WS3410 Active PFC Non-isolated Buck LED Driver

Features

- High Power Factor Correction, Low Total Harmonic Distortion
- Dynamic Temperature Compensation
- No Auxiliary Winding For Supplying
- Valley Switching, High efficiency, Low EMI
- Automatic Compensate the Inductance Variation
- Automatic Adapt to the Change of Output Voltage
- LED Short Circuit Protection
- Over Voltage Protection
- Over Temperature Protection
- Open Circuit Protection
- Few External Components

Applications

- LED Driver Supply

General Description

The WS3410 is designed for active PFC non-isolated buck LED driver. It operates at valley switching mode with high efficiency, low EMI and High PF. The output current automatically adapt to the variation of the inductance and the output voltage. The truly constant current LED is realized.

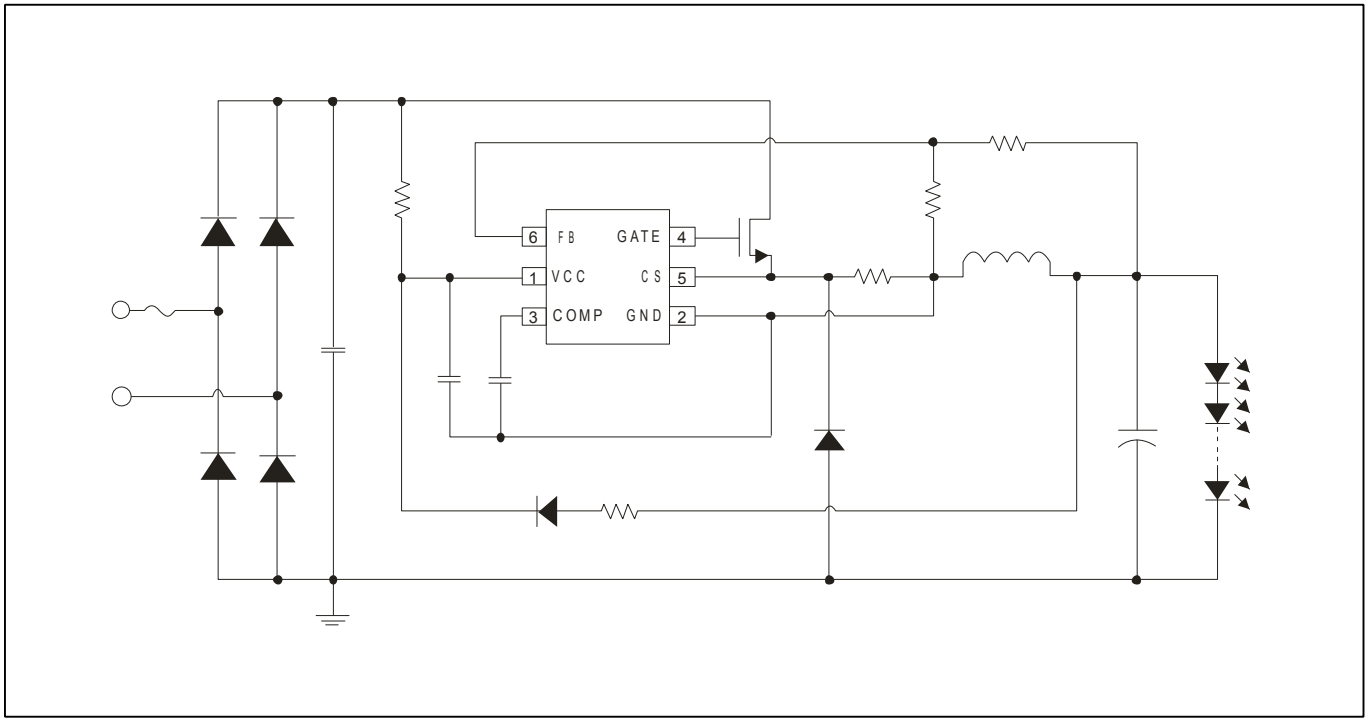
The WS3410 using SOT23-6 package,It can achieve excellent constant current performance with very few external components.

The WS3410 offers rich protection functions, including over voltage protection, LED short circuit protection, cycle by cycle current limiting, dynamic temperature compensation, over temperature protection and soft start.

WS3410 consumes very low start current and operation current, driving LED efficiently under universal AC input(85VAC~265VAC).

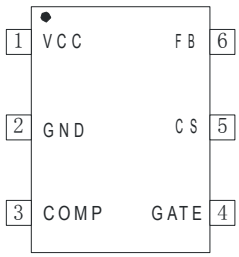
WS3410 is available in SOT23-6 package.

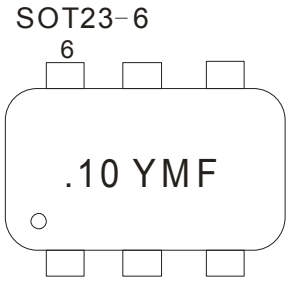
Typical Application Circuit



Pin Definition and Device Marking

WS3410 is available in SOT23-6 package.



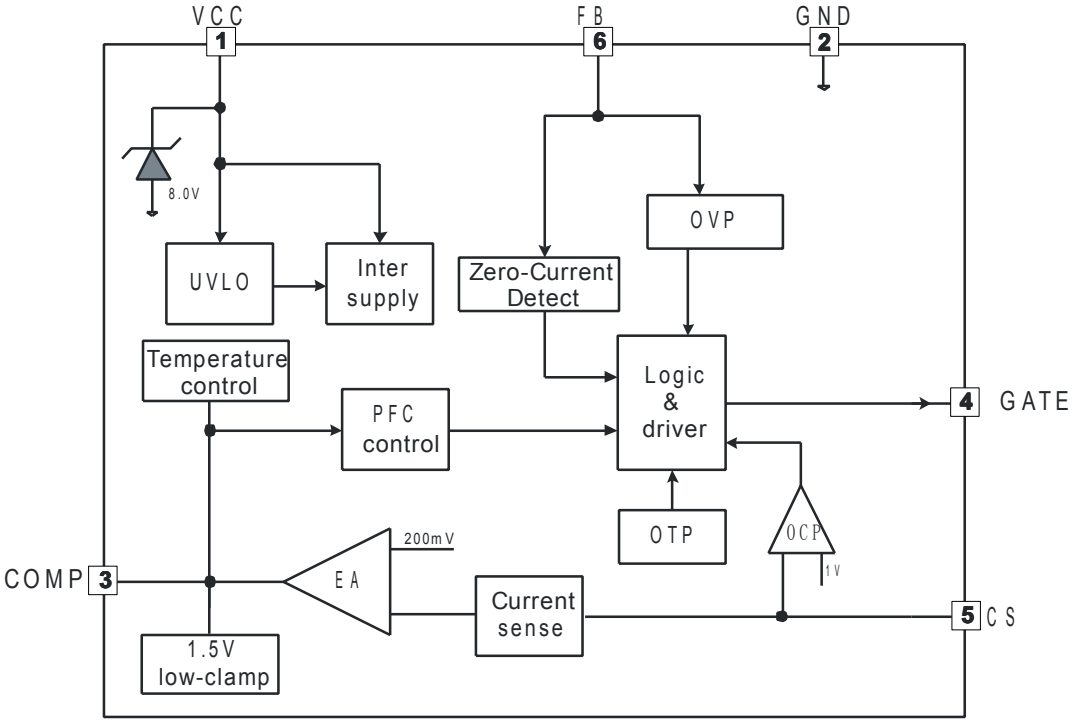


10: WS3410
Y: Year 4=2014，
M: Month 1,2…A=10,B=11,C=12
F: Factory No.

Pin Function Description

Pin Name	Pin NO.	Description
VCC	1	Power supply
GND	2	Ground
COMP	3	Loop compensation, with a cap to GND.
GATE	4	Driver output pins
CS	5	Current sampling end
FB	6	Feedback signal input.

Block Diagram



Ordering Information

Package	Part Number	Marking
6-Pin SOT23-6, Pb-free	10YMF	WS3410YP

Absolute Maximum Ratings

symbol	parameter	Range	Units
V_{CC}	The power supply voltage input	-0.3~Vcc_clamp	V
Gate	Drive output	-0.3~8	V
V_{CS}	CS current sampling voltage	-0.3~7	V
V_{FB}	Feedback voltage input	-0.3~7	V
V_{COMP}	Loop Compensation Pin voltage	-0.3~7	V
P_{DMAX}	Power dissipation	0.5	W
T_J	Max. Operating junction temperature	150	℃
T_{STG}	Max./Min. Storage temperature range	-55~150	℃

Note:Limit parameter exceed the stated in the table will cause device damage. Do not recommend conditions the device work in more than the limit, in extreme conditions, may affect device reliability.

Electrical Characteristics (Unless otherwise specified，T_A=25℃，VCC=8V)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Supply Voltage Section						
V_{cc_clamp}	VCC Clamping Voltage		7.5	8.0	8.5	V
I_{cc_clamp}	VCC Clamping Current				5	mA
V_{CC_ST}	VCC Start Up Voltage	VCC Rise		7.5		V
V_{uvlo_HYS}	VCC Under Voltage Latch Out Hysteresis	VCC Falling		1.25		V
I_{st}	Start Up Current	VCC<VCC_ST-0.5V		70	100	uA
I_{op}	Operation Current			400		uA
Current Sensor Section						
Vocp	Current Sensor Voltage Threshold			1		V
T_{LEB}	Leading Edge Blanking			350		ns
Td	Turn Off Delay Time			200		ns
Loop Compensation Section						
V_{REF}	Internal Reference Voltage		194	200	206	mV
Internal Reference Voltage						
T_{OFF_MIN}	Min. Demagnetization Time			3		us
T_{ON_MAX}	Max. On Time			20		us
Feedback input Section						
V_{FB}	OVP Threshold Voltage			1.6		V
V_{ZCD}	Zero Crossing Checking Threshold			0.2		V
Drive Section						
VOH	Output voltage high	VCC=8V，Io=20mA	7			V
VOL	Output voltage low	VCC=8V，Io=-20mA			0.5	V
Tr	Rising time	VCC=8V，Cgate=1nF		200		ns
Tf	Falling time	VCC=8V，Cgate=1nF		80		ns
Over Temperature Section						
T_{SD}	Thermal Shut Down Temperature			160		℃
T_{SD_HYS}	Thermal Shut Down Hysteresis			30		℃

Function Description

The WS3410 is designed for active PFC non-isolated buck LED driver, using SOT23-6 package, It operates under valley switching mode, automatically adapting to the variation of the inductance and the output voltage. It can achieve excellent constant current performance with very few external components.

Start up

The start current is very low, Typ. 70uA(Max. 100uA). Under the design system of 85VAC, the startup resistor is:

$$R = \frac{85 * \sqrt{2}}{100} = 1.2M$$

Chip Supply

After startup, the output voltage should supply the chip, rectifier diodes D6 need to use fast recovery diodes.Current limiting resistor R4 is calculated as:

$$R_4 = (1 - D) * \frac{V_{LED} - 9}{400uA}$$

Where, D is duty cycle, 400uA is the normal operation current of the chip, Vled is output load voltage. The consumption of R4 is:

$$P_{R4} = \frac{(V_{LED} - 9)^2}{R_4} * (1 - D)$$

For example:

Requirements:180~260V input voltage, 36~80V output, 240mA output current.

The R4 design of above program should be met:

1. Supply Problem when Min. input AC voltage 180V and Min. output voltage 36V(which is the weakest power supply):

D=36/180/1.414=0.141,R4=(1-0.141)*(36-9)/400uA=58k

2.Power consumption problem of R4 when Max. input AC voltage 260V and Max. output voltage 80V(which is the strongest power supply):

D=80/260/1.414=0.218

The power consumption of R4:

P=(80-9)*(80-9)/58*(1-0.218)=68mW

Sence Resistor

The WS3410 is designed for active PFC non-isolated buck LED driver. It operates under valley switching mode and can achieve high accuracy constant current performance with very few external components. The peak current of inductor is continuous detected. CS terminal is connected internal of the chip, and compared with the internal 200mV. Internal Amplifier's output COMP adjust the on-time, making the average value so CS equal to 200mV after the system is stable. In addition, a 1V cycle-by-cycle over current protection is set up inside CS pin.

LED output current:

$$I_{LED} = \frac{0.2V}{R_{CS}}$$

FB Voltage Detection

FB voltage determines the working status of the system, when FB is greater then 1.6V(typ.), WS3410 will automatically considered as output over voltage protection. The system will enter extremely energy efficient hiccup mode. Output over voltage protection voltage as follows:

$$V_{OVP} = 1.6 * \frac{R_2 + R_3}{R_3}$$

R2,R3,please refer to the typical application diagram, in which R3=10k(Not over 15 K, not less than 8.2 K). use 1.3 instead of constant 1.6 in the above formula in the design of system. Assuming Vovp=90V, we got R2=552k from the above formula, choosing 560k for R2 (larger as far as possible).Because VFB2 is between 1.3 and 1.9, choose 1.9 to calculate the withstand voltage of C4, Vovp=1.9*(10+560)/10=108V,The withstand voltage of C4 shoule larger than the above value, 200V capacitor could be used. WS3410 will automatic detect the output voltage when enters hiccup mode; and will re-enter the normal working state when the output voltage is lower than Vovp.

Output Open(Short) protection

Output open/short protection is integrated inside WS3410. Once output open/short circuit is detected, the system will automatic enter hiccup mode until the protection signal disappear.

Over Temperature Automatic adjustment of output current

WS3410 has over temperature regulating function, gradually reducing the output current when the power is over temperature, so as to control the output power and the temperature rise, keeping the power temperature in a setting value in order to improving the reliability of the system. The starting regulation temperature is 135℃.

Input Filter Capacitor

In order to obtain high PF value, the input capacitor can not be too large. 10-100nF is recommended.

Power Factor Correction

Active PFC control circuit is integrated in WS3410, which can get high PF value and low THD.

PCB Design

The following guidelines should be followed in WS3410 PCB layout:

Bypass Capacitor: The bypass capacitor on VCC pin should be as close as possible to the VCC and GND pins.

Ground Path: The power ground path for current sense should be short, and the power ground path should be separated from small signal ground path before the negative node of the bulk capacitor.

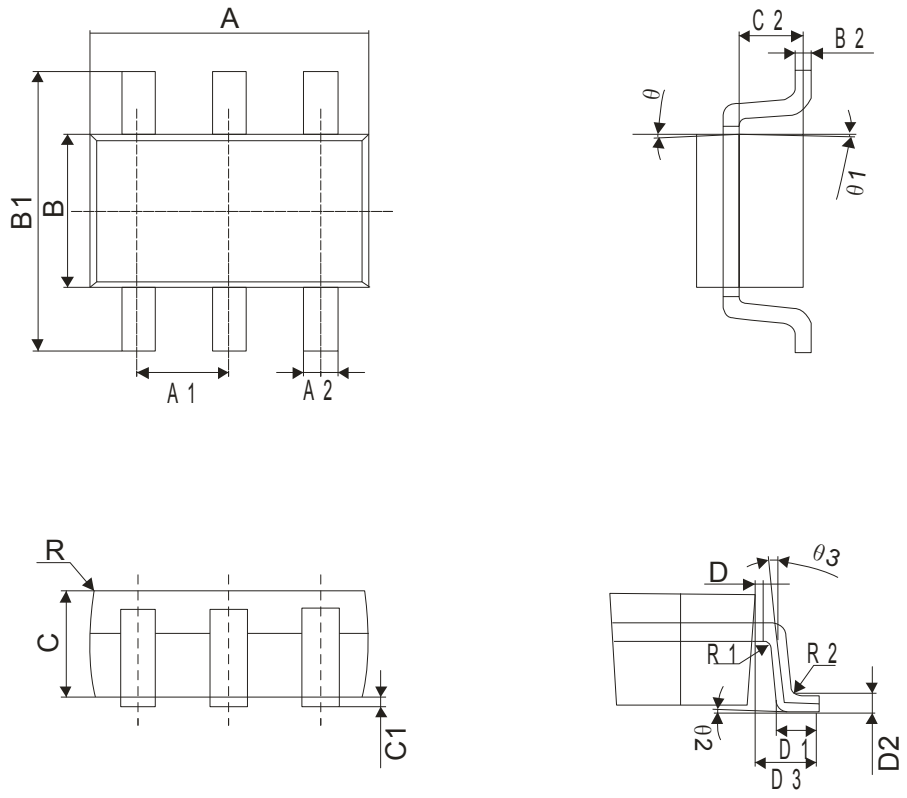
The Area of Power Loop: The area of power loop should be as small as possible to reduce EMI radiation.

And the controller should be placed away from the heat generator, such as the power diode.

Package Information

SOT23-6 Package Outline Dimensions

Unit:mm



Symbol	Winsemi			
	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	2.72	3.12	0.107	0.123
B	1.40	1.80	0.055	0.071
C	1.00	1.20	0.039	0.047
A1	0.90	1.00	0.035	0.039
A2	0.30	0.50	0.012	0.020
B1	2.60	3.00	0.102	0.118
B2	0.119	0.135	0.005	0.005
C1	0.03	0.15	0.001	0.006
C2	0.55	0.75	0.022	0.030
D	0.03	0.13	0.001	0.005
D1	0.30	0.60	0.012	0.024
D2	0.25TYP		0.01TYP	
D3	0.60	0.70	0.024	0.028

NOTE:

1.We strongly recommend customers check carefully on the trademark when buying our product, if there is any question, please don't be hesitate to contact us.

2.Please do not exceed the absolute maximum ratings of the device when circuit designing.

3.Winsemi Microelectronics Co., Ltd reserved the right to make changes in this specification sheet and is subject to change without prior notice.

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