Off-Line Linear LED Driver

FEATURES

- Adaptive Conduction with TRIAC DIM.
- Wide Range, Programmable LED Voltage.
- Output LED Current available from 50mA to 100mA.
- Can be Paralleled for Higher Current
- 5V to 500V Supply Voltage Range.
- High Efficiency.
- Stable LED Brightness.
- Over Temperature Protection.
- SOP-16 Exposed Pad (150 mil) & TSSOP16 Exposed Pad Package.
- Patent Pending Drive Architecture.

APPLICATIONS

- LED Lamps (e.g. E27, GU10)
- General Illumination
- LED Strings (e.g. T-8 Tube)
- Constant Current Sink

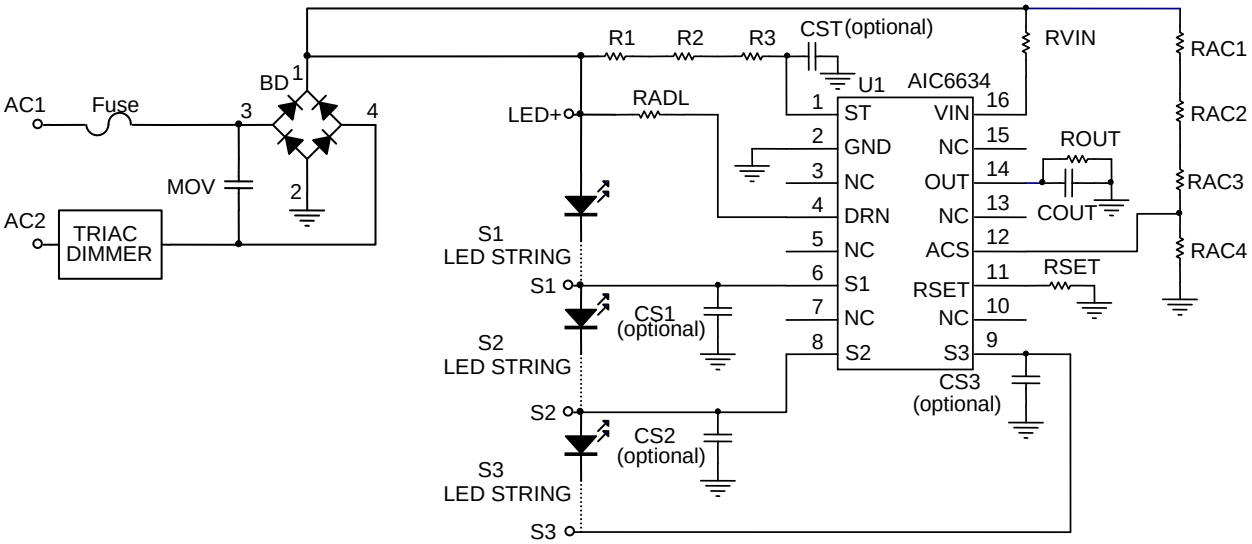
DESCRIPTION

The AIC6634 is an off-line linear LED driver. The application of high bright LED is widely used for general illumination.

The AIC6634 can drive a plurality of LED strings. When the voltage detecting circuit detects the different voltage level of input voltage, it can control the LED strings. If the input voltage is lower that it will bypass some LED strings. And turn on all LED strings when the input voltage is higher. The number of LEDs in LED array is dependent on the voltage level of the AC power source, that includes of ±10% variations. A typical application for the AIC6634 is to drive LEDs with a constant current of 50mA ~ 100mA. Multiple AIC6634 can also be used in parallel to provide higher currents.

The AIC6634 is available in a SOP-16 exposed pad (150 mil) & TSSOP16 exposed pad package.

TYPICAL APPLICATION CIRCUIT



Typical Application Circuit in SOP-16 Exposed Pad (150 mil) Package

■ ORDERING INFORMATION

AIC6634X XX XX

- PACKING TYPE
  TR: TAPE & REEL
  TB: TUBE
- PACKAGING TYPE
  RE: SOP-16 Exposed Pad (150 mil)
  LT: TSSOP-16 Exposed Pad
- G: GREEN PACKAGE

Example: AIC6634GRETR

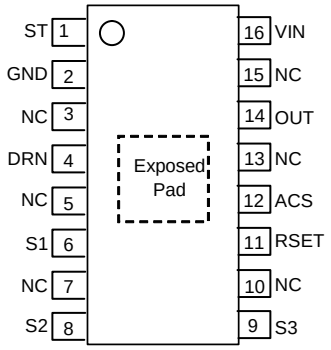
→ in Green SOP-16 Exposed Pad (150 mil) Package and Taping & Reel Packing Type

AIC6634GLTTR

→ in Green TSSOP-16 Exposed Pad Package and Taping & Reel Packing Type

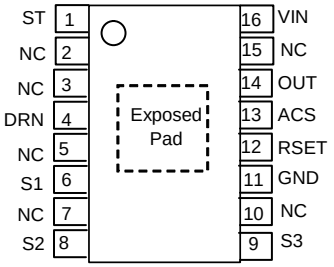
PIN CONFIGURATION

SOP-16 Exposed Pad (150 mil)
TOP VIEW



Note:The exposed pad should be connected with GND pin.

TSSOP-16 Exposed Pad
TOP VIEW



Note:The exposed pad should be connected with GND pin.

ABSOLUTE MAXIMUM RATINGS

VIN Pin Voltage 550V
S1, S2, S3, DRN Pin Voltage 550V
ST Pin Voltage 30V
OUT Pin Voltage 6V
RSET Pin Voltage 6V
ACS Pin Voltage 6V
Operating Ambient Temperature Range T_A ..... -40ºC~85ºC
Operating Maximum Junction Temperature T_J 150ºC
Storage Temperature Range T_{STG} ..... -65ºC~150ºC
Lead Temperature (Soldering 10 Sec.) 260ºC
Thermal Resistance Junction to Case SOP-16 Exposed Pad (150 mil)* ..... 13ºC /W
Thermal Resistance Junction to Case TSSOP-16 Exposed Pad* ..... 14ºC /W
Thermal Resistance Junction to Ambient SOP-16 Exposed Pad (150 mil)* ..... 60ºC /W
Thermal Resistance Junction to Ambient TSSOP-16 Exposed Pad* ..... 50ºC /W

(Assume no Ambient Airflow, no Heatsink)

Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

*The package is place on a two layers PCB with 2 ounces copper and 2 square inch, connected by 8 vias.

■ ELECTRICAL CHARACTERISTICS

(T_J=25°C, unless otherwise specified) (Note 1)

PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Supply Voltage Section						
V_{IN} Operation Voltage		V_{IN}	5		500	V
Quiescent Current	V_{IN}=310V	I_{VIN}		350		μA
S1, S2, S3 Driver Section						
Driver Leakage Current	V_{IN}=V_{S1}=V_{S2}=230V V_{S3}=20V	I_{LK}	0		2	mA
Output LED Current (Note 2)						
LED Current Range	I_{S1}, I_{S2}, I_{S3}		50		100	mA
LED Current Tolerance	I_{S3}		-5		+5	%
Output Voltage Regulator Section						
Regulation Voltage	V_{IN}=230V I_{OUT}=0mA	V_{OUT}	4.5	5	5.5	V
Voltage Tolerance			-10		+10	%
Setting LED Current Section						
RSET Voltage	RSET=37.5KΩ	V_{RSET}		0.5		V
RSET Short	RSET=0Ω	I_{S3}	110			mA
RSET Open	RSET=∞Ω		0		1	mA
AC Sense Section						
ACS Voltage	R_{ACSU}=10MΩ	V_{ACS}		0.5		V
ACS Voltage Tolerance			-10		+10	%
ACS Disable Voltage	ACS connect to out pin		4.5	5	5.5	V
Over Temperature Protection						
Action Junction Temperature				140		℃

Note 1: Specifications are production tested at T_A=25°C. Specifications over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with Statistical Quality Controls (SQC).

Note 2: Output LED Current = peak to peak.

TYPICAL PERFORMANCE CHARACTERISTICS

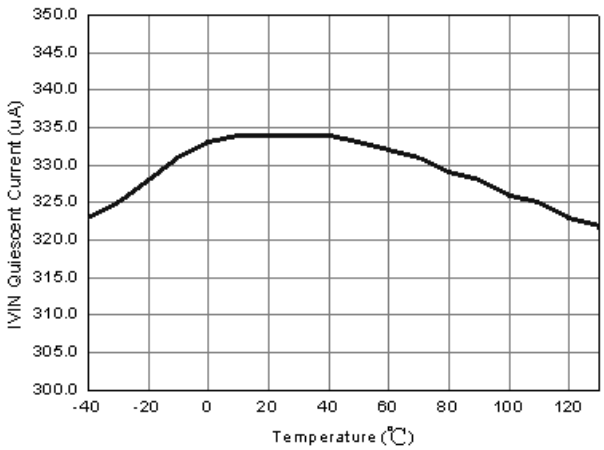


Fig.1 Quiescent Current

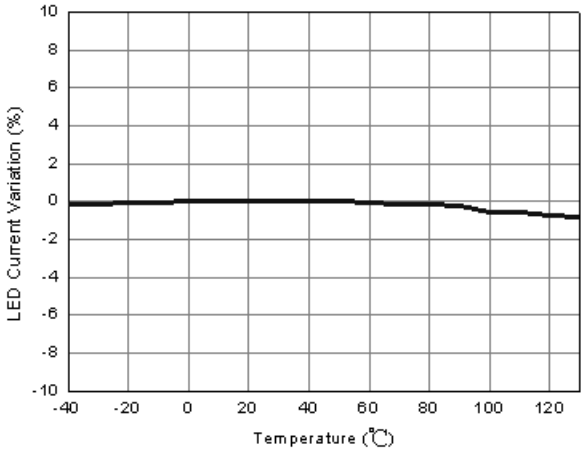


Fig.2 LED current vs. Temperature

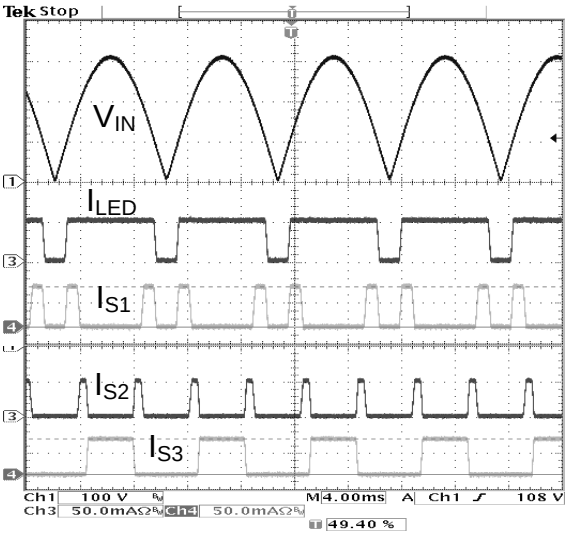


Fig.3 LED current waveform

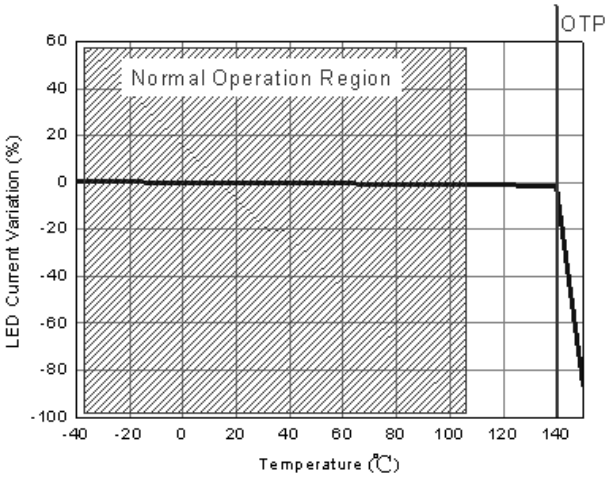
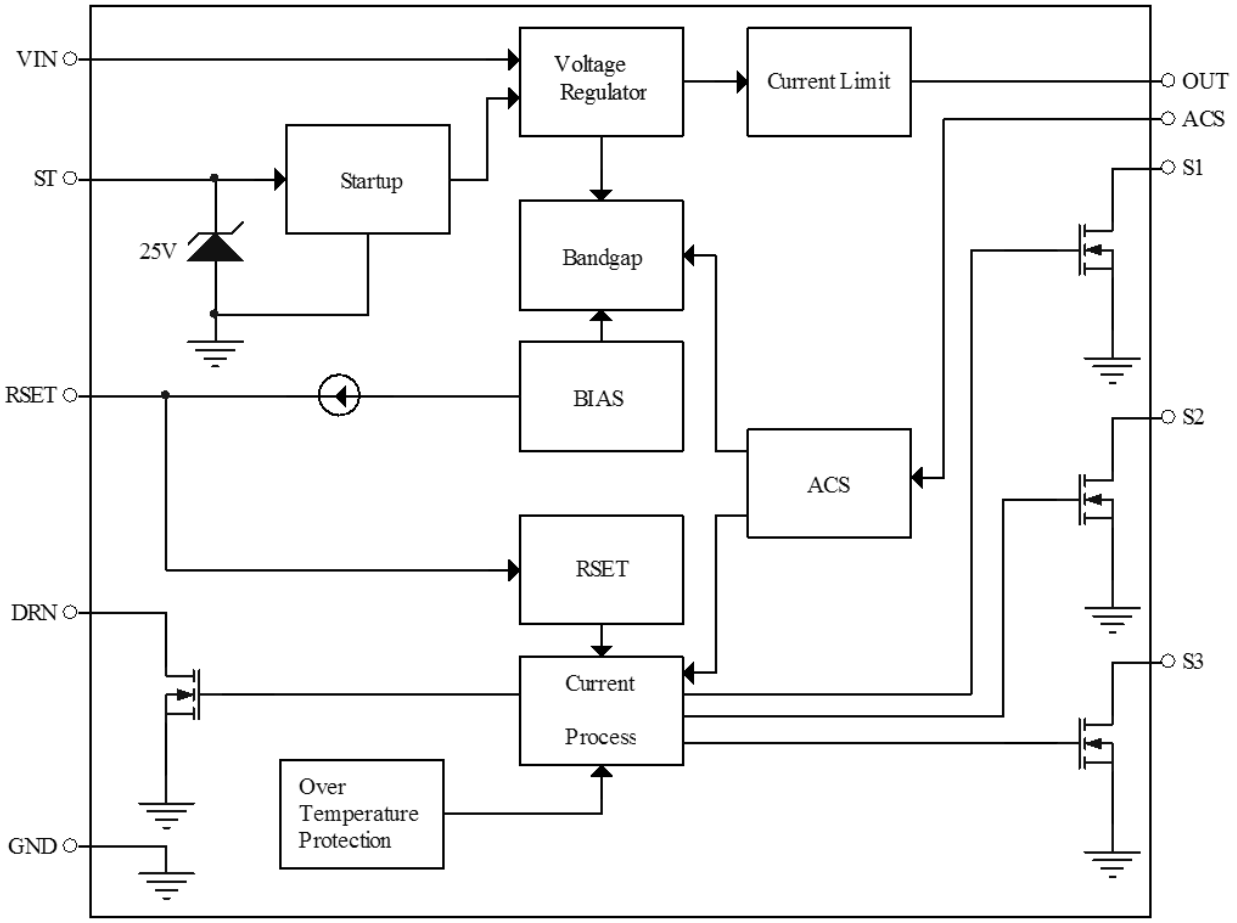


Fig.4 Over Temperature Protection

BLOCK DIAGRAM



Functional Block Diagram of AIC6634

PIN DESCRIPTION

ST PIN -Provide the Startup Current for the Controller.
VIN PIN -Power Supply Input.
S1PIN -LED S1 Cathode Connection.
S2PIN -LED S2 Cathode Connection.
S3 PIN -LED S3 Cathode Connection.
DRN PIN -Dummy Load Controller.
OUT PIN -Connecting an Output Capacitor to Provide a Stable Voltage for the Internal Circuit.
GND PIN -Ground.
ACS PIN -LED turn-on voltage. This pin does not allow floating.
RSET PIN -Set output peak current.

APPLICATION INFORMATION

The AIC6634 is off-line constant current LED driver. It can drive a plurality of LED strings. The AIC6634 can flexibly control the LED strings according to the variance of input voltage. If the input voltage is lower, it will bypass some LED strings. When the input voltage is higher than the total forward voltage of all LED strings, all LED strings will be turned on. The number of LEDs in LED array is dependent on the voltage level of the AC power source. Multiple AIC6634 can also be used in parallel to provide higher LED current.

SOFT START

The AIC6634 has soft start function to reduce the inrush current during the start-up period. According to the different AC input voltage, the Table 01 provides the commanded component value for soft start resistor R_{ST} (R_1~R_3).

Table 01

Input Voltage	Estimated R_{ST} Resistor Value
AC110V	12.2MΩ
AC120V	13.7MΩ
AC220V	25.1MΩ
AC240V	27.5MΩ

DUMMY LOAD CONTROLLER

In order to achieve stable light output when the TRIAC dimmer is used, AIC6634 designs the dummy load control function. By using a suitable dummy load R_{ADL}, the stability of light output can be improved when using the TRIAC dimmer. However, the electrical characteristics of all kinds of TRIAC dimmer are not the same. When the different TRIAC dimmer is used, the suitable dummy load may be different. In order to achieve more stable light output, the dummy load should be adjusted in accordance with the used TRIAC dimmer.

OUTPUT CAPACITOR, INPUT RESISTOR & OUTPUT RESISTOR

By connecting an output capacitor to the OUT pin and an input resistor to the VIN pin, a stable voltage can be provided for the internal circuit of AIC6634. A 1uF~10uF output ceramic capacitor is commanded for most AIC6634 applications. When choosing the output ceramic capacitor, X5R and X7R types are recommended because they retain their capacitance over wider ranges of voltage and temperature than other types. In addition, the input resistance of R_{VIN} must be larger than 33KΩ. When choosing the SMD input resistor, the SMD input resistor size must be bigger than 0805 size.

When using the TRIAC dimmer, the stability of light output can be improved by using a suitable output resistor, R_{OUT}, in parallel with output capacitor. However, when the different TRIAC dimmer or LED string is used, the suitable output resistor may be different. In order to achieve more stable light output, the output resistor should be adjusted in accordance with the used TRIAC dimmer or LED string.

SETTING OUTPUT LED PEAK CURRENT

The output LED peak current of AIC6634 can be set by the external resistor R_{SET}. The relationship between $I_{OUT-PEAK}$ and R_{SET} is

$R_{SET} = 3150/I_{OUT-PEAK}$

Turn ON/OFF LED Current

The device can be activated when the voltage at ACS pin is higher than 0.5V. It can turn off LED current when the voltage at ASC pin is lower than 0.5V. Therefore, by connecting the resistive divider R_{ACSU}(R_{AC1}~R_{AC3}) and R_{ACSD}(R_{AC4}) between the ACS pin and LED+ terminal, the device activated voltage can be set.

$$V_{LED+(ON)} = 0.5 \times \left(1 + \frac{R_{ACSU}}{R_{ACSD}}\right)$$

The recommended R_{ACSU} is 10MΩ. In additional, the ACS function can be disabled while connecting the ACS pin to OUT pin.

THERMAL REGULATION

The AIC6634 includes the thermal-regulation circuit, which is designed to protect the device

from excessive temperature. The internal thermal-regulation circuit adjusts the LED current if the junction temperature rises above the preset value of about 140ºC.

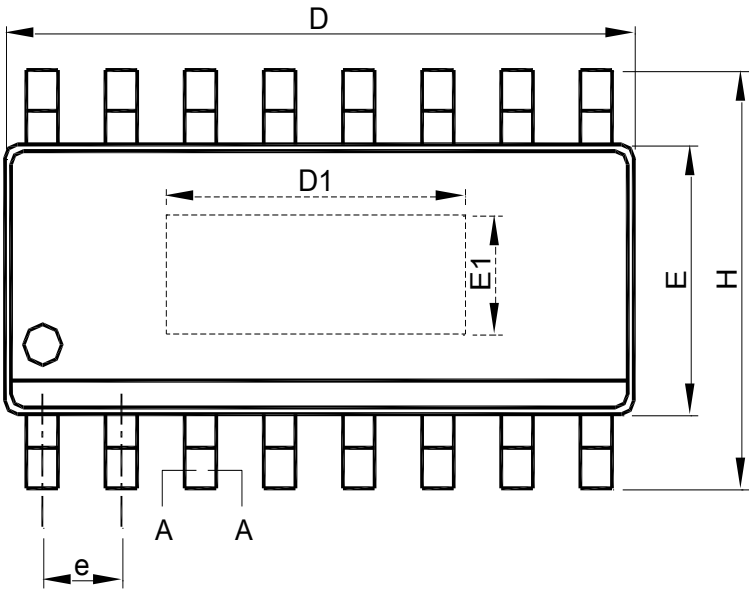
POWER DISSIPATION

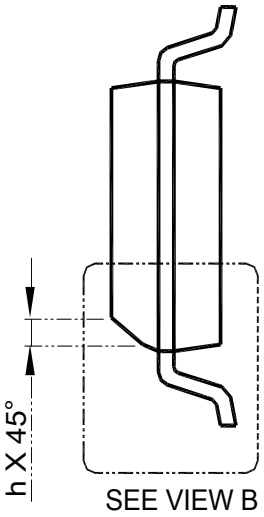
The maximum power dissipation of AIC6634 depends on the thermal resistance of its case and circuit board, the temperature difference between the die junction and ambient air, and the rate of airflow. The rate of temperature rise is greatly affected by the mounting pad configuration on the PCB, the board material, and the ambient temperature. When the IC mounting with good thermal conductivity is used, the junction temperature will be low even when large power dissipation applies.

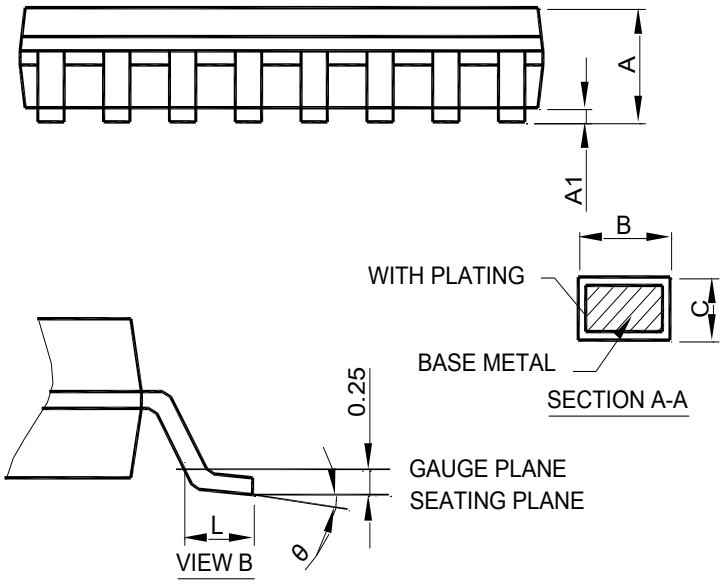
As a general rule, the lower temperature is, the better reliability of the device is. So the PCB mounting pad should provide maximum thermal conductivity to maintain low device temperature.

PHYSICAL DIMENSIONS

- **SOP-16 Exposed Pad (150 mil)**



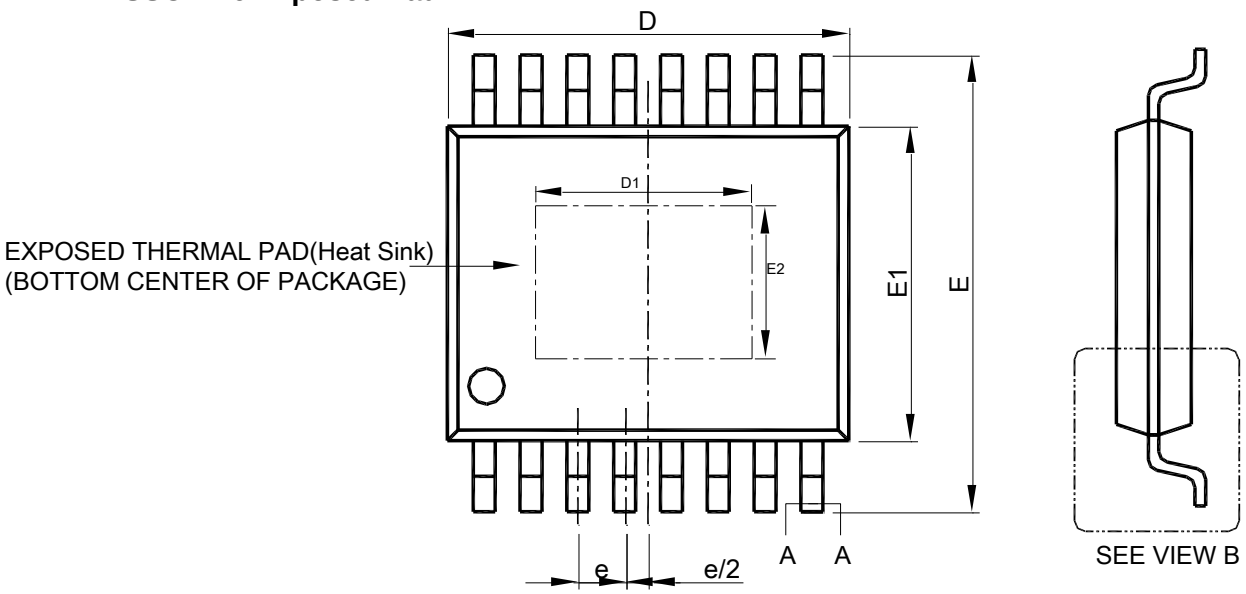


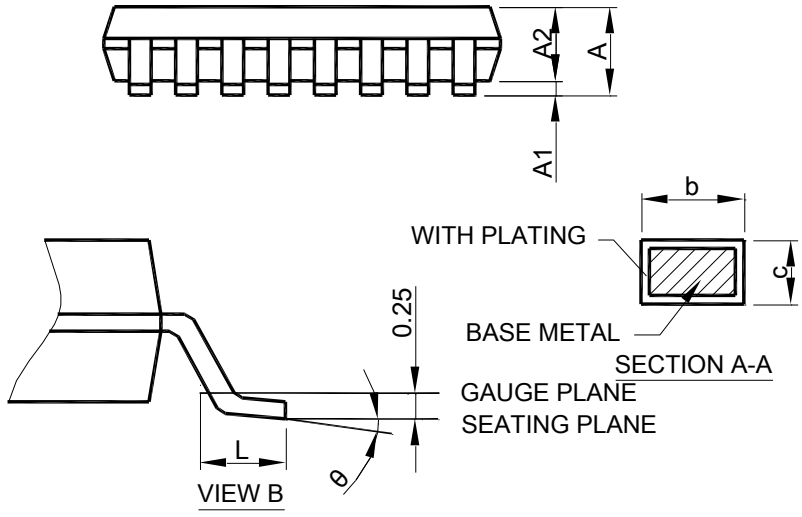


SYMBOL	SOP-16 Exposed Pad(150mil)	
	MILLIMETERS	
	MIN.	MAX.
A	1.35	1.70
A1	0.00	0.15
B	0.31	0.51
C	0.10	0.25
D	9.80	10.00
E	3.80	4.00
e	1.27 BSC	
H	5.80	6.20
h	0.25	0.50
L	0.40	1.27
θ	0°	8°
D1	3.30	5.00
E1	1.30	2.80

Note: 1. Refer to JEDEC MS-012AC.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side on.
3. Dimension "E" does not include inter-lead flash or protrusions.
4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.

- **TSSOP-16 Exposed Pad**





SYMBOL	TSSOP-16 Exposed Pad	
	MILLIMETERS	
	MIN.	MAX.
A		1.20
A1	0.00	0.15
A2	0.80	1.05
b	0.19	0.30
c	0.09	0.20
D	4.90	5.10
E	6.40 BSC	
E1	4.30	4.50
e	0.65 BSC	
L	0.45	0.75
θ	0°	8°
D1	2.00	4.00
E2	1.80	3.40

Note: 1. Refer to JEDEC MO-153AB.
2. Dimension "D" does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side.
3. Dimension "E1" does not include inter-lead flash or protrusions.
4. Controlling dimension is millimeter, converted inch dimensions are not necessarily exact.