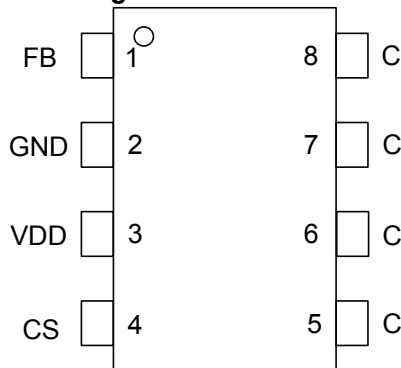




## GENERAL INFORMATION

### Pin Configuration



### Absolute Maximum Ratings

Parameter	Value
CB Voltage	750V
VDD Voltage	-0.3 to 20V
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.

### Ordering Information

Part Number	Description
OB25135CCP	SOP8, Pb-free, Tube
OB25135CCPA	SOP8, Pb-free, T&R
OB25136CCP	SOP8, Pb-free, Tube
OB25136CCPA	SOP8, Pb-free, T&R

### Package Dissipation Rating

Package	RθJA (°C/W)
SOP8	95

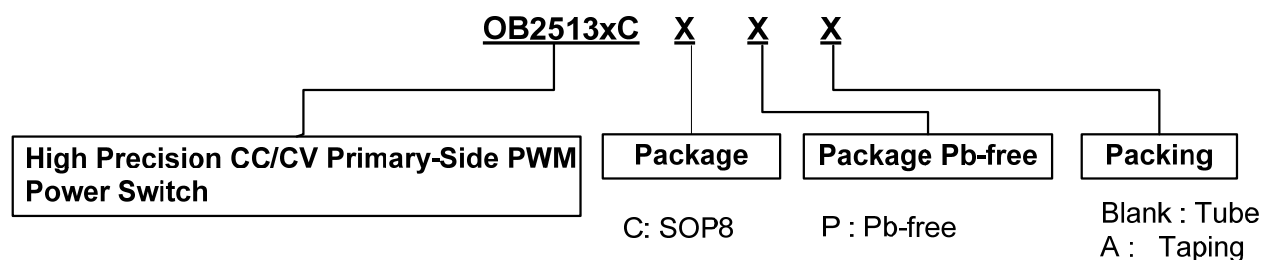
### Recommended Operating Condition

Symbol	Parameter	Range
VDD	VDD Supply Voltage	5 to 16V

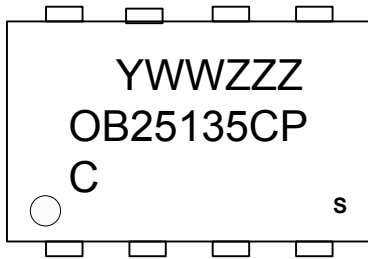
### Recommended Output power Table

Product	Adapter <sup>Note1</sup>
	90V~264V
OB25135C	10W
OB25136C	12W

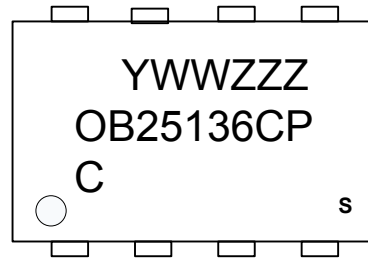
**Notes:** 1. Maximum practical continuous power in an adapter design with sufficient drain pattern as a heat sink, at 40°C ambient



## Marking Information



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

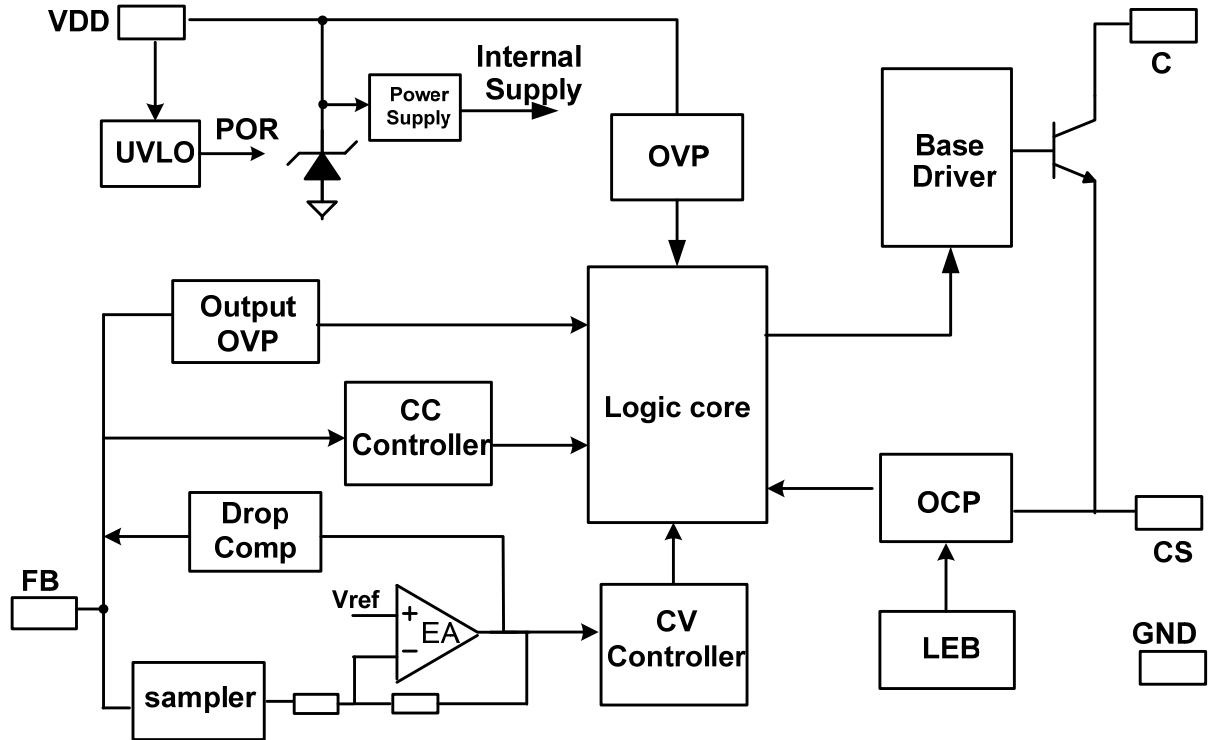


Y:Year Code  
 WW:Week Code(01-52)  
 ZZZ:Lot Code  
 C:SOP8 Package  
 P:Pb-free Package  
 C:Character Code  
 S:Internal Code(Optional)

## TERMINAL ASSIGNMENTS

Pin Num	Pin Name	I/O	Description
1	FB	I	The voltage feedback from auxiliary winding. Connected to resistor divider from auxiliary winding reflecting output voltage.
2	GND	P	Ground
3	VDD	P	Power Supply
4	CS	I	Current sense input
5、6、7、8	C	P	HV BJT collector pin.

**BLOCK DIAGRAM**



### ELECTRICAL CHARACTERISTICS

(TA = 25°C, VDD=15V, if not otherwise noted)

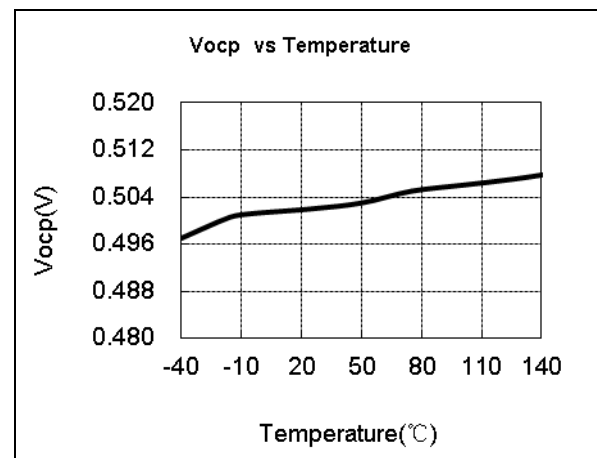
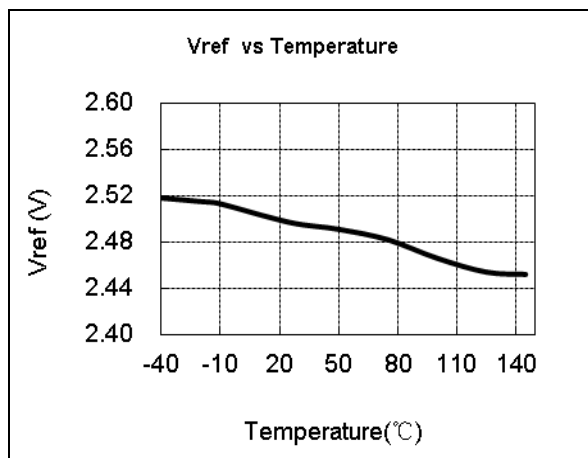
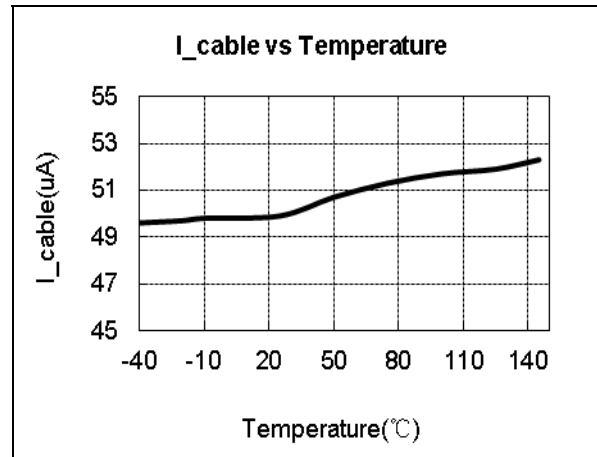
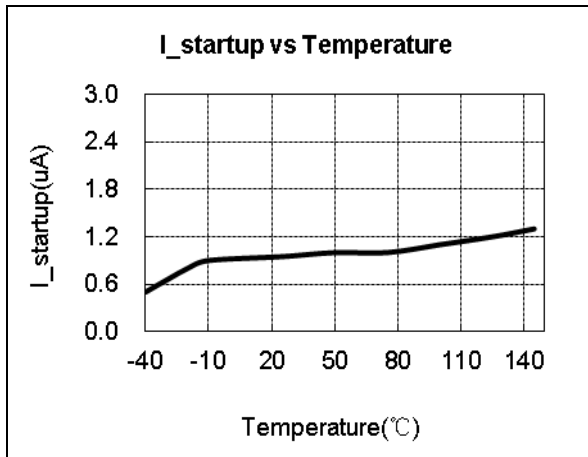
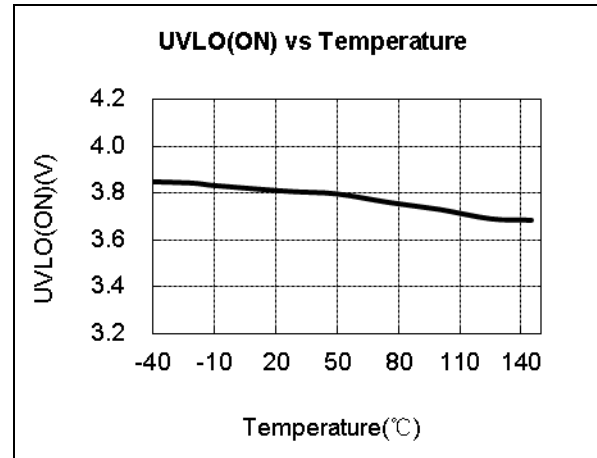
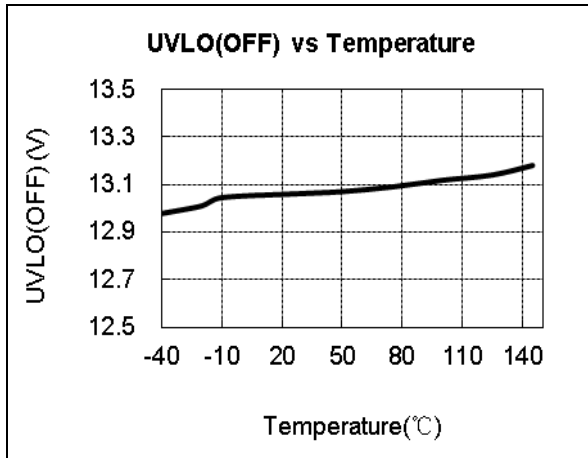
Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
<b>Supply Voltage (VDD) Section</b>						
I <sub>start-up</sub>	Start up current	VDD=UVLO_OFF-1V		1	3	uA
I <sub>op</sub>	Operation current without switching			0.77	1.0	mA
UVLO(OFF)	VDD under voltage lockout exit		12	13	14	V
UVLO(ON)	VDD under voltage lockout enter		3.5	3.7	3.9	V
VDD_OVP	VDD over voltage protection		17	18	19	V
VDD_max	Max. Operating Voltage				20	V
<b>Current Sense Input Section</b>						
TLEB	LEB time			0.33		us
V <sub>th_ocp_min</sub>	Minimum over current threshold		485	500	515	mV
V <sub>th_ocp_max</sub>	Maximum over current threshold			555		mV
Ton_max	Maximum Ton			40		us
Td_oc	OCP propagation delay			100		ns
<b>FB Input Section</b>						
V <sub>ref_fb</sub>	Reference voltage for feedback threshold		2.475	2.500	2.525	V
T <sub>pause_min</sub>	Minimum Toff			2.0		us
F_min	Minimum frequency		450	500	550	Hz
I <sub>comp_cable</sub>	Maximum cable compensation current			53		uA
<b>Output Over Voltage Protection</b>						
V <sub>ovp</sub>	Output Over voltage threshold		2.85	3.00	3.15	V
<b>On chip Over temperature Section</b>						
T <sub>otp</sub>	Over temperature protection trigger point			165		°C
T <sub>otp_rec</sub>	Over temperature protection recovery point			130		°C

<b>Power BJT Section</b>									
Parameter Product	V <sub>ceo</sub> (V) <small>Note1</small>			V <sub>cbeo</sub> (V) <small>Note2</small>			I <sub>c</sub> (A)		
	Collector-emitter breakdown voltage			Collector-base breakdown voltage			Collect Peak Current		
	Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.
OB25135		450		750				1.3	
OB25136				750					

Note1: Test condition: I<sub>c</sub>=10mA, I<sub>b</sub>=0

Note2: Test condition: I<sub>c</sub>=10mA

**CHARACTERIZATION PLOTS**



### OPERATION DESCRIPTION

OB2513xC is a cost effective PSR power switch optimized for off-line low power AC/DC applications including battery chargers. It operates in primary side sensing and regulation, thus opto-coupler and TL431 are not required. Proprietary built-in CV and CC control can achieve high precision CC/CV control meeting most charger application requirements.

#### Startup Current and Startup Control

Startup current of OB2513xC is designed to be very low so that VDD can be charged up quickly. A large value startup resistor can therefore be used to minimize the power loss in application.

#### Operating Current

The operating current of OB2513xC is as low as 550uA (typical). Good efficiency and low standby power is achieved with the low operating current.

#### CC/CV Operation

OB2513xC 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 primary side control. In CC operation mode, OB2513xC will regulate the output current constant regardless of the output voltage drop.

#### Principle of Operation

To support OB2513xC proprietary CC/CV control, system needs to be designed in DCM mode for flyback system (Refer to Typical Application Diagram on page1).

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

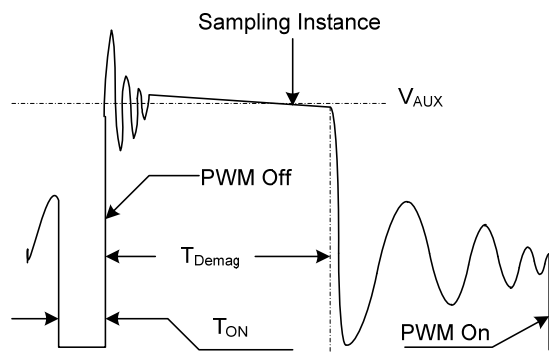


Figure 2 Auxiliary voltage waveform

Via a resistor divider connected between the auxiliary winding and FB (pin 1), the auxiliary voltage is sampled at the middle of the de-magnetization and it is hold until the next sampling. The sampled voltage is compared with Vref (typical 2.5V) and the error is amplified. The error amplifier output reflects the load condition and controls the switching off time to regulate the output voltage, thus constant output voltage can be achieved.

When the sampled voltage is below Vref and the error amplifier output reaches its minimum, the switching frequency is controlled by the sampled voltage to regulate the output current, thus the constant output current can be achieved.

#### Adjustable CC Point and Output Power

In OB2513xC, the CC point and maximum output power can be externally adjusted by external current sense resistor Rs at CS pin as illustrated in typical application diagram. The larger Rs, the smaller CC point is, and the smaller output power becomes, and vice versa as shown in Figure.3.

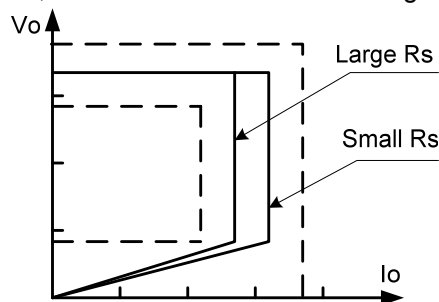


Figure 3. Adjustable output power by changing Rs

#### On Time OCP Compensation

The variation of max output current in CC mode can be rather large if no compensation is provided. The OCP threshold value is self adjusted higher at higher AC voltage. This OCP threshold slope adjustment helps to compensate the increased output current limit at higher AC voltage. In OB2513xC, a proprietary OCP compensation

block is integrated and no external components are needed. The OCP threshold in OB2513xC is a function of the switching ON time. For the ON time less than 4.0us (typical), the OCP threshold changes linearly from 500mV (typical) to 555mV (typical). For the ON time larger than 4.0us (typical), the OCP threshold is clamped to 555mV (typical), as shown in Figure 4.

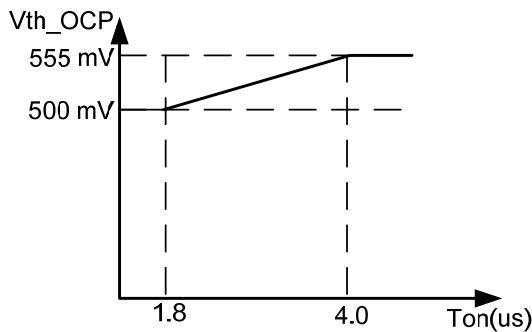


Figure.4. On time OCP compensation

### Operation Switching Frequency

The switching frequency of OB2513xC 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 such that 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.

### Programmable Cable Drop Compensation

In OB2513xC, cable drop compensation is implemented to achieve good load regulation. An offset voltage is generated at FB pin by an internal current flowing into the resistor divider. The current is proportional to the switching off time, as a result, it is inversely proportional to the output load

current, thus the drop due to the cable loss can be compensated. As the load current decreases from full-load to no-load, the offset voltage at FB will increase. It can also be programmed by adjusting the resistance of the divider to compensate the drop for various cable lines used.

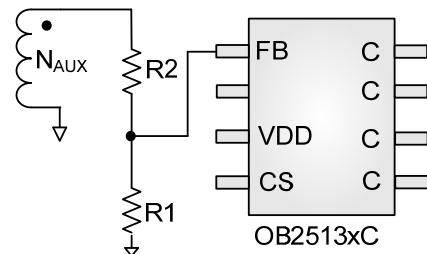
The percentage of maximum compensation is

$$\frac{\Delta V}{V_{out}} = \frac{I_{comp\_cable} \times R_1 // R_2 \times 10^{-6}}{2.5} \times 100\%$$

$\Delta V$  is load compensation voltage and  $V_{out}$  is output voltage;

For example:  $R_1 // R_2 = 5.1\text{Kohm}$ , the percentage of maximum compensation is

$$\frac{\Delta V}{V_{out}} = \frac{53 \times 5100 \times 10^{-6}}{2.5} \times 100\% = 10.8\%$$



### Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting is offered in OB2513xC. 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 BJT on state so that the external RC filtering on sense input is no longer needed.

### Protection Control

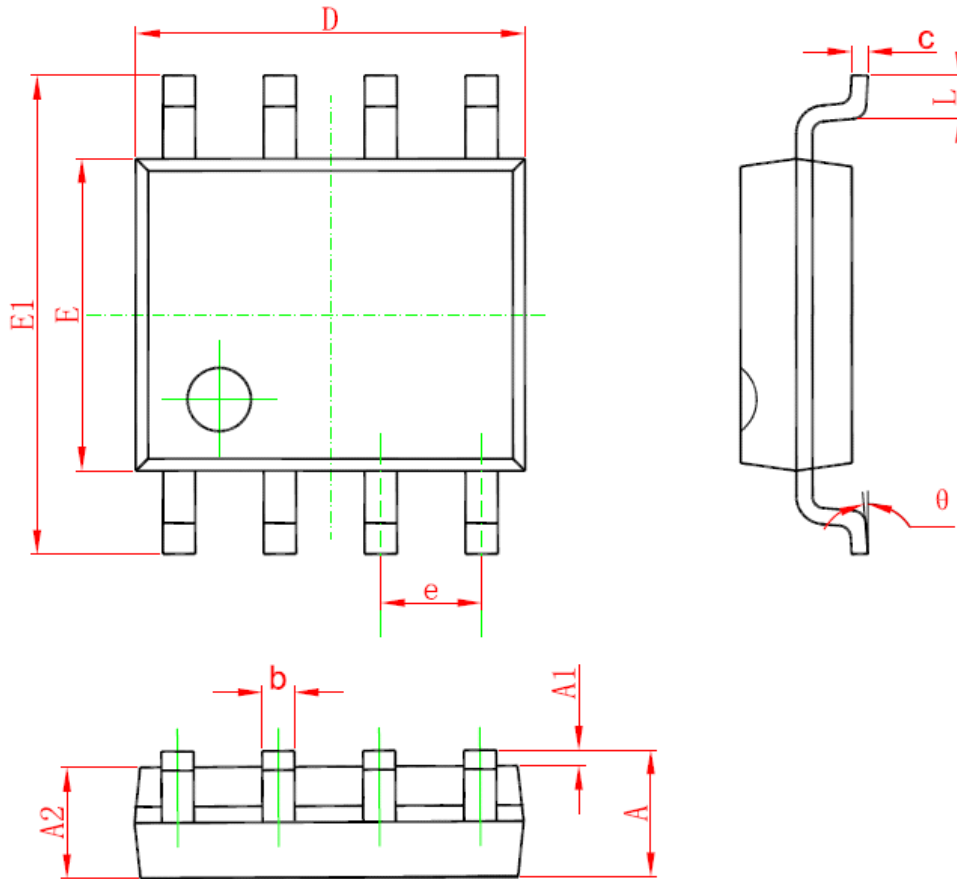
Good power supply system reliability is achieved with its rich protection features including Cycle-by-Cycle current limiting (OCP), Output over voltage protection, VDD over voltage protection, short circuit protection, Under Voltage Lockout on VDD (UVLO) and over temperature protection (OTP).

VDD is supplied by transformer auxiliary winding output. The output of OB2513xC is shut down when VDD drops below UVLO (ON) and the power converter enters power on start-up sequence thereafter.

To prevent the circuit being damaged under abnormal conditions, OB2513xC provides over thermal protection function. When the die temperature rises above over temperature threshold  $T_{otp}$ , the OB2513xC will shut down the base output and then latch the power supply off. The controller will remains latched until the die temperature drops below the recovery threshold  $T_{otp\_rec}$  and the OB2513xC will reset at the same time.

**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	0.170	0.250	0.006	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)		0.05 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°

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