

GENERAL DESCRIPTION

OB5686x is a flyback and buck power switch with high power factor, low THD and high constant voltage (CV) precision. It can achieve low system cost for isolated and non-isolated applications.

The proprietary CV control scheme is used and the system can achieve high power factor with constant on-time control scheme. Quasi-resonant (QR) operation and clamping frequency greatly improves the system efficiency. The advanced high voltage start-up technology is used to meet the fast start-up time and low standby power requirements.

OB5686x offers comprehensive protection including open circuit protection, short circuit protection, over load protection, cycle-by-cycle current limiting, built-in leading edge blanking, VDD under voltage lockout (UVLO), etc.

OB5686x is offered in SOP8 package.

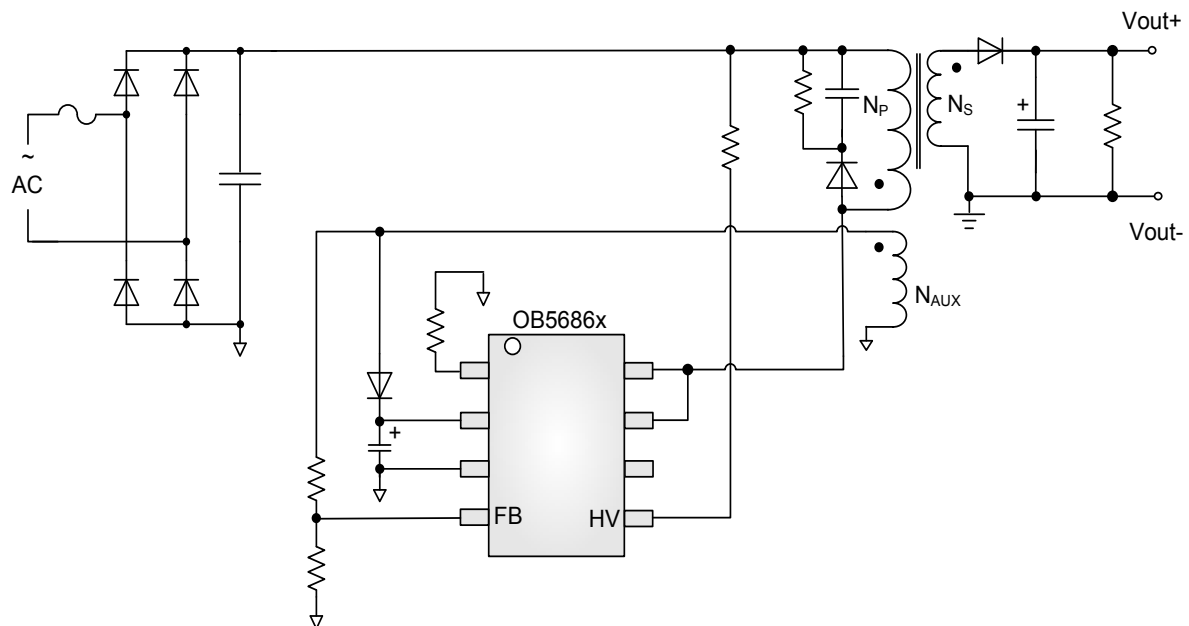
FEATURES

- High precision constant voltage regulation
- High PF and low THD
- HV start-up
- <50mW low standby power
- Fast dynamic response adaptively
- Externally configurable minimum frequency
- Low system cost and high efficiency
- Quasi-resonant operation
- Output short circuit protection
- Output open circuit protection
- Cycle-by-cycle current limiting
- Built-in leading edge blanking (LEB)
- VDD under voltage lockout with hysteresis (UVLO)
- VDD over voltage protection
- Over temperature protection (OTP)
- Over load protection (OLP)
- Audio Noise Free

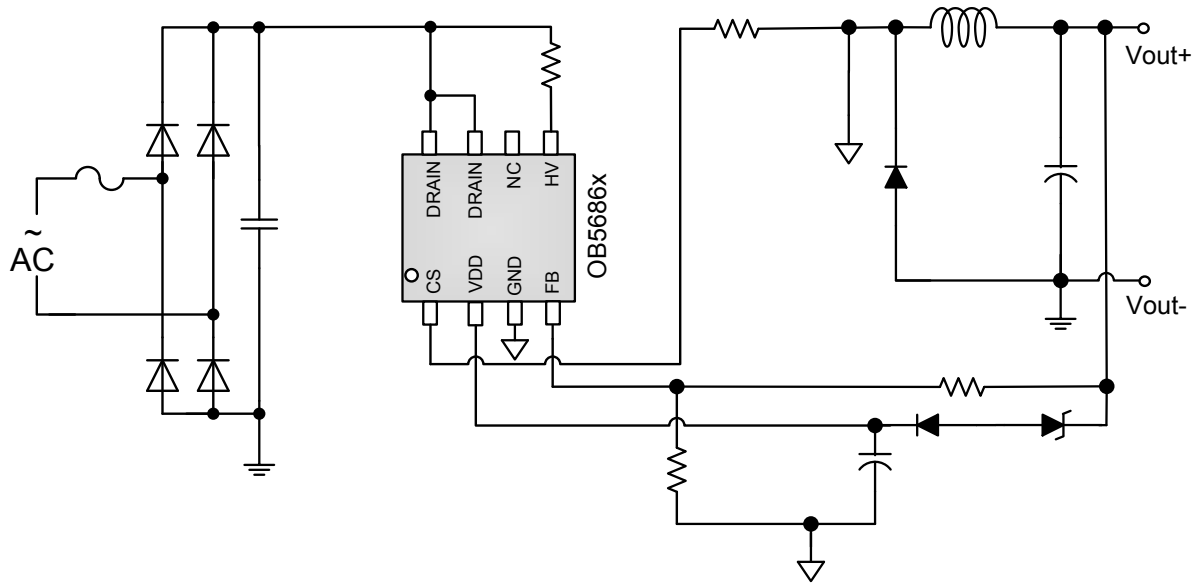
APPLICATIONS

- Smart LED lighting
- Motor drive power supply

FLYBACK TYPICAL APPLICATION



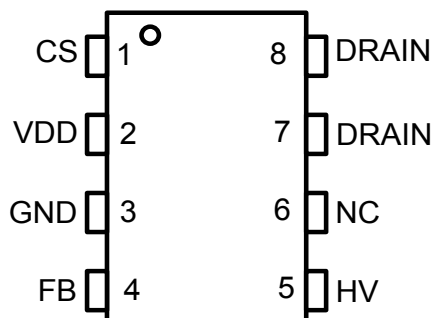
BUCK TYPICAL APPLICATION



GENERAL INFORMATION

Pin Configuration

The pin map is shown as below for SOP8.



Ordering Information

Part Number	Description
OB5686PCP-H	SOP8, Halogen-free in Tube
OB5686PCPA-H	SOP8, Halogen-free in T&R
OB5686PCP-J	SOP8, Halogen-free in Tube
OB5686PCPA-J	SOP8, Halogen-free in T&R
OB5686TCP-H	SOP8, Halogen-free in Tube
OB5686TCPA-H	SOP8, Halogen-free in T&R

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

Package Dissipation Rating

Package	R θ JA (°C/W)
SOP8	90

Absolute Maximum Ratings

Parameter	Value
HV Voltage	-0.3 to 700 V
DRAIN Voltage	-0.3 to BVdss

VDD Voltage	-0.3 to 40V
CS Input Voltage	-0.3 to 7V
FB Input Voltage ²	-1 to 7V
Min/Max Operating Junction Temperature T _J	-40 to 150 °C
Operating Temperature T _A Ambient	-20 to 85 °C
Min/Max Storage Temperature T _{stg}	-55 to 150 °C
Lead Temperature (Soldering, 10secs)	260 °C

Note1: 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.

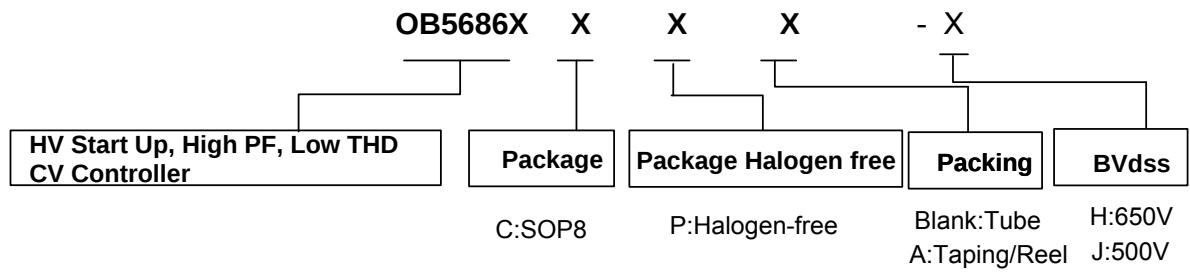
Note2: The negative voltage amplitude is relaxed to -1V under the condition that its max negative current is in less than 10mA.

Output Power Table

Product	90-264VAC	220Vac±20%
	Open Frame	Open Frame
OB5686PCP-H	11.8W	17.5W
OB5686PCP-J	11.5W	15.2W
OB5686TCP-H	15.5W	21W

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

Marking Information



Y:Year Code
 WW:Week Code(01-52)
 ZZZ:Lot Code
 P:Halogen-free Package
 S:Internal Code(Optional)

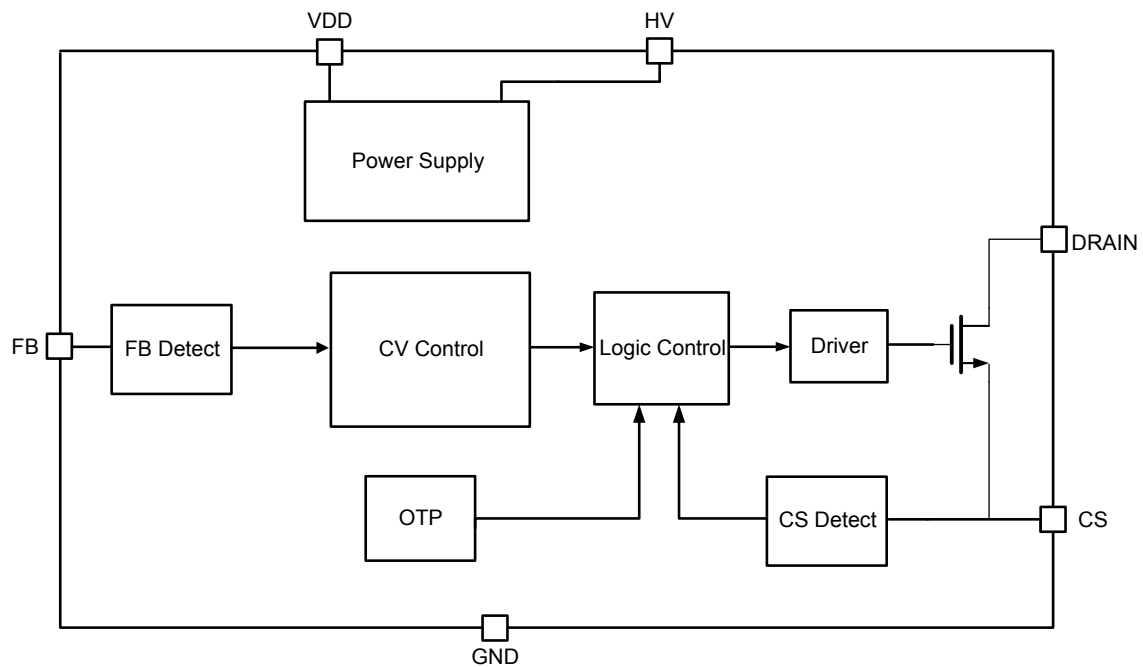
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TERMINAL ASSIGNMENTS

Pin Num	Pin Name	I/O	Description
1	CS	I	Current sense input pin.
2	VDD	P	Power supply.
3	GND	P	Power ground.
4	FB	I	Output voltage feedback.
5	HV	P	High voltage power supply
6	NC		No connection
7,8	DRAIN	O	MOSFET Drain terminal

BLOCK DIAGRAM



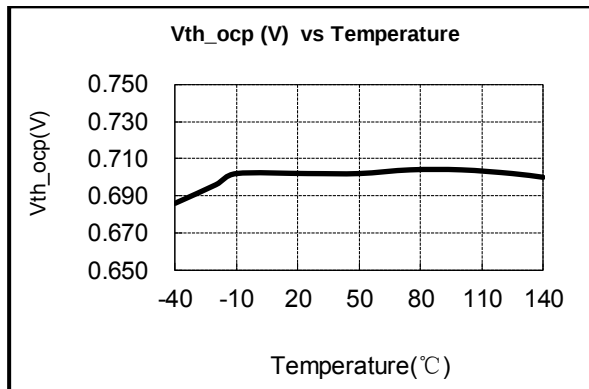
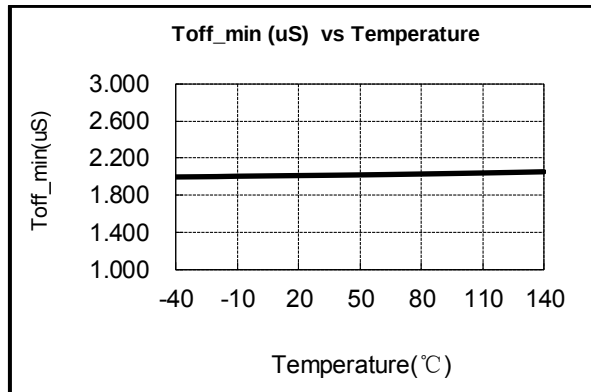
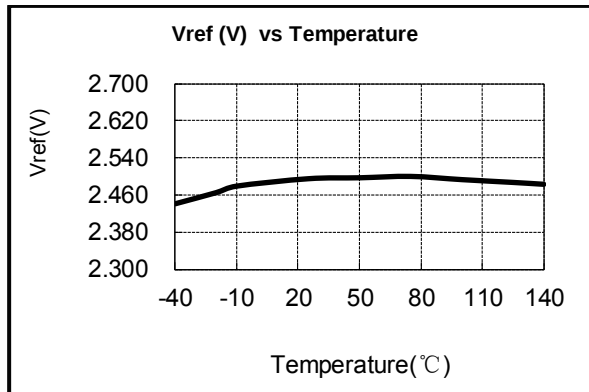
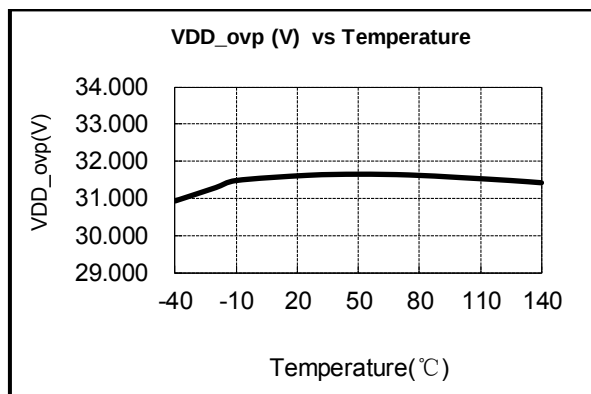
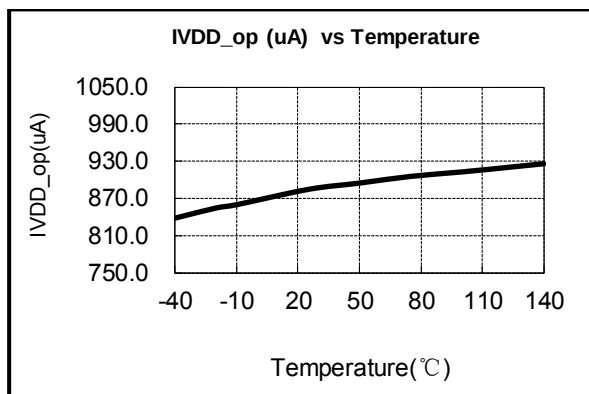
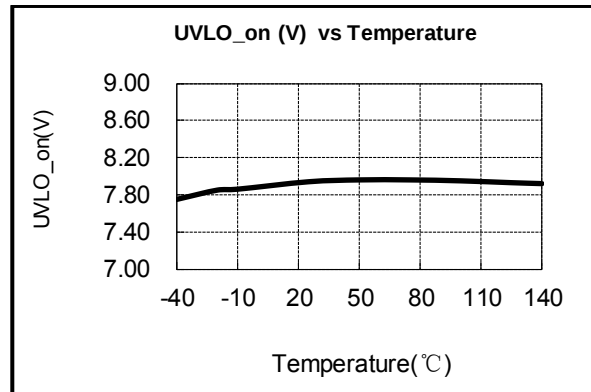
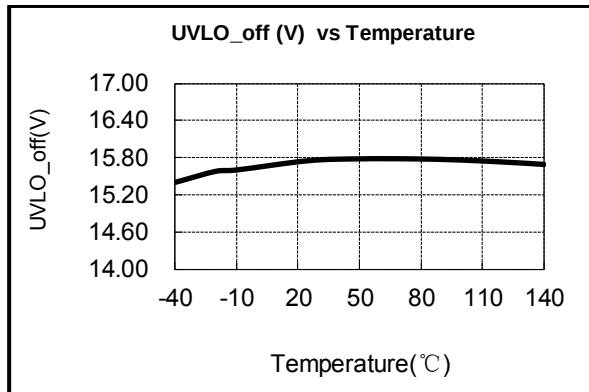
ELECTRICAL CHARACTERISTICS

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

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
Supply Voltage Section						
IVDD_op	Static current	VDD=20V		850		uA
UVLO_off	VDD under voltage Lockout Exit	VDD rising		16.2		V
UVLO_on	VDD under voltage Lockout Enter	VDD falling		8		V
VDD_ovp	VDD overvoltage protection			32		V
FB Detect Section						
Vth_ovp	Output overvoltage protection			3.2		V
Vth_scp	Output short protection			0.4		V
CS Detect Section						
TLEB	Leading Edge Blanking time			420		ns
Vth_ocp	Over current threshold voltage	Ton=0us		0.7		V
CV Control Section						
Vref	Error Amplifier Reference Voltage		2.45	2.5	2.55	V
Fmax	Maximum Frequency			120		KHz
Toff_min	Minimum off time			2		us
Toff_max	Maximum off time			110		us
Ton_max	Maximum on time			20		us
Fmin	Minimum frequency			500		Hz
OTP section						
OTP	Over temperature protection			150		°C

Product \ Parameter	BVdss(V) MOSFET Drain-Source Breakdown Voltage		
	Min	Typ.	Max
OB5686PCP-H	650		
OB5686PCP-J	500		
OB5686TCP-H	650		

CHARACTERIZATION PLOTS



OPERATION DESCRIPTION

OB5686x is a flyback and buck power switch with HV startup high power factor, low THD and high constant voltage (CV) precision. It can achieve low system cost for isolated and non-isolated applications.

Startup

OB5686x integrates HV startup circuit. During power on state, it provides about 1mA current to charge the capacitor connecting between VDD and ground from HV pin. When the VDD voltage is higher than UVLO_off, the charge current is switched off. At this moment, the VDD capacitor provides current to OB5686x until the auxiliary winding of the main transformer starts to supply the operation current.

In general application, a 20KΩ(typical) resistor is recommended to be placed in the high voltage path to limit the current.

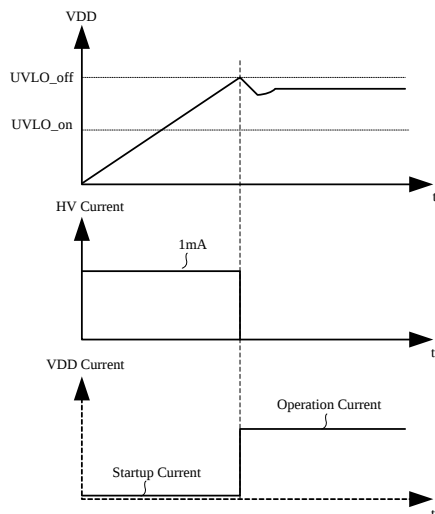


Figure.1 Startup Current Timing

During startup, OB5686x will operate at open loop and over-current protection is set cycle-by-cycle until it senses the output voltage by FB pin up to about 0.4V.

Output voltage regulation

In flyback application, in order to achieve primary side constant voltage control, the output voltage is detected through the auxiliary winding voltage. During OFF time, the voltage across the auxiliary winding is:

$$V_A = (V_{OUT} + V_{DF}) \frac{N_A}{N_S}$$

N_S is the turns of secondary winding

V_{DF} is the forward voltage of the power diode

N_A is the turns of auxiliary winding

At the current zero-crossing point, V_{DF} is nearly

zero, so V_{OUT} is proportional with V_A exactly. The FB voltage of this point is sampled as the feedback of output voltage. The resistor of voltage divider is designed by:

$$V_{OUT} = \frac{V_{ref}}{\frac{N_A}{N_S} \frac{R_2}{R_1 + R_2}}$$

V_{ref} is the internal voltage reference

R_1 is high side resistance of voltage divider

R_2 is low side resistance of voltage divider

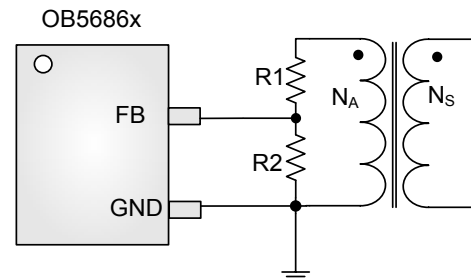


Figure.2 Flyback FB Section Circuit

In buck application, in order to achieve constant voltage control, the output voltage is detected by the buck inductor voltage.

The resistor divider is designed by:

$$V_{OUT} = \frac{V_{ref}}{\frac{R_4}{R_3 + R_4}}$$

V_{ref} is the internal voltage reference

R_3 is high side resistance of voltage divider

R_4 is low side resistance of voltage divider

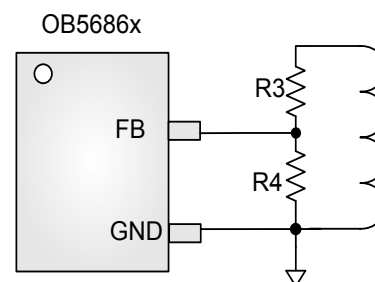


Figure.3 Buck FB Section Circuit

Adaptively adjust dynamic response

When the output load changes from heavy load to light load, the FB voltage will be detected higher than V_{FB_H} , OB5686x is forced into Fmin mode operation for fast response to reduce the output energy. When the FB voltage returns to V_{FB_R} , OB5686x works in normal operation. When the output load changes from light load to heavy load, the FB voltage will be detected lower than V_{FB_L} , OB5686x works in OCP mode for fast response to

ensure sufficient energy supply to the output. When the FB voltage returns to VFB_R, OB5686x works in normal operation.

OB5686x is offered fast dynamic response, the dynamic thresholds VFB_H and VFB_L is adjusted adaptively according to the ripple of the output voltage. So OB5686x can internally select different dynamic thresholds for different output capacitors.

The threshold of VFB as shown in table:

Dynamic	VFB_H	VFB_R
+10%	2.75V	2.6V
+20%	3V	2.6V
	VFB_L	VFB_R
-10%	2.25V	2.4V
-20%	2V	2.4V

PF and THD

The duration of the turn on period t_{on} is generated and keeps constant by a patented control method. Constant on time and quasi-resonant operation provide high power factor (PF) and low total harmonic distortion (THD).

Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting (OCP) is offered in OB5686x. The switching current is detected through the sense resistor 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 snubber diode reverse recovery. The current limit comparator is disabled during this blanking time and thus the external MOSFET is not closed during this period.

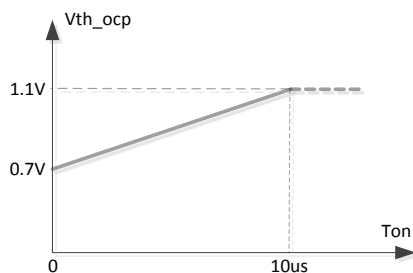


Figure.4 OCP and Ton Curve

Quasi-Resonant Operation

OB5686x performs quasi-resonant detection through FB pin by monitoring the output voltage.

FB voltage drops when the energy stored in transformer or inductance is released to the output. When FB pin voltage falls below 0V (typical), an internal FB comparator is triggered and a new PWM switching cycle is initiated after the FB trigger.

Protection Controls

OB5686x ensures good reliability design through its good protection coverage. Output over voltage protection (OVP), Over Load Protection (OLP), VDD under voltage lockout (UVLO), VDD over voltage protection (VDD OVP), cycle-by-cycle current limiting, output short circuit protection, output open circuit protection, over temperature protection and diode short protection are standard features provided by OB5686x.

Short Circuit Protection

When output is shorted, the FB voltage is low. If the voltage at FB pin falls below a threshold of approximately 0.4 V (typical), the OCP threshold voltage is reduced to 0.4 V (typical). In this way, the power dissipation is greatly reduced. OB5686x shuts down during SCP protection, after 0.5S (typical) VDD drops below UVLO_on and the OB5686x will be reset.

Open Circuit Protection

When an open circuit happens, the FB pin voltage is high. If the FB pin voltage is higher than a threshold of approximately 3.2V (typical), the IC will shut down and enter power on startup sequence thereafter. The OB5686x shuts down during OCP protection, after 0.5S (typical) VDD drops below UVLO_on and the OB5686x will be reset.

Over Load Protection

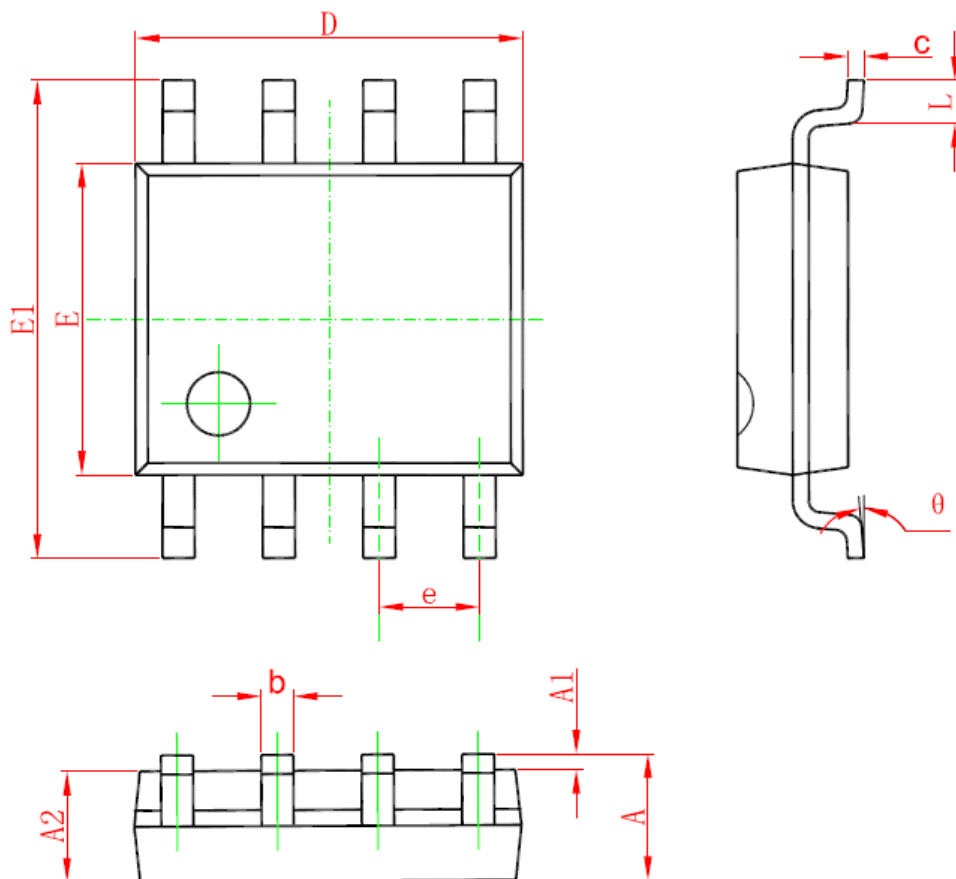
OB5686x detects output power and offers over load protection (OLP). If output power exceeds the power limit threshold (about 1.3 times of full load), the control circuit reacts by turning off the power MOSFET. The OB5686x shuts down during OLP protection, after 0.5S (typical) VDD drops below UVLO_on and the OB5686x will be reset.

Over Temperature Protection

Over temperature protection is offered in OB5686x. When temperature of the device rises above 150°C (typical), the IC will shut down. And the state will remain until the device is restarted.

PACKAGE MECHANICAL DATA

8-Pin Plastic SOP (SOP8)



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	3.700	4.100	0.146	0.161
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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