

GENERAL DESCRIPTION

The OB3638 is a high power factor, monolithic flyback controller with advanced features to provide high efficiency control and high accuracy constant current output for LED lighting applications.

OB3638 offers fast startup feature by charging VDD through the SW pin, a constant on-time control for power factor correction (PFC), zero current detector (ZCD) to ensure transition mode (TM) operation, an error amplifier for accurate current regulation and on-chip MOSFET for switching.

OB3638 offers comprehensive protection coverage including VDD under voltage lockout (UVLO), VDD over voltage protection, load voltage over voltage protection, cycle-by-cycle current limiting, over temperature protection, LED string open/short protection, driver output clamping for external power MOSFET protection, current sense resistor short protection, transformer saturation protection.

OB3638 is offered in SOP8 package.

FEATURES

- Primary-Side Control with Single Stage PFC Topology
- Minimized BOM Count
- Fast startup time (<0.1S)
- Transition Mode (TM) operation to achieve high efficiency
- High current accuracy
- Selectable threshold of load compensation
- Source drive operation mode
- Cycle-by-Cycle Current Limiting (OCP)
- VDD Over Voltage Protection
- Output Over Voltage Protection
- Over-temperature Protection
- VDD Under Voltage Lockout (UVLO)
- LED string open protection
- LED string short protection
- Current sense resistor short/open protection
- Transformer saturation protection

APPLICATIONS

- LED lighting

TYPICAL APPLICATION

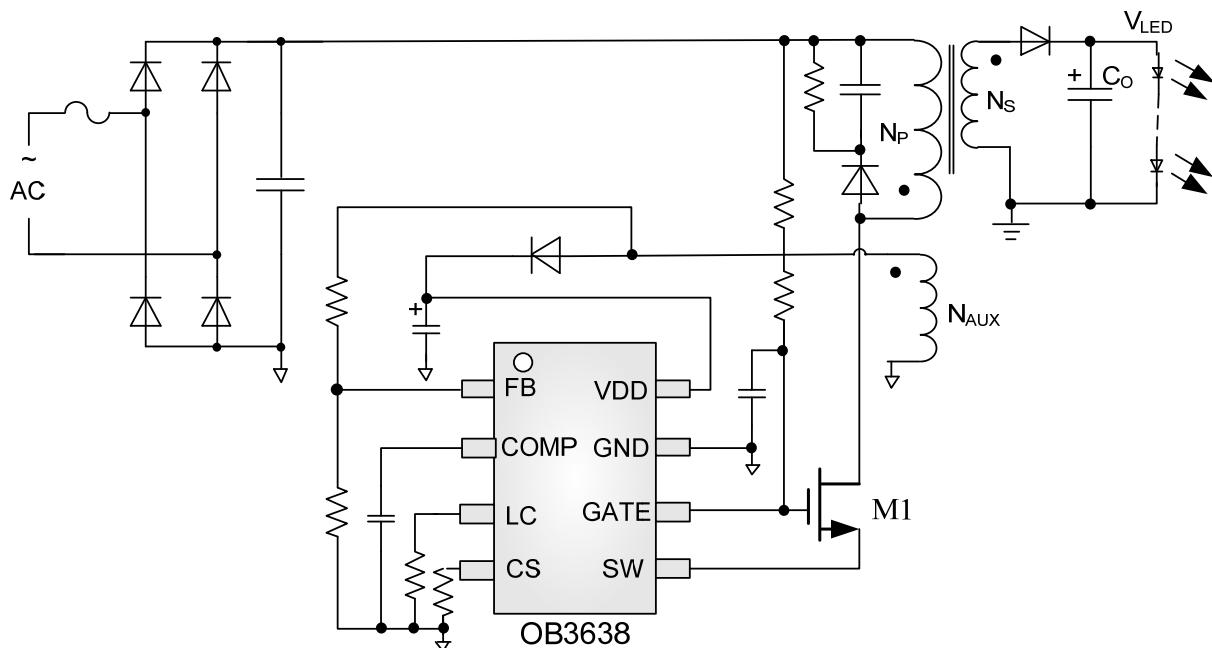
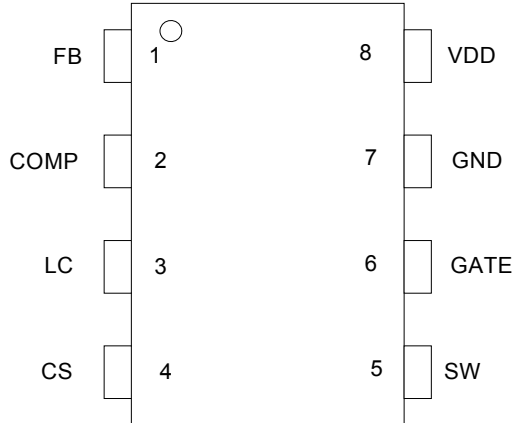


Figure1: OB3638 Typical Application Schematic

GENERAL INFORMATION
Terminal Assignment
 In SOP8 Package.

Package Dissipation Rating

Package	R θ JA (°C/W)
SOP8	150

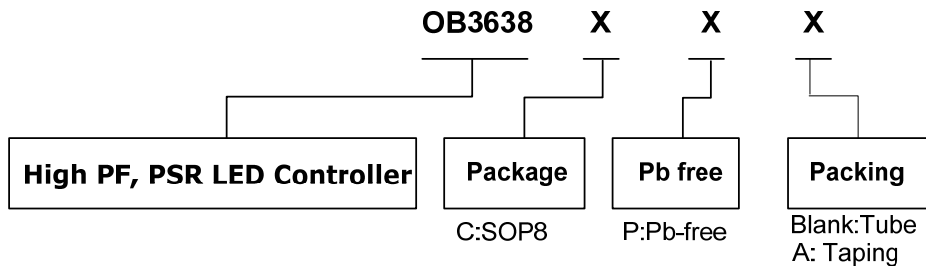
Absolute Maximum Ratings

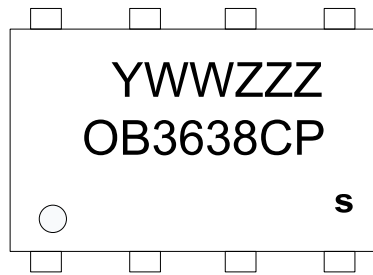
Parameter	Value
VDD Input Voltage to GND	-0.3V to 24V
GATE to GND	-0.7V to 24V
SW to GND	-0.7V to 24V
FB, COMP, LC and CS to GND	-0.7V to 7V
Operating Ambient Temp. T _A	-20°C ~ 85°C
Operating Junction Temp. T _J	-40 ~ 150°C
Min/Max Storage Temp. T _{stg}	-55 ~ 150°C
Lead Temp. (10 Sec)	260 °C

Ordering Information

Part Number	Description
OB3638CP	8 Pin SOP, Pb free in Tube
OB3638CPA	8 Pin SOP, Pb free in Taping

Note1: All Devices are offered in Pb-free Package if not otherwise noted.

Note2: 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
 C: SOP8
 P: Pb-free Package
 S: Internal Code(Optional)

Terminal Assignment

Number	Pin Name	I/O	Pin Function
1	FB	I/O	Feedback pin. When activated, a new switching cycle starts. Connect this pin through a resistor divider from the auxiliary winding to ground. This pin is also used for output over voltage protection (OVP).
2	COMP	I/O	Loop compensation pin. Connect to a compensation network to stabilize the LED driver and achieve a constant LED driver current.
3	LC	I/O	Load compensation pin. This pin sets the range of load compensation. This pin can be float, ground and connected a resistor to GND to set three different compensation range.
4	CS	I/O	Current sense input pin.
5	SW	I/O	Drain of internal MOSFET.
6	GATE	I/O	The gate voltage clamp of external power MOSFET.
7	GND	P	Ground.
8	VDD	P	Power supply voltage pin.

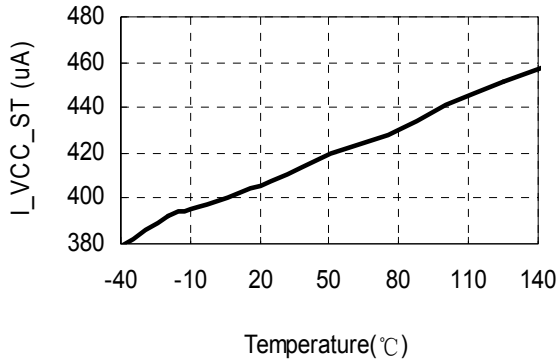
Electrical Characteristics

 VDD=16V, T_A=25°C, if not otherwise noted.

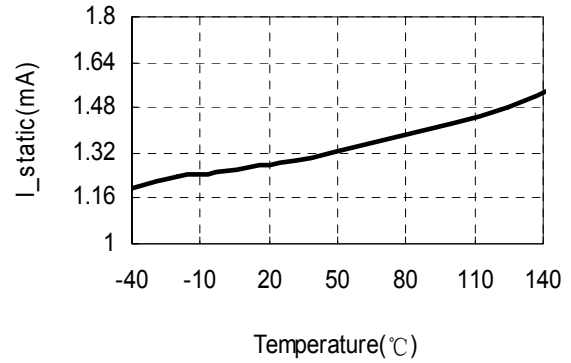
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
Supply Voltage Section						
I_VDD_ST	Standby Current	VDD=14V		450	500	uA
I_static	Static Current	VDD=16V, no switching		1.2	1.5	mA
UVLO(ON)	Under Voltage Lockout Enter	VDD falling	5.5	6.0	6.5	V
UVLO(OFF)	Under Voltage Lockout Exit	VDD rising	9	9.5	10	V
VDD_HOLD	VDD Hold Voltage	VDD failing	7	7.5	8	V
VDD_OVP	VDD Over Voltage Protection		19.5	21	22.5	V
Current Sense Section						
TLEB	LEB time			300		ns
Vth_oc	Over Current Threshold		0.95	1.00	1.05	V
Vth_oc_short	Over Current Threshold when VFB < 0.5V		0.45	0.50	0.55	V
Td_oc	OCP Propagation Delay			40		ns
FB Section						
Vovp	Output over voltage protection		3.395	3.500	3.605	V
Tfb_leb	FB leading edge blanking time		1.5	2.0	2.5	us
Gm amplifier section						
Vref	EA Reference Voltage		0.196	0.200	0.204	V
Gm	EA Transconductance Gain			100		us
PWM Control Section						
Toff_max	Re-start timer period			75		us
Ton_max	Maximum on time			25		us
Fmax	Maximum operation frequency			100		kHz
Temperature Section						
OTP	OTP trigger threshold			150		°C
Gate Section						
Vclamp_startup	Gate clamp voltage at startup			20		V
Vclamp_op	Gate clamp voltage at operation			13.5		V
Iclamp	Gate clamp current at operation			10		mA
SW Section						
Rds_on	On-chip MOSFET on resistor			0.4		Ω

TYPICAL PERFORMANCE CHART

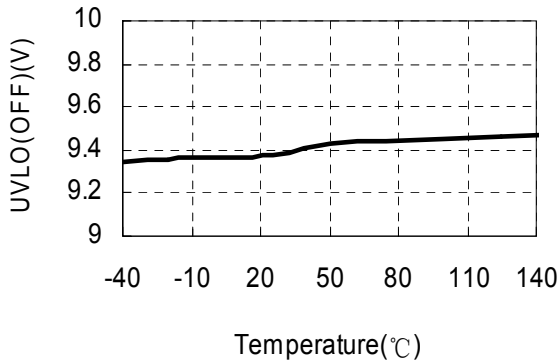
I_{VCC_ST} (uA) vs Temperature



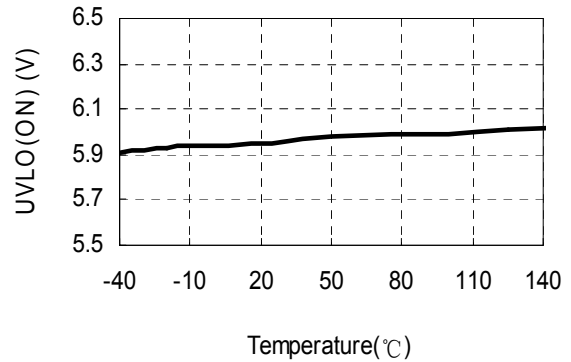
I_{static}(mA) vs Temperature



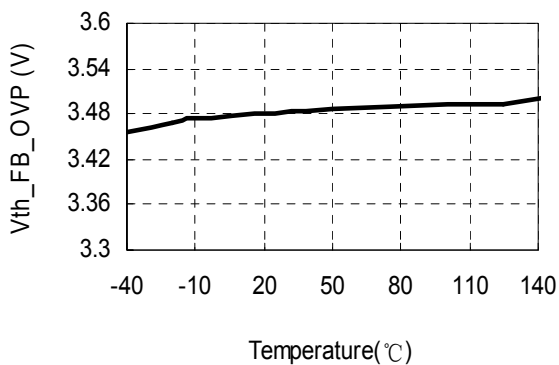
UVLO(OFF)(V) vs Temperature



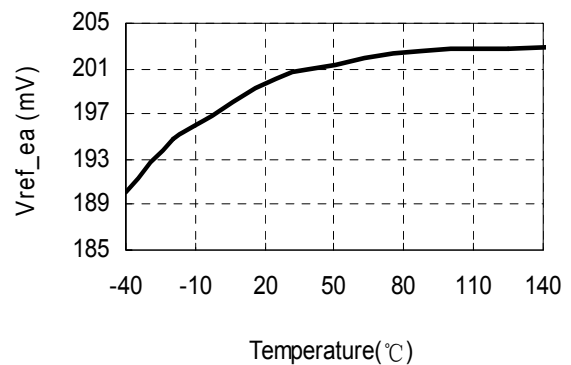
UVLO(ON) (V) vs Temperature



V_{th_FB_OVP} (V) vs Temperature



V_{ref_ea} (mV) vs Temperature



Function Description

General Operation

The OB3638 is a primary-side-control and high power factor flyback PWM controller specialized for LED lighting application. It operates in primary side sensing and regulation, thus opto-coupler and TL431 are not required. The transition mode control greatly reduces the switch turn-on loss, improves the conversion efficiency. It provides very good power factor.

The principle of operation can be understood by referring to the block diagram.

Startup

When system starts up, the GATE pin is charged by the line voltage through a resistor and finally clamped at 20V (typical), the external MOSFET turns on. And the VDD pin is directly charged by line voltage through MOSFET and from SW to internal charge control circuit, this makes the startup very fast (normally within 0.1S) than conventional startup structure. When the VDD voltage exceeds UVLO_OFF threshold voltage (typical 9.5V), the IC starts to switch and the internal charge control circuit stop charging to VDD, and the VDD is supplied by the AUX winds instead of line voltage. At normal operation, when AUX winds positive voltage not enough to charge VDD, causing VDD to drop. Instead, if the VDD drops below the VDD_HOLD threshold voltage (typical 7.5V), the internal charging circuit triggers and charges VDD holding at 7.5V. Therefore, output voltage can operate in widely range by this function.

UVLO

An under-voltage lockout with a hysteresis control is provided on VDD. When the voltage at this pin exceeds a threshold of approximately 9.5V, the IC starts the normal operation. If the voltage at this pin drops below a threshold of approximately 6V, the IC stops switching operation. The IC resumes switching operation when the voltage at pin VDD recovers to a voltage above 9.5V (typical).

LED Constant Current Regulation

OB3638 uses the primary side constant current control method to accurately control the LED current. The LED mean current can be approximated as:

$$I_{LED}[mA] = \eta * \frac{N}{2} * \frac{200[mV]}{R_{CS}[\Omega]}$$

η — The transformer coupling coefficient.

N—Turn ratio of primary side winding to secondary side winding.

Rcs—the sensing resistor connected between CS pin and GND.

Current Sensing

OB3638 performs zero current detection (ZCD) through FB pin by monitoring the voltage activity on the auxiliary windings in series with external resistors. This voltage features output voltage. When the stored energy of the flyback transformer fully release to the output, the voltage at FB pin decreases. When FB pin voltage falls below 0.3V (typical), an internal ZCD comparator is triggered and a new PWM switching cycle is initiated.

Load Compensation Setting

The OB3638 offers load compensation range setting function by configuration the LC pin to be compatible with different system. The following table shows the setup and the related load compensation percent of the full current range.

LC pin	Compensation Range
Floating	3.33%
GND	5.56%
100K~200K ohm resistor	8.33%

Maximum and Minimum On-Time

The minimum on-time of the system is determined by the LEB time (typical 300ns). The IC limits the on-time to a maximum value of approximately 25us (typical).

Output OVP Protection

The output over-voltage condition is monitored independently through the voltage at FB pin. During normal operation, when the voltage at FB pin exceeds a threshold of approximately 3.5V (typical), the over-voltage protection function is activated and the driver is turned off immediately.

VDD OVP Protection

VDD is supplied with auxiliary winding output. When VDD is higher than 21V (typical), OVP protection is triggered and driver is shut down, so the device enters power on startup sequence thereafter.

LED String Open Protection

When LED string open happens, the positive plateau of FB voltage rise up due to the auxiliary winding voltage increases. If the voltage at FB pin is higher than a threshold of approximately 3.5V (typical), the over-voltage protection function is activated and the driver is turned off immediately.

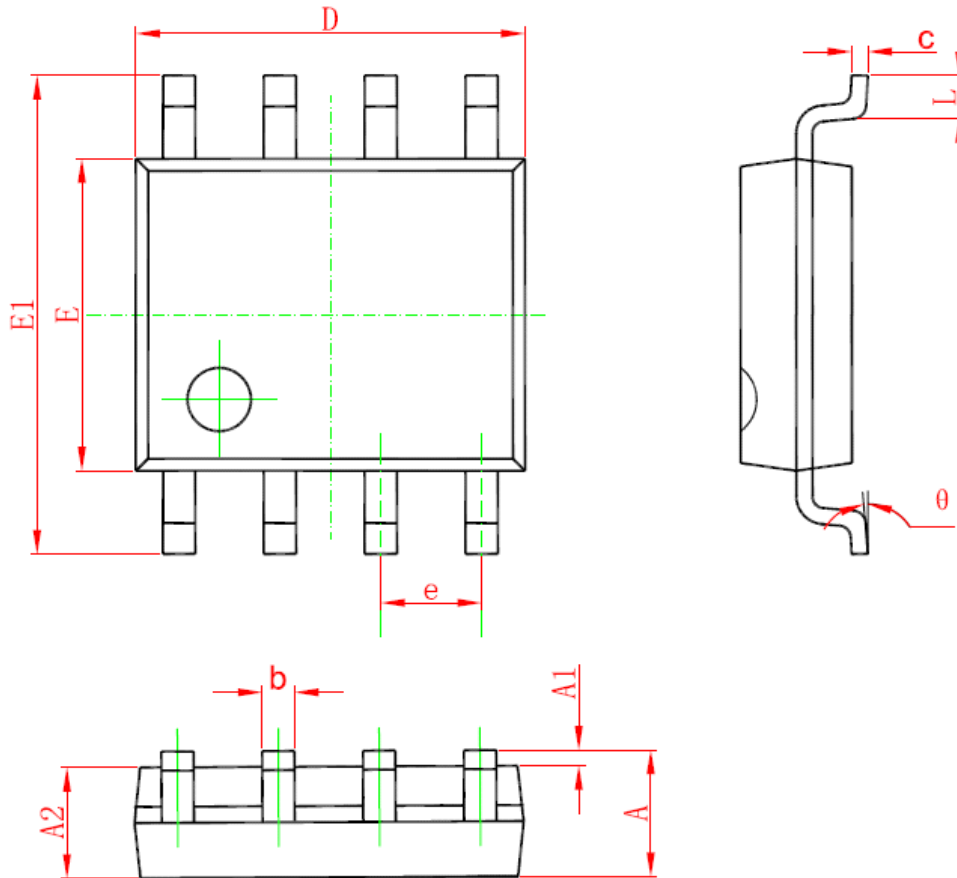
LED String Short Protection

When LED string is short, the positive plateau of FB voltage from auxiliary winding falls to near zero. If the voltage at FB pin is lower than a threshold of approximately 0.45V (typical), the threshold of OCP will drop down from 1V (typical) to 0.5V

(typical), COMP pin voltage will increase. When COMP voltage reach 4.2V, the switching is stopped immediately.

Thermal Shutdown

OB3638 provides an on chip thermal shutdown protection. The IC will stop switching when the junction temperature exceeds the thermal shutdown temperature, typically 150 °C

PACKAGE MECHANICAL DATA
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	0.050	0.250	0.002	0.010
A2	1.250	1.650	0.049	0.065
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	4.700	5.150	0.185	0.203
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°

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