

DESCRIPTION

The PT6984A is a non-isolated buck and applicable to 85V AC ~ 265V AC input voltage range for LED lighting.

The PT6984A integrates high precision current detection and constant current circuit, realizes high precision LED constant current and excellent line voltage regulation. The PT6984A works in CRM mode, the LED current is constant with inductance and LED output voltage change, good load regulation.

The PT6984A integrates a 500V power MOSFET, uses the source driver architecture, with a low operating current, so the PT6984A doesn't need the auxiliary winding for sensing the output current and supplying the chip. It has a few external components, saves the cost and volume system.

The multi-protection features of PT6984A greatly enhance the system reliability and safety. The PT6984A provides CS resistance short-circuit protection, short LED protection, open LED protection, VIN under voltage protection, temperature intelligent control, etc.

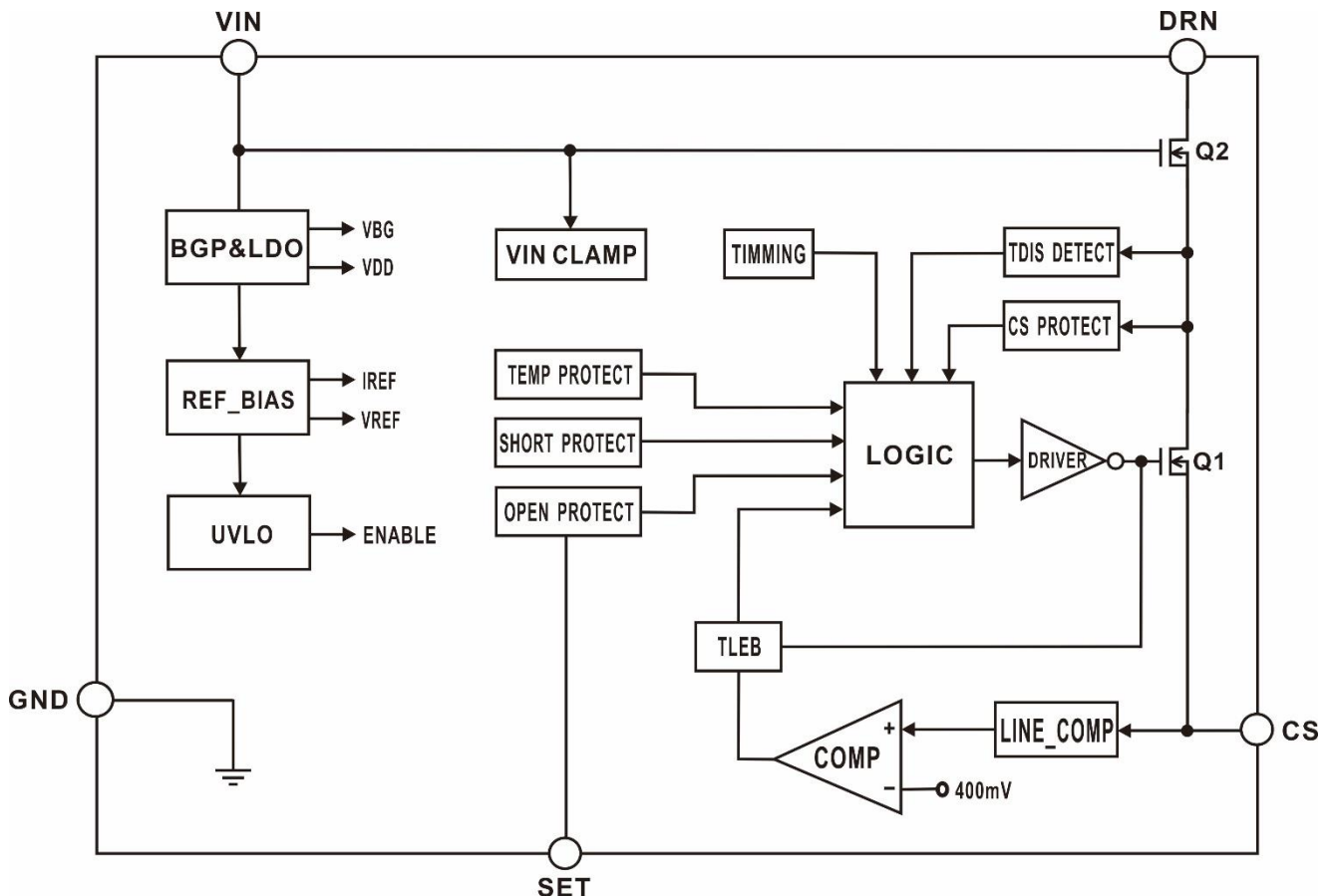
FEATURES

- Integrates 500V Power MOSFET
- CRM Mode
- No Auxiliary Winding for Sensing and Supplying
- Low Operating Current
- Universal Input Voltage Range
- $\pm 5\%$ Output Current Accuracy
- LED Open/Short Circuit Protection
- VIN Under Voltage Protection
- CS Resistor Short Circuit Protection
- Temperature Intelligent Control
- System Auto-Restart Function
- SOP-8 Package

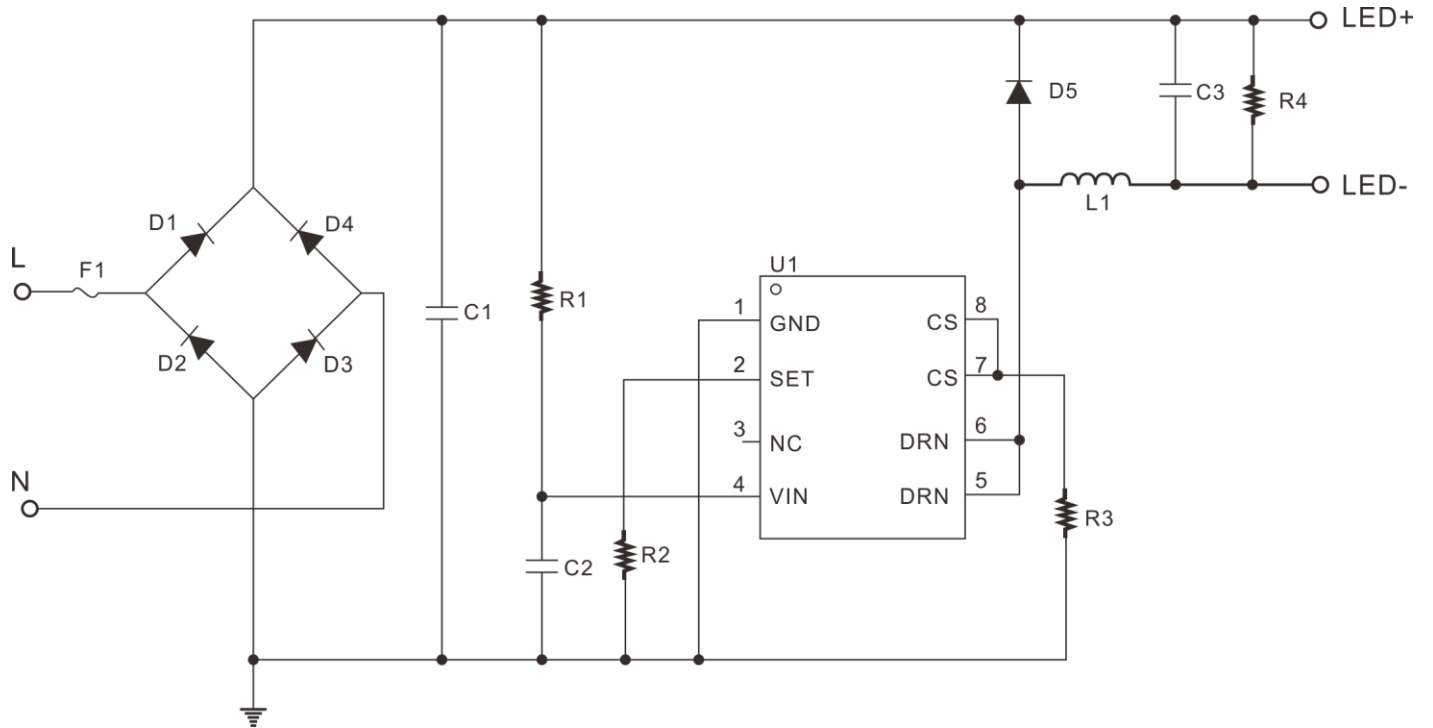
APPLICATIONS

- LED Bulb lamp, LED PAR lamp
- LED Tube lamp
- Other LED lighting

BLOCK DIAGRAM



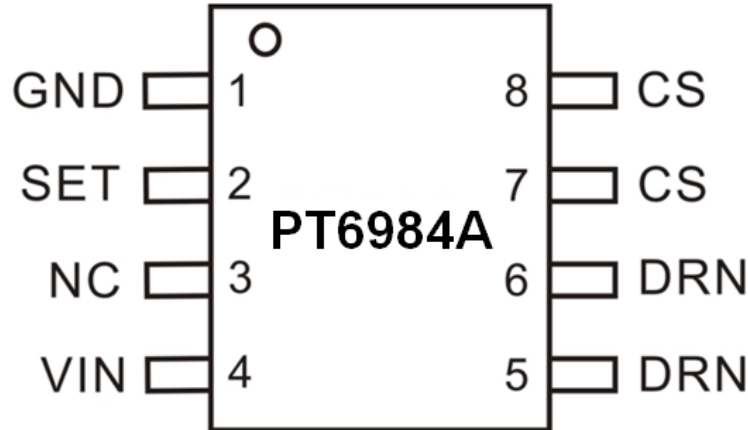
TYPICAL APPLICATION



ORDER INFORMATION

Valid Part Number	Package Type	Top Code
PT6984A-S	8-Pin, SOP	PT6984A-S
PT6984A-D	8-Pin, DIP	PT6984A-D

PIN CONFIGURATION



PIN DESCRIPTION

Pin Name	Description	Pin No.
GND	Ground	1
SET	LED open-circuit voltage protection Settings, by connecting the resistance to the ground	2
NC	No connection	3
VIN	Power supply pin	4
DRN	Power MOSFET Drain	5, 6
CS	Current sense pin, sense the inductor current while the switch is on-state.	7, 8

FUNCTION DESCRIPTION

OPERATION

PT6984A is designed to work in CRM mode and is especially suitable for non-isolated buck LED lighting applications. It is designed to work in CRM mode, can achieve high precision LED constant current without any closed loop control. PT6984A integrates a 500V power MOSFET, and doesn't need the auxiliary winding for sensing the output current and supplying the chip. System only needs a few peripheral devices can achieve excellent line regulation and load regulation.

When the VIN pin voltage is higher than chip's starting-threshold, PT6984A begins to work. When the switch of PT6984A is turned on, the inductor current sensed by the CS resistor rises up linearly at a rate. When the CS pin voltage rises up to the internal reference voltage, the switch will be turned off. During the switch is off-state, the inductor current falls down linearly at a rate. When the inductor current drop to zero, the switch will be turned on again. This switching process will be repeated to realize the constant current control.

START-UP

The PT6984A provides VIN under voltage protection. The PT6984A has a low start-up current (140μA Typical). When VIN voltage is greater than 14V, PT6984A begins to work. The PT6984A has a low operating current (120μA Typical) which means the current could be provided by the resistor R1 connected between DC-BUS and VIN pin. So, the PT6984A doesn't need the auxiliary winding for supplying the chip. The PT6984A integrates a power-supply clamped circuit to realize the over voltage protection, the clamped voltage is 16.8V typically.

Place a bypass capacitor in the range of 1 μF to 2.2 μF across the VIN and GND to ensure proper operation.

CONSTANT CURRENT CONTROL

The PT6984A output current is controlled by the inductance peak current. The inductance peak current is sensed by the resistor Rcs. When the CS voltage rises up to the internal reference voltage 400mV, the switch is turned off. The inductor peak current is given by the following equation:

$$I_{PEAK} = \frac{400}{R_{CS}} \text{ (mA)} \quad (1)$$

Where, Rcs is the current sense resistor which connects CS pin and GND.

Because the PT6984A works in CRM mode, the LED output current is half the peak inductor current. The output current is given by the following equation:

$$I_{LED} = \frac{I_{PEAK}}{2} \text{ (mA)} \quad (2)$$

INDUCTANCE CALCULATION

The PT6984A is a buck controller for LED lighting, and it works in CRM mode. The switch on-time is given by the following equation:

$$T_{ON} = \frac{L \times I_{PEAK}}{V_{BUS} - V_{LED}} \quad (3)$$

The switch off-time is given by the following equation:

$$T_{OFF} = \frac{L \times I_{PEAK}}{V_{LED}} \quad (4)$$

The L is the value of the inductance. The I_{PEAK} is the inductor peak current. The V_{BUS} is the DC-BUS voltage after rectification. The V_{LED} is the LED output voltage.

The value of the inductances given by the following equation:

$$L = \frac{V_{LED} \times (V_{BUS} - V_{LED})}{f_{osc} \times I_{PEAK} \times V_{BUS}} \quad (5)$$

Where, f_{osc} is the operating frequency.

When the inductance L is selected, the system operating frequency rises with the DC-BUS voltage rising. To define the inductance L, the parameters should be set with the minimum input voltage (V_{BUSMIN}), the minimum LED output voltage (V_{LEDMIN}) and the minimum operating frequency (f_{oscmin})

MULTI-PROTECTION FEATURES

To greatly enhance the system reliability and safety, the PT6984A provides multi-protection functions such as VIN under voltage protection, LED open circuit protection, LED short circuit protection, CS resistor short circuit protection, temperature intelligent control, etc.

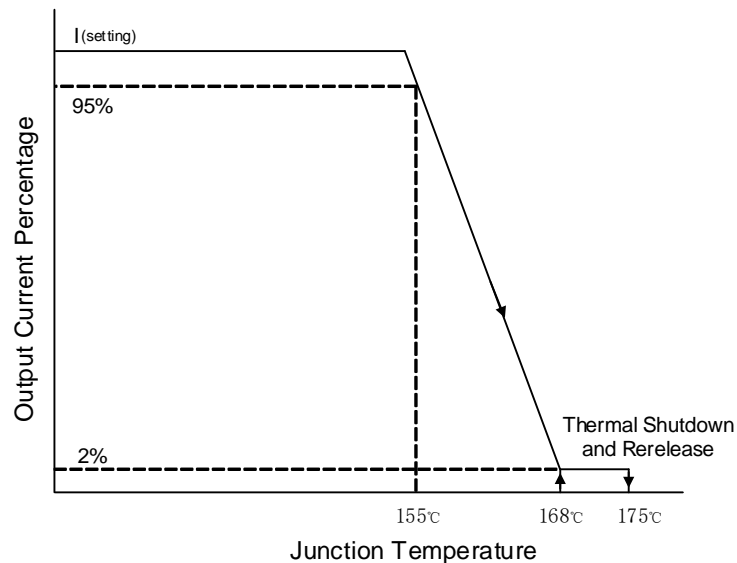
When the LED short circuit happens, the system works at a low frequency, which is 4kHz typically, and the internal reference voltage V_{REF} will be changed to 200mV.

When the LED open circuit happens, protection logic is active. PT6984A enters a state of HIPCUP mode. So VIN voltage began to decline, the system restart when VIN drops to the UVLO threshold. When the LED open circuit happens, the output capacitance has been charging, output voltage is slowly rising. So to set the maximum output voltage, prevent to damage output capacitance when the LED open circuit happens. PT6984A provides LED open-circuit voltage protection which set by connecting the resistance to the ground to set the maximum output voltage. The SET resistance formula is equation (6), Where V_{cs} is the internal reference voltage 400mV, V_{OVP} the maximum output voltage, When the LED open circuit happens, the system will goes into the auto-restart mode, therefore need a resistor paralleled in the output capacitance to discharge energy produced during the restart system.

$$R_{SET} \approx 15 \times \frac{V_{CS} \times L}{R_{CS} \times V_{OVP}} \times 10^6 (k\Omega) \quad (6)$$

When the CS resistance short circuit protection happens, protection logic is active. PT6984A enters a state of HIPCUP.

The temperature intelligent control function is built in the PT6984A to protect the chip and system. when the temperature of PT6984A rises up to 155°C typically, the output current is reduced gradually with the temperature rises; when the temperature of PT6984A rises up to 175°C typically, the output turns off. To control the output power and the IC junction temperature, the device reduces the output current linearly. This function not only protects the chip, but also avoid the traditional way of chip overheat shut off as a result of the LED flashing phenomenon, in order to improve the reliability of the system.



Thermal Foldback Function

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Rating	Unit
Input Voltage	V_{IN}	18	V
Maximum V_{IN} Input Current	I_{VIN}	5	mA
DRN to GND	V_{DRN}	-0.3~500V	V
SET to GND	V_{SET}	-0.3~6	V
CS to GND	V_{CS}	-0.3~6	V
Power Loss	P_{Total}	0.45	W
Operating Temperature	T_{OP}	-40~150	°C
Storage Temperature	T_{ST}	-40~150	°C
ESD	ESD	2	KV
Junction-to-ambient thermal resistance (SOP8)	$R_{\theta JA}$	112.06	°C/W
Junction-to-case thermal resistance (SOP8)	$R_{\theta JC}$	39.34	°C/W

RECOMMENDED OPERATING CONDITIONS

I_{LED}	Input AC Voltage : 176V~265V, Output Voltage 80V	PT6984A-S	280	mA
		PT6984A-D	320	
	Input AC Voltage : 176V~265V, Output Voltage 40V	PT6984A-S	340	
		PT6984A-D	360	
	Input AC Voltage : 90V~265V, Output Voltage 40V	PT6984A-S	280	
		PT6984A-D	300	
V_{LEDMIN}	Minimum LED Output Voltage		>12	V

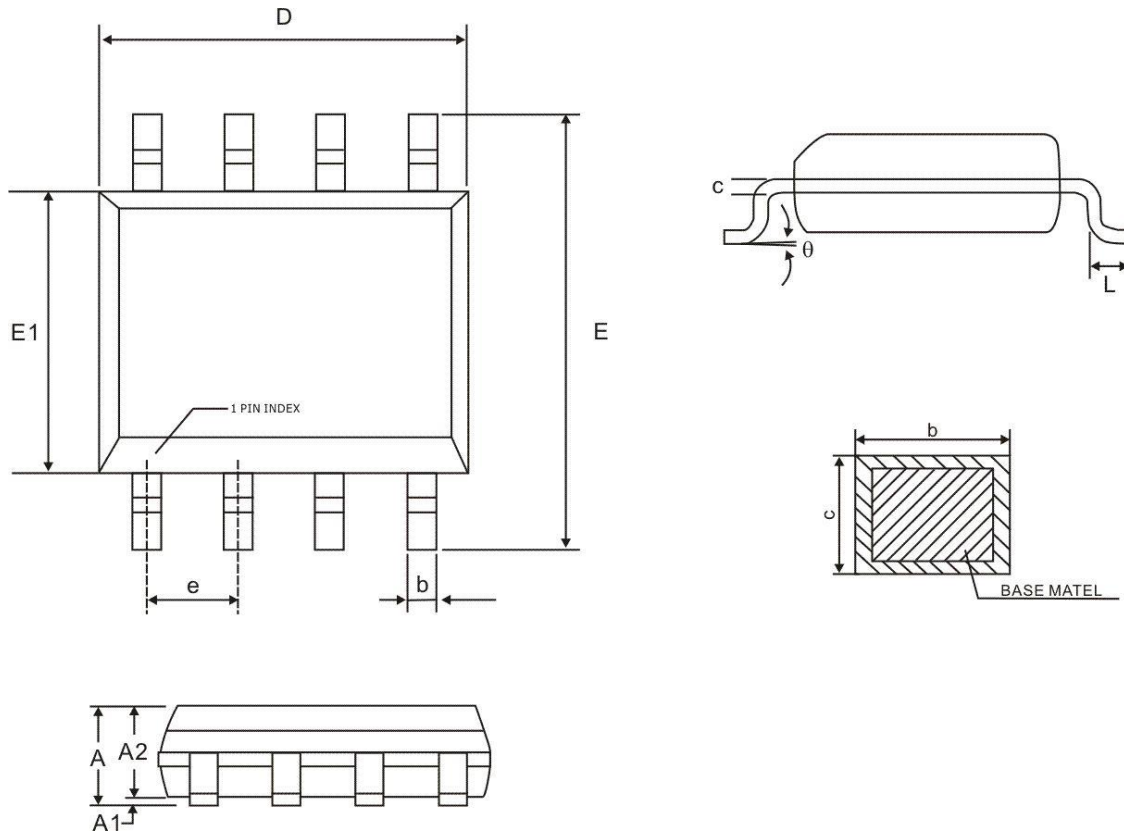
ELECTRICAL CHARACTERISTICS

 (Unless otherwise specified, $T_a=25^{\circ}\text{C}$, $V_{IN}=15\text{V}$,)

Parameter	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Characteristics						
VIN Start-up Voltage	V_{ST}	V_{VIN} rising	13	14	15	V
VIN Shutdown Voltage	V_{SD}	V_{VIN} falling	8	9	10	V
VIN Clamp Voltage	V_{CLAMP}	$I_{VIN}=1\text{mA}$	16	16.8	18	V
IC Start-up Current	I_{ST}	$V_{VIN}=V_{ST}-1\text{V}$	90	140	160	μA
IC Operating Current	I_{OP}	$F_{OSC}=70\text{KHz}$	170	230	250	μA
Current Sense Section						
Internal Reference Voltage	V_{CS}		388	400	412	mV
Leading Edge Blanking Time	T_{LEB}		350	800	950	ns
Switch-off Delay Time	T_{DELAY}		150	200	250	ns
Switching Section						
Max OFF Time	T_{DIS_MAX}		200	280	400	μs
Min OFF Time	T_{DIS_BLK}		2	3	4	μs
Max ON Time	T_{ON_MAX}		40	55	100	μs
Power MOSFET Section						
Drain-Source On-Resistance	R_{ON}	$V_{GS}=10\text{V}$, $I_D=1\text{A}$	-	3	3.5	Ω
Drain-Source Leakage Current	I_{LEAK}	$V_{DS}=500\text{V}$, $V_{GS}=0\text{V}$	0	-	1	μA
Drain-Source Breakdown Voltage	BV_{DSS}	$V_{GS}=0\text{V}$, $I_D=250\mu\text{A}$	500	-	-	V
Protection Features						
Set Reference Voltage	V_{set}		1.4	1.5	1.6	V
Thermal foldback activation temperature	T_{STR}	95% of $I_{setting}$	145	155	165	$^{\circ}\text{C}$
Thermal Shutdown Temperature	T_Z		165	175	185	$^{\circ}\text{C}$
Thermal Shutdown Release Hysteresis				7		$^{\circ}\text{C}$

PACKAGE INFORMATION

SOP8, 150MIL

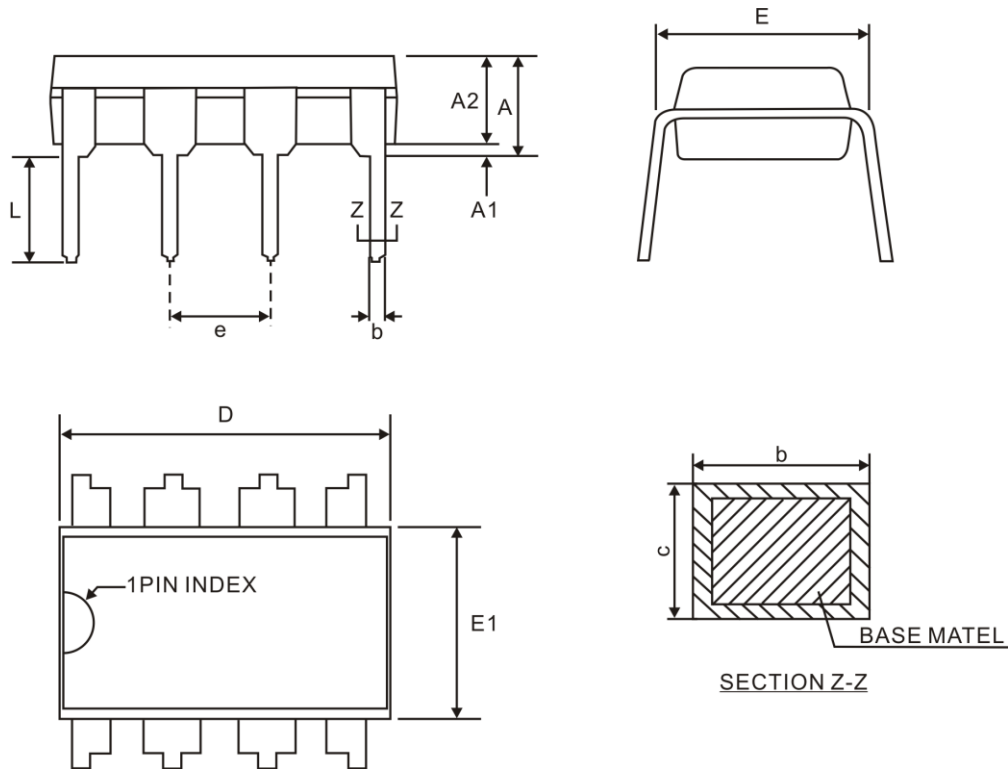


Symbol	Dimensions(mm)		
	Min.	Nom.	Min.
A	1.35	1.60	1.77
A1	0.08	0.15	0.28
A2	1.20	1.40	1.65
b	0.33	-	0.51
c	0.17	-	0.26
D	4.70	4.90	5.10
E	5.80	6.00	6.20
E1	3.70	3.90	4.10
e	1.27BSC.		
L	0.38	0.60	1.27
θ	0°	-	8°

Notes:

1. Refer to JEDEC MS-012AA
2. All dimensions are in millimeter

8-PIN, DIP, 300 MIL



Symbol	Dimensions (mm)		
	Min.	Nom.	Max.
A	-	-	4.80
A1	0.50	-	-
A2	3.10	3.30	3.50
b	0.38	-	0.55
c	0.21	-	0.35
e	2.54 BSC		
D	9.10	9.20	10.10
E	7.62	7.87	8.25
E1	6.25	6.35	6.45
L	2.92	3.30	3.81

- Notes:
 1. Refer to JEDEC MS-001 BA
 2. All dimensions are in millimeter

IMPORTANT NOTICE

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