and the inductor is fully utilized.

BP2318 utilizes patented current detection, with few external components, it achieves high precision output current, excellent line regulation and load regulation, also the advanced line regulation from flex configuration of external components.

BP2318 offers full of protection functions to improve the system reliability, including LED load open circuit protection, LED load short protection, VCC under voltage protection, Current Sense resistor open circuit protection, and over temperature protection. All the protection functions are auto-recovery. The system reliability is further improved by the thermal regulation function. The output current is reduced when the driver is in condition of over temperature, interface available for external setting.

Features

- Active-PFC for High PF and Low THD
- System Efficiency up to 95%
- Dimming interface available
- $\pm 3\%$ LED Output Current Accuracy
- Excellent Line and Load Regulation
- Critical Conduction Mode Operation
- Ultra Low (33uA) Start Up Current
- LED Short/Open Protection
- Current Sensing Resistor Open Protection
- Cycle by Cycle Current Limit
- VCC Under Voltage Protection
- Auto Fault Recovery
- Thermal Regulation Function
- Available in SOP8 Package

Applications

- LED retrofit lamps, Bulb, Spot Light, GU10/E27
- LED PAR30, PAR38 Lamp
- LED tube, LED String
- Other LED Lighting

Typical Application

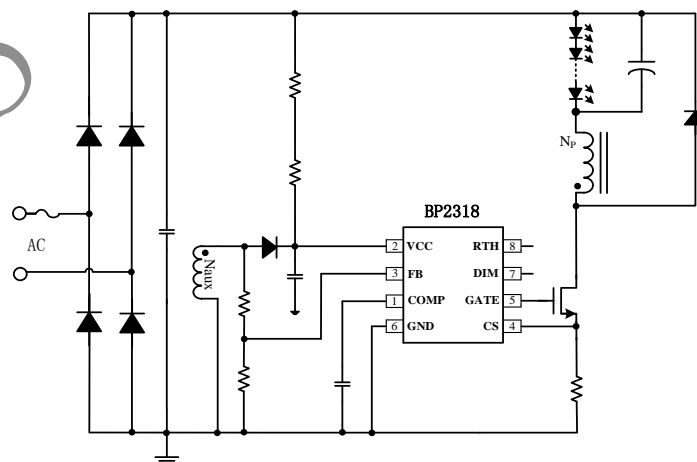


Figure 1 Typical application circuit for BP2318

Ordering Information

Part Number	Package	Operating Temperature	Packing Method	Marking
BP2318	SOP8	-40 °C to 105 °C	tape 4,000 pcs/reel	BP2318 XXXXXY XYY

Pin Configuration and Marking Information

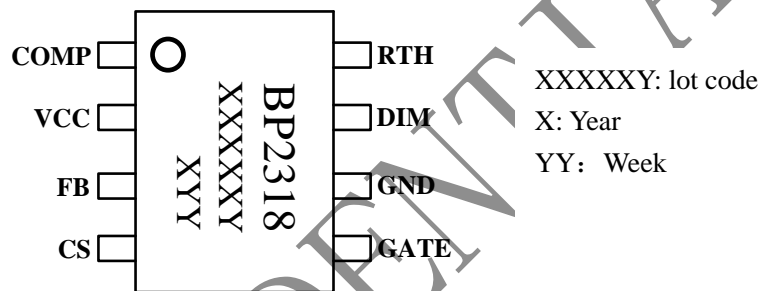


Figure 2. Pin configuration

Pin Definition

Pin No.	Name	Description
1	COMP	Loop Compensation Node. This pin connects a capacitor to GND for stabilization of the control loop, achieving accurate LED current, high Power Factor and low THD.
2	VCC	Power Supply Pin. Connect a bypass capacitor from this pin to GND.
3	FB	Feedback Voltage detection Pin. This pin detects the inductor demagnetization signal and the output voltage.
4	CS	Current Sense Pin. Connect a resistor to GND to sense the inductor current.
5	GATE	External MOSFET driving
6	GND	Ground.
7	DIM	Dimming interface, default offset
8	RTH	Thermal regulation setting, connect resistor to GND, default offset

Absolute Maximum Ratings (note1)

Symbol	Parameters	Range	Units
V _{CC}	IC supply	-0.3~25	V
I _{CC_MAX}	Max. Clamp current on VCC	5	mA
COMP	Compensation pin voltage	-0.3~6	V
FB	Feedback Voltage detection Pin	-0.3~6	V
CS	Current sense pin	-0.3~6	V
DIM	Dimming interface	-0.3~6	V
RTH	Thermal regulation	-0.3~6	V
GATE	MOSFET driving	-0.3~25	V
P _{DMAX}	Power dissipation (note2)	0.45	W
θ _{JA}	Thermal resistance (Junction to Ambient)	145	°C/W
T _J	Operating junction temperature	-40 to 150	°C
T _{STG}	Storage temperature range	-55 to 150	°C
	ESD (note3)	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
V _{CC}	Power supply voltage	8.5 ~ 19	V

Electrical Characteristics (Notes 4, 5) (Unless otherwise specified, $V_{CC}=17V$ and $T_A=25\text{ }^\circ\text{C}$)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Supply Voltage Section						
V_{CC_ON}	V_{CC} Turn On Threshold	V_{CC} Rising		17.5		V
V_{CC_UVLO}	V_{CC} Turn Off Threshold	V_{CC} Falling		7.6		V
V_{CC_OVP}	Over voltage protection			21		V
V_{CC_CLAMP}	V_{CC} Clamp Voltage			25		V
I_{CC_UVLO}	V_{CC} Startup Current			33	50	μA
I_{CC}	V_{CC} Operating Current			1	2	mA
Feedback						
V_{FB_FALL}	Falling Edge low	FB Falling		0.2		V
V_{FB_HYS}	FB Hysteresis Voltage	FB Rising		0.15		V
V_{FB_OVP}	FB OVP Threshold			1.6		V
T_{ON_MAX}	Maximum On Time			25		μs
T_{OFF_MIN}	Minimum Off Time			3		μs
T_{OFF_MAX}	Maximum Off Time			150		μs
Current Sense						
V_{CS_LIMIT}	CS Peak Voltage Limit			1.5		V
T_{LEB_CS}	Blanking Time for CS			350		ns
T_{DELAY}	Switch off Delay Time			200		ns
Compensation						
V_{REF}	Internal Reference Voltage		0.291	0.3	0.309	V
V_{COMP_LO}	COMP Low Voltage			1.5		V
V_{COMP}	COMP Linear operation Range		1.5		3.5	V
V_{COMP_OVP}	COMP High Voltage			3.6		V

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Dimming						
V _{DIM_ON}	Dimming on	DIM rising		0.9		V
V _{DIM_HYS}	Hysteresis for Dimming	DIM falling		0.2		V
V _{DIM_MIN}	Min. range of analog			1.0		V
V _{DIM_MAX}	Max. range of analog			3.0		V
V _{DIM_OPEN}	DIM open voltage			5		V
R _{DIM_PULL UP}	DIM pull up resistor			600		kΩ
Driving						
I _{SOURCE_MAX}	Max. sourcing			200		mA
I _{SINK_MAX}	Max, sinking			220		mA
Thermal Regulation						
V _{RTH}	Thermal regulation voltage			1.0		V
T _{REG}	Thermal Regulation Temperature	RTH pin open		150		°C

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

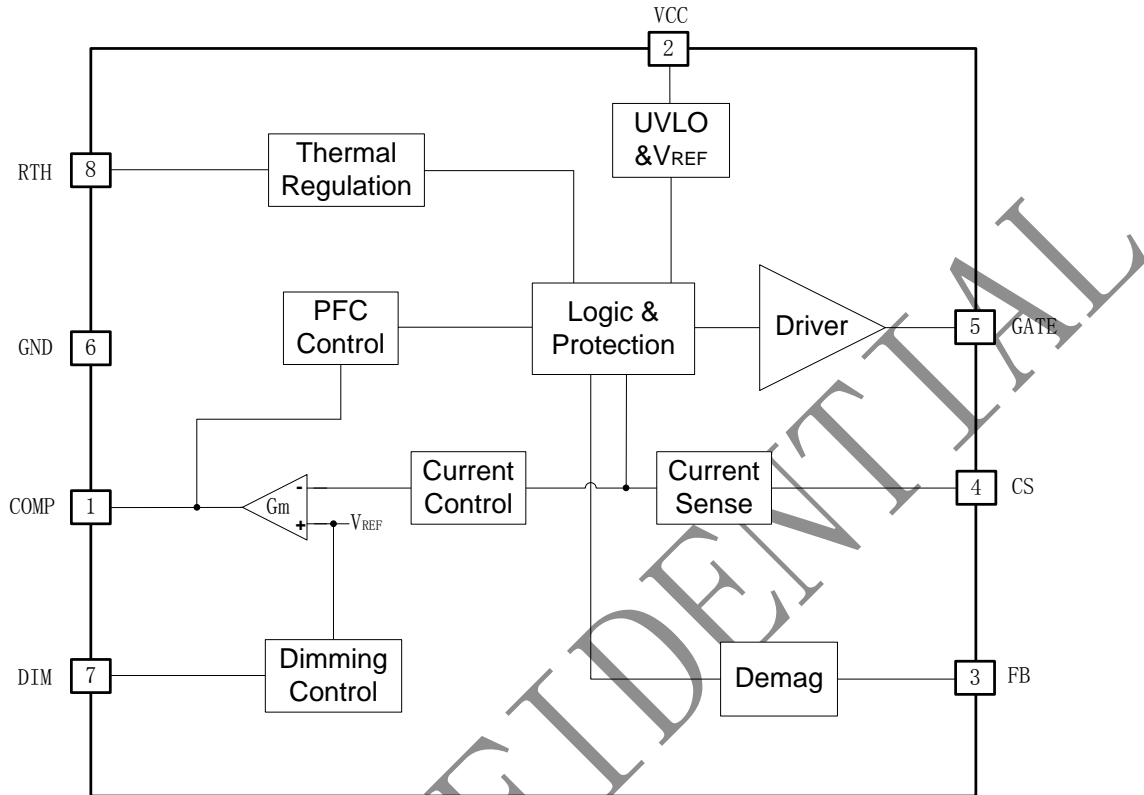


Figure 3. BP2318 Internal Block Diagram

Application Information

BP2318 with dimming function is a high-precision non-isolated buck APFC 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 powered on, the capacitor on VCC pin is charged up by the startup resistor. When the VCC pin voltage reaches the turn on threshold, the internal circuits start working. The COMP pin voltage is pulled up to 1.5V quickly, then the system starts switching from 7kHz frequency at the beginning, the COMP voltage rises up gradually, and the inductor peak current also rises up. The LED current hence achieves a soft start without

overshoot. After the output voltage is built up, the VCC power is supplied by auxiliary winding.

2 Constant Current Control

BP2318 utilizes patented current detection, with few external components, it achieves high precision output current, excellent line regulation and load regulation.

The LED current can be calculated by:

$$I_{OUT} \approx \frac{V_{REF}}{2 \times R_{CS}}$$

Where,

V_{REF}: Internal reference voltage

R_{CS}: Value of the current sensing resistor

3 Feedback Network

BP2318 senses the zero current crossing information through the feedback network, the FB

falling threshold voltage is set to 0.2V with 0.15V hysteresis. The FB pin is multiple used to detect output voltage, the OVP threshold voltage is 1.6V. The ratio of FB upper resistor to lower resistor can be set as:

$$\frac{R_{FBL}}{R_{FBL} + R_{FBH}} = \frac{1.6V}{V_{OVP_FB}} \times \frac{N_P}{N_A}$$

Where,

R_{FBL}: The lower resistor of the feedback network

R_{FBH}: The upper resistor of the feedback network

V_{OVP}: Output over voltage setting point

N_P: Main winding;

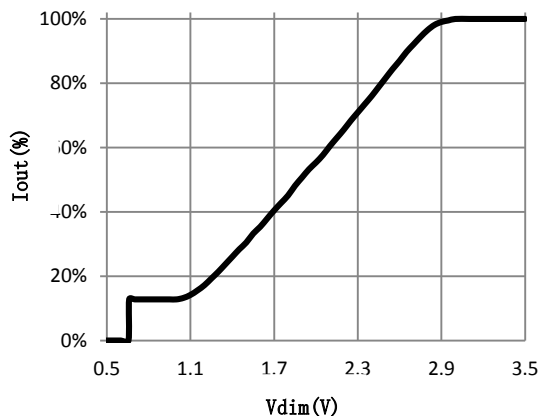
N_A: Auxiliary winding

Typical FB upper resistor is 220kΩ, and it helps on the accuracy line regulation.

4 Dimming

BP2318 is compile with PWM dimming and DC dimming. The dimming range for DIM pin is from 1V to 3V, see the dimming curve attached. When V_{dim} < 0.7V, the controller is to set gate off followed by COMP voltage drop to 1.5V clamped; when V_{dim} > 3V, the output current reach 100% and constant.

If no dimming request, on 100pF filter capacitor is connect to GND as default.

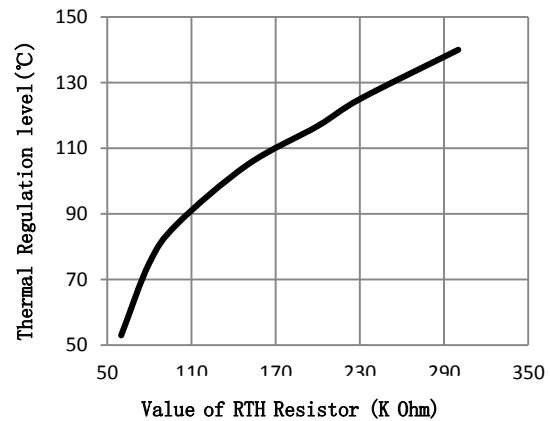


Dimming curve of Iout vs V_DIM

5 Thermal Regulation

BP2318 integrates thermal regulation function. When the system is over temperature, 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.

BP2318 has the threshold temperature of thermal regulation as optional of resistor value on RTH pin. The pull high voltage for RTH pin is 1.0V, lower resistor to lower thermal regulation level, and the relationship shown as below:



RTH resistor setting for thermal regulation

When RTH open, the thermal regulation level is 150°C as default.



6 Protection Functions

To improve the system reliability, BP2318 offers protection functions:

When the LED is open circuit, the output voltage will gradually rise up. The output voltage is sensed by the FB pin when power MOSFET is turned off. When FB voltage reaches the OVP threshold, it will trigger fault logic and the system stops switching.

In series, the output voltage is sensed by the reflection voltage on Vcc. When $V_{cc} > 21V$, it will trigger OVP protection and the system stops switching. The Vcc voltage is clamped at 25V.

When the LED is shorted circuit, the switching frequency will work under 7 kHz. Meanwhile, the output voltage is low and the VCC pin cannot be charged up by the output voltage, so the VCC pin voltage will gradually decrease and finally reaches the UVLO threshold.

After the system enters into fault condition, the VCC voltage will decrease until it reaches UVLO threshold. Then the system will re-start again. If the fault condition is removed, the system will resume normal operation.

When the output is short circuit or the inductor is saturated, the CS peak voltage will be relatively high. When CS voltage reaches the internal limitation (1.5V), the power MOSFET will be turned off instantaneously. This cycle by cycle current limitation can help protecting the power MOSFET, the inductor and the output diode

7 PCB Layouts

The following guidelines should be followed in BP2318 PCB layout:

Bypass Capacitor

Put the bypass capacitor close to VCC pin, and loop compensation capacitor to COMP pin.

Ground Path

Keep a short and wide ground path for current sense resistor. The IC signal ground for COMP and FB components should be connected to the IC GND.

The Area of Power Loop

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

FB Pin

Put the divider resistor close to the FB pin as possible, and keep the trace away to the switching node.

Package

