

## GENERAL DESCRIPTION

OB2365x combines a dedicated current mode PWM controller with a high voltage power MOSFET. It is optimized for high performance, low standby power, and cost effective off-line flyback converter applications.

OB2365x offers comprehensive protection coverage with auto-recovery including Cycle-by-Cycle current limiting (OCP), over load protection (OLP), VDD under voltage lockout (UVLO) and internal over temperature protection (OTP). Excellent EMI performance is achieved with On-Bright proprietary frequency shuffling technique.

The tone energy at below 23KHz is minimized in the design and audio noise is eliminated during operation.

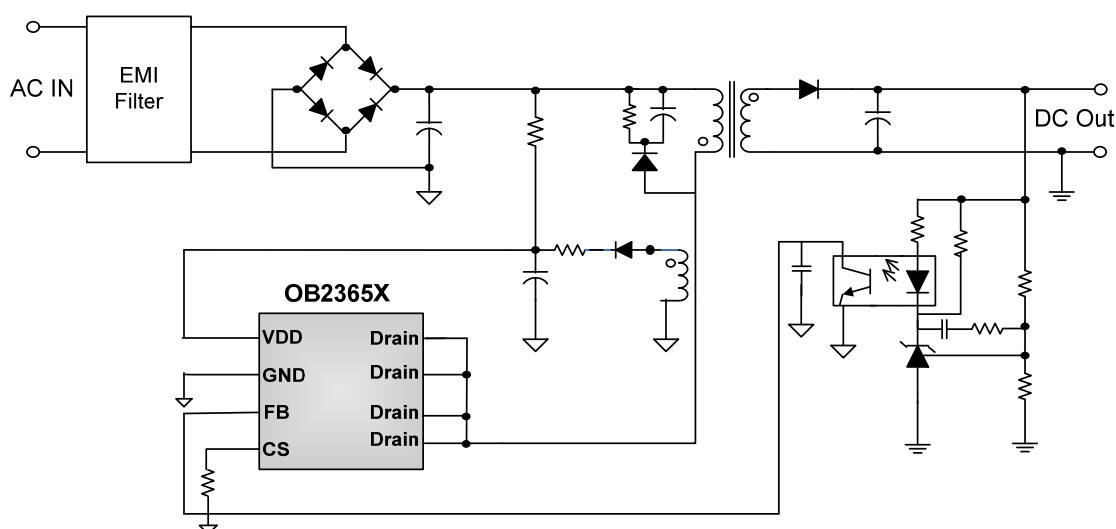
OB2365x is offered in SOP8 package.

## APPLICATIONS

Offline AC/DC flyback converter for

- AC/DC adapter
- PDA power supplies
- Digital Cameras and Camcorder Adapter
- VCR, SVR, STB, DVD&DVCD Player SMPS
- Set-Top Box Power
- Auxiliary Power Supply for PC and Server
- Open-frame SMPS

## TYPICAL APPLICATION



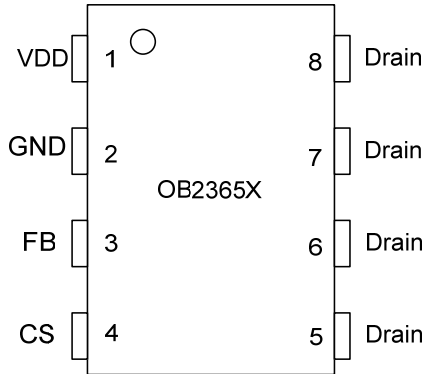
## FEATURES

- Standby power < 75mW at universal AC input
- Power on soft start reducing MOSFET Vds stress
- Frequency shuffling for EMI
- Extended burst mode control for improved efficiency and minimum standby power design
- Audio noise free operation
- Fixed 65KHZ (typical) switching frequency
- Internal synchronized slope compensation
- Low VDD startup current and low operating current
- Leading edge blanking on current sense input
- Comprehensive protection coverage
  - VDD Under Voltage Lockout with hysteresis (UVLO)
  - VDD Over Voltage Protection (VCC OVP)
  - Cycle-by-cycle over current threshold setting for constant output power limiting over universal input voltage range
  - Over Load Protection (OLP) with auto-recovery
  - Output diode short protection with auto-recovery

### GENERAL INFORMATION

#### Pin Configuration

The OB2365x is offered in SOP8 package as shown below.



#### Ordering Information

Part Number	Description
OB2365PCP	SOP8, Halogen-free, Tube
OB2365PCPA	SOP8, Halogen-free, T&R
OB2365TCP	SOP8, Halogen-free, Tube
OB2365TCPA	SOP8, Halogen-free, T&R

#### Package Dissipation Rating

Package	R $\theta$ JA (°C/W)
SOP8	85

Note: Drain Pin Connected to 100mm<sup>2</sup> PCB copper clad.

#### Absolute Maximum Ratings

Parameter	Value
Drain Voltage (off state)	-0.3V to BV <sub>dss</sub>
VDD Voltage	-0.3V to 30 V
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
Min/Max Storage Temperature T <sub>stg</sub>	-55 to 150°C
Lead Temperature (Soldering, 10secs)	260°C

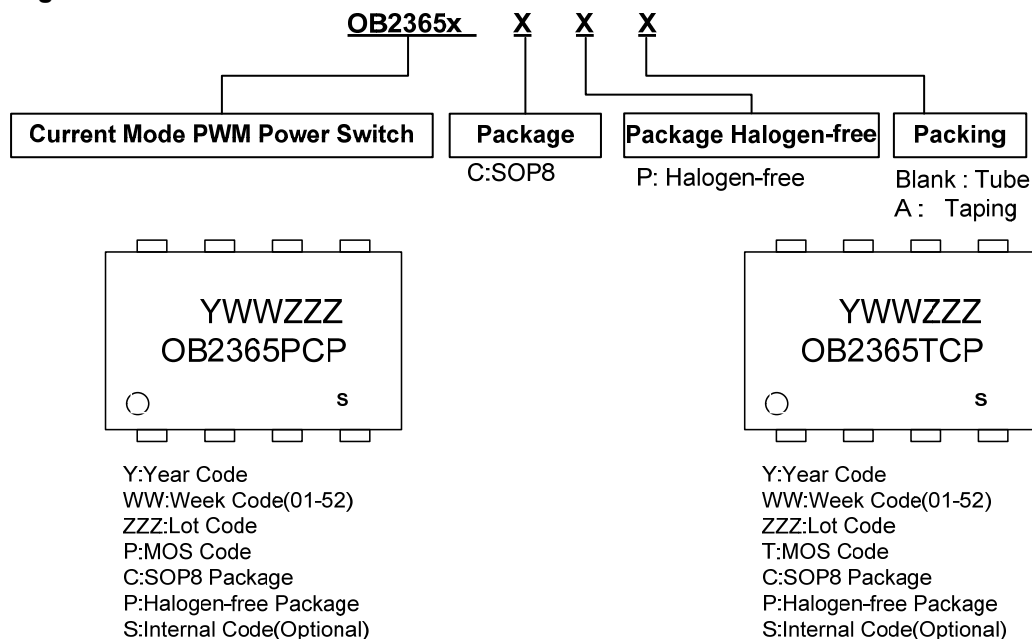
**Note:** Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure to absolute maximum-rated conditions for extended periods may affect device reliability.

#### Output Power Table

Product	230VAC±15%	85-265VAC
	Adapter <sup>1</sup>	Adapter <sup>1</sup>
OB2365PCP	18W	12W
OB2365TCP	23W	18W

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

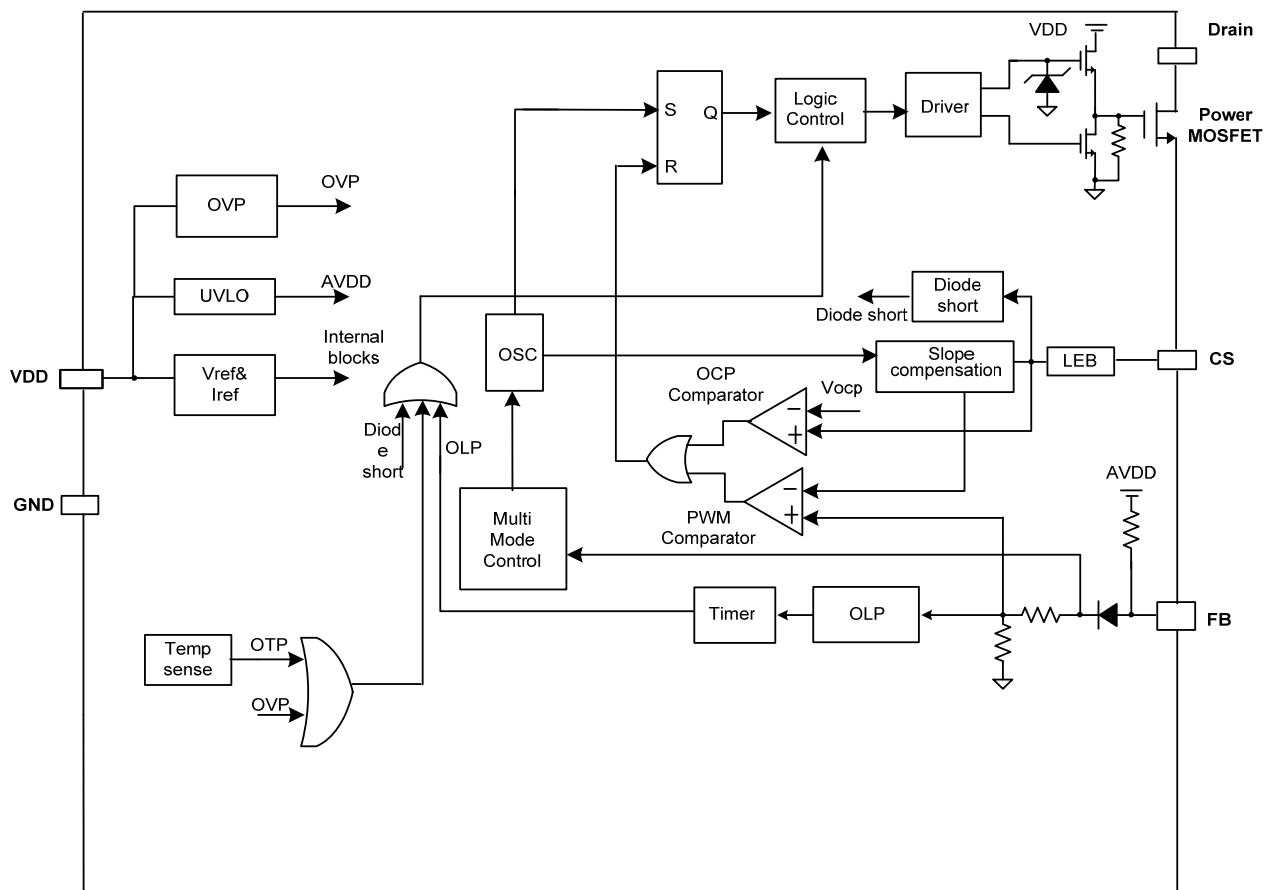
#### Marking Information



### TERMINAL ASSIGNMENTS

Pin Name	I/O	Description
GND	P	Ground
FB	I	Feedback input pin. The PWM duty cycle is determined by voltage level into this pin and the current-sense signal at Pin 4
CS	I	Current sense input
VDD	P	IC DC power supply Input
Drain	O	HV MOSFET drain pin. The drain pin is connected to the primary lead of the transformer

### BLOCK DIAGRAM



### ELECTRICAL CHARACTERISTICS

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

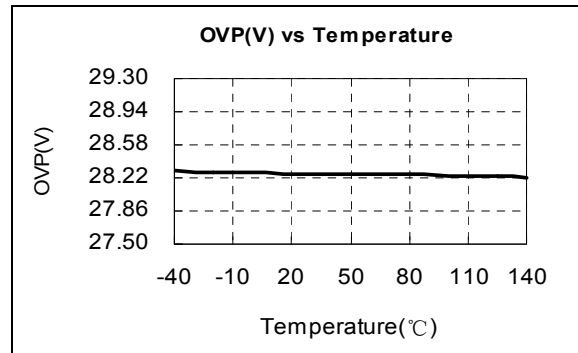
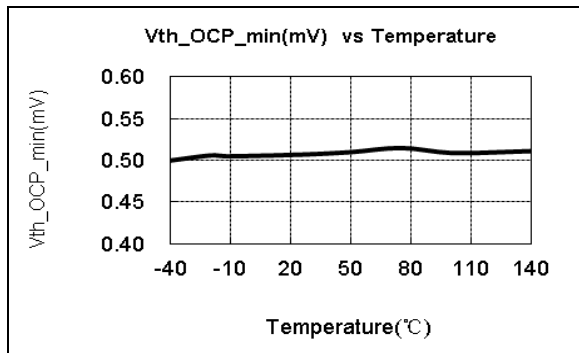
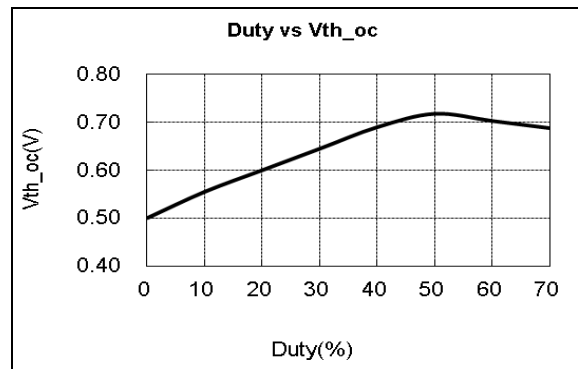
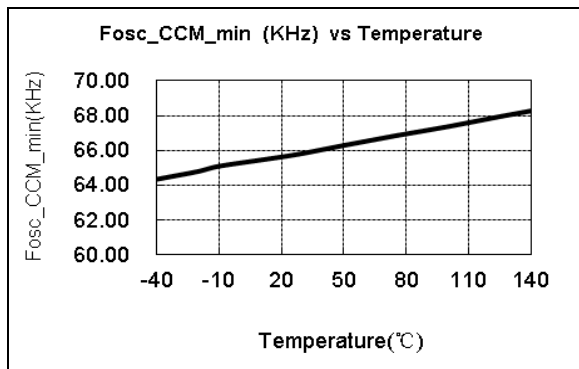
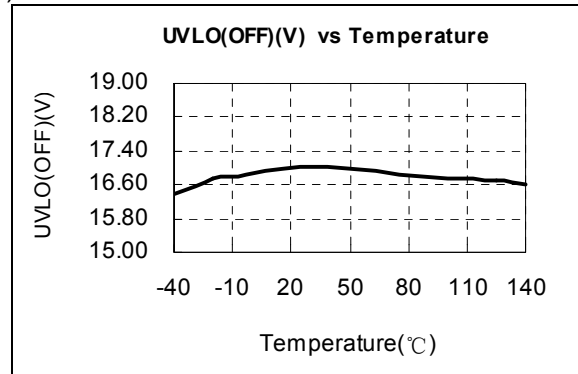
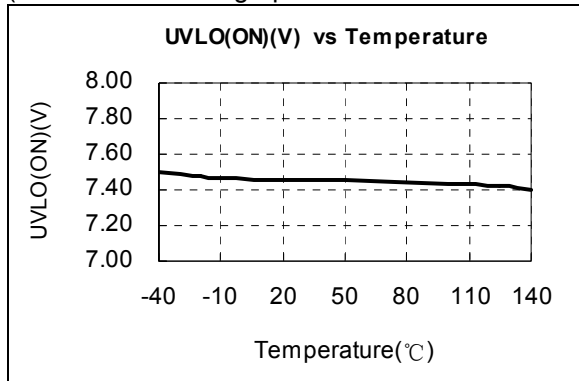
Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
<b>Supply Voltage (VDD)</b>						
I <sub>startup</sub>	VDD Start up Current	VDD=UVLO(OFF)-1V, measure leakage current into VCC		2	5	uA
I <sub>VDD_Operation</sub>	Operation Current	VDD=18V,CS=4V, FB=3.5V,measure I(VCC)		2	3	mA
I <sub>VDD_Burst</sub>	Burst Current	CS=0V,FB=0.5V, measure I(VCC)		0.3	0.5	mA
UVLO(ON)	VDD Under Voltage Lockout Enter		7.0	7.5	8.0	V
UVLO(OFF)	VDD Under Voltage Lockout Exit (Recovery)		16	17	18	V
V <sub>pull-up</sub>	Pull-up PMOS active			10		V
OVP	VDD Over Voltage Protection threshold voltage	FB=3V,CS=0V. Slowly ramp VCC, until no gate switching.	26.5	28	29.5	V
<b>Feedback Input Section(FB Pin)</b>						
V <sub>FB_Open</sub>	V <sub>FB</sub> Open Loop Voltage			5.1		V
A <sub>vcs</sub>	PWM input gain $\Delta V_{FB}/\Delta V_{CS}$			3.3		V/V
Maximum duty cycle	Max duty cycle @ VDD=18V,VFB=3V,VCS=0V		70	75	80	%
V <sub>ref_burst_H</sub>	The threshold exits burst mode			1.33		V
V <sub>ref_burst_L</sub>	The threshold enters burst mode			1.23		V
I <sub>FB_Short</sub>	FB pin short circuit current	Short FB pin to GND and measure current		0.16		mA
V <sub>TH_OLP</sub>	Open loop protection, FB Threshold Voltage			4.0		V
T <sub>d_OLP</sub>	Open loop protection, Debounce Time			60		ms
Z <sub>FB_IN</sub>	Input Impedance			30		K $\Omega$
<b>Current Sense Input(CS Pin)</b>						
SST_CS	Soft start time for CS peak			2.5		ms
T <sub>blanking</sub>	Leading edge blanking time			330		ns
T <sub>d_OC</sub>	Over Current Detection and Control Delay	From Over Current Occurs till the Gate driver output start to turn off		80		ns
V <sub>TH_OC</sub>	Internal Current Limiting Threshold Voltage with zero duty cycle			0.5		V
V <sub>TH_OC_Clap</sub>	OCP CS voltage clamber			0.72		V
<b>In-chip OTP</b>						
OTP enter				150		°C
OTP exit				120		°C

Oscillator						
Fosc	Normal Oscillation Frequency	VDD=15V, FB=3V,		65		KHz
$\Delta f_{OSC}$	Frequency Modulation range /Base frequency			$\pm 7$		%
F_shuffling	Shuffling frequency			240		Hz
$\Delta f_{Temp}$	Frequency Temperature Stability			1		%
$\Delta f_{VCC}$	Frequency Voltage Stability			1		%
F_Burst	Burst Mode Switch Frequency			23		KHz

Parameter Product	BVdss(V) MOSFET Drain-Source Breakdown Voltage			Rdson( $\Omega$ ) On resistance		
	Min	Typ.	Max	Min	Typ.	Max
OB2365PCP	600				4.4	
OB2365TCP	600				2.2	

## CHARACTERIZATION PLOTS

(The characteristic graphs are normalized at Ta=25°C)



## OPERATION DESCRIPTION

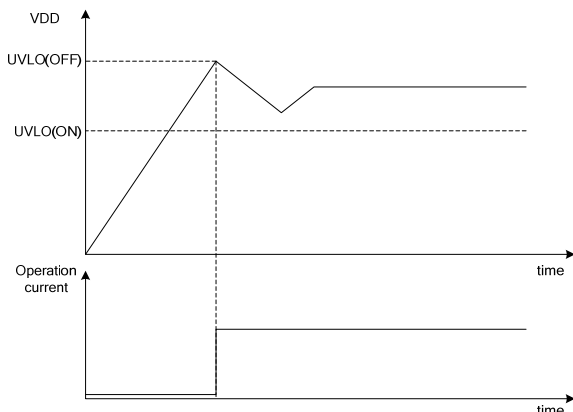
OB2365x is a highly integrated current mode PWM control IC optimized for high performance, low standby power and cost effective offline flyback converter applications. The 'extended burst mode' control greatly reduces the standby power consumption and helps the design easier to meet the international power conservation requirements.

### Startup Current and Start up Control

Startup current of OB2365x is designed to be very low so that VDD 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 OB2365x is low at 2mA (typical). Good efficiency is achieved with OB2365x low operation current together with the 'extended burst mode' control features.



### Soft Start

OB2365x features an internal 2.5ms (typical) soft start to soften the electrical stress occurring in the power supply during startup. It is activated during the power on sequence. As soon as VDD reaches UVLO(OFF), the CS peak voltage is gradually increased from 0.05V to the maximum level. Every restart up is followed by a soft start.

### Frequency shuffling for EMI improvement

The frequency Shuffling (switching frequency modulation) is implemented in OB2365x. The oscillation frequency is modulated so that the tone energy is spread out. The spread spectrum minimizes the conduction band EMI and therefore eases the system design.

### Extended Burst Mode Operation

At light load or zero load condition, most of the power dissipation in a switching mode power supply is from switching loss on the MOSFET, the core loss of the transformer and the loss on the snubber circuit. The magnitude of power loss is in proportion to the switching frequency. Lower switching frequency leads to the reduction on the power loss and thus conserves the energy.

The switching frequency is internally adjusted at no load or light load condition. The switch frequency reduces at light/no load condition to improve the conversion efficiency. At light load or no load condition, the FB input drops below burst mode threshold level and device enters Burst Mode control. The gate drive output switches only when VDD voltage drops below a preset level and FB input is active to output an on state. Otherwise the gate drive remains at off state to minimize the switching loss and reduces the standby power consumption to the greatest extend.

The switching frequency control also eliminates the audio noise at any loading conditions.

### Oscillator Operation

The switching frequency of OB2365x is internally fixed at 65KHZ. No external frequency setting components are required for PCB design simplification.

### Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting is offered in OB2365x current mode PWM control. 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 internal power MOSFET on state due to snubber diode reverse recovery and surge gate current of internal power MOSFET so that the external RC filtering on sense input is no longer needed. The current limiting comparator is disabled and cannot turn off the internal power MOSFET during the blanking period. The PWM duty cycle is determined by the current sense input voltage and the FB input voltage.

### Internal Synchronized Slope Compensation

Built-in slope compensation circuit adds voltage ramp into the current sense input voltage for PWM generation. This greatly improves the close loop stability at CCM and prevents the sub-harmonic oscillation and thus reduces the output ripple voltage.

**Driver**

The internal power MOSFET in OB2365x is driven by a dedicated gate driver for power switch control. Too weak the gate driver strength results in higher conduction and switch loss of MOSFET while too strong gate drive results in the compromise of EMI. A good tradeoff is achieved through the built-in totem pole gate design with right output strength and dead time control. The low idle loss and good EMI system design is easier to achieve with this dedicated control scheme.

**Protection Controls**

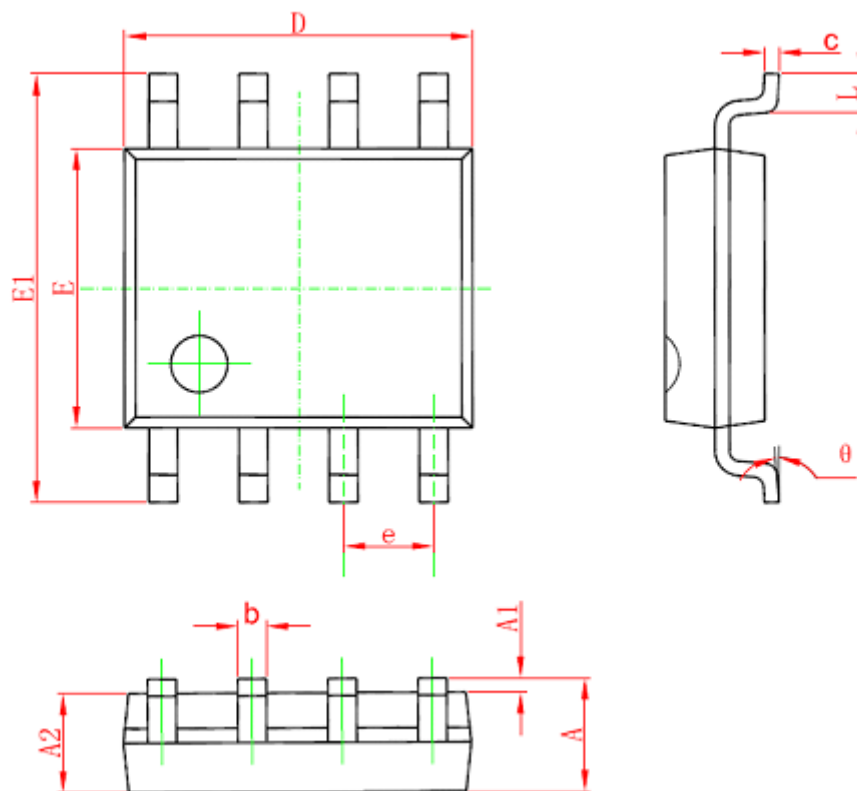
Good power supply system reliability is achieved with auto-recovery protection features including

Cycle-by-Cycle current limiting (OCP), Under Voltage Lockout on VDD (UVLO), Over Temperature Protection (OTP), VDD Over Voltage Protection (OVP).

With On-Bright proprietary technology, the OCP is line voltage compensated to achieve constant output power limit over the universal input voltage range.

At overload condition when FB input voltage exceeds power limit threshold value for more than  $T_{d\_OLP}$ , control circuit reacts to shut down the converter. It restarts when VDD voltage drops below UVLO limit.



**PACKAGE MECHANICAL DATA**


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°

## **IMPORTANT NOTICE**

### **RIGHT TO MAKE CHANGES**

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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