

## GENERAL DESCRIPTION

OB2506x is a highly integrated current mode PFM control IC optimized for high performance, low standby power and cost effective offline flyback converter applications.

Proprietary Constant Voltage (CV) and Constant Current (CC) control is integrated as shown in the figure below. In CC control, the current and output power setting can be adjusted externally by the sense resistor  $R_s$  at CS pin. In CV control, multi-mode operations are utilized to achieve high performance and high efficiency. Device operates in PFM in CC mode at heavy load condition and it operates in PWM with frequency reduction at medium load. When the load is very small, the IC operates in 'Extended Burst Mode' to minimize the standby power loss. As a result, high conversion efficiency can be achieved in the whole loading range.

OB2506x offers comprehensive protection coverage with auto-recovery feature including Cycle-by-Cycle current limiting, VCC over voltage protection, built-in leading edge blanking, VCC under voltage lockout (UVLO), OTP etc. OB2506x is offered in SOP8 and DIP8 packages.

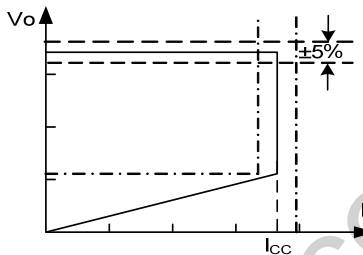


Figure.1. Typical CC/CV Curve

## FEATURES

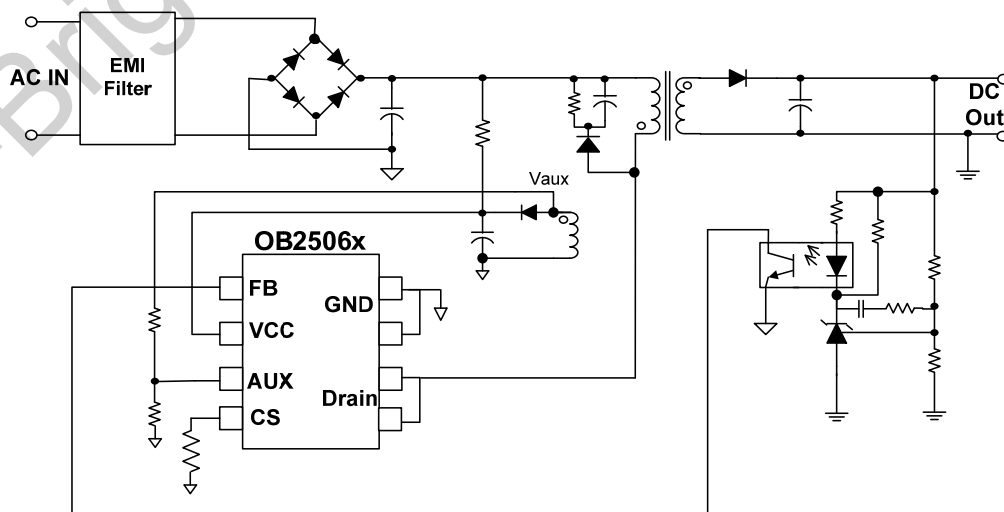
- Extended burst mode control for improved efficiency and low standby power design
- High precision constant voltage and current regulation at universal AC input
- Multi-mode PWM/PFM operation for efficiency improving
- Integrated 1A/2A MOSFET
- Programmable CV and CC regulation
- Built-in primary winding inductance compensation
- Built-in leading edge blanking (LEB)
- Ultra low start-up current and low operating current.
- Comprehensive protection coverage with auto-recovery
  - On-chip OTP
  - VCC over voltage protection
  - VCC under voltage lockout with hysteresis (UVLO)
  - Cycle-by-Cycle current limiting
  - Output over voltage protection

## APPLICATIONS

Offline AC/DC flyback converter for

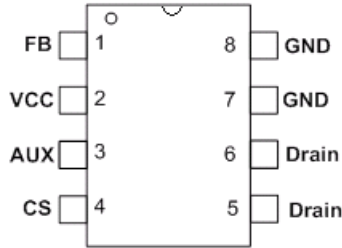
- General power supply
- Power Adapter

## TYPICAL APPLICATION



## GENERAL INFORMATION

### Pin Configuration



### Ordering Information

Part Number	Description
OB2506NCP	SOP8, Halogen-free in Tube
OB2506NCPA	SOP8, Halogen-free in T&R
OB2506PCP	SOP8, Halogen-free in Tube
OB2506PCPA	SOP8, Halogen-free in T&R
OB2506PAP	DIP8, Halogen-free in Tube

### Package Dissipation Rating

Package	R $\theta$ JA(°C/W)
SOP8	95
DIP8	70

### Recommended operating condition

Symbol	Parameter	Range
VCC	VCC Supply Voltage	8 to 25V

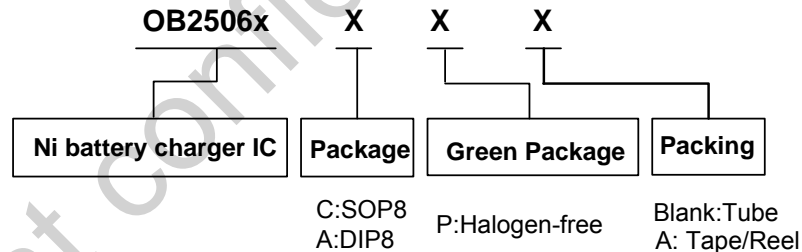
### Absolute Maximum Ratings

Parameter	Value
Drain Voltage (off state)	-0.3V to Bvdss
VCC Voltage	-0.3 to 28V
AUX Input Voltage	-0.3 to 7V
FB Input Voltage	-0.3 to 7V
CS Input Voltage	-0.3 to 7V
Min/Max Operating Junction Temperature T <sub>J</sub>	-40 to 150 °C
Operating Ambient Temperature T <sub>A</sub>	-20 to 85 °C
Min/Max Storage Temperature T <sub>stg</sub>	-55 to 150 °C
Lead Temperature (Soldering, 10secs)	260 °C

**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

Part Number	90Vac~264Vac
OB2506NCP	5W
OB2506PCP	12W
OB2506PAP	12W



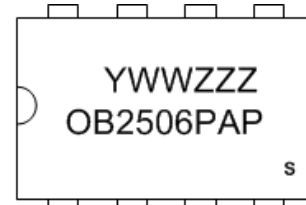
### Marking Information



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



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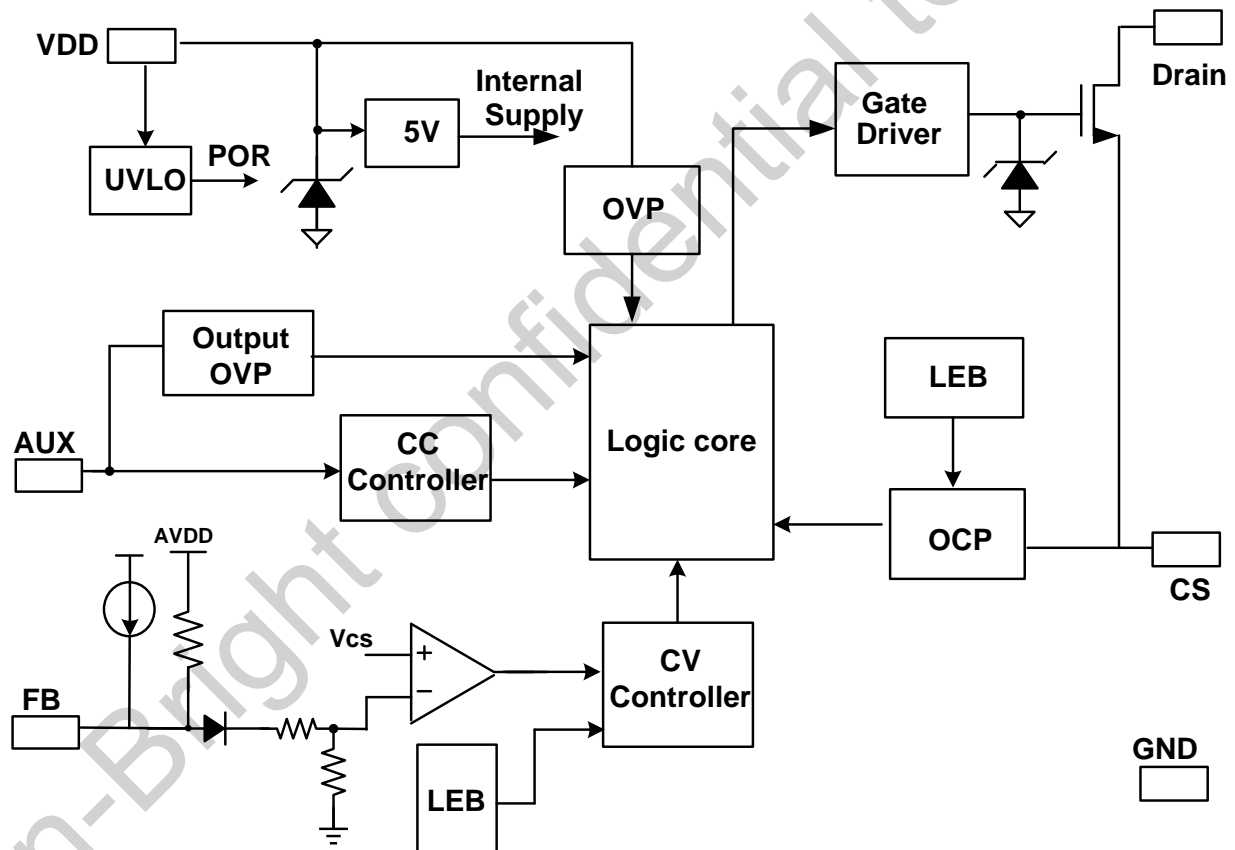


Y:Year Code  
 WW:Week Code(01-52)  
 ZZZ:Lot Code  
 A:DIP8 Package  
 P:Green Package(Halogen-free)  
 S:Internal Code(Optional)

## TERMINAL ASSIGNMENTS

Pin Name	I/O	Description
VCC	P	Power Supply
CS	I	Current sense input
AUX	I	The voltage feedback from auxiliary winding. Connected to resistor divider from auxiliary winding reflecting output voltage.
GND	P	Ground
Drain	O	Drain of internal power MOSFET
FB	I	Feedback input pin. The PWM duty cycle is determined by voltage level into this pin and the current-sense signal at Pin CS.

## FUNCTIONAL BLOCK DIAGRAM



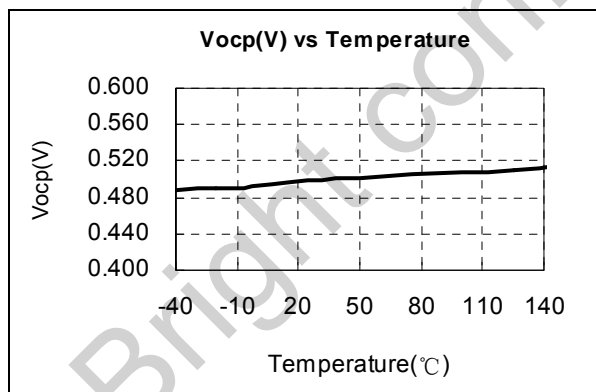
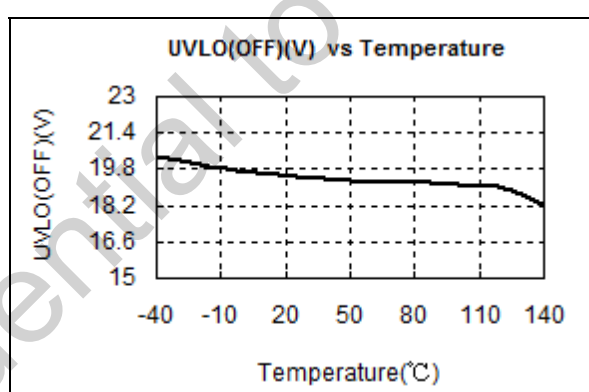
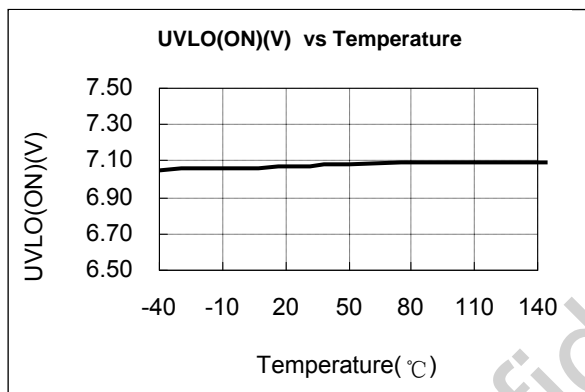
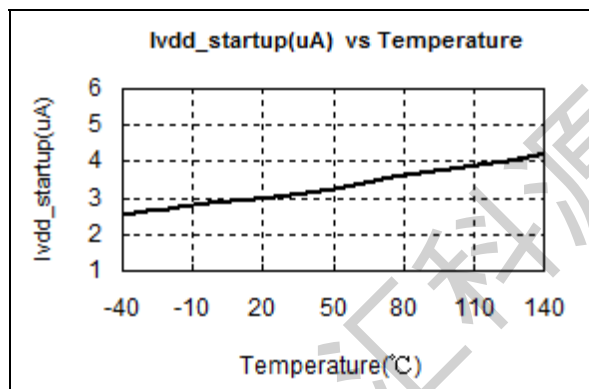
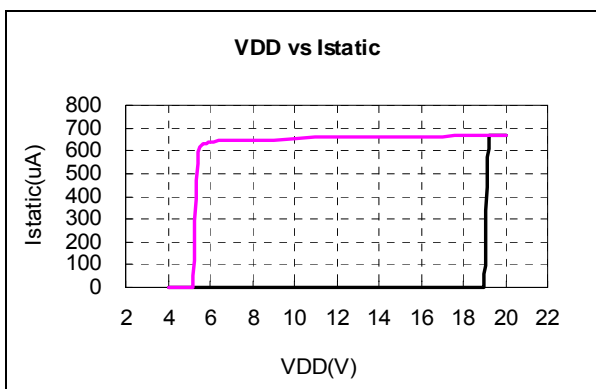
**ELECTRICAL CHARACTERISTICS**

 (T<sub>A</sub> = 25°C, VCC=18V, unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
<b>Supply Voltage (VCC) Section</b>						
I <sub>start-up</sub>	Start up current	VCC=UVLO_OFF-1V		5		uA
I <sub>static</sub>	Static current			0.7		mA
UVLO(OFF)	VCC under voltage lockout exit		16.0	18.2	20.5	V
UVLO(ON)	VCC under voltage lockout enter		6.5	7.0	7.5	V
VCC_OVP	VCC over voltage protection		26.0	27.0	28.5	V
Max. Operating Voltage					25	V
<b>Current Sense Input Section</b>						
TLEB	LEB time			300		ns
V <sub>th_ocp_min</sub>	Minimum over current threshold		485	500	515	mV
V <sub>th_ocp_max</sub>	Maximum over current threshold			590		mV
V <sub>cs_min</sub>	CS minimum threshold		150			mV
<b>Feedback Input Section(FB Pin)</b>						
V <sub>FB Open</sub>	V <sub>FB</sub> Open Loop Voltage			5		V
Av <sub>cs</sub>	PWM input gain ΔVFB/ΔVCS			4.8		V/V
V <sub>ref_burst_H</sub>	The threshold exits burst mode			1.05		V
V <sub>ref_burst_L</sub>	The threshold enters burst mode			0.95		V
R <sub>fb</sub>	FB pin pull high resistor			15		KΩ
I <sub>fb</sub>	FB pin pull high current			35		uA
<b>Output Over Voltage Protection</b>						
V <sub>OVP</sub>	Output Over voltage threshold		2.8	3.0	3.2	V
<b>On chip Over temperature Section</b>						
T <sub>otp</sub>	Over temperature protection trigger point		135	150	165	°C
T <sub>otp_rec</sub>	Over temperature protection recovery point		105	120	135	°C
<b>MOSFET Section</b>						
BV <sub>dss</sub>	Mosfet Drain-Source Breakdown Voltage		600			V
R <sub>dson</sub>	Static drain to source on resistance	OB2506N		8		Ω
		OB2506P		4		Ω

### CHARACTERIZATION PLOTS

VCC = 18V, TA = 25°C condition applies if not otherwise noted.



## OPERATION DESCRIPTION

OB2506x is a highly integrated current mode PWM control IC optimized for high performance, low standby power and cost effective offline flyback converter applications. The 'extended burst mode' control greatly reduces the standby power consumption and helps the design easier to meet the international power conservation requirements.

### Startup Current and Start up Control

Startup current of OB2506x is designed to be very low so that VCC could be charged up above UVLO threshold level and device starts up quickly. A large value startup resistor can therefore be used to minimize the power loss yet achieve a reliable startup in application.

### Operating Current

The Operating current of OB2506x is low at 0.7mA (typical). Good efficiency is achieved with OB2506x low operation current together with the 'extended burst mode' control features.

### CC/CV Operation

OB2506x is designed to produce good CC/CV control characteristic as shown in the Figure. 1. In charger applications, a discharged battery charging starts in the CC portion of the curve until it is nearly full charged and smoothly switches to operate in CV portion of the curve. The CC portion provides output current limiting. In CV operation, the output voltage is regulated through the secondary side control.

### Principle of Operation

To support OB2506x series proprietary CC/CV control, system needs to be designed in DCM mode for flyback system (Refer to Typical Application Diagram in page1).

In the DCM flyback converter, the output voltage can be sensed via the auxiliary winding. During MOSFET turn-on time, the load current is supplied from the output filter capacitor, Co, and the current in the primary winding ramps up. When MOSFET turns off, the energy stored in the primary winding is transferred to the secondary winding and the current in the secondary winding is

$$I_S = \frac{N_P}{N_S} \cdot I_P \quad (1)$$

The auxiliary voltage reflects the output voltage as shown in Figure.2 and it is given by

$$V_{AUX} = \frac{N_{AUX}}{N_S} \cdot (V_O + \Delta V) \quad (2)$$

Where  $\Delta V$  indicates the voltage drop of the output Diode.

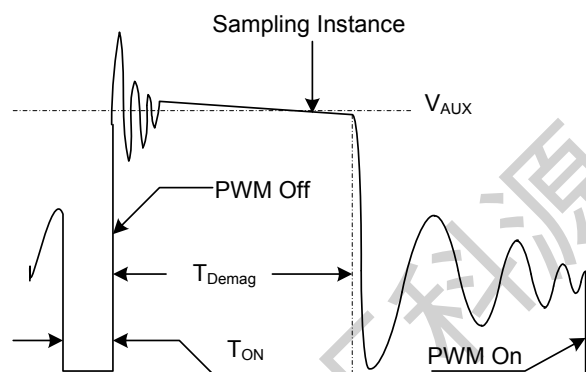


Figure.2. Auxiliary voltage waveform  
Via a resistor divider connected between the auxiliary winding and AUX pin, the auxiliary voltage is sampled at the middle of the demagnetization and it is hold until the next sampling. The sampled voltage is compared with reference voltage  $V_{ovp}$  (typical 3V). When the sampled voltage is higher than  $V_{ovp}$  OB2506x will stop switching and enter output OVP mode.

### Adjustable CC Point and Output Power

In OB2506x series, the CC point and maximum output power can be externally adjusted by external current sense resistor  $R_s$  at CS pin as illustrated in the typical application diagram. The larger  $R_s$ , the smaller CC point is, and the smaller output power becomes, and vice versa as shown in Figure.3.

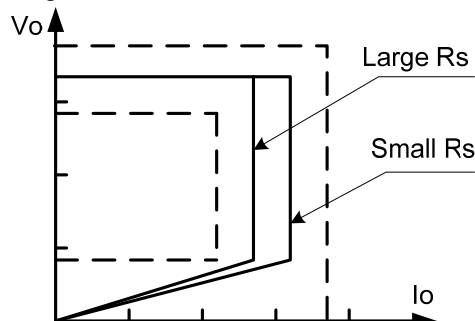


Figure.3. Adjustable output power by changing  $R_s$

### Operation Switching Frequency

The switching frequency of OB2506x is adaptively controlled according to the load conditions and the operation modes.

For flyback operating in DCM, the maximum output power is given by

$$P_{O_{MAX}} = \frac{1}{2} L_P F_{SW} I_P^2 \quad (3)$$

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

Refer to the equation 3, the change of the primary winding inductance results in the change of the maximum output power and the constant output current in CC mode. To compensate the change from variations of primary winding inductance, the switching frequency is locked by an internal loop and the switching frequency is

$$F_{sw} = \frac{1}{2T_{Demag}} \quad (4)$$

Since  $T_{Demag}$  is inversely proportional to the switching frequency, as a result, the product  $L_p$  and  $f_{sw}$  is constant, thus the maximum output power and constant current in CC mode will not change as primary winding inductance changes. Up to  $\pm 7\%$  variation of the primary winding inductance can be compensated.

### CC Line Voltage Compensation

The variation of maximum output current in CC mode can be rather large at high input voltage (such as 264Vac) if no compensation is provided. The CC threshold value is self adjusted higher at higher AC voltage due to CC propagation delay. In OB2506x, the AC line voltage information is sampled through detecting AUX sourcing current when gate turns on, and the AC line voltage information is added to the CS pin voltage. So the maximum CS threshold voltage  $V_{cs\_max}$  in OB2506x is a function of the CC threshold and AC line voltage information as shown in Figure4.

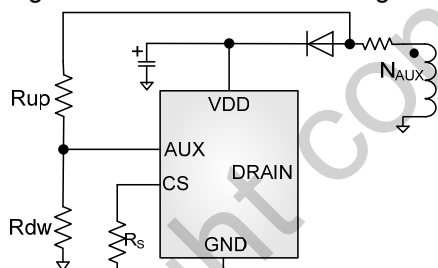


Figure.4. CC line voltage compensation

The maximum CS threshold voltage  $V_{cs\_max}$  is given by

$$V_{cs\_max} = V_{th\_ocp} - \frac{1}{M} \cdot \frac{N_{aux}}{N_p} \cdot \sqrt{2} \cdot V_{ac} \cdot \frac{R_{os}}{R_{up}} \quad (5)$$

Where  $V_{th\_ocp}$  a threshold determined by internal CC comp voltage,  $M$  is the FB current mirror ratio ( $M=32$ ),  $N_{aux}/N_p$  is the auxiliary winding to primary winding turns ratio,  $V_{ac}$  is the effective voltage of input voltage,  $R_{os}$  is the internal line compensation offset resistor ( $R_{os}=2.63K\Omega$ ),  $R_{up}$  is the external AUX PIN up side resistor.

### Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting is offered in OB2506x. 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 so that the external RC filtering on sense input is no longer needed.

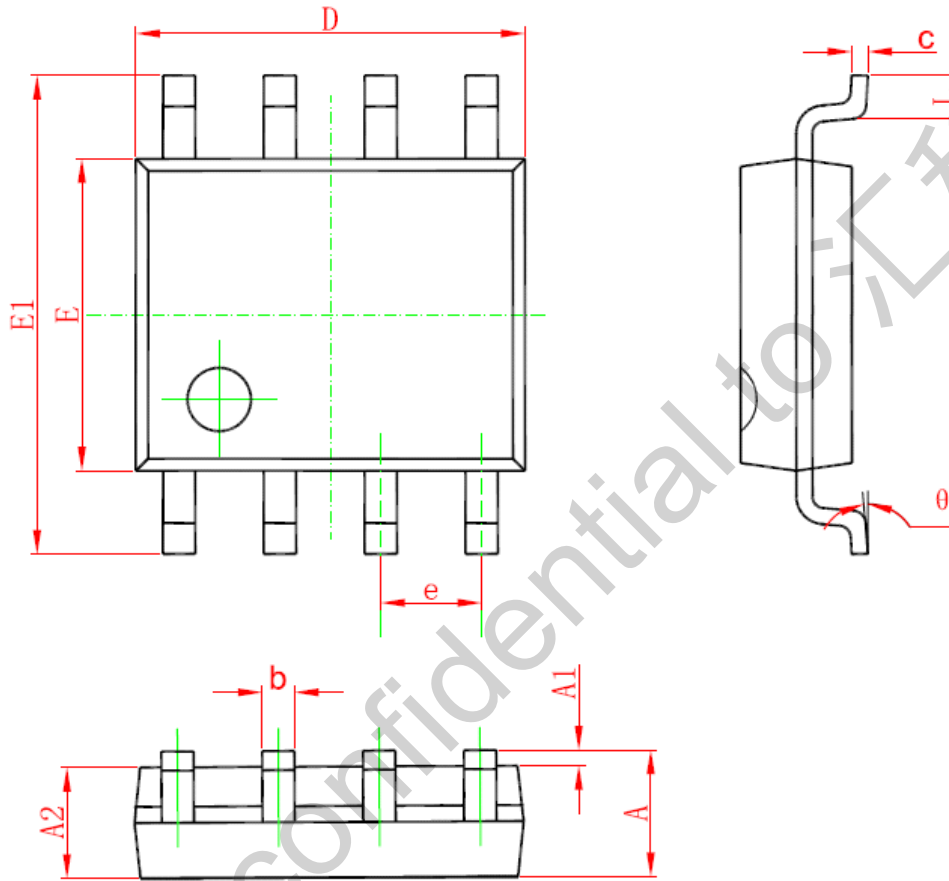
### Protection Control

Good power supply system reliability is achieved with its rich protection features including precise on-chip OTP, cycle-by-cycle current limiting (OCP), output over voltage protection, VCC over voltage protection, under voltage lockout on VCC (UVLO).

VCC is supplied by transformer auxiliary winding output. The output of OB2506x is shut down when VCC drops below UVLO (ON) and the power converter enters power on start-up sequence thereafter.

**PACKAGE MECHANICAL DATA**

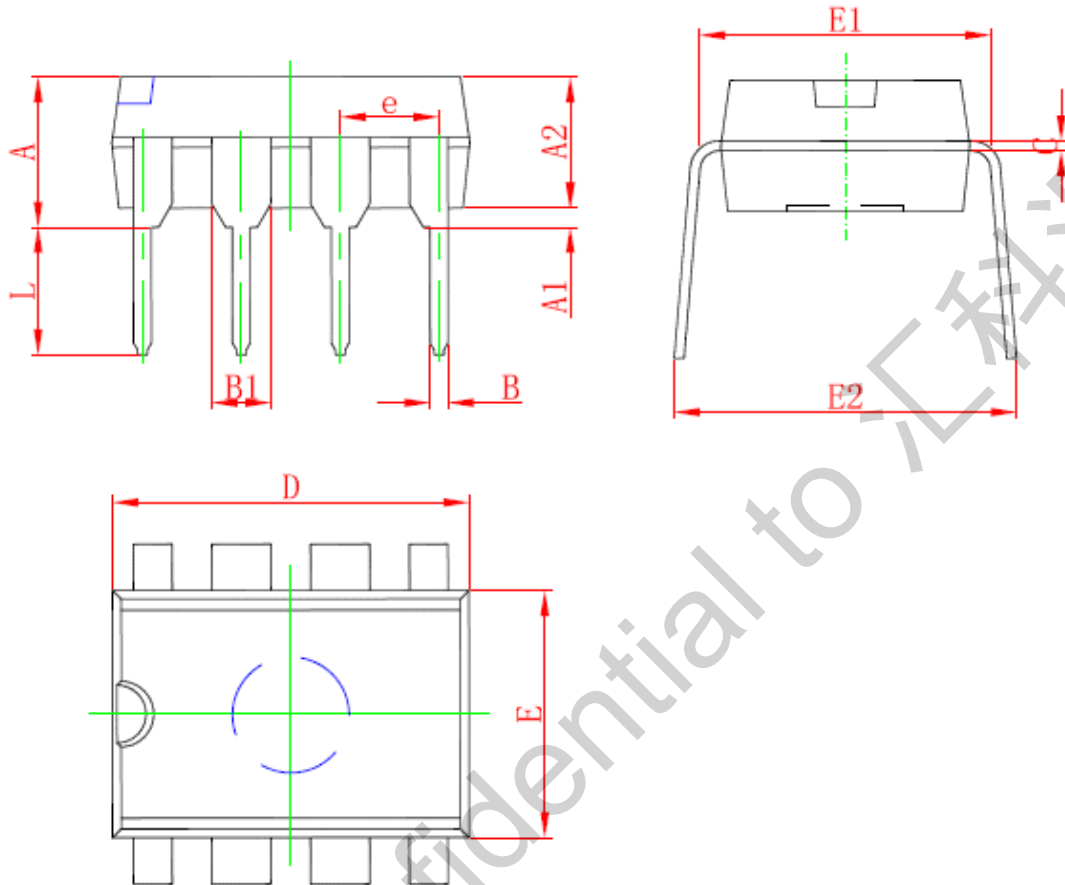
**SOP8 PACKAGE OUTLINE DIMENSIONS**



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
theta	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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