

# ZHT431

## Adjustable precision Zener shunt regulator

### Description

The ZHT431 is a three terminal adjustable shunt regulator offering excellent temperature stability and output current handling capability up to 100mA. The device offers extended operating temperature range working from -55 to +125°C. The output voltage may be set to any chosen voltage between 2.5 and 20 volts by selection of two external divider resistors.

The devices can be used as a replacement for zener diodes in many applications requiring an improvement in zener performance.

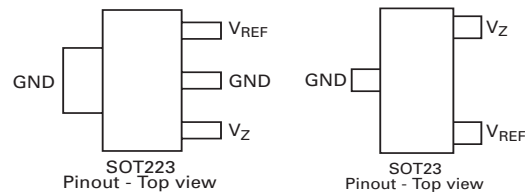
### Features

- Surface mount SOT223 and SOT23 packages
- 2% and 1% tolerance
- Maximum temperature coefficient 67 ppm/°C
- Temperature compensated for operation over the full temperature range
- Programmable output voltage
- 50µA to 100mA current sink capability
- Low output noise
- Wide temperature range -55 to +125°C

### Applications

- Series and shunt regulator
- Voltage monitor
- Over voltage / under voltage protection
- Switch mode power supplies

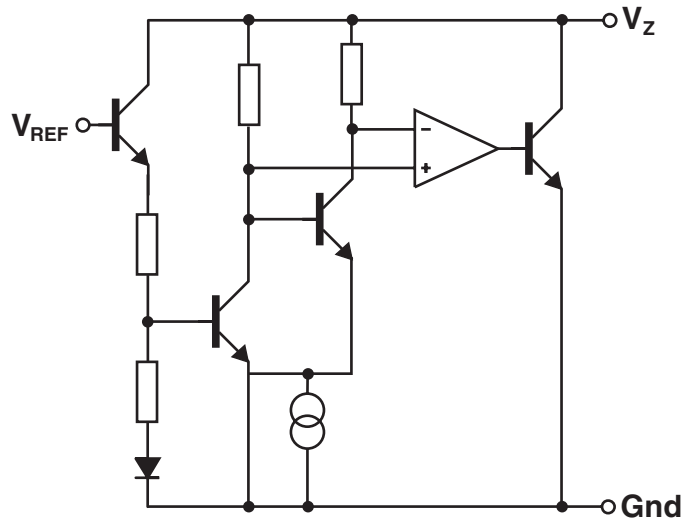
### Pinout information



### Ordering information

Order reference	Tolerance (%)	Package	Part mark	Status	Reel size (inches)	Quantity per reel	Tape width
ZHT431C01L	1	TO92	ZHT43101	Obsolete	Loose	4000	-
ZHT431C01STOB	1	TO92	ZHT43101	Obsolete	12.5	1500	-
ZHT431C01STZ	1	TO92	ZHT43101	Obsolete	Concertina	1500	-
ZHT431C02L	2	TO92	ZHT43102	Obsolete	Loose	4000	-
ZHT431C02STOB	2	TO92	ZHT43102	Obsolete	12.5	1500	-
ZHT431C02STZ	2	TO92	ZHT43102	Obsolete	Concertina	1500	-
ZHT431F01TA	1	SOT23	43C	Released	7	3000	8mm
ZHT431F02TA	2	SOT23	43D	Released	7	3000	8mm
ZHT431G01TA	1	SOT223	ZHT43101	Released	7	1000	12mm
ZHT431G02TA	2	SOT223	ZHT43102	Released	7	1000	12mm

## Schematic diagram



## Absolute maximum rating

Cathode voltage ( $V_Z$ )	20V
Cathode current	150mA
Operating temperature	-55 to 125°C
Storage temperature	-55 to 150°C

## Power dissipation ( $T_{amb}=25^{\circ}\text{C}$ )

( $T_{jmax} = 150^{\circ}\text{C}$ )

SOT23	330mW
TO92	780mW
SOT223	2W

## Recommended operating conditions

	Min.	Max.
Cathode voltage	$V_{REF}$	20V
Cathode current	50 $\mu\text{A}$	100mA

## Electrical characteristics test conditions (unless otherwise stated): $T_{amb}=25^{\circ}\text{C}$

Symbol	Parameter	Value			Units	Conditions	
		Min.	Typ.	Max.			
$V_{REF}$	Reference voltage	2%	2.45	2.50	2.55	V	$I_L=10\text{mA}$ (Fig.1), $V_Z=V_{REF}$
		1%	2.475	2.50	2.525	V	
$V_{DEV}$	Deviation of reference input voltage over temperature		10	30	mV	$I_L=10\text{mA}$ , $V_Z=V_{REF}$ $T_{amb}=\text{full range}$ (Fig1)	
$\frac{\Delta V_{REF}}{\Delta V_Z}$	Ratio of the change in reference voltage to the change in cathode voltage		-1.85	-2.7	mV/V	$V_Z$ from $V_{REF}$ to 10V $I_Z=10\text{mA}$ (Fig.2)	
			-1.0	-2.0	mv/V	$V_Z$ from 10V to 20V $I_Z=10\text{mA}$ (Fig.2)	
$I_{REF}$	Reference input current		0.12	1.0	$\mu\text{A}$	$R1=10\text{k}$ , $R2=O/C$ , $I_L=10\text{mA}$ (Fig.2)	
$\Delta I_{REF}$	Deviation of reference input current over temperature		0.04	0.2	$\mu\text{A}$	$R1=10\text{k}$ , $R2=O/C$ , $I_L=10\text{mA}$ $T_{amb}=\text{full range}$ (Fig.2)	
$I_{Zmin}$	Minimum cathode current for regulation		35	50	$\mu\text{A}$	$V_Z=V_{REF}$ (Fig.1)	
$I_{Zoff}$	Off-state current			0.1	$\mu\text{A}$	$V_Z=20\text{V}$ , $V_{REF}=0\text{V}$ (Fig.3)	
$R_Z$	Dynamic output impedance			0.75	$\Omega$	$V_Z=V_{REF}$ (Fig.1), $f=0\text{Hz}$ , $I_C=1\text{mA}$ to 100mA	

Deviation of reference input voltage,  $V_{DEV}$ , is defined as the maximum variation of the reference input voltage over the full temperature range.

The average temperature coefficient of the reference input voltage,  $V_{REF}$  is defined as:

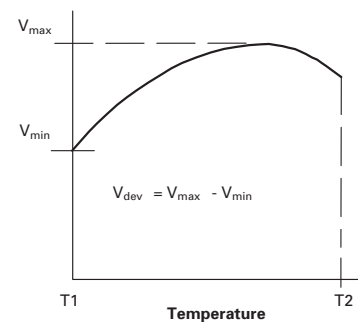
$$V_{REF} \left( \frac{\text{ppm}}{^{\circ}\text{C}} \right) = \frac{V_{DEV} \times 1000000}{V_{REF} (T1 - T2)}$$

The dynamic output impedance,  $R_Z$ , is defined as:

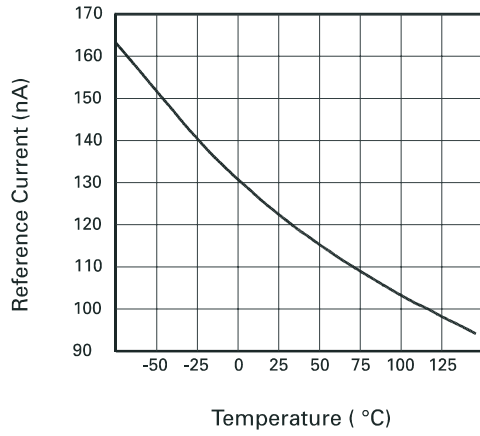
$$R_Z = \frac{\Delta V_Z}{\Delta I_Z}$$

When the device is programmed with two external resistors,  $R1$  and  $R2$ , (fig 2), the dynamic output impedance of the overall circuit,  $R'$ , is defined as:

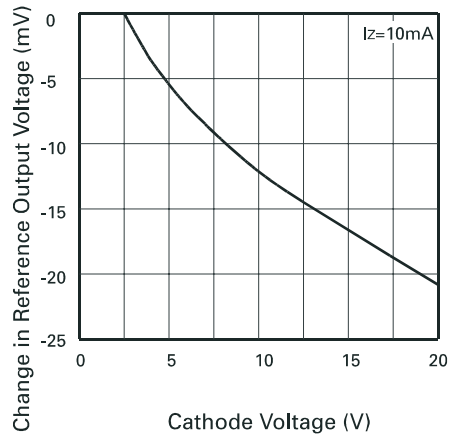
$$R' = R_Z \left( 1 + \frac{R1}{R2} \right)$$



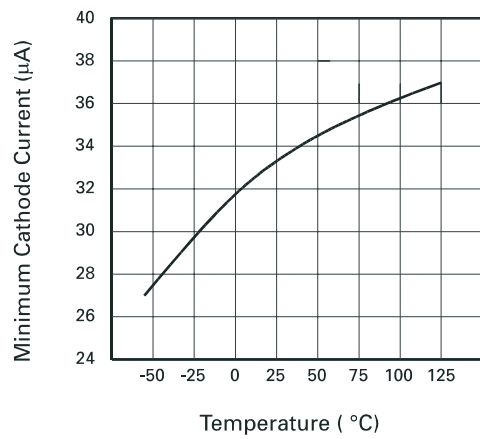
## Typical characteristics



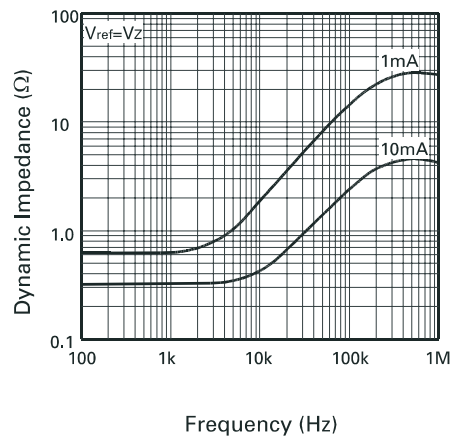
**I<sub>ref</sub> vs. Temperature**



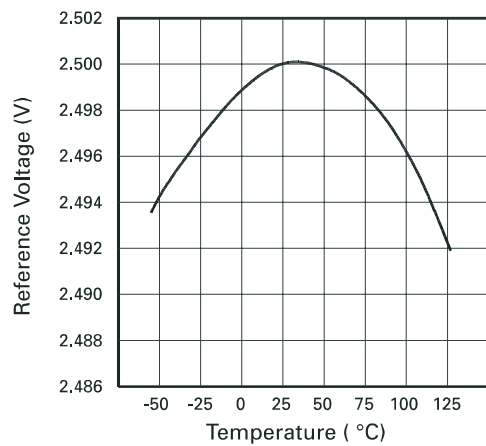
**Change in V<sub>ref</sub> v Cathode Voltage**



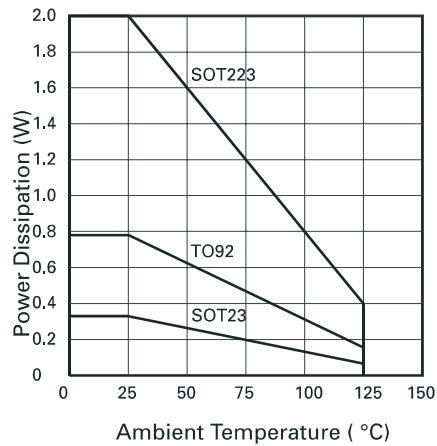
**I<sub>zmin</sub> vs. Temperature**



**Dynamic Impedance v Frequency**

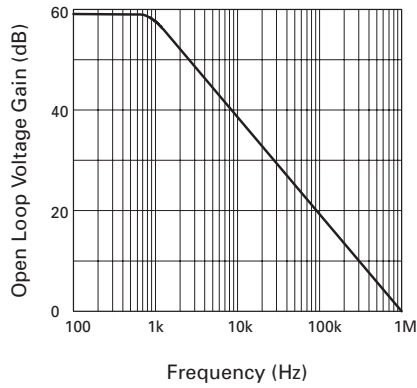


**V<sub>ref</sub> vs. Temperature**

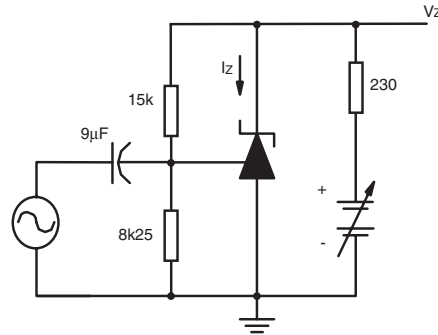


**Power Dissipation Derating**

## Typical characteristics

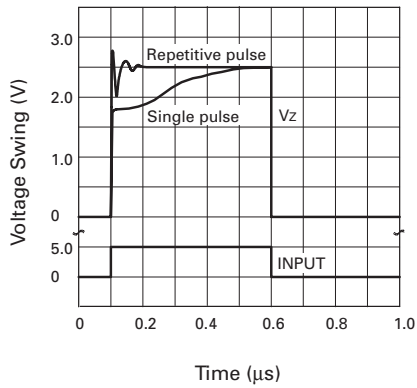


**Gain v Frequency**

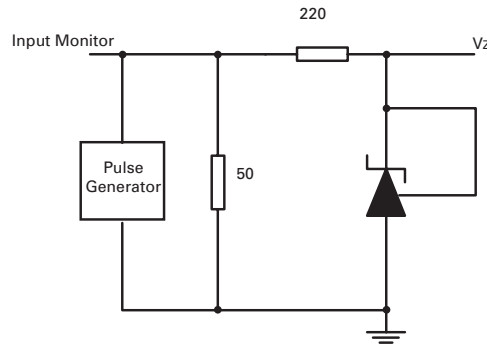


$I_z = 10\text{mA}$ ,  $T_A = 25^\circ\text{C}$

**Test Circuit for Open Loop Voltage Gain**

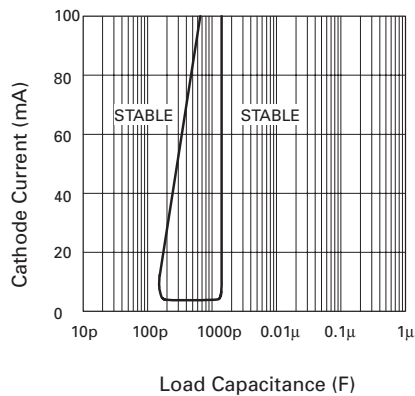


**Pulse Response**

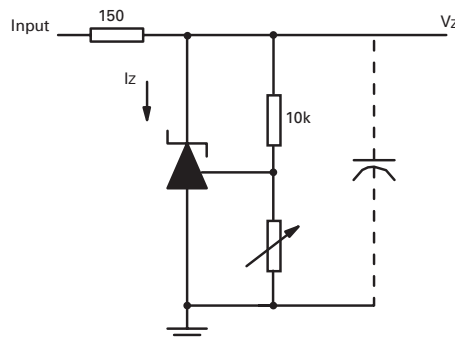


$T_A = 25^\circ\text{C}$

**Test Circuit for Pulse Response**



**Stability Boundary Conditions**



$V_{ref} < V_Z < 20$ ,  $I_z = 10\text{mA}$ ,  $T_A = 25^\circ\text{C}$

**Test Circuit for Stability Boundary Conditions**

## DC test circuits

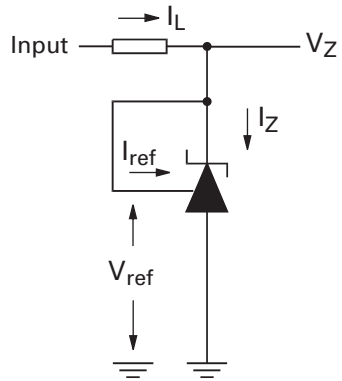


Fig 1 - Test circuit for  $V_Z = V_{ref}$

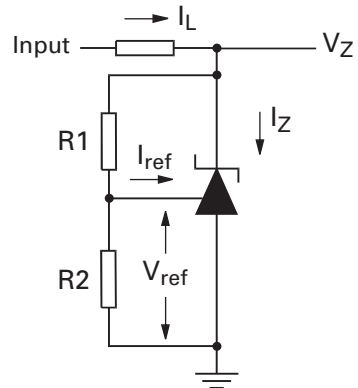


Fig 2 - Test circuit for  $V_Z > V_{ref}$

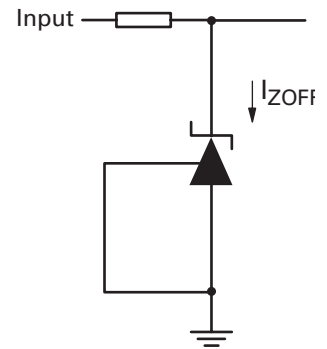
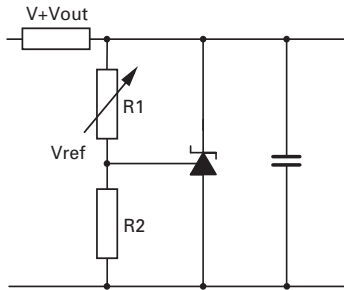


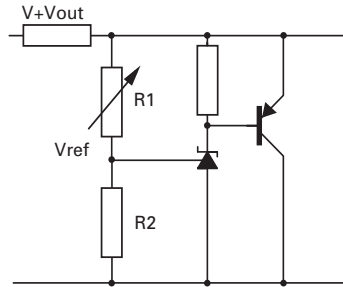
Fig 3 - Test circuit for for OI state current!

## Application circuits



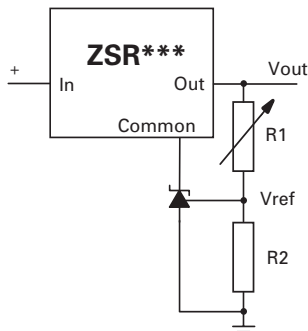
$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

**Shunt regulator**



$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

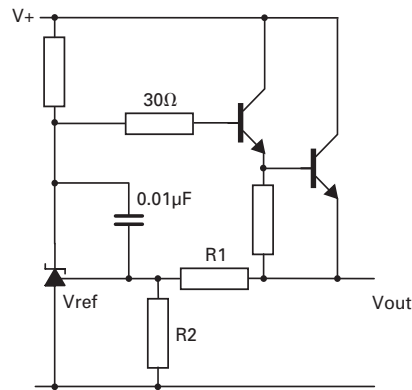
**Higher current shunt regulator**



$$V_{out\_MIN} = V_{ref} + V_{reg}$$

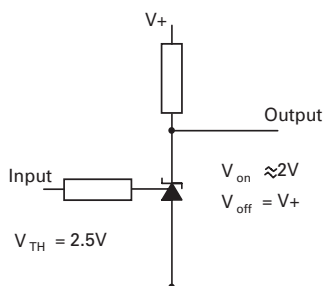
$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

**Output control of a three terminal fixed regulator**

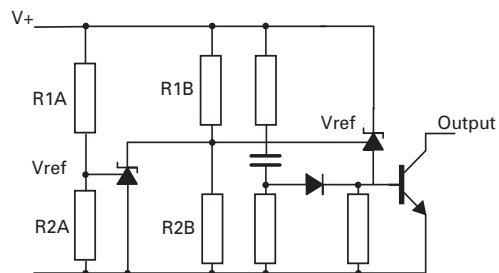


$$V_{out} = \left(1 + \frac{R1}{R2}\right) V_{ref}$$

**Series regulator**



**Single supply comparator with temperature compensated threshold**

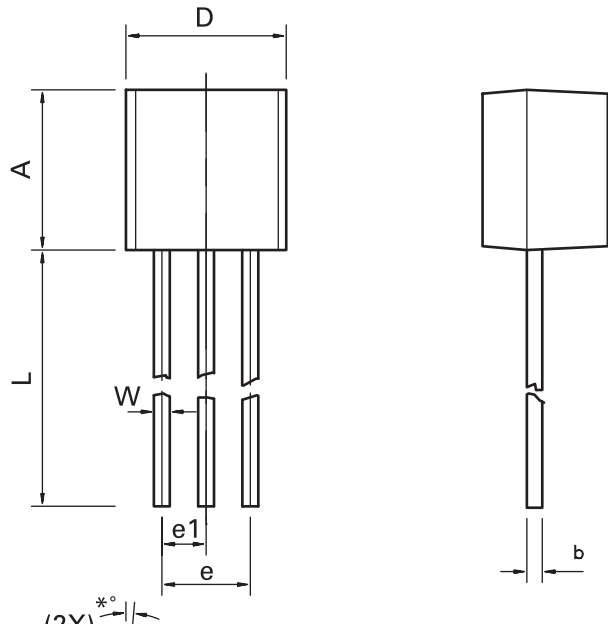


$$\text{Low limit} = \left(1 + \frac{R1B}{R2B}\right) V_{ref}$$

$$\text{High limit} = \left(1 + \frac{R1A}{R2A}\right) V_{ref}$$

**Over voltage / under voltage protection circuit**

## Package outline - T092

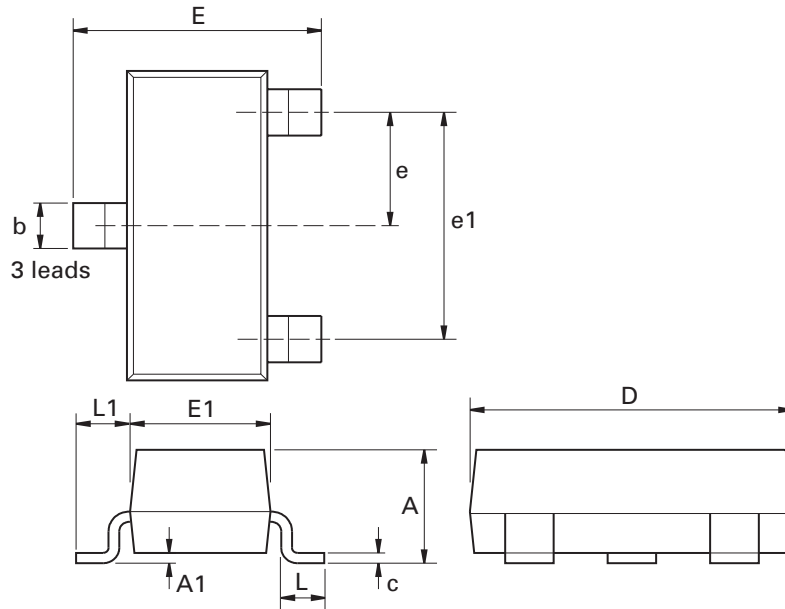


DIM	Millimeters		Inches	
	Min.	Max.	Min.	Max.
A	4.32	4.95	0.170	0.195
b	0.36	0.51	0.014	0.020
E	3.30	3.94	0.130	0.155
e	2.41	2.67	0.095	0.105
e1	1.14	1.40	0.045	0.055
L	12.70	15.49	0.500	0.610
R	2.16	2.41	0.085	0.095
S1	1.14	1.52	0.045	0.060
W	0.41	0.56	0.016	0.022
D	4.45	4.95	0.175	0.195
*°	4°	6°	4°	6°

**Note:** Controlling dimensions are in millimeters. Approximate dimensions are provided in inches



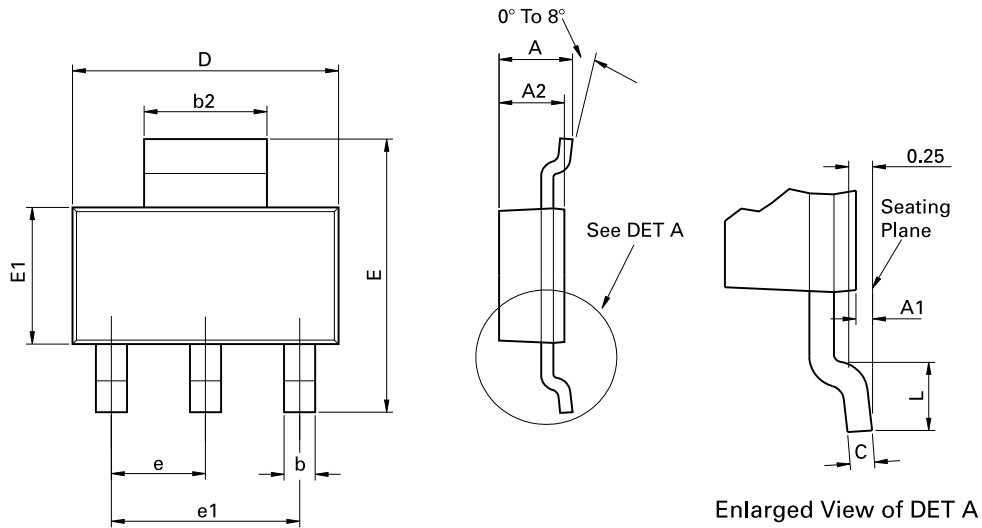
## Package outline - SOT23



Dim.	Millimeters		Inches		Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.		Min.	Max.	Max.	Max.
A	2.67	3.05	0.105	0.120	H	0.33	0.51	0.013	0.020
B	1.20	1.40	0.047	0.055	K	0.01	0.10	0.0004	0.004
C	-	1.10	-	0.043	L	2.10	2.50	0.083	0.0985
D	0.37	0.53	0.015	0.021	M	0.45	0.64	0.018	0.025
F	0.085	0.15	0.0034	0.0059	N	0.95 NOM		0.0375 NOM	
G	1.90 NOM		0.075 NOM		-	-	-	-	-

**Note:** Controlling dimensions are in millimeters. Approximate dimensions are provided in inches

## Package outline - SOT223



Conforms to JEDEC TO-261 AA Issue B

DIM	Millimeters		Inches		DIM	Millimeters		Inches	
	Min	Max	Min	Max		Min	Max	Min	Max
A	-	1.80	-	0.071	e	2.30 BSC		0.0905 BSC	
A1	0.02	0.10	0.0008	0.004	e1	4.60 BSC		0.181 BSC	
b	0.66	0.84	0.026	0.033	E	6.70	7.30	0.264	0.287
b2	2.90	3.10	0.114	0.122	E1	3.30	3.70	0.130	0.146
C	0.23	0.33	0.009	0.013	L	0.90	-	0.355	-
D	6.30	6.70	0.248	0.264	-	-	-	-	-

**Note:** Controlling dimensions are in millimeters. Approximate dimensions are provided in inches

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"Not recommended for new designs"	Device is still in production to support existing designs and production
"Obsolete"	Production has been discontinued

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