

## Features and Benefits

- ☐ Chopper stabilized amplifier stage
- ☐ Optimized for brushless DC motor applications
- ☐ Miniature high reliability package
- ☐ Operation down to 3.5V
- ☐ CMOS for optimum stability, quality and cost
- ☐ Low power consumption

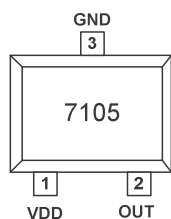
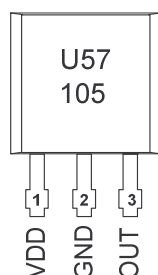
## Ordering Information

Part No.	Temperature Suffix	Package Code
US5781	E (-40°C to 85°C)	SO (SOT-23) or UA(TO-92)
US5781	L (-40°C to 150°C)	SO (SOT-23) or UA(TO-92)

## Applications

- ☐ Solid state switch
- ☐ Limit Switch
- ☐ Current Limit
- ☐ Interrupter

### Pinout:



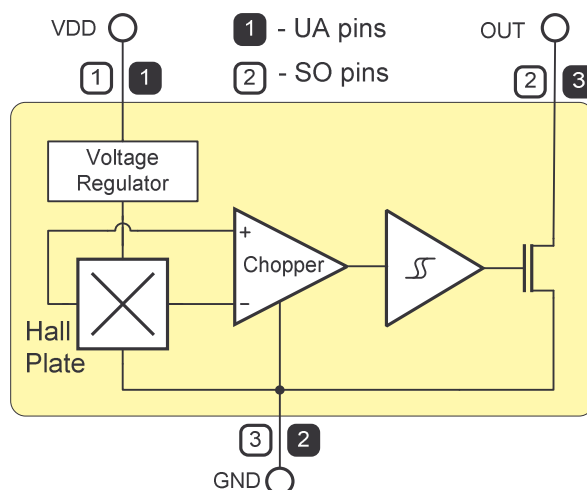
### UA Package:

Pin1: VDD - Supply  
Pin2: GND - Ground  
Pin3: OUT - Output

### SO Package:

Pin1: VDD - Supply  
Pin2: OUT - Output  
Pin3: GND - Ground

## 1 Functional Diagram



**Note:** Static electricity sensitive device; please observe ESD precautions. Reverse voltage protection is not included. For reverse polarity protection, a 100Ω resistor in series with V<sub>DD</sub> pin is recommended.

## 2 Description

The US5781 is unipolar Hall Effect sensor IC based on mixed signal CMOS technology. It incorporates advanced chopper stabilization techniques to provide accurate and stable magnetic switch points. There are many applications for this sensor in addition to those listed above. The design specifications and performance have been optimized for applications of solid state switches.

The output transistor will be switched on (Bop) in the presence of a sufficiently strong South pole magnetic field facing the marked side of the package. Similarly, the output will be switched off (Brp) in the presence of a weaker South field and remain off with "0" field.

The SOT-23 device behaviour is reversed to the UA device. The SOT-23 output transistor will be switched on (Bop) in the presence of a sufficiently strong North pole magnetic field subjected to the marked side of the package. Similarly, the output will be switched off (Brp) in the presence of a weaker North field and remain off with "0" field.

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### 3 Glossary of Terms

**MilliTesla (mT), Gauss:** Units of magnetic flux density; 1 milliTesla = 10 Gauss.

### 4 Absolute Maximum Ratings

Parameter	Symbol	Value	Units
Supply Voltage (Operating)	$V_{DD}$	24	V
Supply Current (Fault)	$I_{DD}$	50	mA
Output Voltage	$V_{OUT}$	24	V
Output Current (Fault)	$I_{OUT}$	50	mA
Power Dissipation, UA/SO packages	$P_D$	700/389	mW
Maximum Junction Temperature	$T_J$	165	°C
Storage Temperature	$T_S$	-50 to 150	°C

Exceeding the absolute maximum ratings may cause permanent damage. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

Operating Temperature Range	Value	Units
Temperature Suffix "E"	-40 to 85	°C
Temperature Suffix "L"	-40 to 150	°C

### 5 US5781 Electrical Characteristics

DC operating parameters:  $T_A = 25^{\circ}\text{C}$ ,  $V_{DD} = 12\text{V}$  (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Supply Voltage	$V_{DD}$	Operating	3.5		24	V
Supply current	$I_{DD}$	$B < B_{RP}$	0.5	2.5	5.0	mA
Saturation Voltage	$V_{DS(on)}$	$I_{OUT} = 20\text{mA}$ , $B > B_{op}$		0.3	0.5	V
Output Leakage	$I_{OFF}$	$B < B_{RP}$ , $V_{OUT} = 24\text{V}$		0.01	10	uA
Output Rise Time	$t_r$	$V_{DD} = 12\text{V}$ , $R_L = 1\text{k}$ , $C_L = 20\text{pF}$		0.04		us
Output Fall Time	$t_f$	$V_{DD} = 12\text{V}$ , $R_L = 1\text{k}$ , $C_L = 20\text{pF}$		0.18		us
Maximum Switching Frequency	fsw	Operating		10		KHz

## 6 US5781 Magnetic Characteristics

DC operating parameters:  $T_A = 25^{\circ}\text{C}$ ,  $V_{DD} = 12\text{V}$  (unless otherwise specified )

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Operating Point	$B_{OP}$	E/LUA, E/LSO	7.0	12.0	15.0	mT
Release Point	$B_{RP}$	E/LUA, E/LSO	3.5	7.5	10.0	mT
Hysteresis	$B_{HYS}$	E/LUA, E/LSO	2.0	5.0	7.0	mT

**Note:** 1 mT = 10 Gauss;

## 7 Unique Features

### CMOS Hall IC Technology

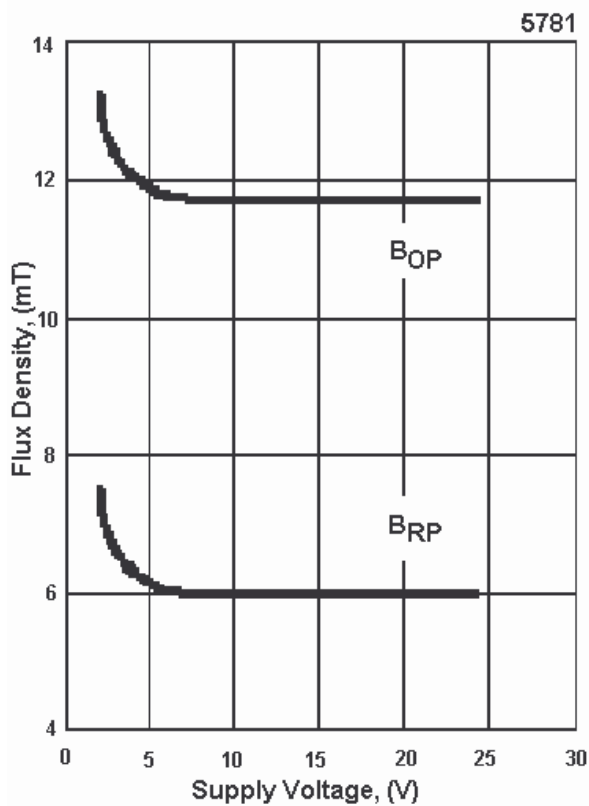
The chopper stabilized amplifier uses switched capacitor techniques to eliminate the amplifier offset voltage, which, in bipolar devices, is a major source of temperature sensitive drift. CMOS makes this advanced technique possible. The CMOS chip is also much smaller than a bipolar chip, allowing very sophisticated circuitry to be placed in less space. The small chip size also contributes to lower physical stress and less power consumption.

### Installation

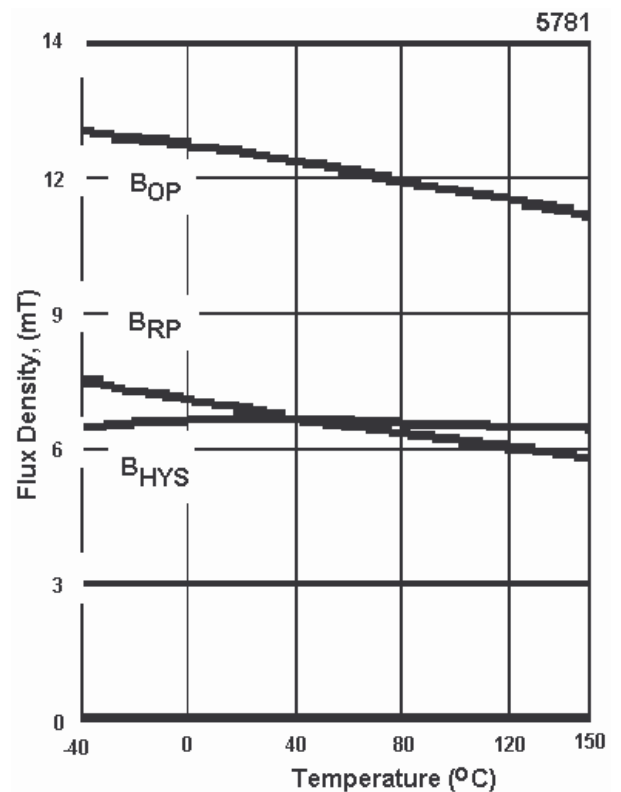
Consider temperature coefficients of Hall IC and magnetics, as well as air gap and life time variations. Observe temperature limits during wave soldering.

**8 Performance Graphs** – unless otherwise specified  $T_A = 25^\circ\text{C}$ ,  $V_{DD} = 12\text{V}$

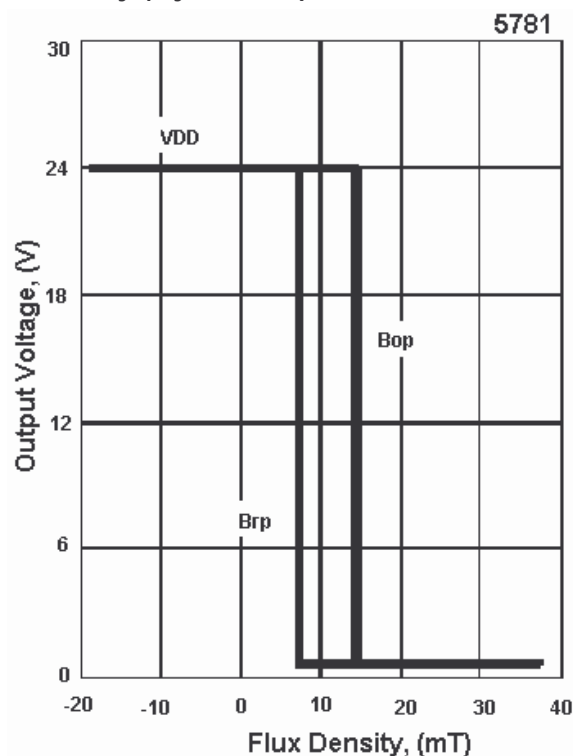
**8.1 Typical Magnetic Switch Points vs  $V_{DD}$**



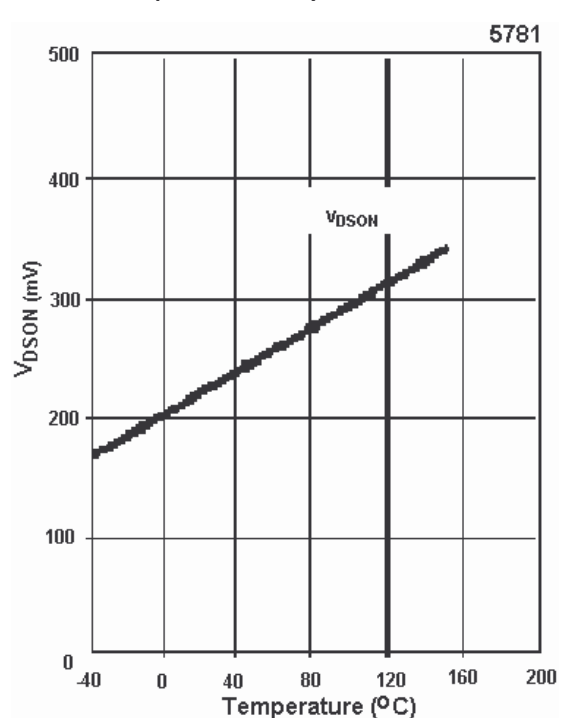
**8.2 Magnetic Switch Points vs Temperature**



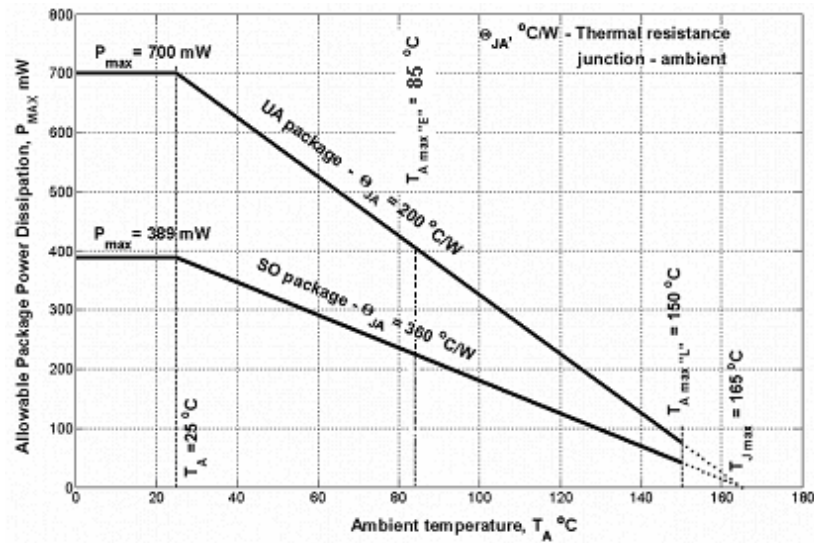
**8.3 Output Voltage vs Magnetic Flux Density (Hysteresis)**



**8.4 Typical Saturation Voltage vs Temperature ( $I_{out}=20\text{mA}$ )**



## 8.5 Maximal Power Dissipation (MPD) Versus Temperature



The thermal resistance  $\theta_{JA}$  and rated power dissipation are defined in accordance with EIA/JESD51-3 Standard.

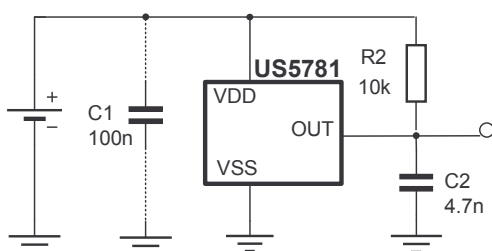
Some differences may be observed between values in the specification tables and the performance graphs. The performance graphs are based on initial characterization of several ICs from one lot. Hence a particular IC may vary from the performance graphs but all ICs should meet the values stated in the specification tables.

## 9 Pin Definitions and Descriptions

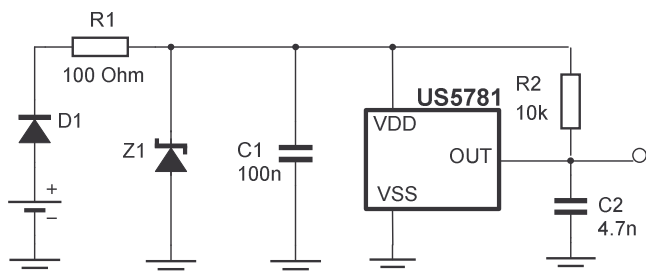
UA Pins	SO Pins	Pin Name	Type	Description
1	1	VDD	Supply	Supply
3	2	OUT	Output	Hall output
2	3	VSS	Ground	Ground

## 10 Application Information

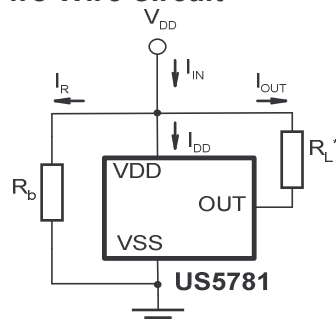
### 10.1 Typical Three-Wire Application Circuit



### 10.3 Automotive and Harsh, Noisy Environments Three-Wire Circuit



### 10.2 Two-Wire Circuit



**Note:**

With this circuit, precise ON and OFF currents can be detected using only two connecting wires.

The resistors  $R_L$  and  $R_b$  can be used to bias the input current. Refer to the part specifications for limiting values.

$$B_{RP} : I_{OFF} = I_R + I_{DD} = V_{DD}/R_b + I_{DD}$$

$$B_{OP} : I_{ON} = I_{OFF} + I_{OUT} = I_{OFF} + V_{DD}/R_L$$

## 11 Application Comments

If a weak power supply is used or the chip is intended to be used in noisy environment, it is recommended that figure 10.3 from the Application Information section is used.  $R_1$  and  $C_1$  form a RC filter, which bypasses the disturbances over the supply pin.

If a continuous reverse polarity protection is required for supply voltages above 5 Volts, it is recommended to use a diode instead of resistor, because the power dissipation demands becomes higher.

## **12 Reliability Information**

This Melexis device is classified and qualified regarding soldering technology, solderability and moisture sensitivity level, as defined in this specification, according to following test methods:

- IPC/JEDEC J-STD-020  
Moisture/Reflow Sensitivity Classification For Nonhermetic Solid State Surface Mount Devices (classification reflow profiles according to table 5-2)
- EIA/JEDEC JESD22-A113  
Preconditioning of Nonhermetic Surface Mount Devices Prior to Reliability Testing (reflow profiles according to table 2)
- CECC00802  
Standard Method For The Specification of Surface Mounting Components (SMDs) of Assessed Quality
- EIA/JEDEC JESD22-B106  
Resistance to soldering temperature for through-hole mounted devices
- EN60749-15  
Resistance to soldering temperature for through-hole mounted devices
- MIL 883 Method 2003 / EIA/JEDEC JESD22-B102  
Solderability

For all soldering technologies deviating from above mentioned standard conditions (regarding peak temperature, temperature gradient, temperature profile etc) additional classification and qualification tests have to be agreed upon with Melexis.

The application of Wave Soldering for SMD's is allowed only after consulting Melexis regarding assurance of adhesive strength between device and board.

Based on Melexis commitment to environmental responsibility, European legislation (Directive on the Restriction of the Use of Certain Hazardous substances, RoHS) and customer requests, Melexis has installed a Roadmap to qualify their package families for lead free processes also. Various lead free generic qualifications are running, current results on request.

For more information on manufacturability/solderability see quality page at our website:  
<http://www.melexis.com/html/pdf/MLXleadfree-statement.pdf>

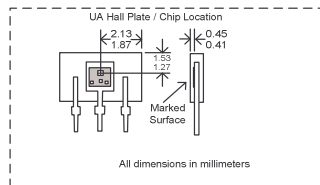
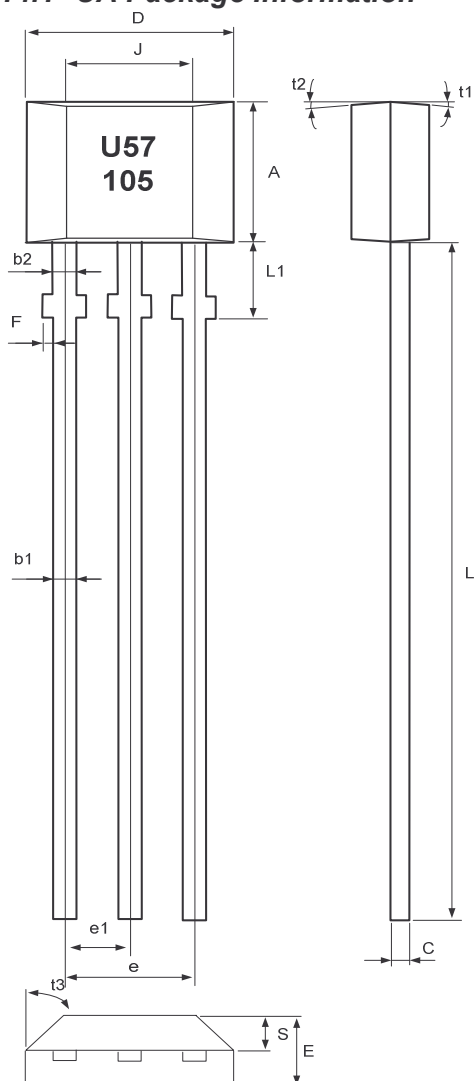
## **13 ESD Precautions**

Electronic semiconductor products are sensitive to Electro Static Discharge (ESD). Always observe Electro Static Discharge control procedures whenever handling semiconductor products.



## 14 Physical Characteristics

### 14.1 UA Package Information



#### MARKING

Line 1:

1<sup>st</sup> letter (U) = Supplier (Melexis)  
2<sup>nd</sup> and 3<sup>rd</sup> digits (57) = Series (5781)

Line2:

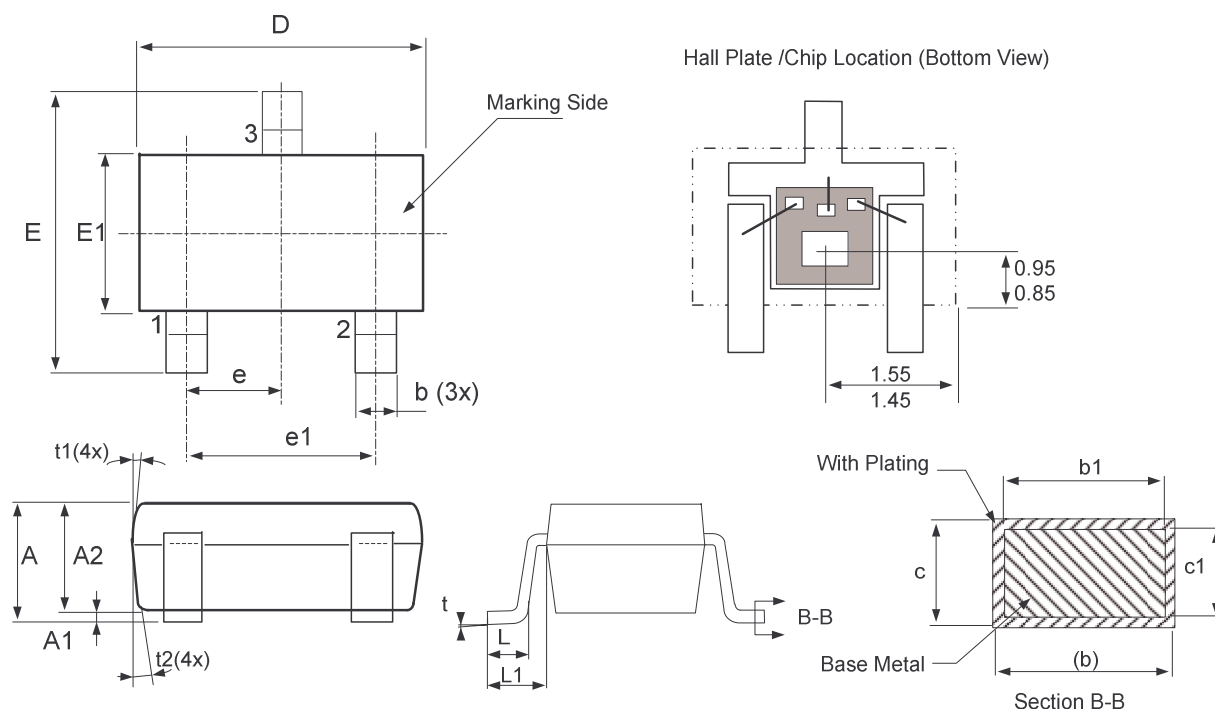
1<sup>st</sup> digit (1) = Year (2001)  
2<sup>nd</sup> and 3<sup>rd</sup> digits = Week of the year

Symbols	Dimensions in millimeters		
	min	nom	max
A	2.80	3.00	3.20
b1	0.35	0.38	0.41
b2	0.43	0.46	0.48
C	0.35	0.38	0.41
D	3.90	4.10	4.30
e	2.51	2.54	2.57
e1	1.24	1.27	1.30
E	1.40	1.50	1.60
J	2.51	2.62	2.72
L	10.0	10.5	11.0
S	0.63	0.74	0.84
t3	-	45°	-
t2	-	5°	-
t1	-	-	5°
L1	1.55	1.65	1.75
F	0	-	0.20

#### Note:

1. Controlling Dimension: mm
2. Tolerance:  $\pm 0.102$  unless otherwise specified
3. Package dimensions exclusive molding flash
4. The end flash shall not exceed 0.127" on each side

## 14.2 SOT23 Package Information



**Note:**

- 1.Dimension D does not include mold flash, protrusions or gate burrs. Mold flash , protrusions or gate burrs shall not exceed 0.10mm per side.
2. Dimension E1 does not include interlead flash or protrusion shall not exceed 0.10mm per side.
3. The package top may be smaller than the package bottom. Dimensions D and E1 are determined at the outermost extremes of the plastic body exclusive or mold flash, tie bar burrs, interlead flash and gate burrs, but including any mismatch between the top and bottom of the molded body.
4. The section B-B apply to the flat section of the lead between 0.08mm and 0.15mm from the lead tip.
5. Marking (on top of the chip)  
7YXX - First Digit (2) - part number; YXX- date code(Y - last digit of the Year, XX - week)

Symbols	Dimensions in millimeters		
	min	nom	max
A	1.05	-	1.35
A1	0.05	-	0.15
A2	1.00	1.10	1.20
b	0.25	-	0.50
b1	0.25	0.40	0.45
c	0.08	-	0.20
c1	0.08	0.11	0.15
D	2.70	2.90	3.00
E	2.60	2.80	3.00
E1	1.50	1.60	1.70
L	0.35	0.45	0.55
L1	0.60 REF		
e	0.95 BSC		
e1	1.90 BSC		
t	0°	5°	10°
t1	3°	5°	7°
t2	6°	8°	10°

## **15 Disclaimer**

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