GENERAL DESCRIPTION

OB3613x is a high power factor, highly integrated buck regulator with advanced features to provide high efficiency control and high precision constant current output for LED lighting applications.

OB3613x integrates a MOSFET to decrease physical volume. The proprietary CC control scheme is used and the system can achieve high power factor with constant on-time control scheme.

OB3613x offers comprehensive protection coverage with auto-recovery features including LED open loop protection, LED short circuit protection, cycle-by-cycle current limiting, built-in leading edge blanking, VDD under voltage lockout (UVLO), etc.

OB3613x is offered in SOP8, SOP7 or DIP8 package.

FEATURES

- Buck topology with high power factor
- Integrated a HV MOSFET
- High precision constant current regulation at universal AC input
- Low system cost and high efficiency
- Quasi-Resonant operation
- Programmable CC regulation
- LED short circuit protection
- LED open loop protection
- Cycle-by-cycle current limiting
- Built-in leading edge blanking (LEB)
- VDD under voltage lockout with hysteresis
- VDD over voltage protection
- Over temperature protection (OTP)

APPLICATIONS

- LED lighting

TYPICAL APPLICATION

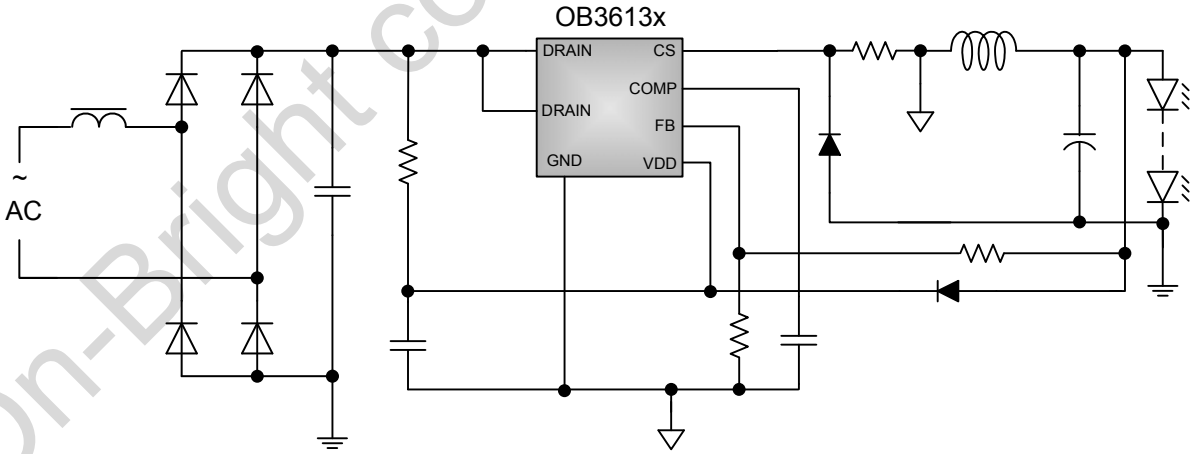
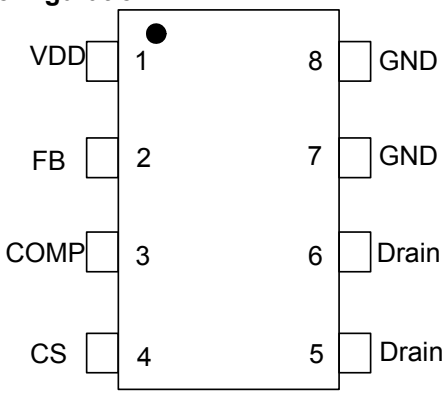


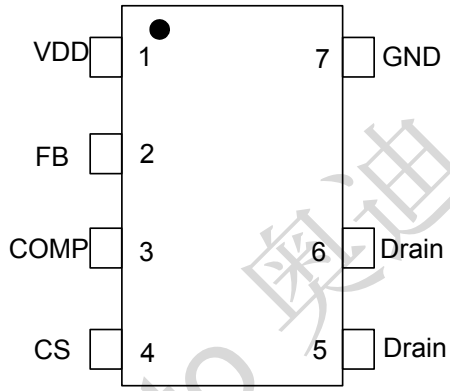
Figure1: OB3613x Typical Application Schematic

GENERAL INFORMATION

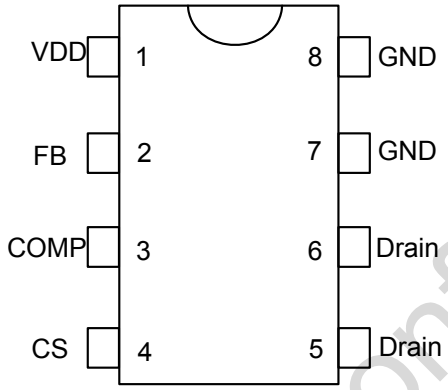
Pin Configuration



Pin map for SOP-8 package



Pin map for SOP-7 package



Pin map for DIP-8 package

Ordering Information

Part Number	Description
OB3613MCP	8 Pin SOP, Pb free in Tube
OB3613MCPA	8 Pin SOP, Pb free in T&R
OB3613NCP	8 Pin SOP, Pb free in Tube
OB3613NCPA	8 Pin SOP, Pb free in T&R
OB3613PJP	7 Pin SOP, Pb free in Tube
OB3613PJPA	7 Pin SOP, Pb free in T&R
OB3613PAP	8 Pin DIP, Pb free in Tube
OB3613RJP	7 Pin SOP, Pb free in Tube
OB3613RJPA	7 Pin SOP, Pb free in T&R
OB3613RAP	8 Pin DIP, Pb free in Tube
OB3613TJP	7 Pin SOP, Pb free in Tube
OB3613TJPA	7 Pin SOP, Pb free in T&R
OB3613TAP	8 Pin DIP, Pb free in Tube

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

Recommended Operating Condition

Symbol	Parameter	Range
VDD	VDD Supply Voltage	11 to 30V

Package Dissipation Rating

Package	RθJA (℃/W)
SOP-8	90
SOP-7	90
DIP-8	75

Absolute Maximum Ratings

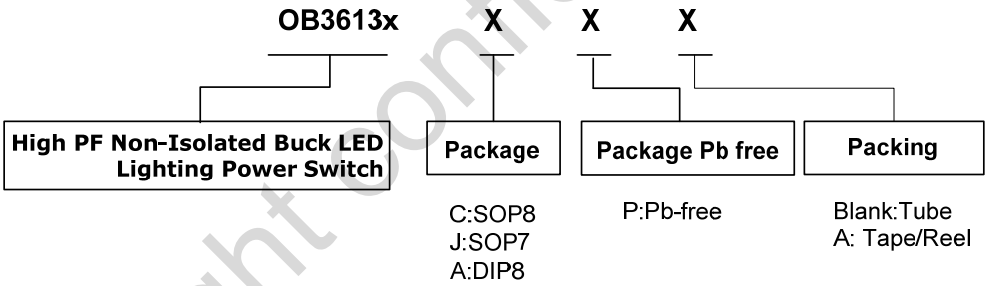
Parameter	Value
VDD Voltage	-0.3 to 40V
DRAIN Voltage	-0.3 to 500V
CS Input Voltage	-0.3 to 7V
FB Input Voltage	-0.3 to 7V
COMP Input Voltage	-0.3 to 7V
Min/Max Operating Junction Temperature T_J	-40 to 150 ℃
Operating Ambient Temperature T_A	-40 to 85 ℃
Min/Max Storage Temperature T_{stg}	-55 to 150 ℃

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.

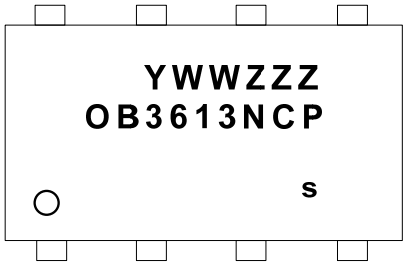
Output Power Table

Product	Condition	90Vac~264Vac Input	220Vac±20% Input
OB3613MCP	I_{OUT}≤0.15A	4.9W	8.7W
OB3613NCP	I_{OUT}≤0.20A	6.8W	10.0W
OB3613PJP	I_{OUT}≤0.2A	9.1W	15.8W
OB3613PAP	I_{OUT}≤0.30A	14.0W	23.2W
OB3613RJP	I_{OUT}≤0.30A	11.3W	14.8W
OB3613RAP	I_{OUT}≤0.30A	15.0W	27.0W
OB3613TJP	I_{OUT}≤0.30A	12.0W	18.4W
OB3613TAP	I_{OUT}≤0.40A	19.0W	28.8W

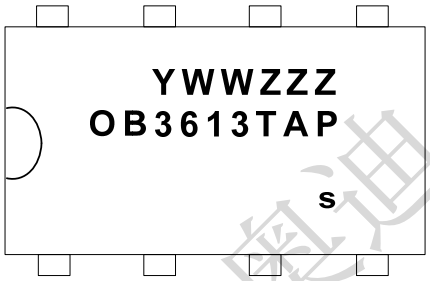
Note: Maximum practical continuous power in an open frame design with sufficient drain pattern as a heat sink, at 50℃ ambient and 60℃ temperature rise. Higher output power is possible with extra added heat sink、air circulation and decrease output current to reduce thermal resistance.



Marking Information



Y: Year Code
WW: Week Code (01-52)
ZZZ:Lot Code
C: SOP8
P:Pb-free Package
s: Internal Code(Optional)



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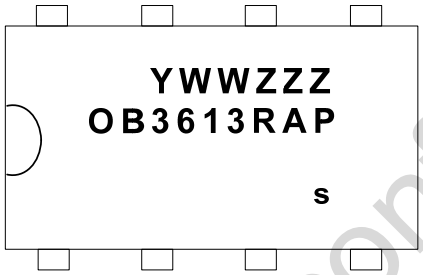

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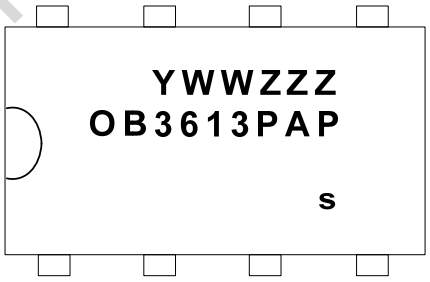

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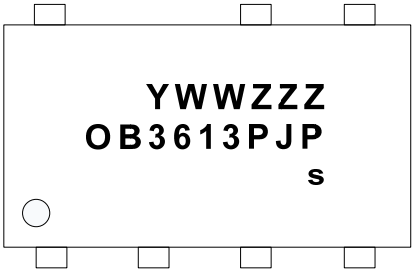

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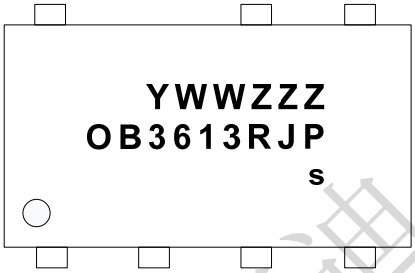
J: SOP7
P:Pb-free Package
S: Internal Code(Optional)



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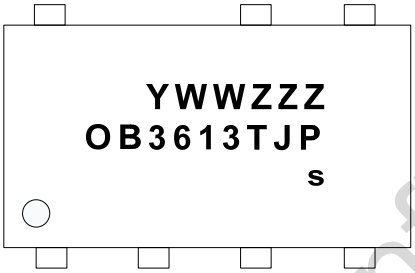
S: Internal Code(Optional)



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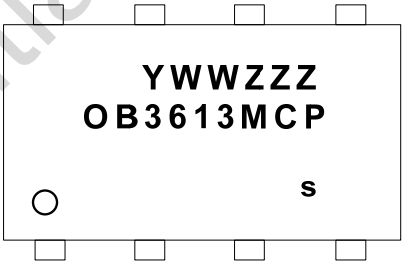
S: Internal Code(Optional)



Y: Year Code
WW: Week Code (01-52)
ZZZ:Lot Code
C: SOP8
P:Pb-free Package
s: Internal Code(Optional)

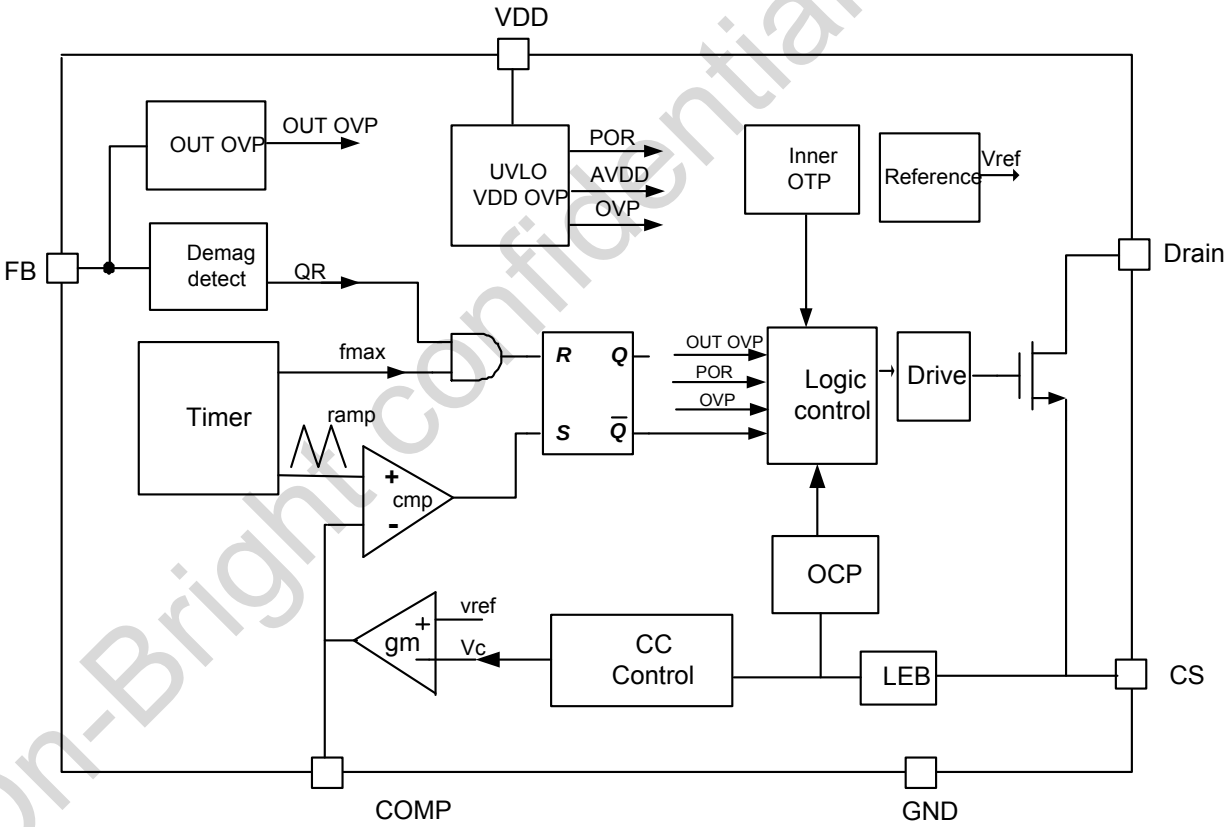
TERMINAL ASSIGNMENTS for OB3613MCP,OB3613NCP, OB3613PAP, OB3613RAP and OB3613TAP

Pin Num	Pin Name	I/O	Description
1	VDD	P	Power supply input.
2	FB	I	The voltage feedback terminal. Connected to resistor divider from output voltage.
3	COMP	O	Loop compensation pin. A capacitor is connected between COMP and GND.
4	CS	I	Current sensing 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

TERMINAL ASSIGNMENTS for OB3613PJP, OB3613RJP, OB3613TJP

Pin Num	Pin Name	I/O	Description
1	VDD	P	Power supply input.
2	FB	I	The voltage feedback terminal. Connected to resistor divider from output voltage.
3	COMP	O	Loop compensation pin. A capacitor is connected between COMP and GND.
4	CS	I	Current sensing terminal.
5,6	DRAIN	I	MOSFET Drain terminal
7	GND	P	Power Ground

BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS

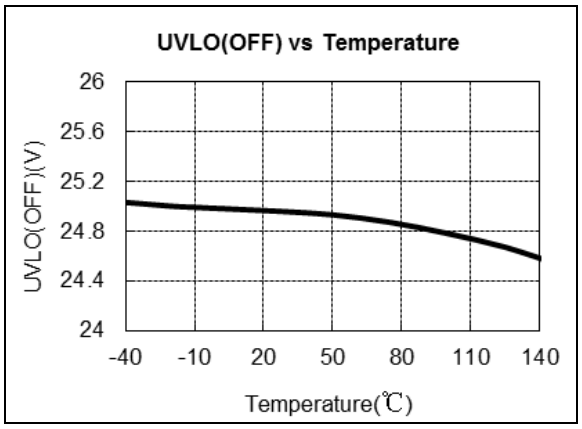
(TA = 25℃, VDD=20V, if not otherwise noted)

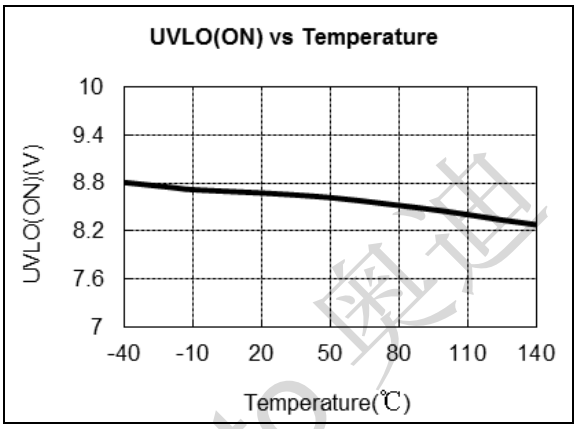
Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
Supply Voltage (VDD) Section						
$I_{start-up}$	Start up current	VDD=UVLO(OFF)-1V		3	7	uA
I_{op}	Operation current	VDD=20V, no loading		1.5	2.2	mA
UVLO(OFF)	VDD under voltage lockout exit		24	25.5	27	V
UVLO(ON)	VDD under voltage lockout enter		8	9	10	V
VDD_OVP	VDD Over Voltage Protection		32	35	38	V
Current Sense Input Section						
TLEB	LEB time			0.3		us
Vth_ocp	Over Current Threshold	FB>0.45V	1.0	1.15	1.3	V
		FB<0.45V		0.5		V
FB Input Section						
Vout_ovp	Output Over Voltage Protection		3.4	3.5	3.6	V
Vout_scp	Output Short Circuit Protection		0.35	0.45	0.55	V
QR Section						
Fmax	Maximum Working Frequency			200		KHz
Toff_max	Maximum Off Time	COMP=4.2V	56	70	84	us
Toff_min	Minimum Off Time	CS>0.15V		2		us
		CS<0.15V		0.5		us
Ton_max	Maximum On Time	COMP=4.2V		25		us
Error Amplifier Section						
Vref	Error Amplifier Reference Voltage		0.196	0.200	0.204	V
Gm	Error Amplifier Transconductance			50		us
I_{source_max}	Error Amplifier Max. Source Current			10		uA
I_{sink_max}	Error Amplifier Max. Sink Current			50		uA
V_{clamp_COMP}	COMP Pin Down_clamp Voltage			1.2		V

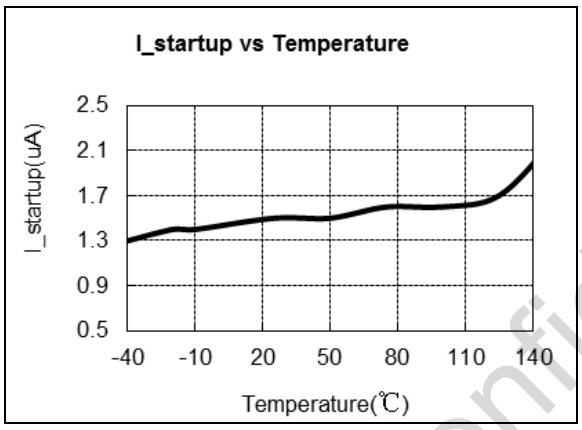
Power MOSFET Section

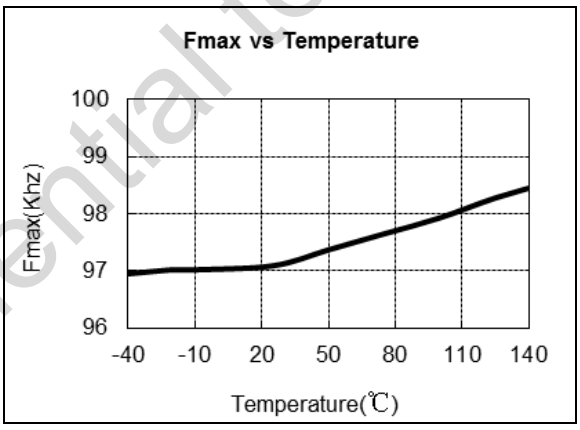
Parameter / Product	**BVdss(V)** MOSFET Drain-Source Breakdown Voltage			**Rds,on(Ω)** On resistance		
	Min	Typ.	Max	Min	Typ.	Max
OB3613MCP	500				18	
OB3613NCP	500				9	
OB3613PJP	500				4.7	
OB3613PAP	500				4.7	
OB3613RJP	500				3.5	
OB3613RAP	500				3.5	
OB3613TJP	500				3	
OB3613TAP	500				3	

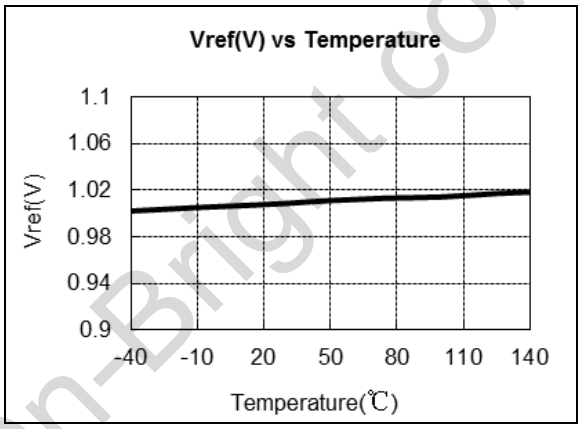
CHARACTERIZATION PLOTS

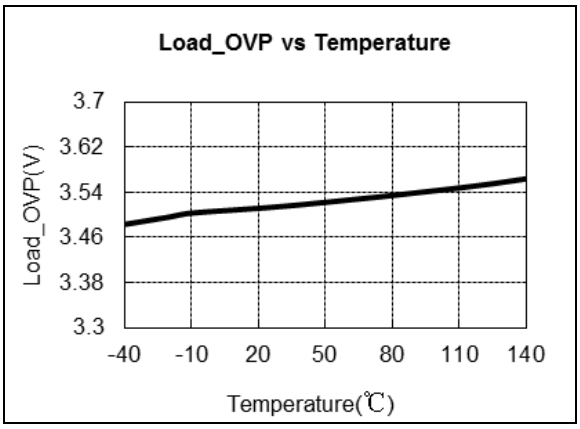


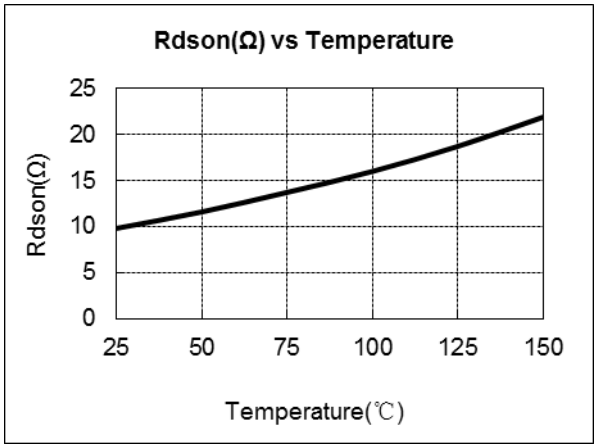




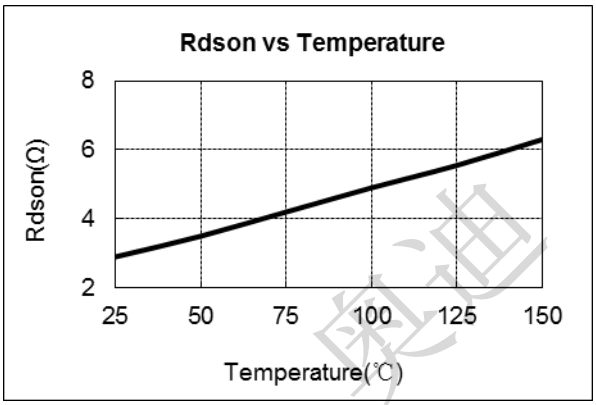








For OB3613N



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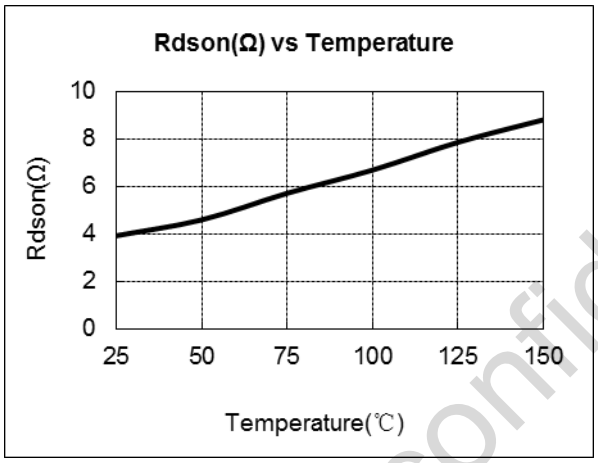

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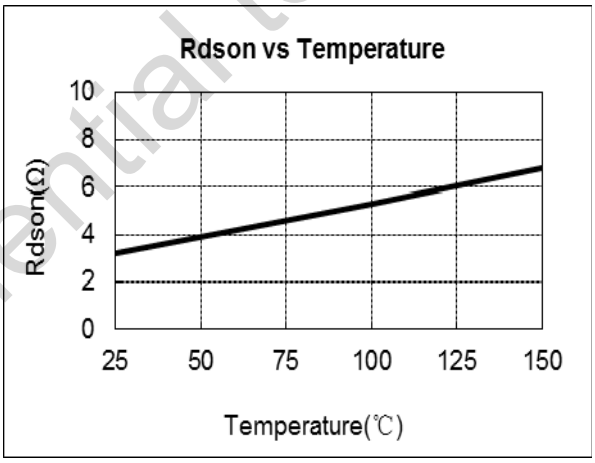
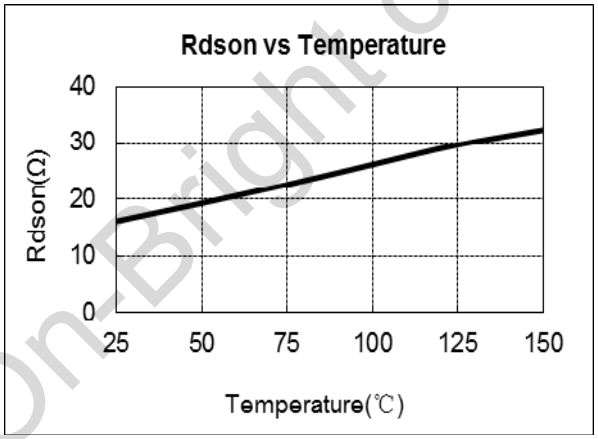


For OB3613R



FOR OB3613M

OPERATION DESCRIPTION

OB3613x is a high power factor, highly integrated buck regulator with advanced features to provide high efficiency control and high precision constant current output for LED lighting applications. It integrates a power MOSFET and provides LED open/short protection.

- **Start up Control**

Low start-up current is designed in OB3613x so that VDD could be charged up above UVLO threshold with small charging current. A large value startup resistor can therefore be used to minimize the power loss in application.
The capacitor at COMP pin is pulled up quickly during starting up until its voltage reaches 1.2V (typical). Then the error amplifier charges the COMP pin capacitor with a transconductance of about 500us (typical), and the OB3613x drives the internal power MOSFET at minimum frequency for low power dissipation. At the startup, the threshold voltage of OCP is set at 0.5V (typical). When the voltage at FB pin reaches 0.45V (typical), the threshold voltage of OCP is increased to 1V (typical). When the voltage at FB pin increases and reaches 1.2V (typical), the transconductance of error amplifier is reduced to 50us (typical).

- **LED Constant Current Regulation**

OB3613x uses the constant current control method to accurately control the LED current. It detects LED current and forces the average LED current equals to the ratio of reference voltage to resistance at CS pin as shown in the equation below:

$$I_{LED} = \frac{V_{ref}}{R_{cs}}$$

Rcs — The sensing resistor connected between the MOSFET source and the GND pin of IC.
Vref — Internal reference voltage.

- **PFC**

The duration of the turn on period Ton is generated by comparing an internal fixed saw-tooth wave with the voltage on the COMP pin. During steady state operation, the voltage on the COMP pin Vcomp is slowly varying due to a large external capacitor connected at the COMP pin, therefore the turn on time Ton is constant. In a buck topology, constant turn on time provides high power factor (PF).

- **Current Sensing and Leading Edge Blanking**

Cycle-by-Cycle current limiting (OCP) is offered in OB3613x. The switching current is detected by a sense resistor connected between the CS pin and GND. An internal leading edge blanking circuit chops off the sense voltage spike at initial MOSFET on state due to wheel diode reverse recovery so that the external RC filter is no longer required. The current limit comparator is disabled at this blanking time and thus the external MOSFET cannot be turned off during this blanking time.

- **LED Open/Output OVP Protection**

When LED string is open, an output over-voltage condition is monitored independently by the voltage at pin FB. 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 GATE is turned off immediately until VDD voltage drops below UVLO (ON), and the device enters power on startup sequence thereafter.

- **VDD Over Voltage Protection**

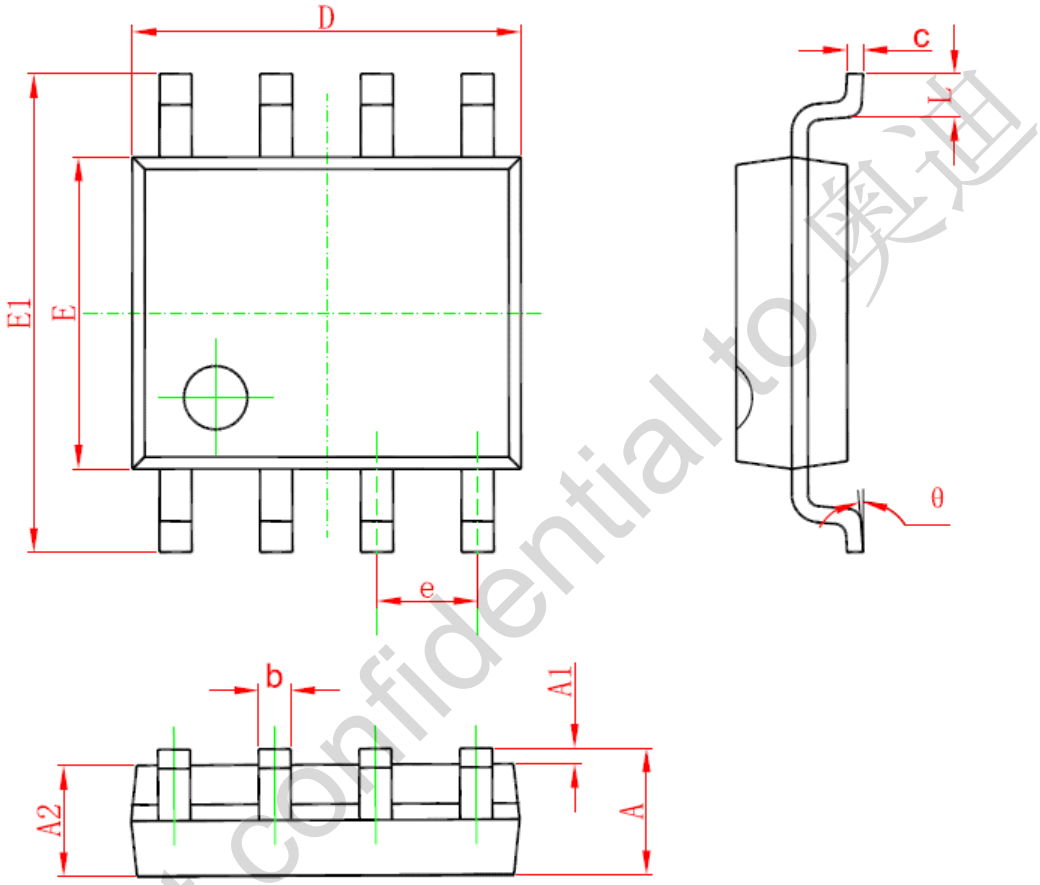
VDD is supplied from the BUCK output as shown in the typical application diagram. When VDD is higher than 35V (typical), VDD OVP protection is triggered and OB3613x is shut down, and the device enters power on startup sequence thereafter.

- **LED Short Circuit Protection**

When LED string is short, the voltage at FB pin drops to below a threshold of approximately 0.45V (typical), the IC will work at minimum frequency and the threshold voltage of OCP is reduced to 0.5V (typical). The power dissipation is greatly reduced in this way. When the VDD voltage drops to UVLO(ON), the device enters power on startup sequence thereafter.

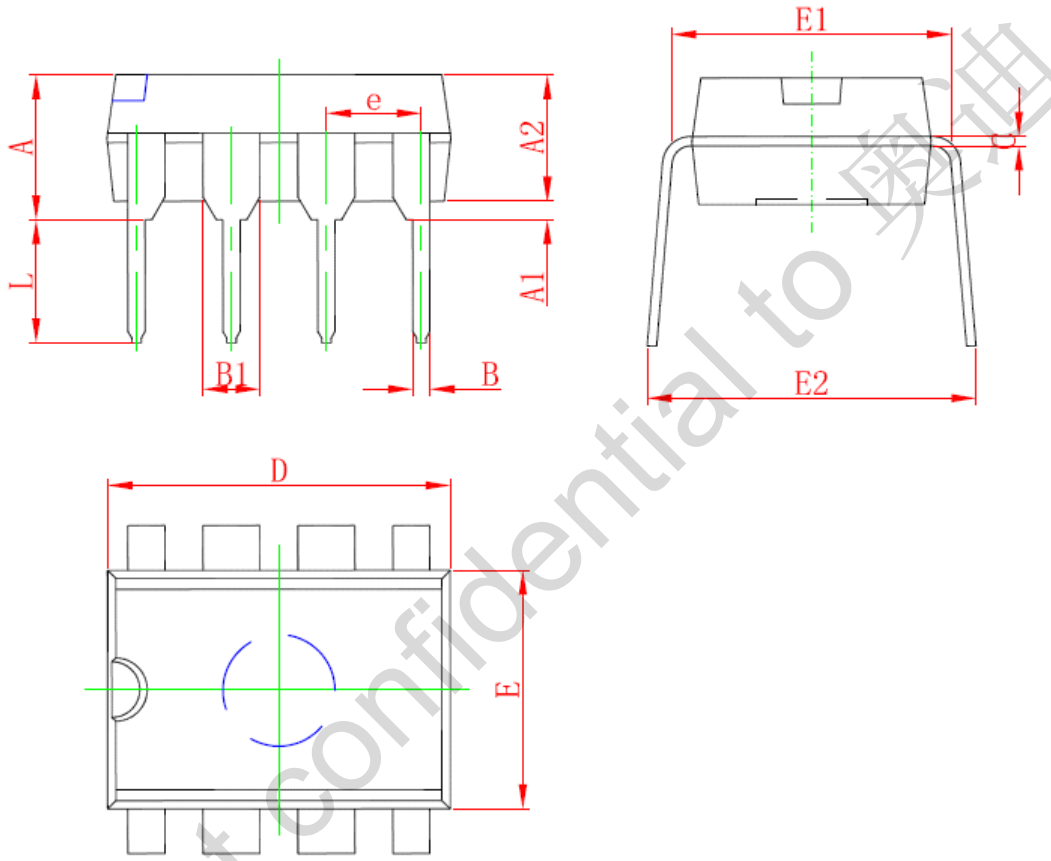
PACKAGE MECHANICAL DATA

SOP7 and 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°

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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On-Bright Electronics Corp. reserves the right to make corrections, modifications, enhancements, improvements and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete.

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