

### GENERAL DESCRIPTION

OB3390 is a primary side control offline LED lighting controller which can achieve accurate LED current and low system cost for an isolated lighting application in a single stage converter. It significantly simplifies the LED lighting system design by eliminating the secondary side feedback components and the opto-coupler.

The LED current can be adjusted externally by the sense resistor  $R_s$  at CS pin. The extremely low start up current and very low operation current (typical 350uA) reduce the power consumption thus lead to high efficiency and low standby power consumption.

OB3390 offers comprehensive protection coverage with auto-recovery features including open loop protection, short circuit protection, cycle-by-cycle current limiting, VDD over voltage protection, built-in leading edge blanking (LEB), VDD under voltage lockout (UVLO), etc.

OB3390 is offered in SOT23-5 package.

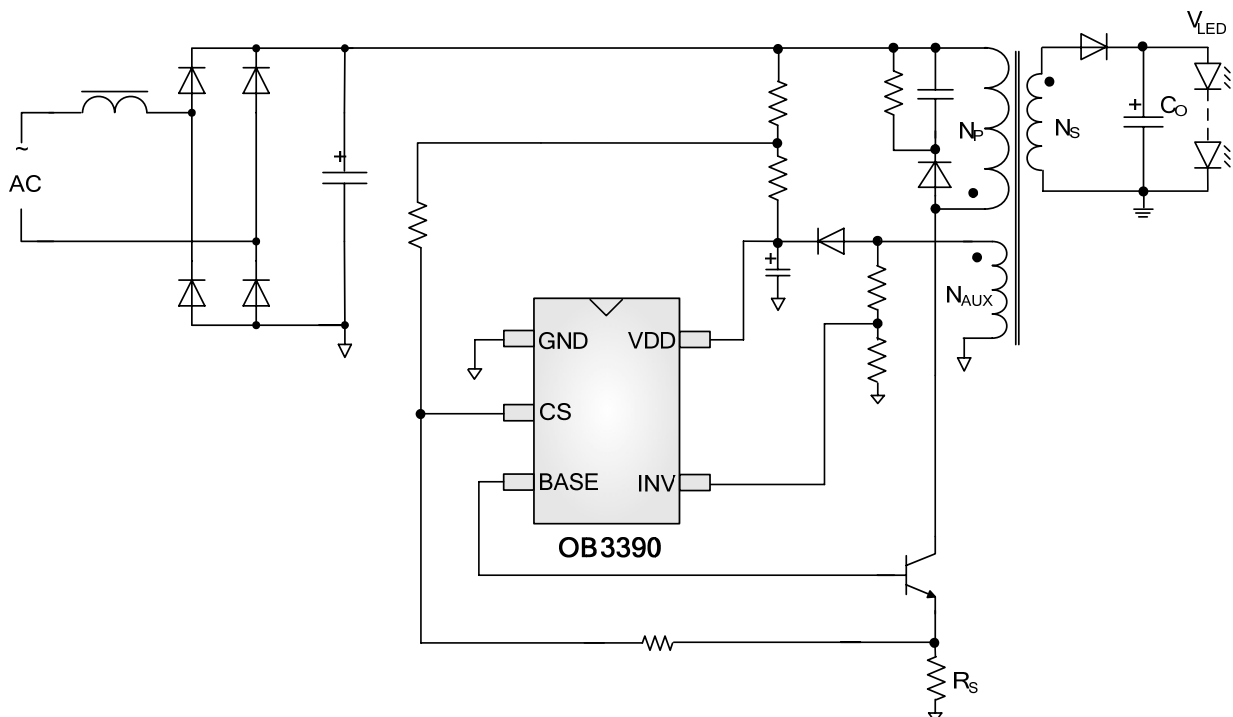
### FEATURES

- High precision Constant Current Regulation at Universal AC input
- Primary-side Sensing and Regulation Without TL431 and Opto-coupler
- Low System Cost and High Efficiency
- Programmable CC Regulation
- Built-in Primary winding inductance compensation
- Drivability for BJT Switch
- Ultra Low Start-up Current (Typ. 1uA)
- Short Circuit Protection
- Open Loop Protection
- Cycle-by-Cycle Current Limiting
- Built-in Leading Edge Blanking (LEB)
- VDD Over Voltage Protection
- VDD Under Voltage Lockout with Hysteresis

### APPLICATIONS

- LED lighting

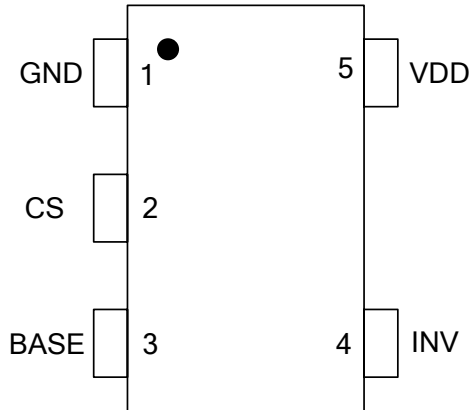
### TYPICAL APPLICATION



### GENERAL INFORMATION

#### Pin Configuration

The pin map is shown as below for SOT23-5.



#### Package Dissipation Rating

Package	R $\theta$ JA (°C/W)
SOT23-5	200

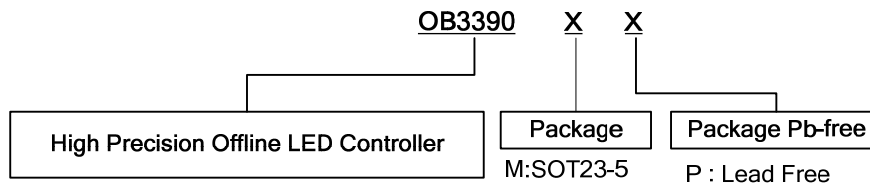
#### Absolute Maximum Ratings

Parameter	Value
VDD Voltage	-0.3 to 30V
BASE Voltage	-0.3 to 7V
CS Input Voltage	-0.3 to 7V
INV Input Voltage	-0.3 to 7V
Min/Max Operating Junction Temperature T <sub>J</sub>	-40 to 150 °C
Min/Max Storage Temperature T <sub>stg</sub>	-55 to 150 °C
Lead Temperature (Soldering, 10secs)	260 °C

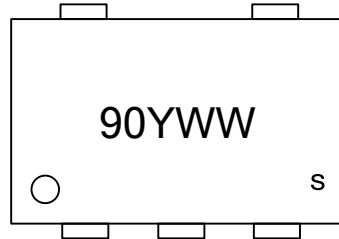
#### Ordering Information

Part Number	Description
OB3390MP	SOT23-5, Pb-free, T&R

**Note:** Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, functional operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute maximum-rated conditions for extended periods may affect device reliability.



## Marking Information

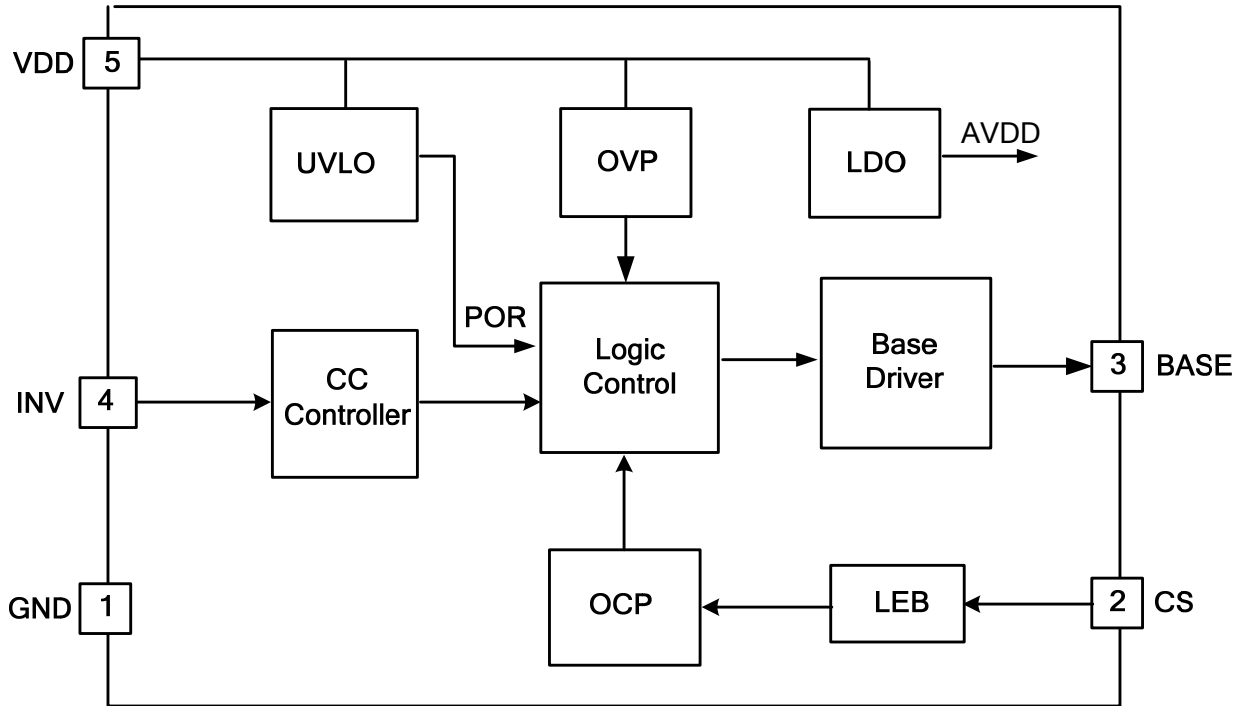


Y: Year Code  
 WW: Week Code(01-52)  
 S: Internal Code(Optional)

## TERMINAL ASSIGNMENTS

Pin Num	Pin Name	I/O	Description
1	GND	P	Ground
2	CS	I	Current sense input.
3	BASE	O	Base driver with current limit for power BJT.
4	INV	I	The voltage feedback from auxiliary winding. Connected to resistor divider from auxiliary winding.
5	VDD	P	Power Supply

**BLOCK DIAGRAM**

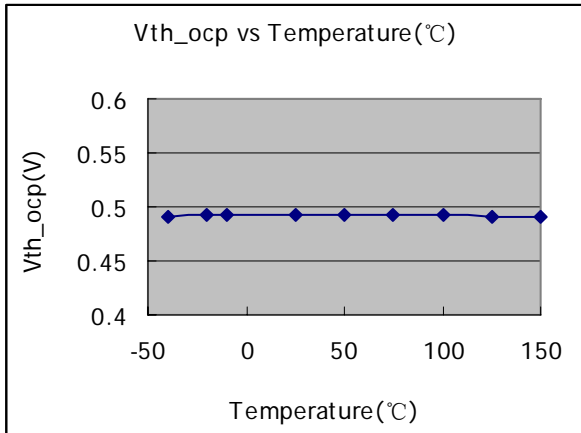
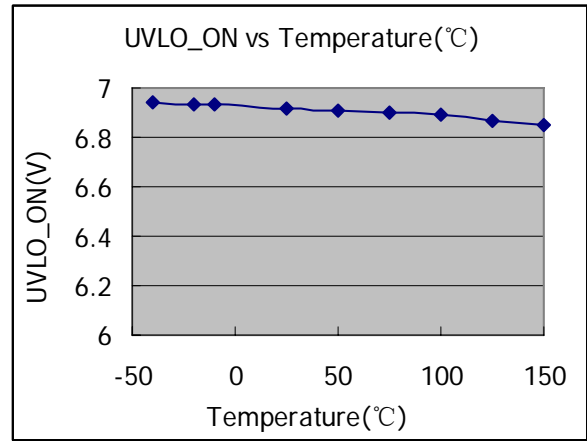
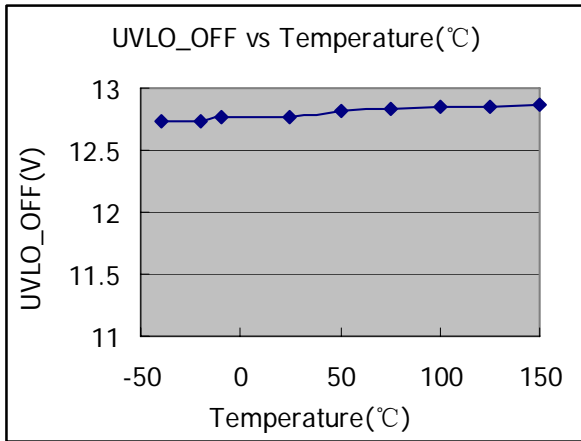
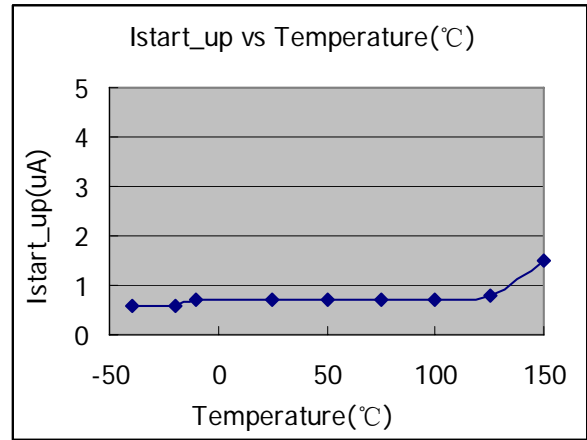
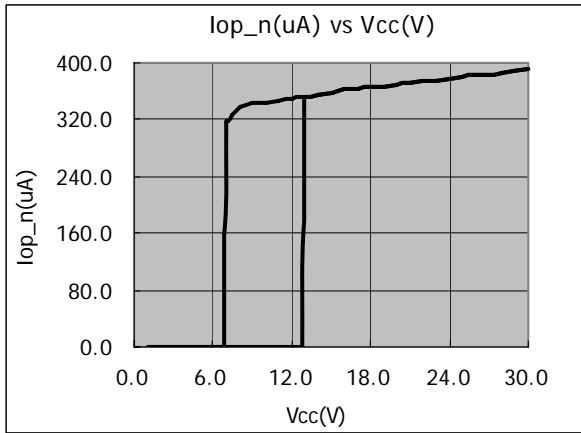


## ELECTRICAL CHARACTERISTICS

(TA = 25°C, VDD=15V, if not otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>Supply Voltage (VDD) Section</b>						
I <sub>start-up</sub>	Start up current	VDD=11V		1	3	μA
I <sub>static</sub>	Static current	VDD=15V		350	500	μA
UVLO(OFF)	VDD under voltage lockout exit		11.5	12.5	13.5	V
UVLO(ON)	VDD under voltage lockout enter		6.0	6.8	7.6	V
VDD_OVP	VDD over voltage protection		25	27	29	V
<b>Current Sense Input Section</b>						
TLEB	LEB time			0.5		μS
V <sub>th_ocp</sub>	Over current threshold		485	500	515	mV
T <sub>d_oc</sub>	OCP propagation delay	From ocp comparator to base drive		100		nS
<b>INV Input Section</b>						
T <sub>pause_max</sub>	Maximum pause		575	640	705	μS
<b>BASE Drive Section</b>						
I <sub>s_max</sub>	Base sourcing maximum current		20	30	40	mA
I <sub>s_preoff</sub>	Base sourcing current after pre-off		0.5	1	1.5	mA
R <sub>dson_l</sub>	Base drive low side on resistor			1		ohm

**CHARACTERIZATION PLOTS**



## OPERATION DESCRIPTION

OB3390 is a cost effective controller optimized for off-line LED lighting applications which can achieve accurate LED current. Based on flyback converter topology working in DCM mode, it operates in primary side sensing and regulation, eliminating the need of opto-coupler and TL431, which makes the solution simple, small and low cost.

- **Startup Current and Start up Control**

Startup current of OB3390 is designed to be very low so that VDD can be charged up quickly. A large value startup resistor can therefore be used to minimize the power loss in application.

- **Operating Current**

The Operating current of OB3390 is as low as 350uA. Good efficiency and very low standby power is achieved with the low operating current.

- **Adjustable CC point**

In OB3390, the CC point can be externally adjusted by external current sense resistor  $R_s$  at CS pin as illustrated in typical application diagram. The larger  $R_s$  is, the smaller CC point is, and vice versa.

- **Principle of CC Operation**

For flyback operating in DCM, the output current  $I_{out}$  is given by

$$I_{out} = \frac{1}{2} L_p F_{sw} I_p^2 \eta / V_{out} \quad (1)$$

Where  $L_p$  indicates the inductance of primary winding and  $I_p$  is the peak current of primary winding.

Refer to the equation 1, the change of the primary winding inductance results in the change of the constant output current. To compensate the change from variations of primary winding inductance, the switching frequency is locked by an internal loop such that the switching frequency is

$$F_{sw} = \frac{1}{2T_{Demag}} \quad (2)$$

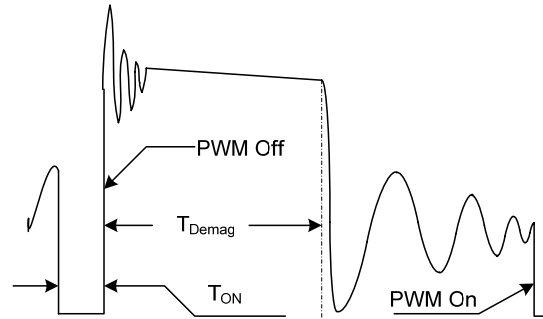


Figure.1 Auxiliary voltage waveform

Since  $T_{Demag}$  is inversely proportional to the inductance, as a result, the product  $L_p$  and  $f_{sw}$  is constant, thus output current will not change as primary winding inductance changes. Up to  $\pm 10\%$  variation of the primary winding inductance can be compensated.

The output LED current is

$$I_{out} = \frac{1}{4} N \frac{V_{thoc}}{R_s} \quad (3)$$

Where  $N$  is the ratio of transformer between primary side winding and secondary winding.

- **Current Sensing and Leading Edge Blanking**

Cycle-by-Cycle current limiting is offered in OB3390. The switch current is detected by a sense resistor into the CS pin. An internal leading edge blanking circuit chops off the sensed voltage spike at initial power BJT on state so that the external RC filtering on sense input is no longer needed.

- **Auto Restart mode for Protection**

Because of the coupling between secondary winding and auxiliary winding, the voltage at VDD pin will rise up if the output of secondary side is open-circuited, when VDD pin voltage is larger than 27V, the OB3390 will stop sending pulses to BASE pin and enter auto restart mode.

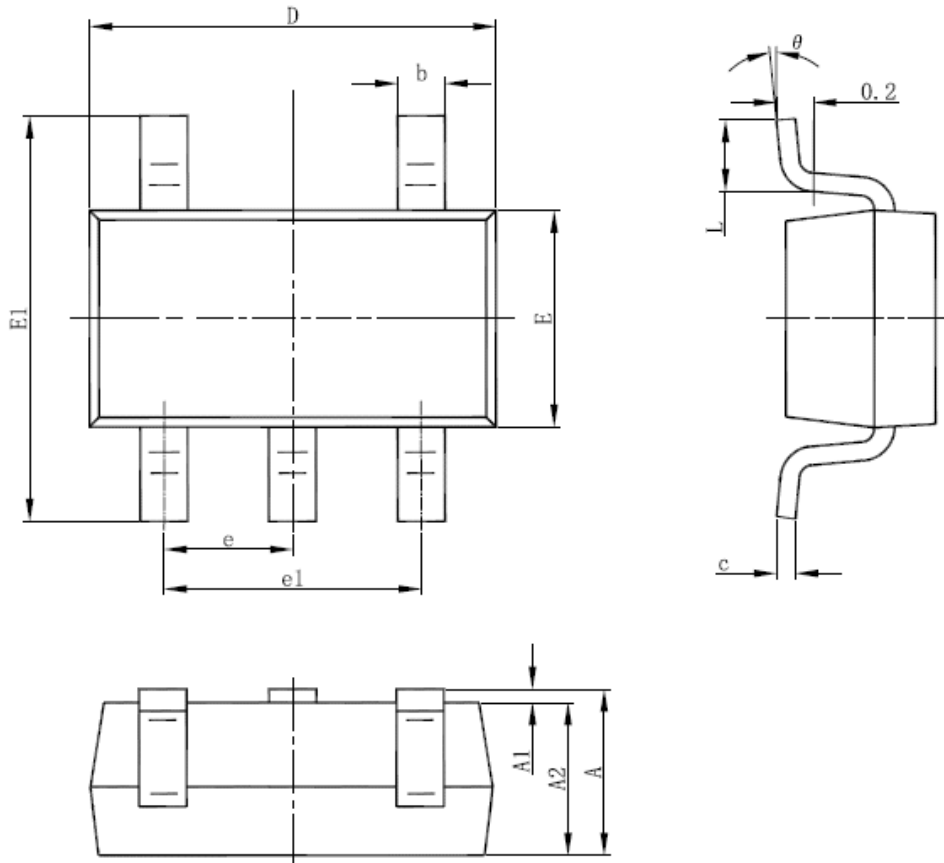
If the output of secondary side is short-circuited, the VDD voltage will drop down and the system enters under voltage lockout protection.

- **Base Drive**

The drive is a push pull stage with supply voltage VDD. It provides the driving current for the external power bipolar transistor. The output signal is current limit to  $I_{s\_max}$  (typical 30mA).

**PACKAGE MECHANICAL DATA**

5-Pin Plastic SOT (SOT23-5)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.000	1.450	0.039	0.057
A1	0.000	0.150	0.000	0.006
A2	0.900	1.300	0.035	0.051
b	0.300	0.500	0.012	0.020
c	0.080	0.220	0.003	0.009
D	2.800	3.020	0.110	0.119
E	1.500	1.726	0.059	0.068
E1	2.600	3.000	0.102	0.118
e	0.950 (BSC)		0.037 (BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°



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