

## GENERAL DESCRIPTION

OB5682x is a primary side regulation off-line LED lighting power switch which can achieve accurate LED current. It significantly simplifies LED lighting system design by eliminating the secondary side feedback circuitry, HV startup resistor and power supply capacitor.

LED current (CC control) can be adjusted by the external sense resistor connected between CS pin and ground.

OB5682x offers comprehensive protection coverage with auto-recovery features including LED open circuit protection, LED short circuit protection, Cycle-by-Cycle current limiting, and thermal foldback, etc.

OB5682x is offered in SOT33-5(A)/SOP7/DIP7 package.

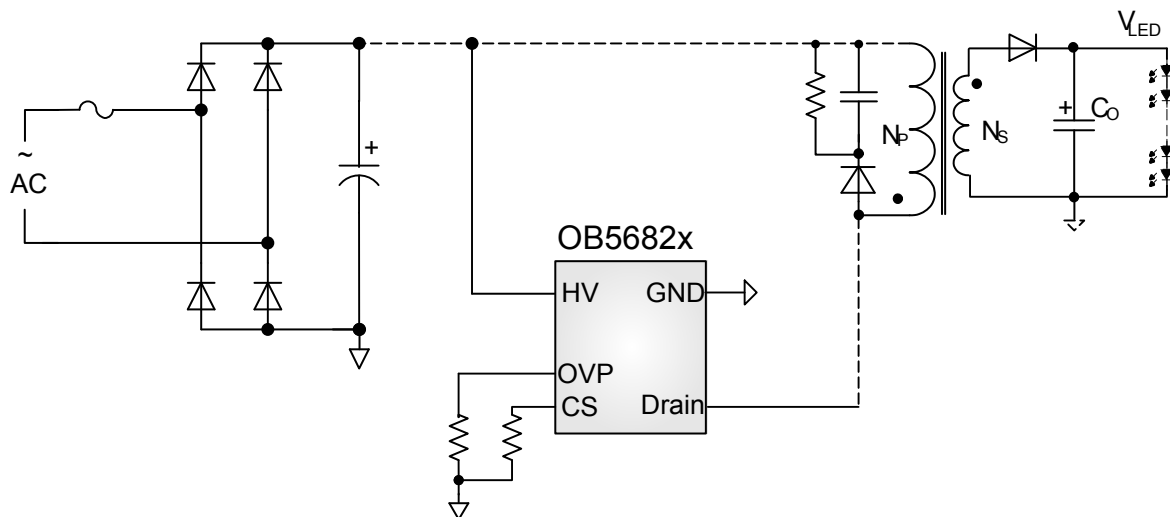
## FEATURES

- HV startup without power supply capacitor
- Low System Cost and High Efficiency
- Low operation current
- Primary-side Sensing and Regulation Without TL431 and Opto-coupler
- Cycle-by-Cycle Current Limiting
- Built-in Leading Edge Blanking (LEB)
- LED Short Circuit Protection
- LED Open Circuit Protection
- Thermal foldback

## APPLICATIONS

- LED lighting

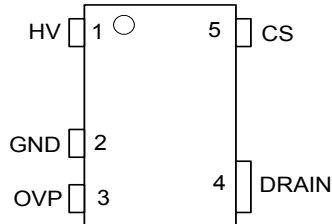
## TYPICAL APPLICATION



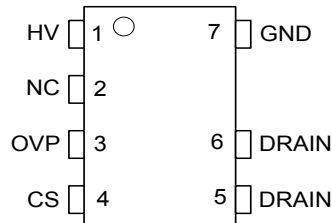
### GENERAL INFORMATION

#### Pin Configuration

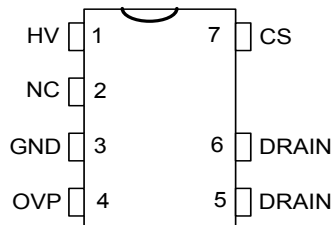
The pin map is shown as below for SOT33-5(A).



The pin map is shown as below for SOP7.



The pin map is shown as below for DIP7.



#### Ordering Information

Part Number	Description
OB5682MMKP-H	SOT33-5(A), Halogen-free in T&R
OB5682NJP-H	SOP7, Halogen-free in Tube
OB5682NJPA-H	SOP7, Halogen-free in T&R
OB5682PJP	SOP7, Halogen-free in Tube
OB5682PJPA	SOP7, Halogen-free in T&R
OB5682PASP	DIP7, Halogen-free in Tube

#### Package Dissipation Rating

Package	RθJA (°C/W)
SOT33-5(A)	145
SOP7	95
DIP7	77

#### Absolute Maximum Ratings

Parameter	Value
Drain Voltage	-0.3 to BVdss
HV Voltage	-0.3 to 650V
CS Input Voltage	-0.3 to 8V
OVP Input Voltage	-0.3 to 8V
Min/Max Operating Junction Temperature T <sub>J</sub>	-40 to 150 °C
Operating Temperature T <sub>A</sub> Ambient	-40 to 85 °C
Min/Max Storage Temperature T <sub>stg</sub>	-55 to 150 °C
Lead Temperature (Soldering, 10secs)	260 °C

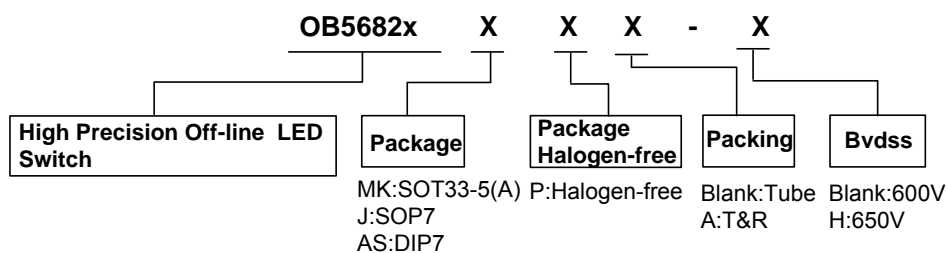
**Note:** Stresses beyond those listed under "absolute maximum ratings" may cause permanent damage to the device. These are stress ratings only, functional operation of the device at these or any other conditions beyond those indicated under "recommended operating conditions" is not implied. Exposure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

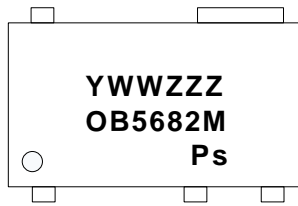
#### Output Power Table

Product	90~264Vac Input	220Vac±20% Input
OB5682MMKP-H	6W	10W
OB5682NJP-H	9W	12W
OB5682PJP	12W	15W
OB5682PASP	14W	20W

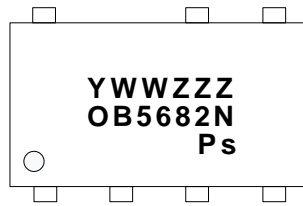
**Note:** Maximum practical continuous power in an open frame design with sufficient drain pattern as a heat sink, at 50°C ambient and 60°C temperature rise. Higher output power is possible with extra added heat sink, air circulation and decrease output current to reduce thermal resistance.

#### Marking Information

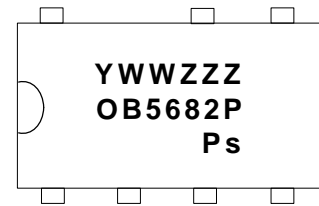




Y: Year Code  
 WW: Week Code (01-52)  
 ZZZ: Lot Code  
 P: Halogen-free Package  
 S: Internal Code(Optional)



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### TERMINAL ASSIGNMENTS for OB5682MMKP-H

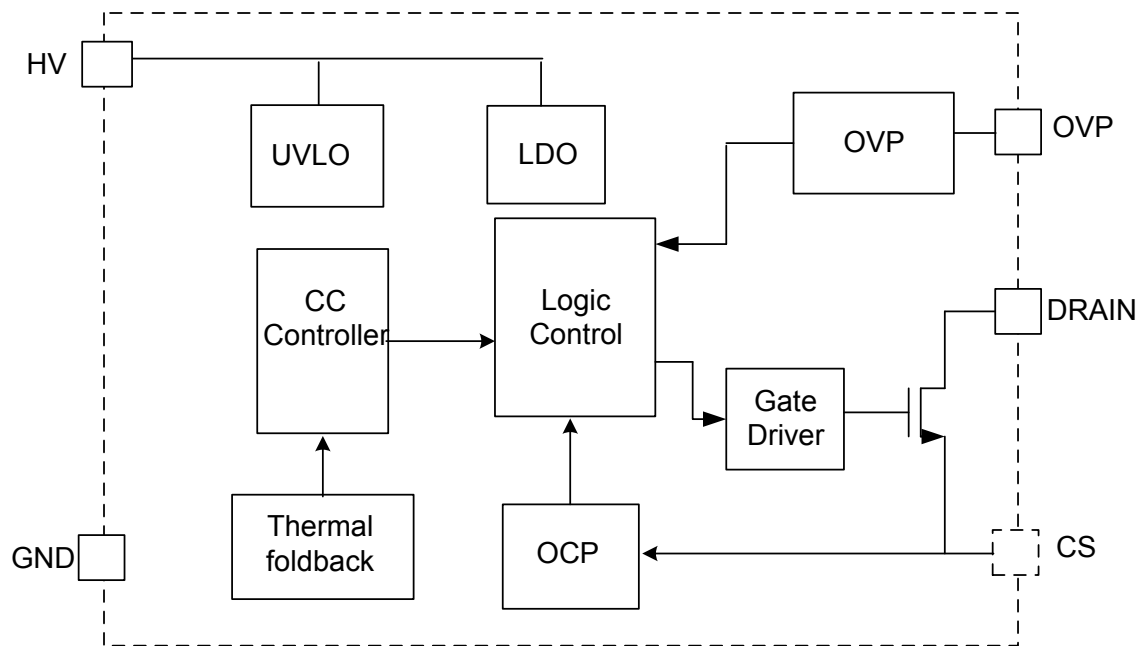
Pin Num	Pin Name	I/O	Description
1	HV	P	High Voltage power supply
2	GND	P	Ground
3	OVP	I	Over Voltage Protection configuration pin
4	Drain	I	Drain of internal MOSFET
5	CS	I	Current sense pin

### TERMINAL ASSIGNMENTS for OB5682NJP-H/ PJP

Pin Num	Pin Name	I/O	Description
1	HV	P	High Voltage power supply
2	NC		No connection
3	OVP	I	Over Voltage Protection configuration pin
4	CS	I	Current sense pin
5,6	Drain	I	Drain of internal MOSFET
7	GND	P	Ground

### TERMINAL ASSIGNMENTS for OB5682PASP

Pin Num	Pin Name	I/O	Description
1	HV	P	High Voltage power supply
2	NC		No connection
3	GND	P	Ground
4	OVP	I	Over Voltage Protection configuration pin
5,6	Drain	I	Drain of internal MOSFET
7	CS	I	Current sense pin

**BLOCK DIAGRAM**


**ELECTRICAL CHARACTERISTICS**

(TA = 25°C if not otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ.	Max	Unit
Supply Voltage (VDD) Section						
I_static	Static Current	HV=45V		200		uA
Current Sense Input Section						
TLEB	Leading Edge Blanking time			0.4		us
Vth_ocr	Over current threshold			500		mV
Toff_max	Maximum off time			600		us
Ton_max	Maximum on time			50		us
Tdem_blk	Demag blanking time			2		us
OVP Section						
Toff_min	Minimum off time	Rovp=10Kohm		5		us
		Rovp=floating		4.7		us
Thermal Section						
Tthermal	Thermal regulation threshold			130		°C

Product \ Parameter	BVdss(V) MOSFET Drain-Source Breakdown Voltage		
	Min	Typ.	Max
OB5682MMKP-H	650		
OB5682NJP-H	650		
OB5682PJP	600		
OB5682PASP	600		

## OPERATION DESCRIPTION

OB5682x is a cost effective PWM power switch optimized for off-line LED lighting applications. Based on flyback converter topology working in DCM mode, it operates in primary side sensing and regulation. It significantly simplifies the LED lighting system design by eliminating the secondary side feedback circuitry, HV startup resistor and power supply capacitor. Proprietary built-in CC control can achieve high precision LED current meeting LED lighting application requirements.

### Start up Control

At work state, OB5682x gets power supply directly from HV pin and regulates the supply voltage by internal startup circuits.

### Principle of CC Operation

To support OB5682x proprietary CC control, system needs to be designed in DCM mode for flyback system (Refer to Typical Application Diagram on page1). The LED output current  $I_{LED}$  is given by:

$$I_{LED} = \frac{1}{2} L_P \cdot F_{SW} \cdot I_{PK}^2 / V_O \quad (1)$$

Where  $L_P$  indicates the inductance of primary winding,  $I_{PK}$  is the peak current of primary winding.

Refer to the equation 1, the change of the primary winding inductance results in the change of the constant output current. 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

$$F_{SW} = \frac{1}{2T_{demag}} \quad (2)$$

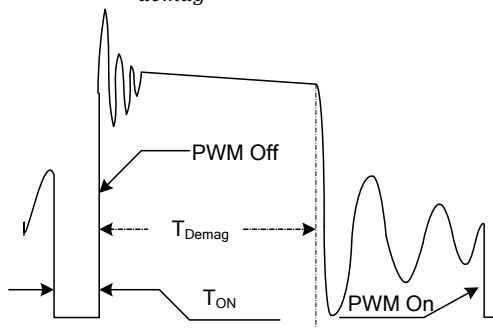


Figure.1 Primary voltage waveform

Since  $T_{demag}$  is direct proportional to the inductance, as a result, the product of  $L_P$  and  $F_{sw}$  is constant, thus output current will not change as primary winding inductance changes. The output LED current is

$$I_{LED} = \frac{1}{4} N \frac{V_{th\_ocp}}{R_{CS}} \quad (3)$$

Where  $V_{th\_ocp}$  is over current threshold,  $N$  is the ratio of transformer between primary winding and secondary winding.

### Adjustable CC point and Output Power

In OB5682x, the CC point and maximum output power can be externally adjusted by external current sense resistor  $R_{cs}$  at CS pin as illustrated in Typical Application Diagram. The output power is adjusted through CC point change. The larger  $R_{cs}$ , the smaller CC point is, and the smaller output power becomes.

### Operation switching frequency

The switching frequency of OB5682x is adaptively controlled according to the load conditions and the operation modes. No external frequency setting components are required.

For flyback operating in DCM, The operation frequency is given by

$$F_{SW} = \frac{V_O \cdot N^2}{8 \cdot L_P \cdot I_{LED}} \quad (4)$$

The switching frequency at maximum output power is recommended 65kHz~75kHz, and the minimum switching frequency at normal operation should not below 30kHz.

### Current Sensing and Leading Edge Blanking

Cycle-by-Cycle current limiting is offered in OB5682x. 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.

### LED Short Circuit Protection

OB5682x detects the states of LED. When LED string short circuit occurs, the switching frequency is reduced to the minimum switching frequency with maximum  $T_{off}$  time. OB5682x resumes normal operation after the fault condition is removed.

### Programmable LED Open Circuit Protection / OVP

The OB5682x provide programmable output over voltage protection when LED string are open. The threshold voltage of OVP is set by the minimum off time ( $T_{off\_min}$ ), when the off time of OB5682x is less than the  $T_{off\_min}$  OB5682x stops switching and re-detect the LED string status after 150ms (typical). If the fault condition is removed, OB5682x resumes normal operation. Otherwise, the above operation is repeated. The minimum off time ( $T_{off\_min}$ ) is given by

$$T_{off\_min} = \frac{L_P \cdot V_{th\_ocp}}{N \cdot R_{CS} \cdot V_{OVP}} \quad (5)$$

Where  $V_{ovp}$  is threshold voltage of OVP.

A resistor  $R_{ovp}$  is connected between the OVP pin and ground. The minimum off time ( $T_{off\_min}$ ) can be adjusting the resistance of  $R_{ovp}$ , the resistance is given by

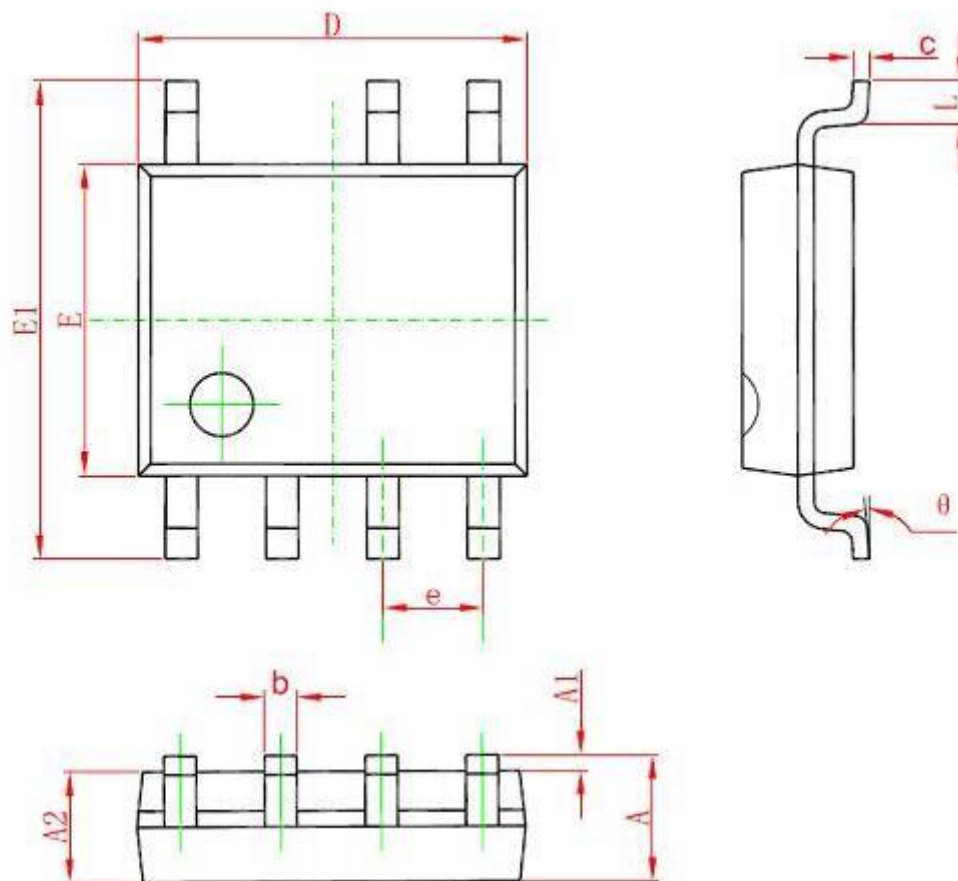
$$R_{OVP} = \frac{0.05}{T_{off\_min}} \quad (6)$$

And the resistance range of  $R_{ovp}$  should be 5K~16K for  $T_{off\_min}$  setting.

When OVP pin floating,  $T_{off\_min}$  is set to 4.7us internally.

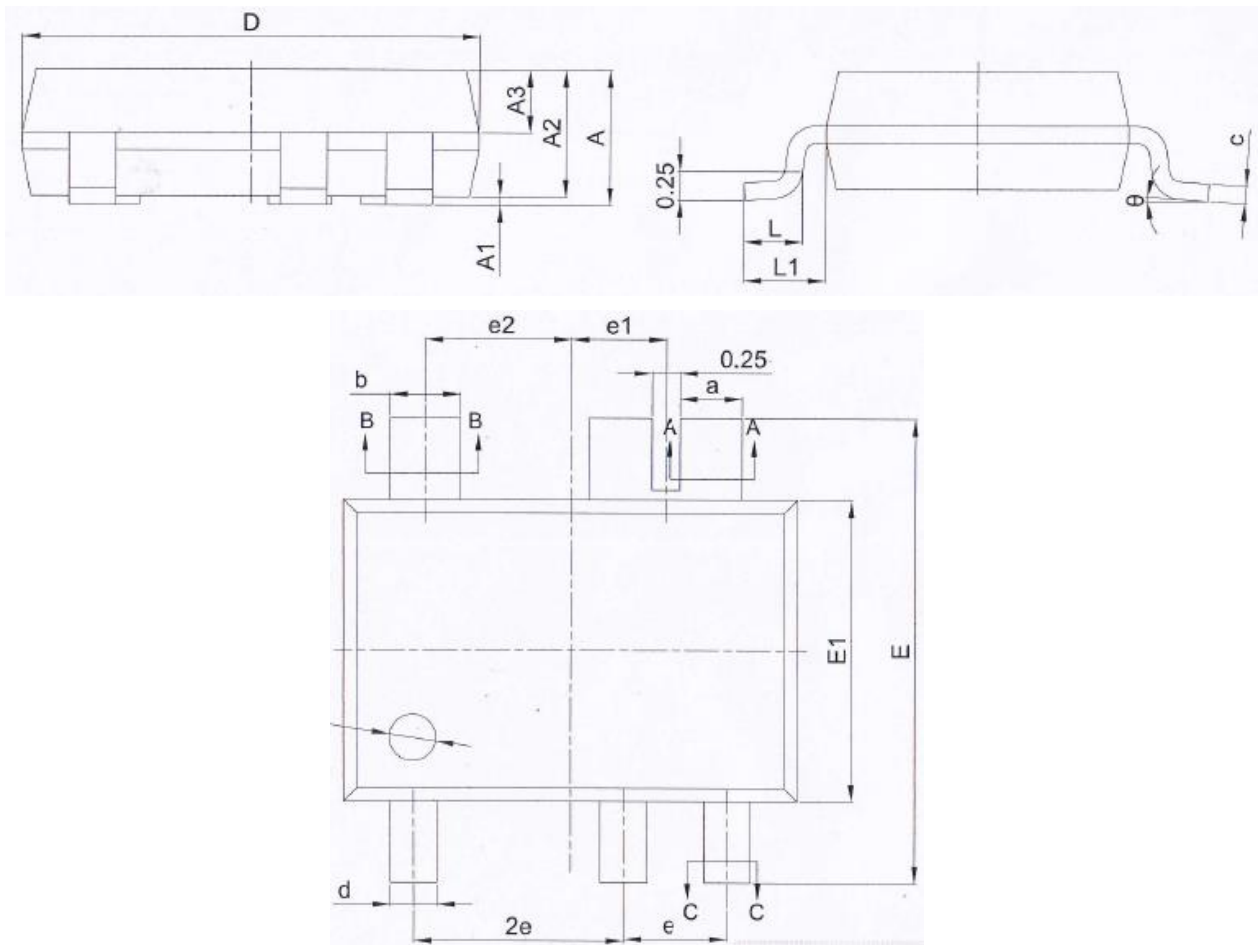
#### **Thermal foldback**

OB5682x provides thermal foldback function to control LED output current. The LED current will reduce with the temperature rise up. When the temperature is over 130℃ (typical), the output current follows the thermal foldback function scheme. When the temperature is below 130℃ (typical), the output current returns to the full level.

**PACKAGE MECHANICAL DATA**
**SOP7**


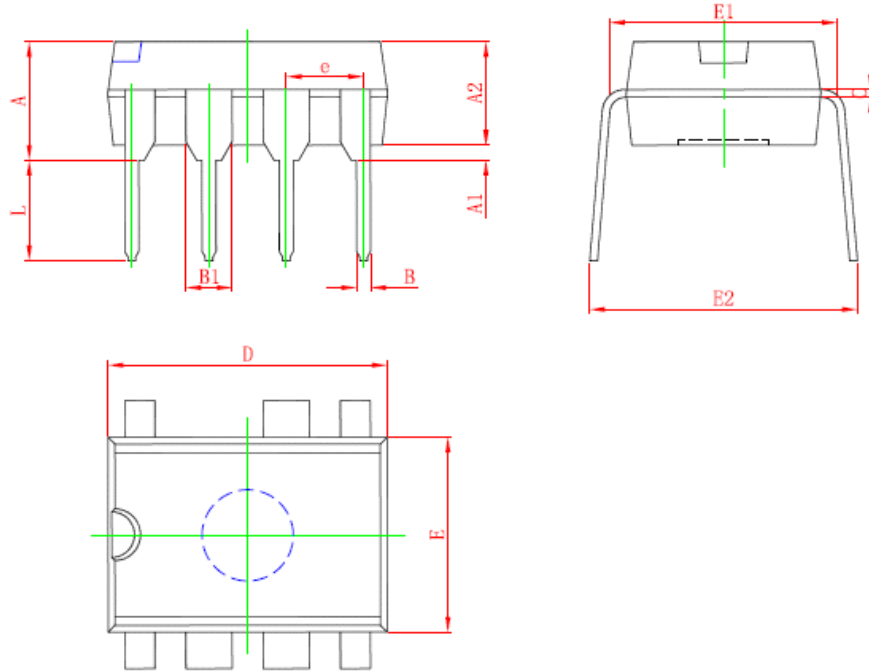
Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.350	1.750	0.053	0.069
A1	0.050	0.250	0.002	0.010
A2	1.250	1.650	0.049	0.065
b	0.310	0.510	0.012	0.020
c	0.100	0.250	0.004	0.010
D	4.700	5.150	0.185	0.203
E	3.800	4.000	0.150	0.157
E1	5.800	6.200	0.228	0.244
e	1.270 (BSC)		0.050 (BSC)	
L	0.400	1.270	0.016	0.050
θ	0°	8°	0°	8°



**SOT33-5(A)**


Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	-	1.30	-	0.051
A1	0.05	0.15	0.002	0.006
A2	1.05	1.15	0.041	0.045
a	0.52	0.60	0.020	0.024
b	0.58	0.66	0.023	0.026
c	0.15	0.19	0.006	0.007
D	3.80	4.00	0.150	0.157
E1	2.50	2.70	0.098	0.106
E	3.80	4.20	0.150	0.165
e	0.90(BSC)		0.035(BSC)	
e1	0.81(BSC)		0.032(BSC)	
e2	1.25(BSC)		0.049(BSC)	
L	0.40	0.60	0.016	0.024
θ	0°	8°	0°	8°

DIP7



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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