晶丰明源半导体

BP3516C

PSR Isolated CCCV Driver IC

Description

BP3516C is PSR isolated CCCV driver IC. The device operates in discontinued conduction mode and is suitable for 85Vac~265Vac universal input offline LED lighting. The BP3516C integrates a 650V power MOSFET with constant current & constant voltage control engine. It can perform in high accurate CCCV without external compensation capacitor, benefit to save the BOM size and cost.

The BP3516C supports multiple control mode of PWM and PFM, which contribute to very low standby power, high efficiency and minimum no load noise.

The BP3516C offers rich protection functions to improve the system reliability, including cycle by cycle peak current control, load open/short protection, VCC under/over voltage protection, and over temperature protection.

Features

- PSR Isolated CCCV control
- PWM/PFM multiple mode control
- Internal 650V Power MOSFET
- Standby power <100mW
- ±5% Output Accuracy
- Internal soft startup
- Load open protection
- Load short protection
- VCC under voltage protection
- Over temperature protection
- Cycle by cycle peak current control
- Available in SOP8 package

Applications

- Chargers
- Standby/auxiliary power
- LED driving model

Typical Application

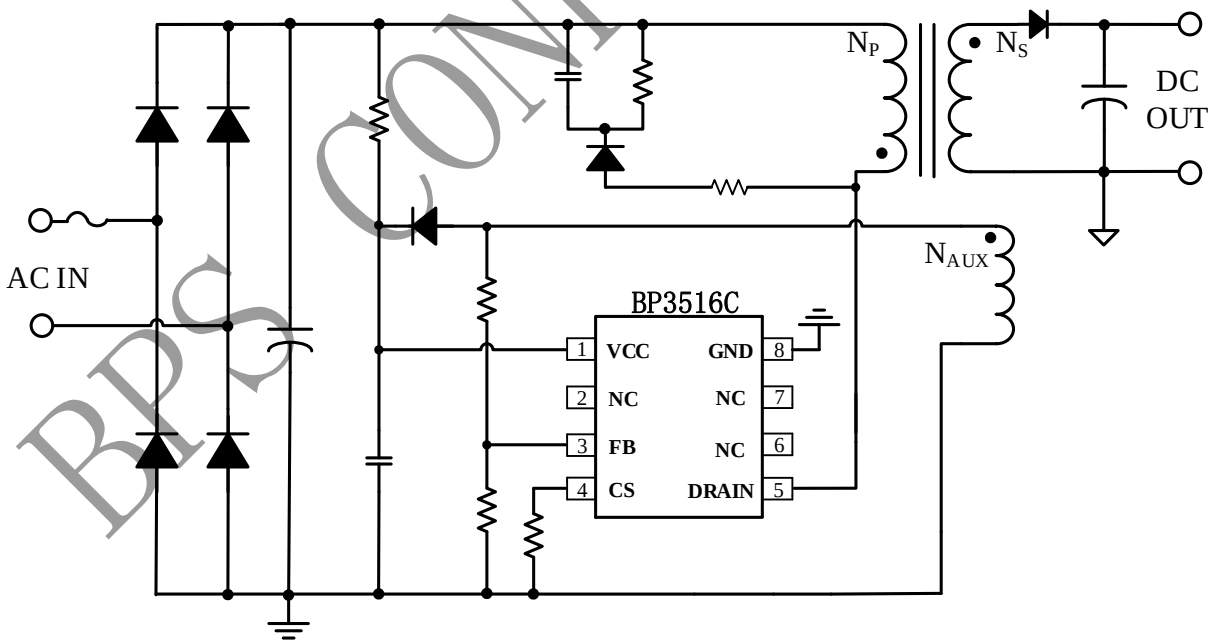
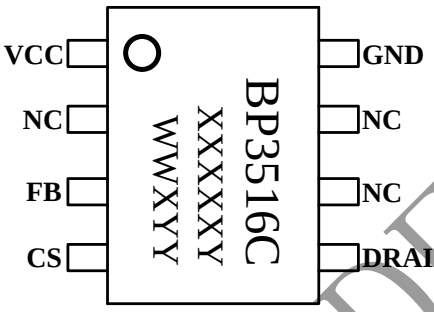


Fig1 Typical application circuit for BP3516C

Ordering Information

Part Number	Package	Operating Temperature	Packing Method	Marking
BP3516C	SOP8	-40℃ to 105℃	Tape 4,000 Piece/Reel	BP3516C XXXXXY WWXYY

Pin Configuration and Marking Information



XXXXXY: Lot Code
WW: Sign
X: Year
YY: Week

Fig2 Pin configuration

Pin Definition

Pin No.	Name	Description
1	VCC	Power Supply Pin
2,6,7	NC	NO connection
3	FB	Feedback pin
4	CS	Current Sense Pin. Connect a sense resistor between this pin and GND pin.
5	DRAIN	Internal HV Power MOSFET Drain.
8	GND	Ground

Absolute Maximum Ratings (note1)

Symbol	Parameters	Range	Units
V_{DS}	Internal HV MOSFET Drain to Source voltage	-0.3~650	V
V_{CC}	VCC pin voltage	-0.3~30	V
I_{CC_MAX}	VCC pin maximum sink current	10	mA
V_{FB}	Feedback Voltage detection Pin	-0.3~6	V
V_{CS}	Voltage on Current sense pin	-0.3~6	V
P_{DMAX}	Power dissipation (note2)	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 (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 $P_{DMAX} = (T_{JMAX} - T_A)/\theta_{JA}$ 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}	Supply voltage	10~ 25	V
P_{OUT1}	Output power（Vin_ac:230V±15%）	6	W
P_{OUT2}	Output power(Vin_ac:85V～265V)	5	W
F_{OSC_MAX}	Max. operation frequency	65k	Hz

Electrical Characteristics (Notes 4, 5) (Unless otherwise specified, V_{CC}=16V and T_A=25 ℃)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Supply Voltage Section						
V_{CC_CLAMP}	V_{CC} Clamp Voltage	5mA		27		V
V_{CC_OVP}	V_{CC} OVP Threshold			29		V
V_{CC_ON}	V_{CC} Turn On Threshold	V_{CC} Rising		15.3		V
V_{CC_UVLO}	V_{CC} Turn Off Threshold	V_{CC} Falling		7.6		V
I_{ST}	V_{CC} Startup Current	V_{CC}= V_{CC-ON} - 1V		12		uA
I_{OP}	V_{CC} Operating Current	V_{FB}=3V,V_{CS}=0		240		uA
Current Sense Section						
V_{CS_TH}	CS Peak Threshold		582	600	618	mV
T_{LEB}	Leading Edge Blanking			500		ns
Feedback Section						
$V_{FB\_EA\_REF}$	Internal EA Reference Voltage		2.91	3	3.09	V
V_{FB_OVP}	FB OVP Threshold			4		V
V_{FB_DEM}	FB ZCD Threshold			0.1		V
V_{FB_SHORT}	Output short protection Threshold			0.58		V
F_{OSC_SHORT}	Clamp frequency for output short			20		kHz
T_{SAMPLE_BIG}	Samples time	V_{CS_TH} =600mV		5.8		us
T_{OFF_MAX}	Max. OFF time			1		ms
T_{DEM}/T_{SW}	Time ratio of CC mode			0.5		
Power MOSFET						
R_{DS_ON}	Static Drain-source On-resistance	V_{GS}=10V/I_{DS}=0.5A		12		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 Section						
T_{SD}	Thermal shunt down			150		℃
T_{SD_HYS}	Hysteretic temperature for thermal recover			30		℃

Note 4: *production testing of the chip is performed at 25 ℃.*

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

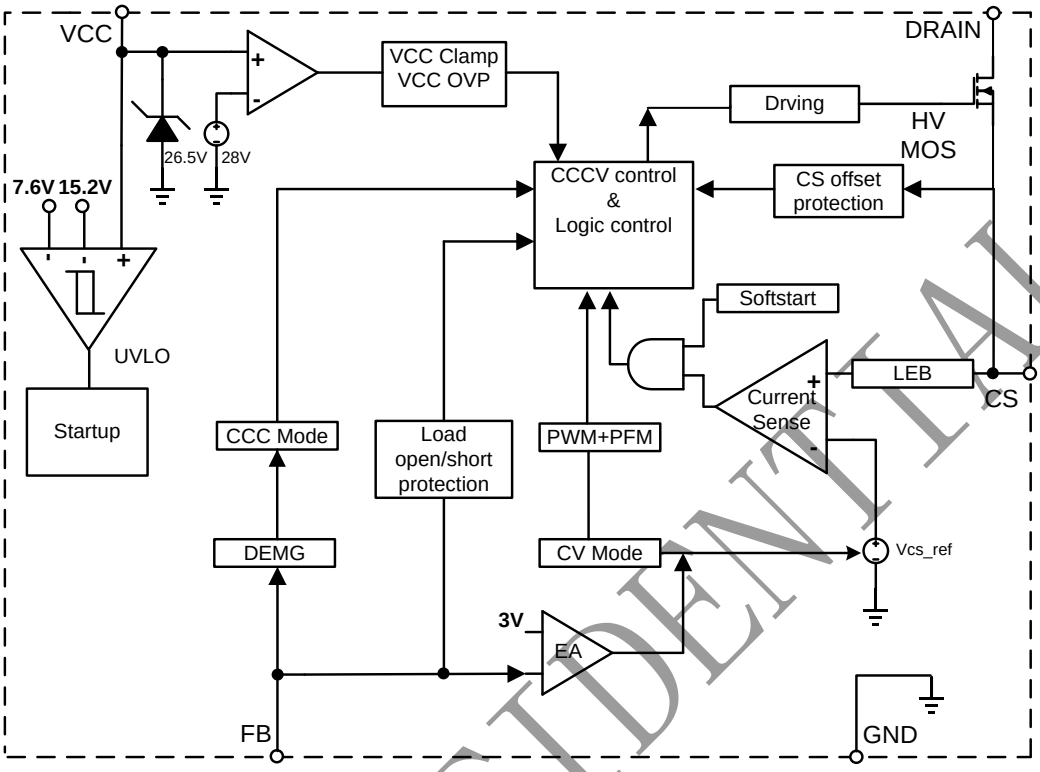


Fig3 BP3516C Internal Block Diagram

Application Information

BP3516C is primary side regulation isolated CCCV driver IC, operating in DCM mode. BP3516C can work in multiple control mode of PFM and PWM providing high accurate constant current control and constant voltage control. BP3516C has a 650V HV MOS integrated so that there is very few external components required in bill of material. BP3516C provides the popular solutions for chargers, standby power, LED drivers and any CCCV request.

Start Up

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. Once the start level has been reached the start-up current source is switched off. During switching operation it is supplied by the regulated source from auxiliary winding.
Soft start is also implemented during startup within 1ms timeslot, and activated to increase the primary side peak current in steps. The soft start is available in every restart cycle.

Constant Current Control

The peak current of primary side inductor is sensed cycle by cycle. The CS pin monitors the peak level and inputs into the internal comparator with converted voltage of the switching status; once the voltage above the reference threshold, the switching would be stopped.

The peak current for full load is defined as:

$$I_{P\_PK} = \frac{600}{R_{CS}}(mA)$$

The peak detection has a fixed 500ns lead edge

blanking time on CS.

The LED current is defined as:

$$I_{OUT} = \frac{I_{P\_PK}}{4} \times \frac{N_P}{N_S}$$

Where,

Np is the primary side windings;

Ns is the secondary side windings.

I_{P_PK} is the primary side peak current.

Constant Voltage Control

BP3516C senses the reflection voltage from auxiliary winding by divider resistor on FB pin. The constant output voltage is ensured by this sense voltage and internal reference in close loop.

The output voltage V_{OUT} is defined as:

$$V_{OUT} = \frac{3*(R_{FBL} + R_{FBH})}{R_{FBL}} * \frac{N_S}{N_{aux}}$$

Where,

R_{FBL} is pull high resistor on FB pin;

R_{FBH} is pull high resistor on FB pin;

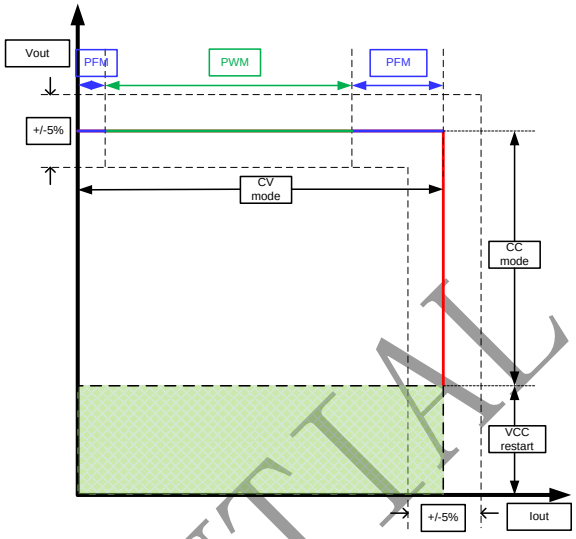
Naux is the auxiliary winding.

This sense voltage is also serve for over voltage protection, and the Vovp defined as:

$$V_{OVP} = \frac{4*(R_{FBL} + R_{FBH})}{R_{FBL}} * \frac{N_S}{N_{aux}}$$

Multiple mode control: PWM/PFM

BP3516C is to use multiple mode control to improve the performance on efficiency, standby power, and audible noise in low load condition.



Protections

BP3516C offers rich protections to improve the system reliability, including output overvoltage protection, load short protection, Vcc under voltage lock out protection, over temperature protection.

This sense voltage on FB is also serve for load over voltage protection. The detection threshold is 4V on FB, and the Vovp defined as:

$$V_{OVP} = \frac{4*(R_{FBL} + R_{FBH})}{R_{FBL}} * \frac{N_s}{N_{aux}}$$

Where Vovp is the design expectation on OVP.

When the sense voltage on FB is under 0.58V, as default the system would open guard for short protection and operating frequency clamped to 20kHz, which could save the stress on MOSFET. The system will restart after 48ms timeout.

During any fault condition, the Vcc voltage would be discharged. As well the Vcc voltage under UVLO threshold, the system will restart till shift to normal condition once the fault condition removed.

PCB Design Guide

Suggestions for PCB layout of BP3516C application:
1. Bypass Capacitor on Vcc:

The bypass capacitor on V_{CC} pin should be as close as possible to the V_{CC} Pin and GND pin.

2. Divider resistor for FB pin

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

3. GND

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

4. NC pins

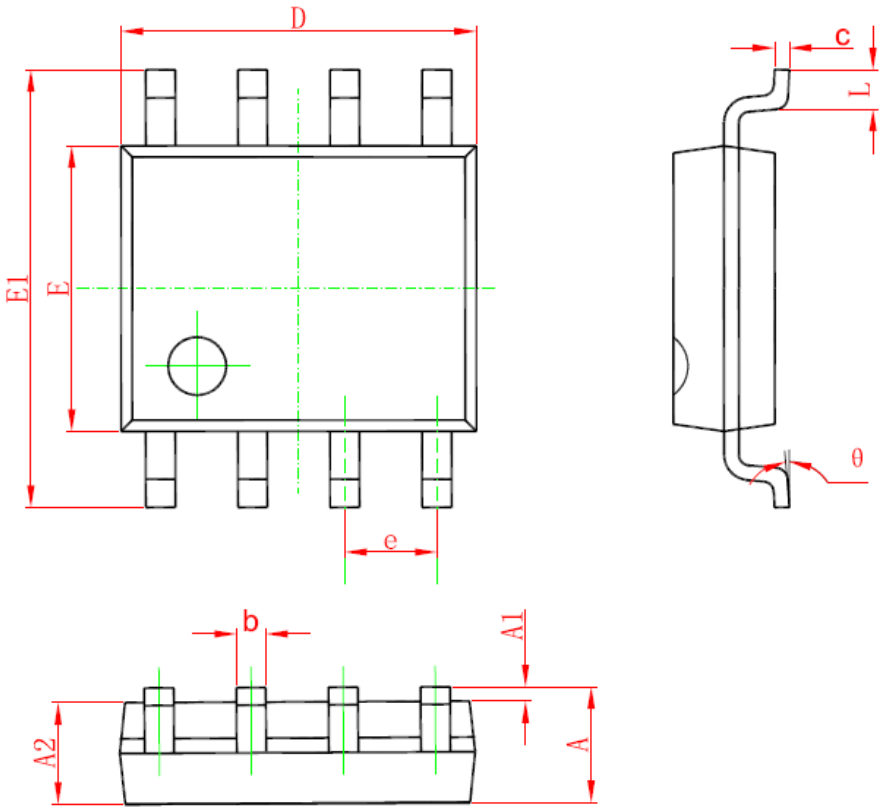
Set Pin6 and Pin7 offset to keep the safety space.

5. The Area of Power Loop

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

Physical Dimensions

SOP8 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°