GENERAL DESCRIPTION

OB3652P is a primary side control offline LED lighting controller with very low operation current which can achieve accurate LED current 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, and also the auxiliary winding inductance. A HV 600V power switch is also integrated into the device. The LED current can be adjusted externally by the sense resistor Rs at CS pin and high precision constant current regulation is realized.

OB3652P offers comprehensive protection coverage with auto-recovery features including open loop protection, short circuit protection, cycle-by-cycle current limiting, built-in leading edge blanking, VDD under voltage lockout (UVLO), latched over temperature protection (OTP), etc.

OB3652P is offered in DIP-8 package.

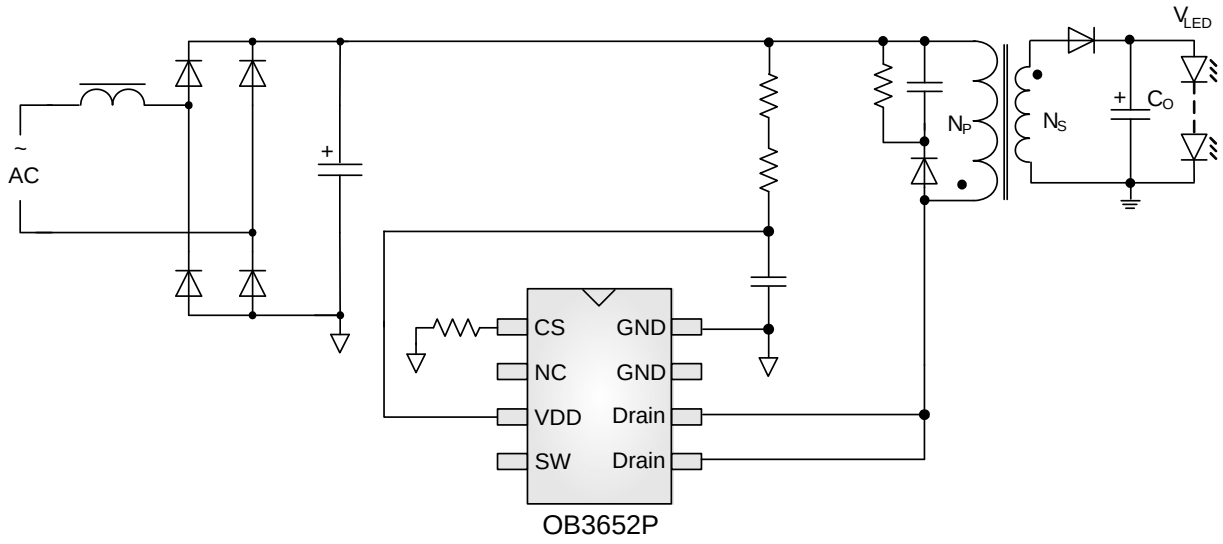
FEATURES

- High precision Constant Current Regulation at Universal AC input
- Primary-side Sensing and Regulation Without TL431 and Opto-coupler
- Sense and supply without auxiliary winding inductance
- Low System Cost and High Efficiency
- Low operation current
- Programmable CC Regulation
- Built-in Primary winding inductance compensation
- Built-in line compensation
- Short Circuit Protection
- Open Loop Protection
- Cycle-by-Cycle Current Limiting
- Built-in Leading Edge Blanking (LEB)
- VDD Under Voltage Lockout with Hysteresis
- Latched over temperature protection (OTP)

APPLICATIONS

- LED lighting

TYPICAL APPLICATION



OUTPUT POWER TABLE

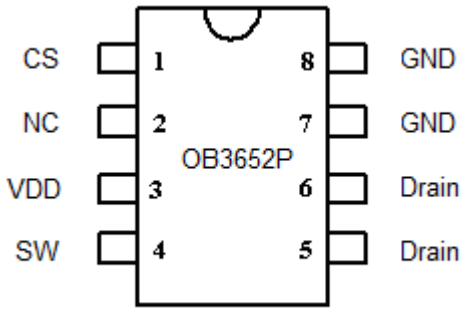
Product	230VAC±15%	90-264VAC
	Open Frame	Open Frame
OB3652PAP	18W	12.5W

Notes: Maximum practical continuous power in an open frame design with sufficient drain pattern as a heat sink, at 50℃ ambient and 60℃ temperature rise. Higher output power is possible with extra added heat sink or air circulation to reduce thermal resistance.

GENERAL INFORMATION

Pin Configuration

The pin map is shown as below for DIP-8.



Ordering Information

Part Number	Description
OB3652PAP	DIP8, Pb-free in tube

Note: All Devices are offered in Pb-free Package if not otherwise noted.

Package Dissipation Rating

Package	RθJA (℃/W)
DIP-8	75

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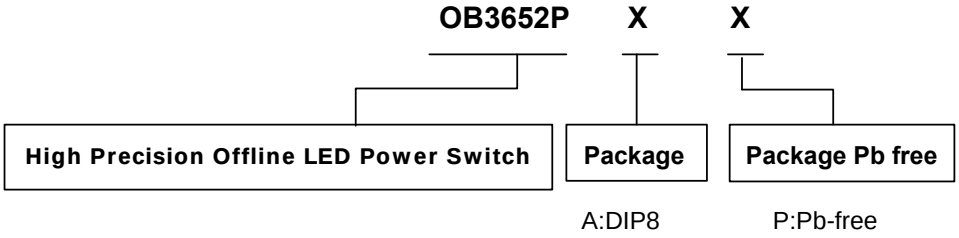
Absolute Maximum Ratings

Parameter	Value
VDD Voltage	-0.3 to 20V
DRAIN Voltage	-0.3 to 600V
CS Input Voltage	-0.3 to 7V
SW Input Voltage	-0.3 to 20V
Min/Max Operating Junction Temperature T_J	-40 to 150 ℃
Min/Max Storage Temperature T_{stg}	-55 to 150 ℃
Lead Temperature (Soldering, 10secs)	260 ℃

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)
ZZZ: Lot Code
A: DIP8 Package
P: Pb-free Package
S: Internal Code(Optional)

TERMINAL ASSIGNMENTS

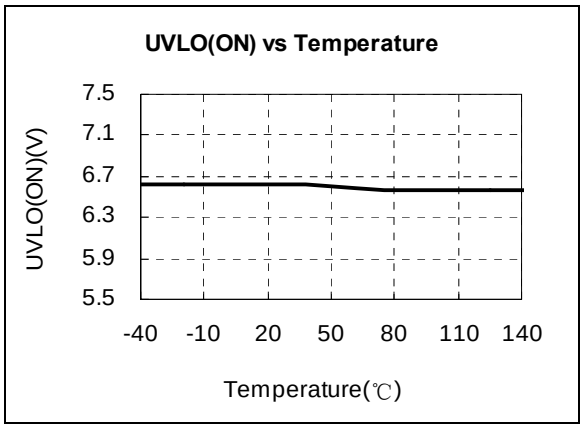
Pin Num	Pin Name	I/O	Description
1	CS	I	Current sensing terminal
2	NC		No Connection
3	VDD	P	Power supply Input
4	SW	I	MOSFET Source Terminal
5,6	DRAIN	I	MOSFET Drain Terminal
7	GND	P	Power Ground, suggest to be left floating with no pad in PCB layout.
8	GND	P	Power Ground

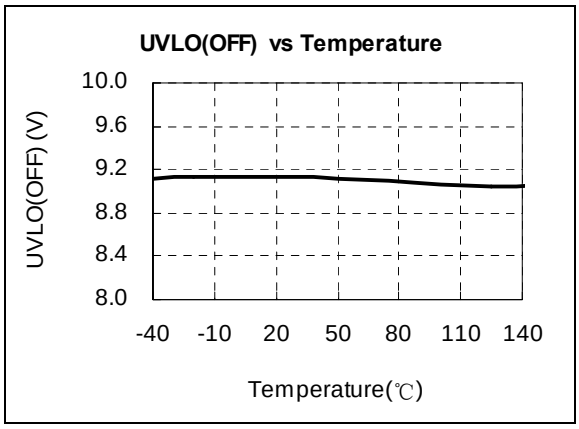
ELECTRICAL CHARACTERISTICS

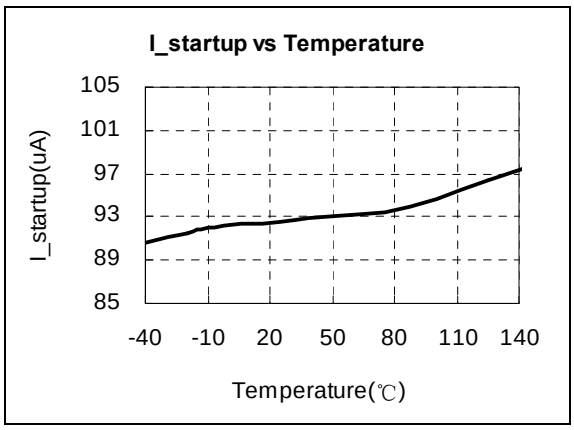
(TA = 25℃, VDD=7.5V, if not otherwise noted)

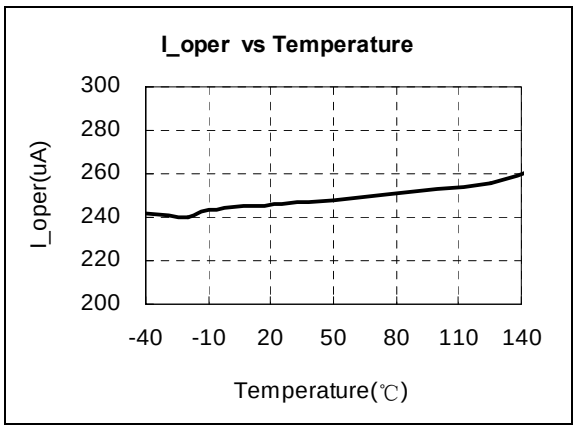
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Supply Voltage (VDD) Section						
$I_{start-up}$	Start up current	VDD=UVLO(OFF)-1V		120	150	uA
I_{op}	operation current	VDD=7.5V, no loading		250	300	uA
UVLO(OFF)	VDD under voltage lockout exit			9		V
UVLO(ON)	VDD under voltage lockout enter			6.5		V
VDD_CLAMP	VDD CLAMP	VDD current 1mA		10.5		V
Current Sense Input Section						
TLEB	LEB time			0.3		us
Vth_ocp	Over current threshold		485	500	515	mV
Td_oc	OCP propagation delay	From OCP comparator to gate drive		100		ns
Toff_max	Maximum off time			600		us
Toff_min	Minimum off time			5.5		us
Ton_max	Maximum on time			75		us
Source Drive Section						
Rdson_l	Source drive low side on resistor			1.3		ohm
OTP Section						
OTP	Over temperature protection			150		℃
Power MOSFET Section						
BVdss	MOSFET Drain-Source Breakdown Voltage		600			V
Rds,on	On resistance			4.4		ohm

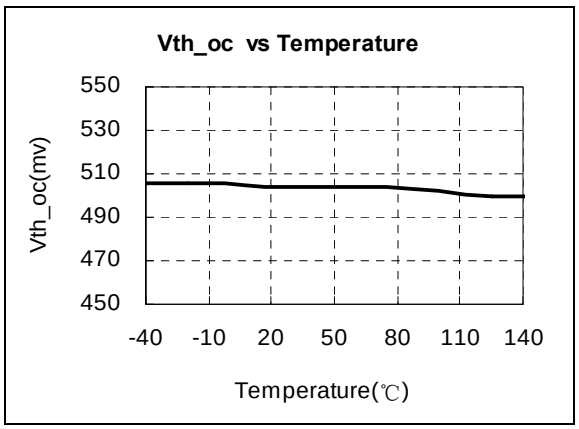
CHARACTERIZATION PLOTS

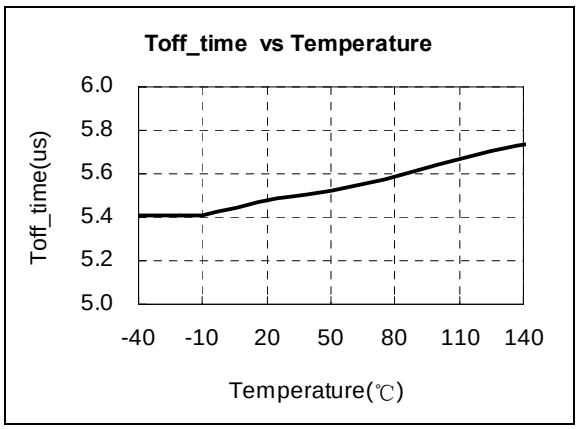


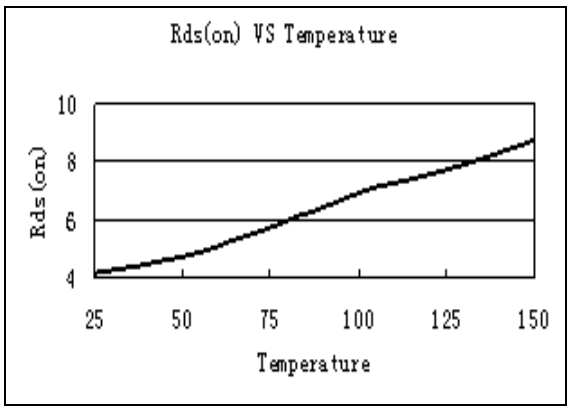


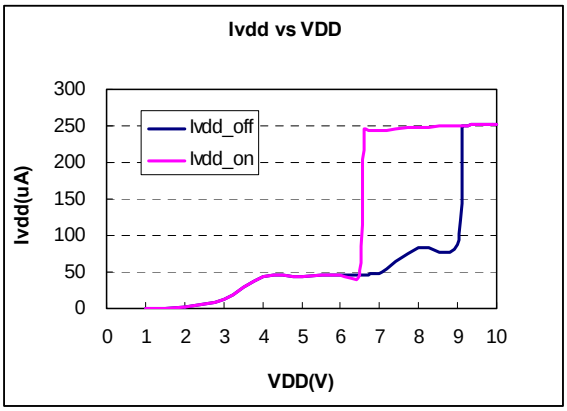












OPERATION DESCRIPTION

OB3652P is a primary side control offline LED lighting controller with very low operation current which can achieve accurate LED current 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, and also the auxiliary winding inductance. A HV 600V power switch is also integrated into the device.

- **Start up Control**

Startup process is realized by charging VDD capacitor. When VDD voltage reaches up to UVLO(OFF), the inner circuit works. An 10.5V (typical) clamp circuit is designed to clamp VDD voltage. At work state, no auxiliary winding inductance is necessary.

- **Adjustable CC point**

In OB3652P, the CC point can be externally adjusted by external current sense resistor Rs at CS pin as illustrated in typical application diagram. The larger Rs is, the smaller CC point is, and vice versa.

- **Principle of CC Operation**

For flyback operating in DCM, the output current Iout is given by

$$Iout = \frac{1}{2} L_p F_{sw} I_p^2 \eta / Vout \quad (1)$$

Where Lp indicates the inductance of primary winding and Ip 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

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

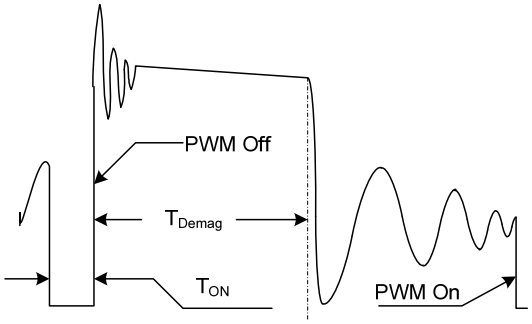


Figure.1 Drain voltage waveform

Since T_{Demag} is inversely proportional to the inductance, as a result, the product *Lp* and *fsw* is constant, thus output current will not change as primary winding inductance changes. Up to ± 10% variation of the primary winding inductance can be compensated.

The output LED current is

$$Iout = \frac{1}{4} N \frac{Vthoc}{Rs} \quad (3)$$

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

- **Current Sensing and Leading Edge Blanking**

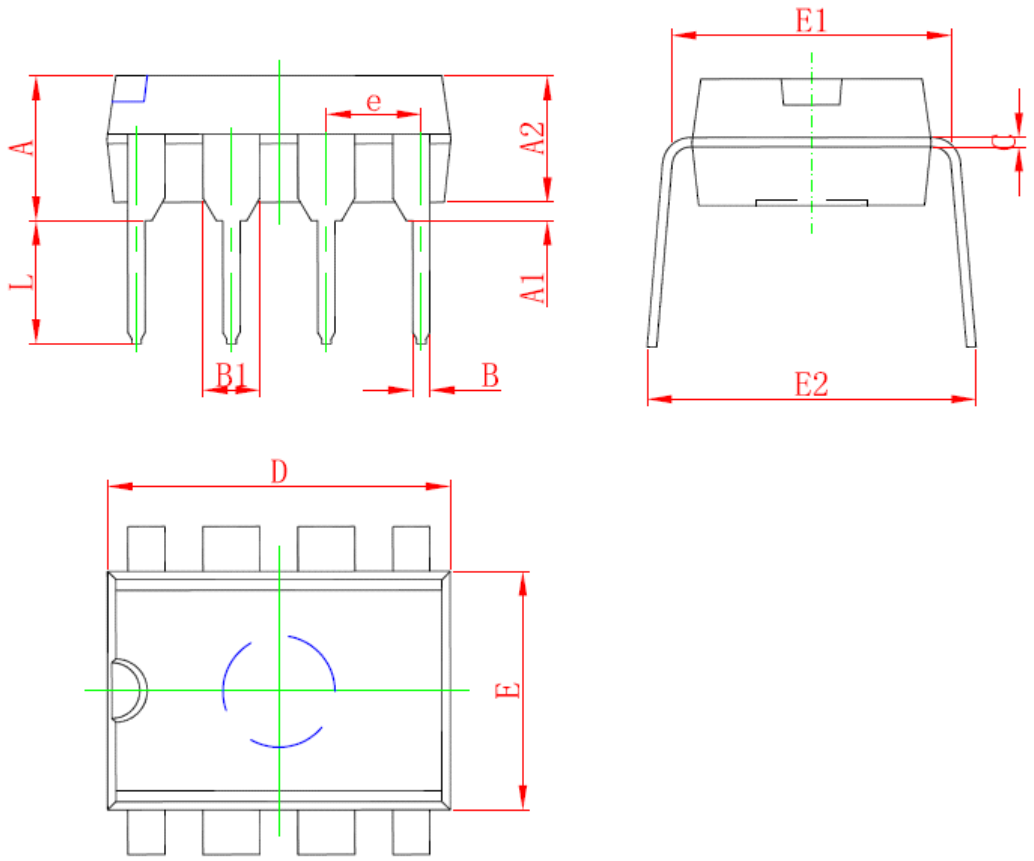
Cycle-by-Cycle current limiting is offered in OB3652P. The switch current is detected by a sense resistor into the CS pin. An internal leading edge blanking circuit chops off the sensed voltage spike at initial power MOSFET on state.

- **Latched Over Temperature Protection**

Over temperature protection is offered in OB3652P. When temperature of the device rises over 150℃ (typical), the switching frequency will decrease to half. And the state will be kept until the device restarts.

PACKAGE MECHANICAL DATA

DIP8 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.710	5.334	0.146	0.210
A1	0.381		0.015	
A2	2.921	4.953	0.115	0.195
B	0.350	0.650	0.014	0.026
B1	1.524 (BSC)		0.06 (BSC)	
C	0.200	0.360	0.008	0.014
D	9.000	10.160	0.354	0.400
E	6.096	7.112	0.240	0.280
E1	7.320	8.255	0.288	0.325
e	2.540 (BSC)		0.1 (BSC)	
L	2.921	3.810	0.115	0.150
E2	7.620	10.920	0.300	0.430

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