

High Precision PSR LED Constant Current Driver

Features

- Built-in 650V UHV Power MOS
- LED Constant Current: $\pm 5\%$
- Fixed Primary Peak Current: 185mA
- Without the Secondary winding
- Start up time less than 100ms
- High precision constant current regulation due to patented CC control
- Built-in line compensation
- Ultra low operation current
- Maximum power 4W
- LED open/short protection
- Floating pin protection
- Excellent EMI performance with PFM control
- Cycle-by-cycle current limit
- Built-in leading Edge Blanking
- VDD Under Voltage Lockout (UVLO)
- Built-in over temperature protection

Applications

- LED lighting

Description

WS3241 is a high precision primary side feedback constant current LED driver, suitable for flyback isolated LED in sub 4W power range at universal AC input. It operates in discontinuous current mode.

WS3241 integrates 650V power MOS. It operates in primary side sensing and regulation, without a secondary feedback circuit, also need not the auxiliary transformer winding detection and power supply, only need few peripheral components can realize constant current, greatly saves the cost and size of the system.

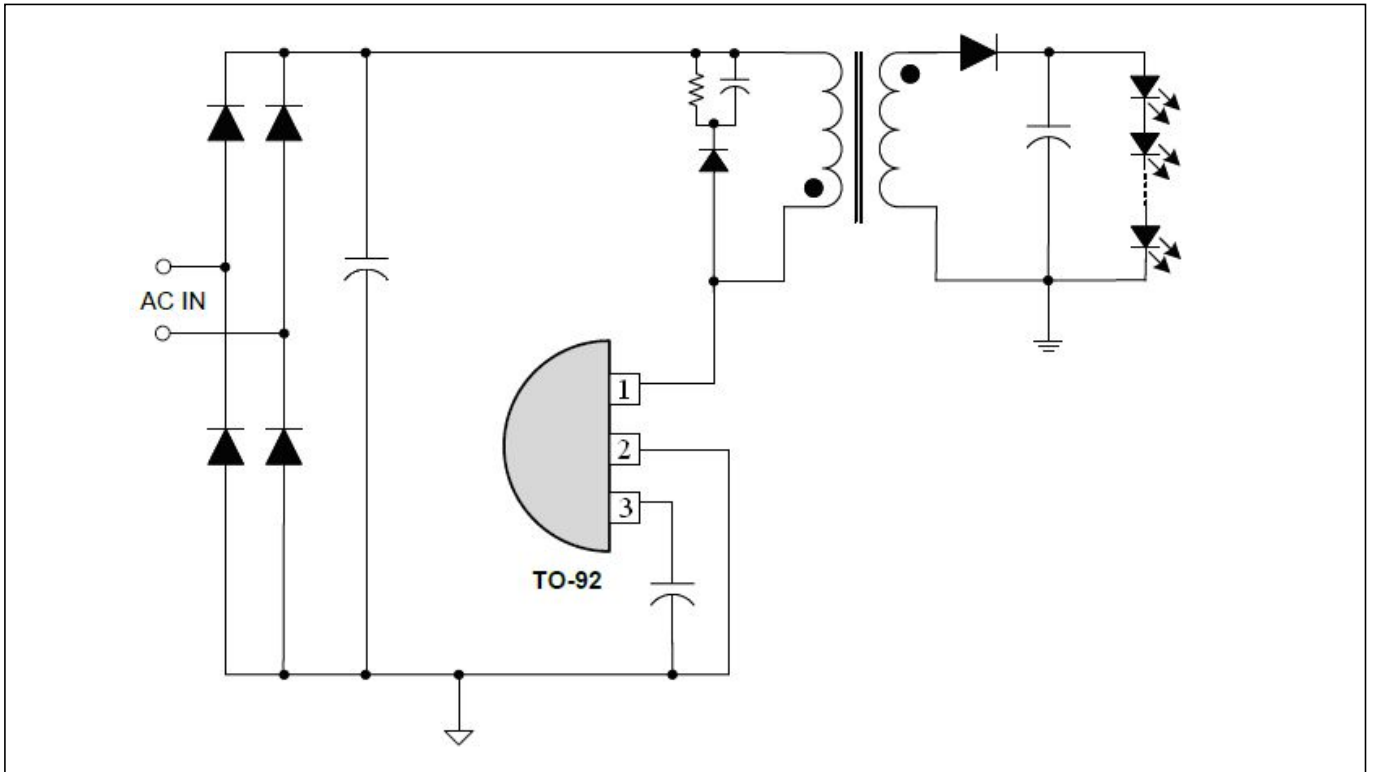
The start time of WS3241 is less than 100ms at universal AC input with the high voltage start technology, realizing instant bright of the LED lamp.

The current precision is less than $\pm 5\%$ with high precision current sampling circuit and line compensation. With patented constant current controlling mode, excellent linear regulation is achieved.

WS3241 provides a variety of comprehensive protection mode, including: cycle by cycle current limit protection(OCP), LED open/short circuit protection, under voltage protection and clamping, over temperature protection, pin floating protection etc..

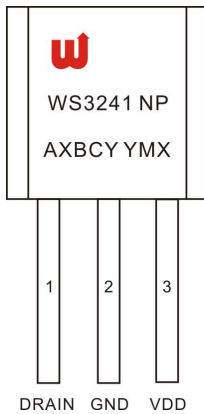
WS3241 is offered in TO-92 package.

Typical Application



Pin Configuration and Marking Information

WS3241 is offered in TO-92 package, as bellows:

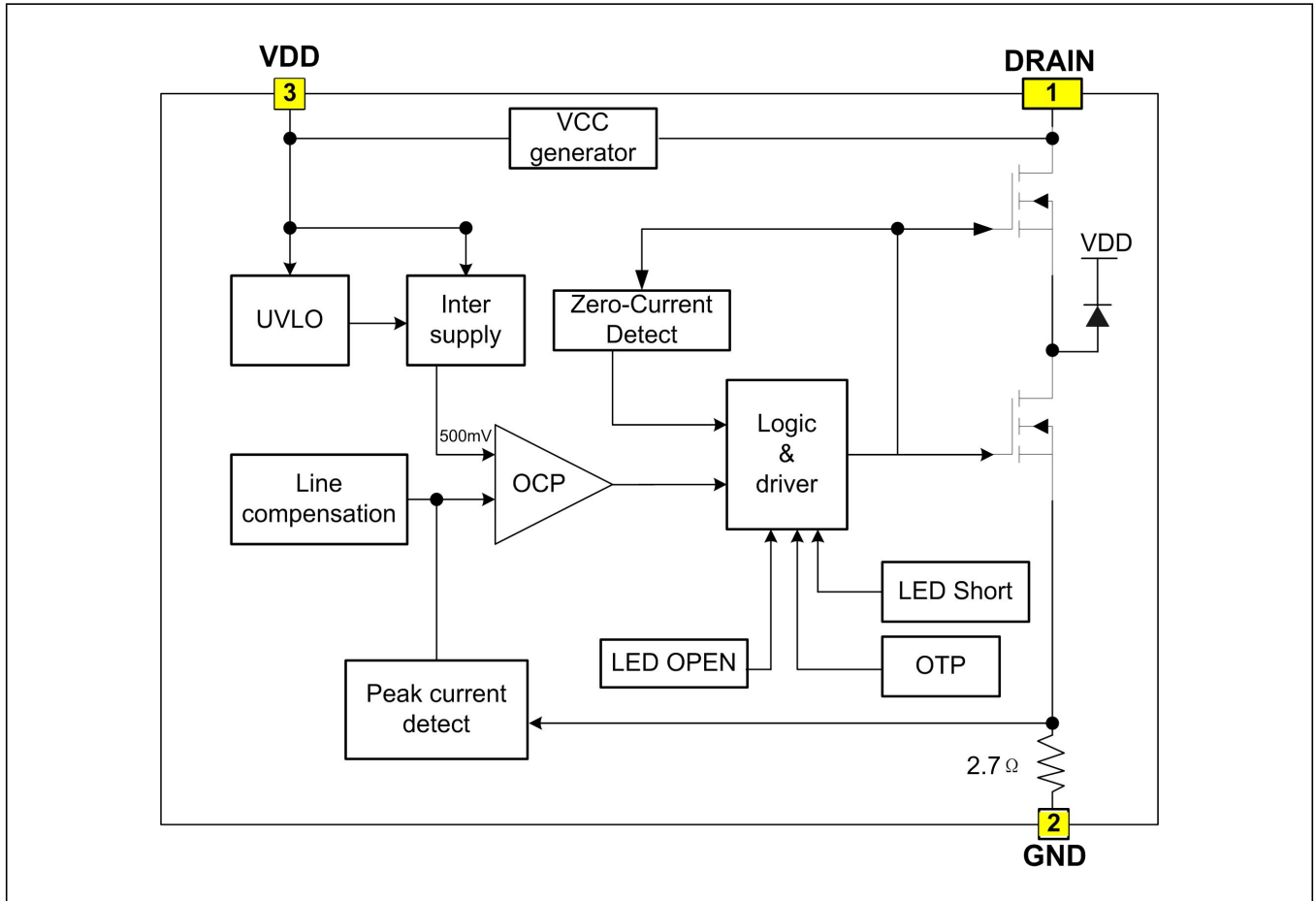


WS3241NP
 A: Product Code
 X: Internal Code
 BCY: Internal Code For QC
 YMX: D/C

Pin Definition

Pin Name	Pin No.	Pin Type	Function Description
Drain	1	Drain	The drain terminal of Power MOSFET
GND	2	Ground	Ground.
VDD	3	Power	Power Supply.

Internal Block Diagram



Ordering Information

Package	Marking	Part Number
3-Pin TO-92, Pb-free	WS3241NP	WS3241NP

Recommended Operation Conditions

Part Number	Package	Input voltage	Maximum output power
WS3241NP	TO-92	175VAC-264VAC	4 W
		90VAC-264VAC	3 W

Absolute Maximum Ratings

symbol	paramete	limites	unit
VDD	Power Supply	7	V
Ivdd_max	VDD Clamping current	10	mA
Drain	Drain of internal power MOS	-0.3~650	V
Tj	Maximun junction temperature	150	°C
Tjo	Operating temperature range	-40~150	°C
TSTG	Minimum/Maximum storage temperature	-55~150	°C

Note : Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device.

Electrical Characteristics (Unless otherwise specified, VCC=8V and TA =25 °C)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Supply Voltage Section						
VDD_C LAMP	VDD Clamping Voltage	10mA		6.3		V
VDD_re g	VDD Power Supply			5.8	6.1	V
UVLO_ off	VDD Under Voltage Lockout			5.3		V
I_VDD	Quiet Current	VDD=6.1V		150	250	uA
Current Sense Section						
Vcs	Threshold Voltage for Peak Current Limit		490	500	510	mV
TLEB	Lead Edge Blanking			500		ns
TDELA Y	Shutdown Delay			100		ns
D_max	Maximum Duty Cycle			50		%
Feedback Input Section						
Toff_m ax	Maximum Demagnetization time			255		us
Toff_mi n	Minimum Demagnetization time			3.6		us
Tdem_ OVP	Open loop detection reference Demagnetization time			4.5		us
Tcc/Tde m	Cycle time/demagnetization time @constant current			2		
Power MOSFET						
Rds_on	Power On Resistor	Idrain=50mA		30		Ω
BVdss	Breakdown Voltage		650			V
Idss	Leakage Current of Power MOS				10	uA
Over Temperature Protection						
TREG	Thermal Regulation Temperature			135		°C

Application Information

WS3241 is a constant current driver for LED lighting, adopted advanced constant current control method. It integrates 650V power switch. Only need a few peripheral components can achieve excellent constant current characteristic. With the primary side feedback technology, WS3241 do not need optocoupler and TL431, also need not the auxiliary winding for power supply and detection. Thus achieve the low system cost.

Low operation current

The operating current of WS3241 is very low. The typical value is 150uA. The low operating current improves the efficiency of the system, while reducing the VDD capacitor requirements.

Primary Feedback PSR Technology

Assume that the system works in DCM flyback mode, the power transmission equations can be expressed

$$P = \frac{\eta}{2} \times L_m \times I_{pk}^2 \times f_s = V_o \times I_o$$

Where, P is the output power, Vo and Io is the system output voltage and current, η is the system power conversion efficiency, Ipk is the primary side peak current, fixed 185mA.

In DCM mode, Demagnetization time Tdem can be expressed as:

$$\frac{V_o}{L_m} \times T_{dem} = \frac{N_s}{N_p} \times I_{pk}$$

Where, Np and Ns is the transformer primary and secondary turns, respectively. Combination of the above two formula, the average output current can be expressed as:

$$I_o = \frac{\eta}{2} \times I_{pk} \times \frac{N_p}{N_s} \times f_s \times T_{dem}$$

$$I_o = \frac{\eta}{2} \times I_{pk} \times \frac{N_p}{N_s} \times \frac{T_{dem}}{T_s}$$

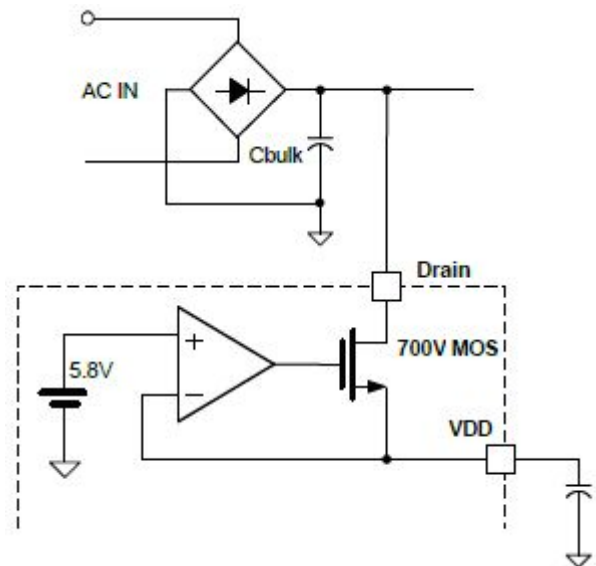
Where Ts is the switch cycle. WS3241 adopts PFM mode to realize constant current, making the peak inductor

current of primary side constant, also remains the ratio of the demagnetization time and the cycle time, which can realize constant output current, but also independent with the line input voltage and transformer inductance. The ratio of the demagnetization time and the cycle time is 0.5:

$$\frac{T_{dem}}{T_s} = 0.5$$

Single Chip Built-in 650V High Voltage Power Supply, Start time less than 100ms

Fig.1 shows the internal high voltage power supply module. When the system access AC power, VDD capacitor is charged by the internal 650V high voltage MOS. It will not reset and start working until the VDD voltage reaches 5.8V. The start time is less than 100ms, which means that the light achieves instant bright. In normal operation, VDD is dynamically charged by Drain, which can save the power supply auxiliary Winding.



Demagnetization Detection

WS3241 detects the demagnetization time through the drain terminal waveform, which can save auxiliary winding.

Cycle by Cycle Current Protection and Lead Edge Blanking

Cycle-by-cycle current limiting is offered in WS3241. An internal leading edge blanking circuit chops off the sense

voltage spike on the current sense resistor at initial MOSFET on state. The typical value of lead edge blanking is 500ns. The current limit comparator is disabled and thus cannot turn off the internal MOSFET.

PFM Control improves the EMI performance

WS3241 uses the PFM control method, which can improve the system performance. Because PFM belongs to frequency conversion control, built-in spread spectrum function.

Over Voltage Protection

WS3241 has a built-in over voltage protection circuit. When the LED open, the output voltage increased cycle by cycle, secondary demagnetization time induced. When the secondary demagnetization time is less than 5us, the over voltage protection will be triggered.

Minimum off time

WS3241 integrates the minimum off time control, the typical value is 3.6us. It prevents the interference on the chip operation voltage caused by the burrs of the switch off, especially when larger leakage inductance of the transformer and lower output voltage.

Pin Floating Protection

In WS3241, pin floating phenomenon will not cause damage to the system.

Automatic restart protection

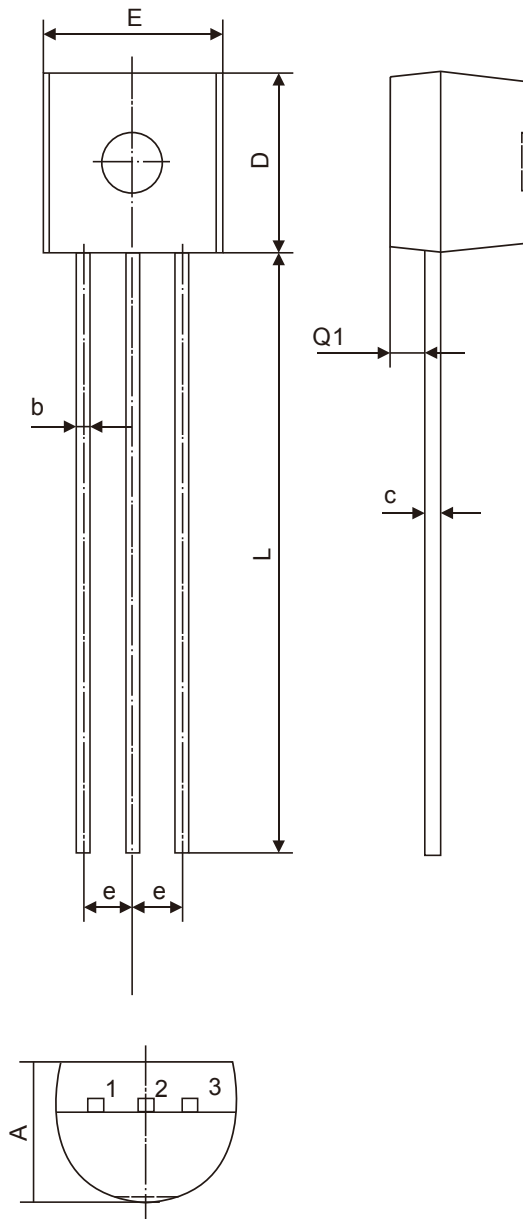
In WS3241, protection is locked when a certain protection is triggered, while the switching stops, entering restart delay mode. Here the VDD voltage is oscillates between 5.3V and 5.8V, and entering into normal start mode after 64 cycles. After start up, it works and confirms whether the protection is removed. If the protection is not removed, the chip will enter into protection latch state, and repeat delay to restart, until the protection is released.

Soft Driver of Internal Power MOSFET

WS3241 has a built-in soft driver, improving the EMI performance, realizing a balance between the efficiency, the reliability and the EMI.

Package Information

TO-92 Package Outline Dimensions



Symbol	Winsemi			
	Dimensions in Millimeters		Dimensions in Inches	
	Min	Max	Min	Max
A	3.30	3.90	0.130	0.154
b	0.35	0.55	0.014	0.022
c	0.31	0.51	0.012	0.020
D	4.30	4.90	0.169	0.193
E	4.30	4.90	0.169	0.193
e	1.17	1.37	0.046	0.054
L	12.5	15.5	0.492	0.610
Q1	0.74	0.89	0.029	0.035

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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