

## GENERAL DESCRIPTION

OB2223F is a high performance, high precision and low cost PWM Power switch for non-isolated buck and flyback application. It combines a dedicated current mode PWM controller (with a high voltage power MOSFET with SOP8/DIP7 package) and built-in error amplifier optimized for good overshoot and dynamic response for low cost and component count. With precise inner resistor divider, precise reference of EA, accurate constant voltage regulation 12V at universal AC input can be guaranteed. For high efficiency, oscillator with frequency-reduction and burst mode control is implemented. And EMI performance is achieved with On-Bright proprietary frequency shuffling technique and soft gate driver design.

OB2223F offers power on soft start control and protection coverage with auto-recovery features including Cycle-by-Cycle current limiting, Over Loading Protection, Output Short-Circuit Protection, On-Chip OTP, VDD OVP, and UVLO.

## FEATURES

- Low cost and component count buck application
- Current Mode Control
- Multiple mode control with good dynamic response
- Oscillator of fixed maximum switching frequency with frequency-reduction and burst mode control for high efficiency
- Frequency shuffling for EMI improvement
- Power on Soft-start
- Built-in Leading Edge Blanking (LEB)
- Cycle-by-Cycle Current Limiting
- Over Loading Protection
- Output Short-Circuit Protection
- VDD Under Voltage Lockout with Hysteresis (UVLO)
- VDD OVP
- On-Chip OTP

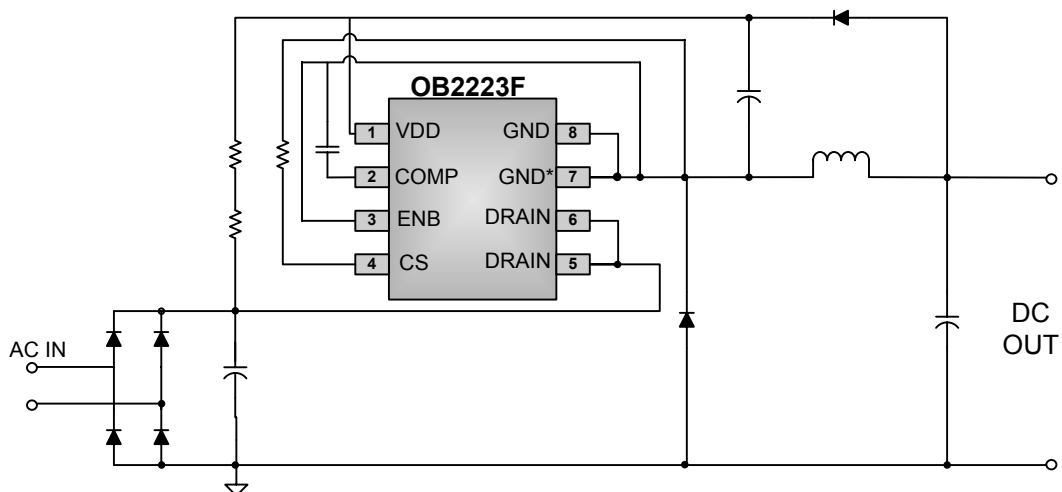
## APPLICATIONS

Low Power AC/DC offline SMPS for

- Electrical Appliance
- Linear Regulator/RCC Replacement

OB2223F is offered in SOP8/DIP7 package.

## TYPICAL APPLICATION

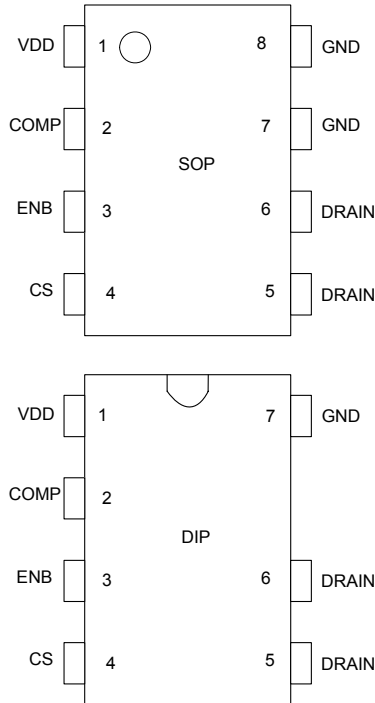


Note : GND\* Only in SOP8 package

### GENERAL INFORMATION

#### Pin Configuration

The pin map is shown as below for SOP8/DIP7



#### Package Dissipation Rating

Package	R $\theta$ JA (°C/W)
SOP8	90
DIP7	75

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

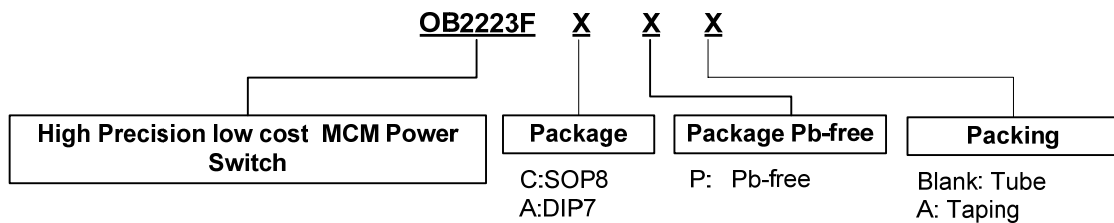
#### Absolute Maximum Ratings

Parameter	Value
Drain Voltage (off state)	-0.3V to Bvdss
VDD Voltage	-0.3 to 40V
VDD Zener Clamp Continuous Current	10 mA
COMP Voltage	-0.3 to 7V
CS Input Voltage	-0.3 to 7V
ENB 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.

#### Ordering Information

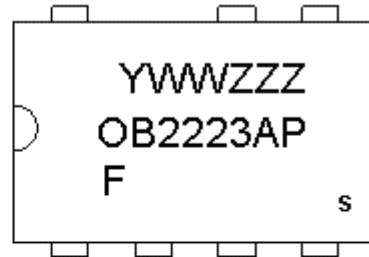
Part Number	Description
OB2223FCP	SOP8, Pb-free, Tube
OB2223FCPA	SOP8, Pb-free, T&R
OB2223FAP	DIP7, Pb-free, Tube



## Marking Information



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

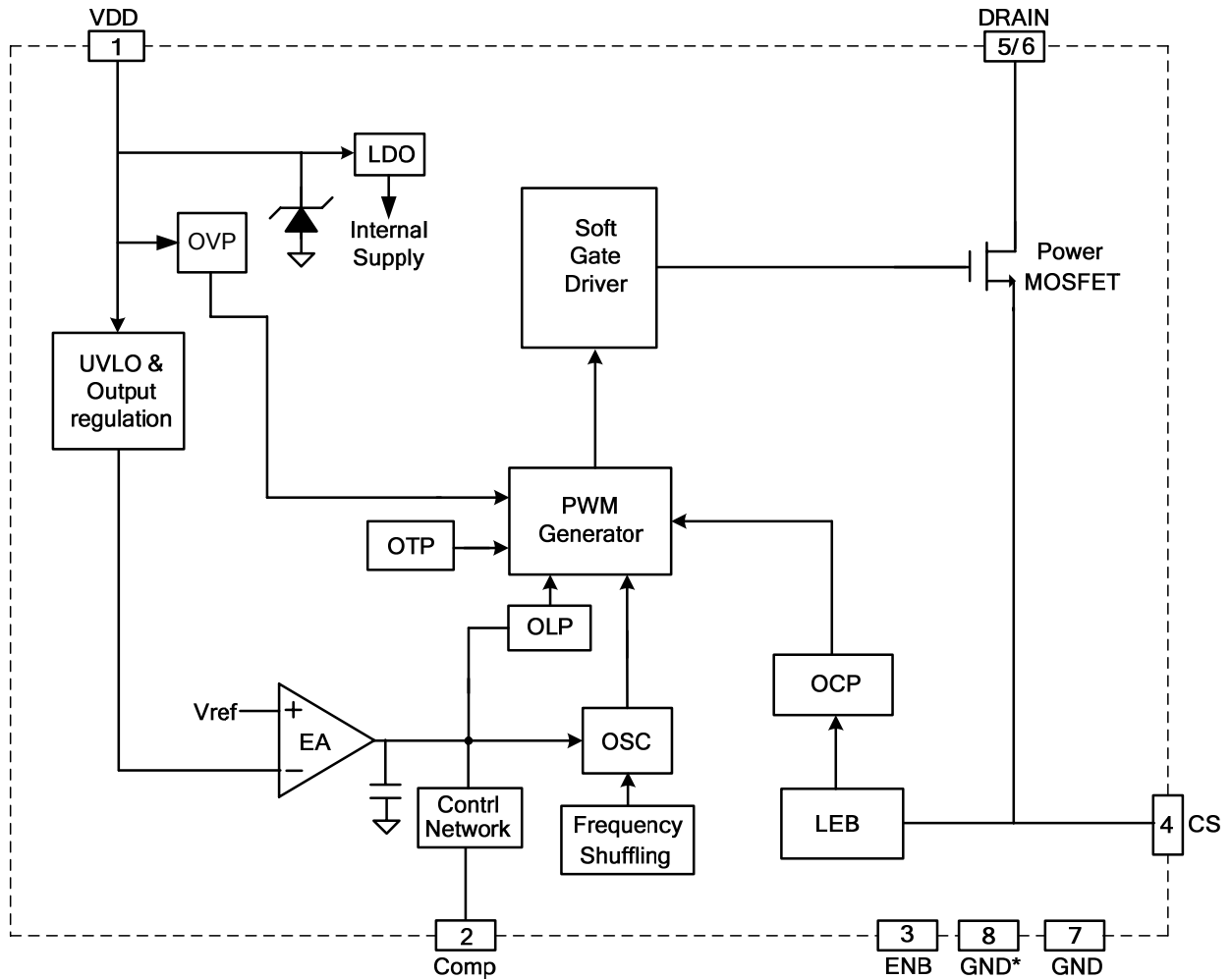


Y: Year Code  
 WW: Week Code(01-52)  
 ZZZ: Lot Code  
 A: DIP7 Package  
 P: Pb-free Package  
 S: Internal Code(Optional)

## TERMINAL ASSIGNMENTS

Pin Num	Pin Name	I/O	Description
1	VDD	P	Power Supply and Output Voltage Feedback
2	COMP	I	Compensation Pin. Connect a Cap to GND
3	ENB	I	Connected to GND for 12V output
4	CS	I	Current sense input
5/6	DRAIN	O	HV MOSFET Drain Pin. The Drain pin is connected to the primary lead of the transformer / inductance.
7	GND	P	Ground
8	GND	P	Ground (Only in SOP8 package)

**BLOCK DIAGRAM**



Note: GND\* only in SOP8 package

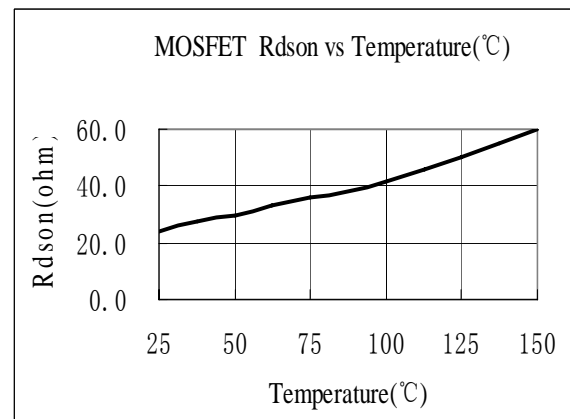
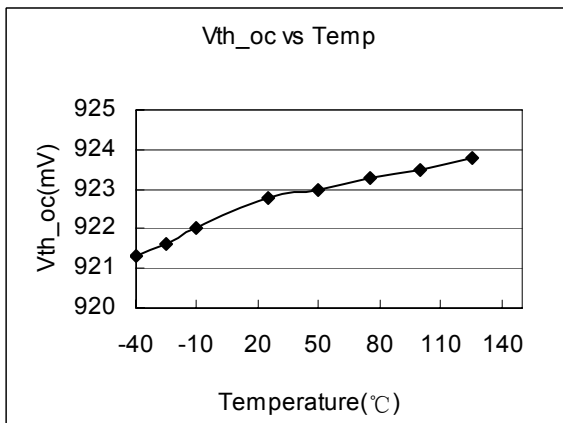
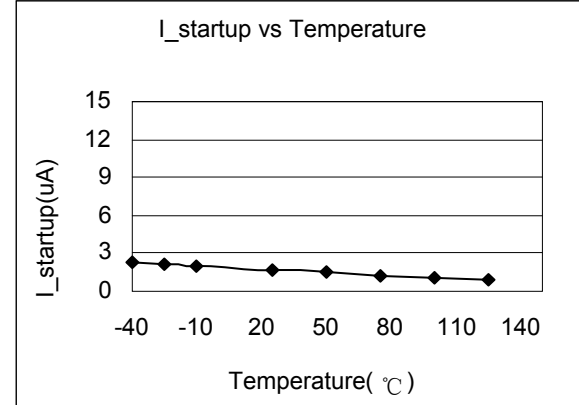
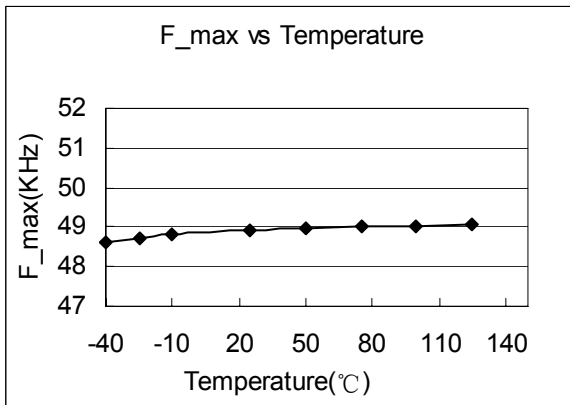
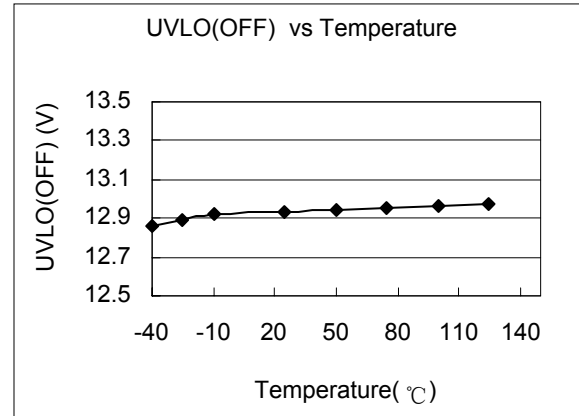
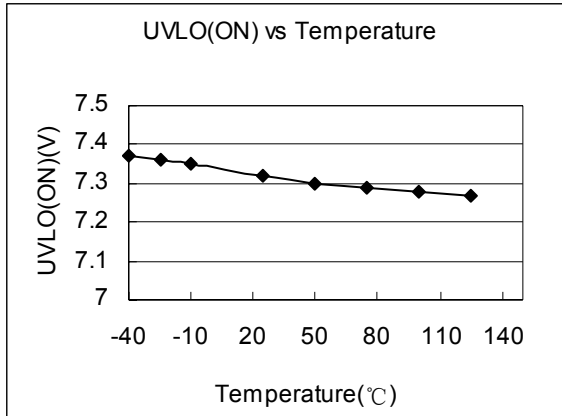
**ELECTRICAL CHARACTERISTICS**

 (T<sub>A</sub> = 25°C, VDD=16V, if not otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
<b>Supply Voltage (VDD) Section</b>						
I <sub>DD ST</sub>	Standby Current	VDD=UVLO(off) -1V		3	10	uA
I <sub>DD op</sub>	Operation Current	Operation supply current CS=0V, VDD=12V	-	0.9	1.5	mA
		Operation supply current CS=0V, VDD=12V, CL=0.5nF		1.2	1.7	mA
UVLO(ON)	VDD Under Voltage Lockout Enter	VDD falling	6.0	7.0	8.0	V
UVLO(OFF)	VDD Under Voltage Lockout Exit	VDD rising	11.5	12.5	13.5	V
OVP	Over voltage protection Threshold	Ramp VDD until gate shut down	23	25	27	V
V <sub>pmos</sub>	Pull-up PMOS Active	CS=0V, Comp=3V		10		V
VDD Regulation Voltage	In normal regulation, VDD will be regulated to 12.5V	Ramp VDD until Comp voltage lower than 2.5V	12.0	12.5	13	V
<b>Current Sense Input Section</b>						
TLEB	LEB time			200		ns
V <sub>th_oc</sub>	Over current threshold		890	925	960	mV
T <sub>d_oc</sub>	OCP Propagation delay			100		ns
Z <sub>SENSE_IN</sub>	Input Impedance		50			Kohm
<b>Frequency Section</b>						
Freq_Max <sup>Note 1</sup>	IC Maximum frequency		27	30	33	KHz
Δf/Freq	Frequency shuffling range			+/-7		%
F_shuffling	Shuffling frequency			60		Hz
F_Burst	Burst Mode Switch Frequency			20		KHz
<b>PWM Section</b>						
Dmax	Maximum Duty Cycle			50		%
Vref_green	Threshold enter green mode			1.65		V
Vref_burst_H	Threshold exit burst mode			1.25		V
Vref_burst_L	Threshold enter burst mode			1.15		V
<b>Error Amplifier section</b>						
Gain	DC gain of EA			70		dB
G <sub>m</sub>	Trans-conductance of EA			110		uS
<b>Protection Section</b>						

Vth_OLP	Over loading protection			3.6		V
Debounce Time		Frequency=30Khz	110	118	126	mS
OTP	Exit Over temperature protection			105		°C
	Enter Over temperature protection			135		°C
<b>Power MOSFET Section</b>						
BVdss	MOSFET Drain-Source Breakdown Voltage		600			V
Rdson	On Resistance (DIP7)	Static, Id=0.45A			15	Ω
	On Resistance (SOP8)	Static, Id=0.45A			25	Ω

### CHARACTERIZATION PLOTS



## OPERATION DESCRIPTION

OB2223F is a cost effective PWM power switch optimized for off-line non-isolated buck and flyback applications including electrical appliance and linear regulator replacement. It operates in current mode and regulates output voltage with dedicated features. High integration can afford low cost and component count solution.

- **Startup Current and Start up Control**

Startup current of OB2223F is designed to be very low so that VDD could be charged up above UVLO threshold and starts up quickly. A large value startup resistor can therefore be used to minimize the power loss in application.

- **Operating Current**

The Operating current of OB2223F is as low as 1.2mA. Good efficiency is achieved with the low operating current together with 'Multi-mode' control features.

- **Oscillator operation**

The maximum switching frequency of OB2223F is internally fixed at 30KHZ. No external frequency setting components are required for PCB design simplification.

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 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 frequency reduction and burst mode is implemented depends on loading condition. The minimum switching frequency is 20KHz.

- **Frequency shuffling for EMI improvement**

The frequency shuffling (switching frequency modulation) is implemented in OB2223F. 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.

- **Multiple mode control with good dynamic response**

In OB2223F, the On-Bright proprietary on-chip EA (error amplifier) is implemented to regulate output voltage in either ON/OFF control mode or integration control mode. Through precise inner resistor divider and proprietary control network, the VDD voltage is detected at EA to regulate output voltage and achieve great stability and dynamic response.

- **Current Sensing and Leading Edge Blanking**

Cycle-by-Cycle current limiting is offered in OB2223F 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 so that the external RC filtering on sense input is no longer needed. The PWM duty cycle is determined by the current sense input voltage and the EA output voltage.

- **Gate Drive**

The internal power MOSFET in OB2223F is driven by a dedicated gate driver for power switch control. Too weak the gate drive strength results in higher conduction and switch loss of MOSFET while too strong gate drive compromises EMI. A good tradeoff is achieved through the built-in totem pole gate design with right output strength control.

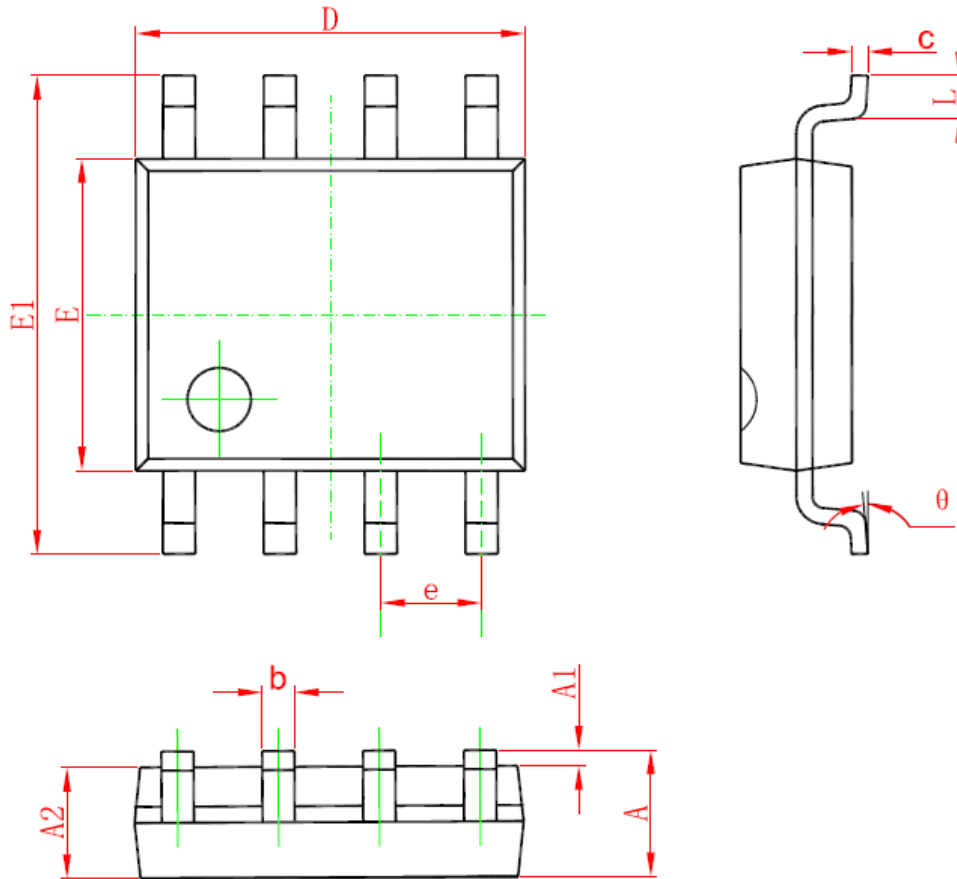
- **Protection Control**

Good power supply system reliability is achieved with its rich protection features including Cycle-by-Cycle current limiting (OCP), Over Loading Protection, Over Voltage Protection, Over Temperature Protection, Output Short-Circuit Protection and Under Voltage Lockout on VDD (UVLO).



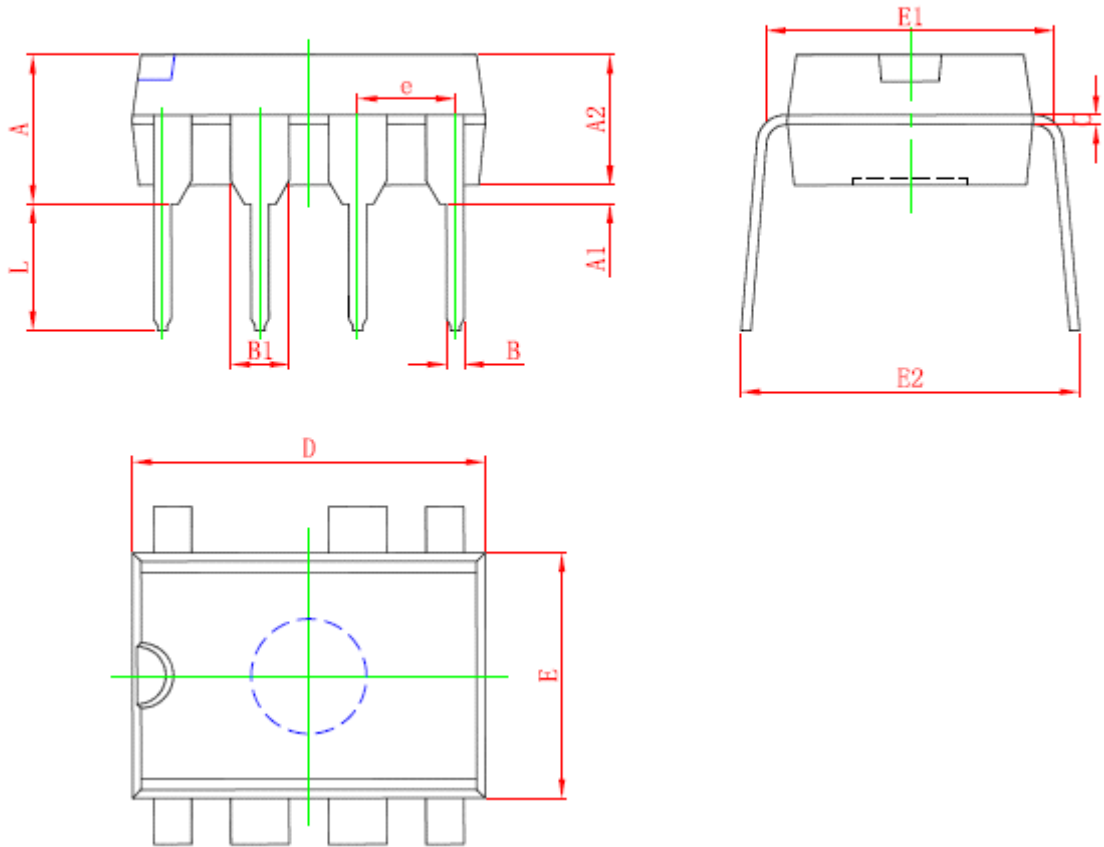
**PACKAGE MECHANICAL DATA**

**SOP8 PACKAGE OUTLINE DIMENSIONS**



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Min
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°

**DIP7 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

## **IMPORTANT NOTICE**

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