ZR431L
Adjustable precision shunt regulator

Summary

Description

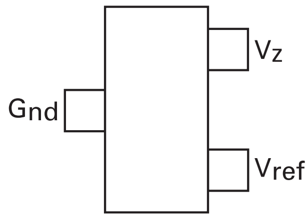
The ZR431L is a three terminal adjustable shunt regulator offering excellent temperature stability and output current handling capability up to 25mA. The output voltage may be set to any chosen voltage between 1.24 and 10 volts by selection of two external divider resistors.

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

The ZR431L is particularly used in the feedback control loop of switch mode power supplies. In this application the device 1.24 volt reference enables the generation of low voltage supplies, typically 3.3 volts or 3 volts.

Features

- 2.5% and 1% tolerance
- Max. temperature coefficient 50 ppm/°C
- Temperature compensated for operation over -40 to 85°C
- 100mA to 25mA current sink capability
- Surface mount SOT23 package



Applications

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

Ordering information

Device	Pack	Part mark	Status	Quantity per reel	Reel size (inches)	TOL %
ZR431LF01TA	SOT23	43M	Active	3000	7	1
ZR431LF02TA	SOT23	43L	Active	3000	7	2.5
ZR431LC01STOB	TO92	ZR431L01	Obsolete	1500		1
ZR431LC02STOB	TO92	ZR431L02	Obsolete	1500		2.5
ZR431LC01L	TO92	ZR431L01	Obsolete		Loose	1
ZR431LC02L	TO92	ZR431L02	Obsolete		Loose	2.5

Absolute maximum ratings

Parameter	Symbol	Limit	Unit
Cathode voltage	V_Z	10	V
Cathode current		50	mA
Storage temperature	T_{STG}	-55 to 105	°C
Junction temperature	T_J	-40 to 125	°C

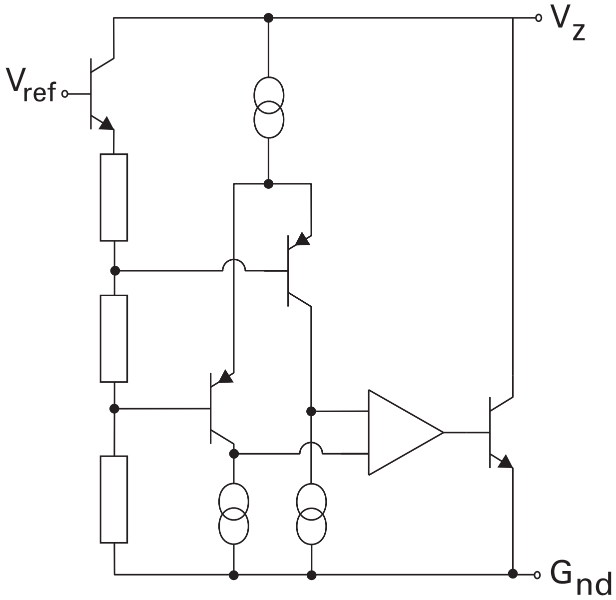
Power dissipation (at T_{amb} = 25°C unless otherwise stated)

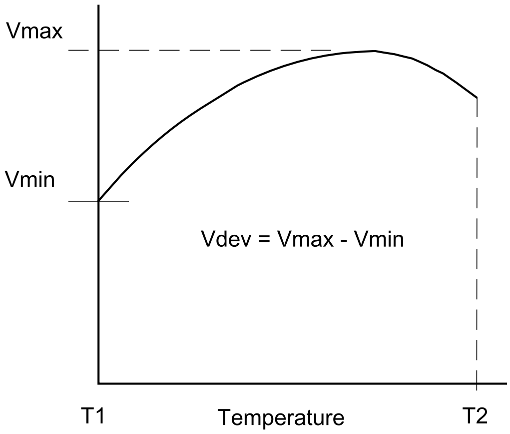
Package	Value	Unit
SOT23	330	mW

Recommended operating conditions

Parameter	Min.	Max.
Cathode voltage	V_{REF}	10V
Cathode current	100μA	25mA
Operating temperature	-40°C	85°C

Block diagram





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:

$$Vref(ppm/C) = \frac{V_{dev} x 1000000}{V_{ref}(T1 - T2)}$$

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:

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

Electrical characteristics (at T_{amb} = 25°C unless otherwise stated)

Parameter	**Symbol**	**Min.**	**Typ.**	**Max.**	**Unit**	**Conditions**
Reference Voltage 2.5% 1.0%	V_{ref} V_{ref}	1.209 1.228	1.24 1.24	1.271 1.252	V V	I_L = 10mA (Fig1), $V_Z = V_{ref}$
Deviation of Reference Input Voltage over Temperature	V_{dev}		4.0	8.0	mV	I_L = 10mA, $V_Z = V_{ref}$ T_a = full range (Fig 1)
Ratio of the change in Reference Voltage to the change in Cathode Voltage)	$\frac{\Delta V_{ref}}{\Delta V_Z}$		0.5	2.0	mV/V	V_Z from V_{ref} to 10V I_Z = 10mA (Fig2)
Reference Input Current	I_{ref}	0.02	0.11	0.4	μA	R1 = 10k, R2 = O/C, I_L = 10mA (fig2)
Deviation of Reference Input Current over Temperature	ΔI_{ref}		0.02	0.2	μA	R1 = 10k, R2 = O/C, I_L = 10mA T_a = full range (Fig2)
Minimum Cathode Current for Regulation	I_{Zmin}		30	100	μA	
Off-state Current	I_{Zoff}		10	30	μA	V_Z = 10V, V_{ref} = 0V (Fig3)
Dynamic Output Impedance	R_Z		0.25	2	Ω	$V_Z = V_{ref}$(Fig1), f = 0Hz, I_L = 10mA

DC Test circuits

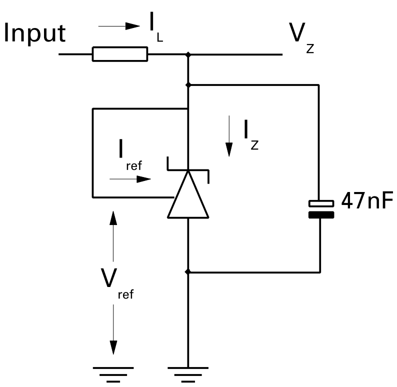


Fig 1 - Test Circuit for $V_Z = V_{ref}$

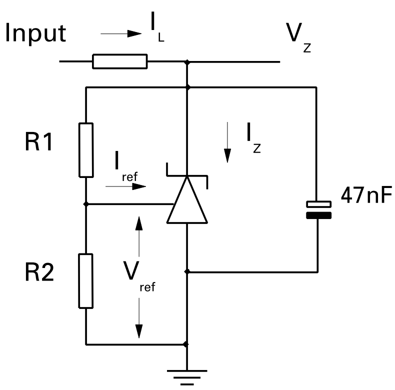


Fig 2 - Test Circuit for $V_Z > V_{ref}$

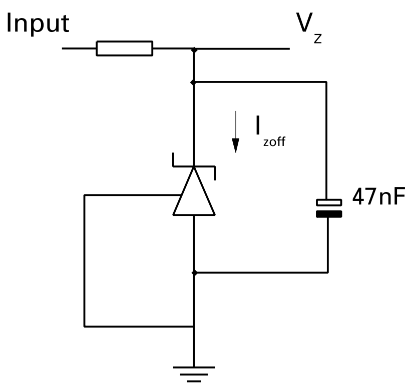
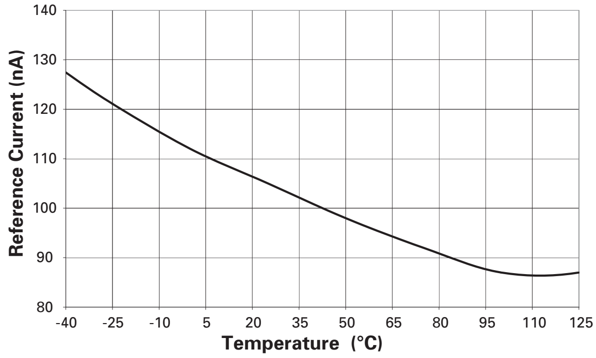
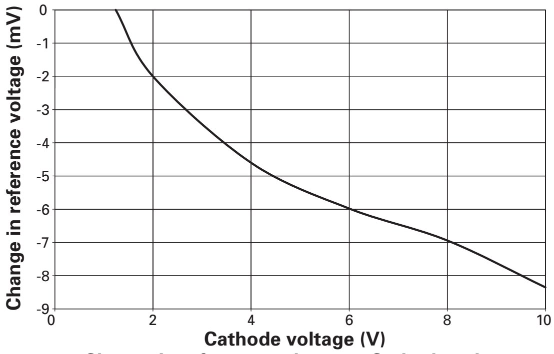


Fig 3 - Test Circuit for Off State current

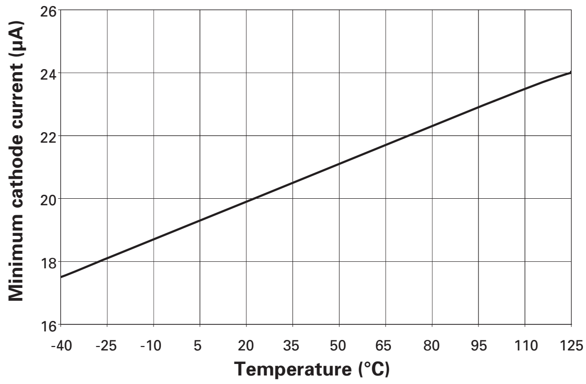
Typical characteristics



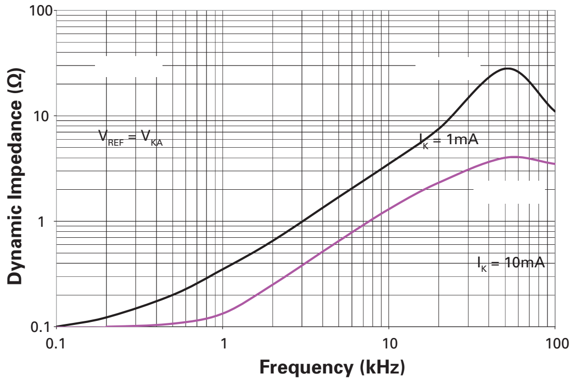
Reference Current v Temperature



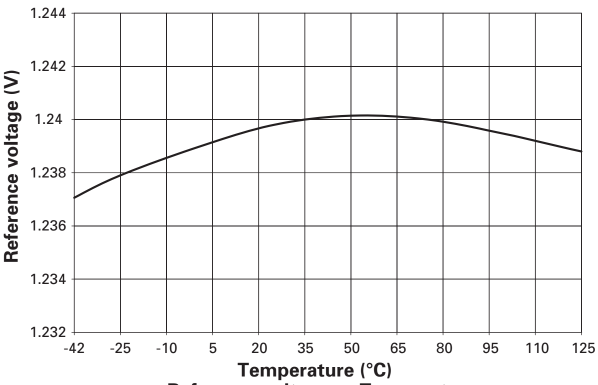
Change in reference voltage vs Cathode voltage



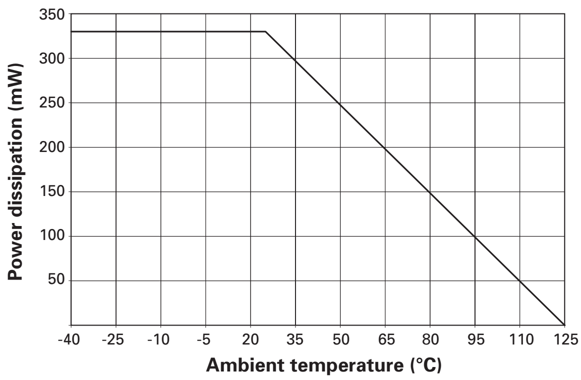
Minimum cathode current vs temperature



Dynamic impedance vs frequency

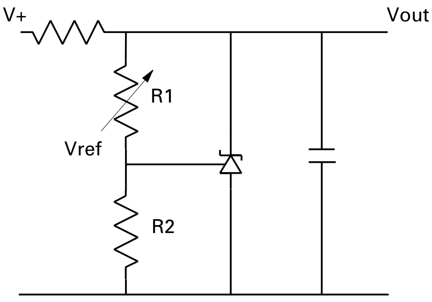


Reference voltage vs Temperature



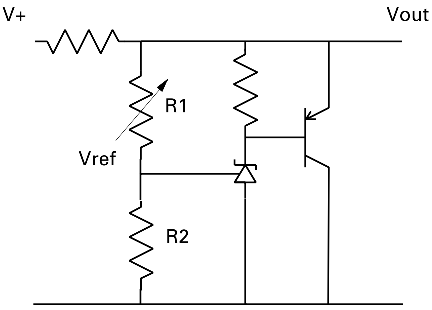
Power dissipation derating

Application circuits



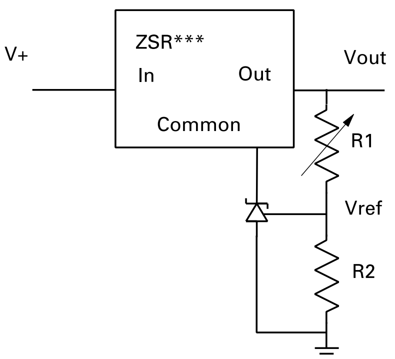
$$Vout = \left(1 + \frac{R1}{R2}\right) Vref$$

SHUNT REGULATOR



$$Vout = \left(1 + \frac{R1}{R2}\right) Vref$$

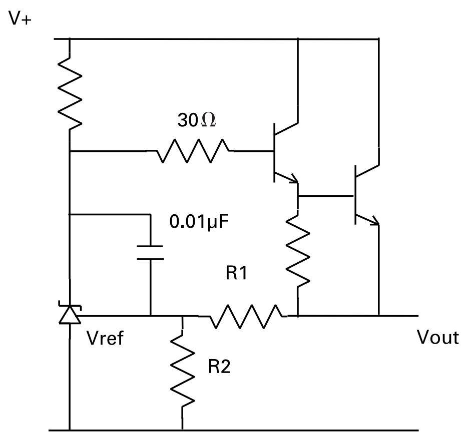
HIGHER CURRENT SHUNT REGULATOR



$$Vout_{MIN} = Vref + Vreg$$

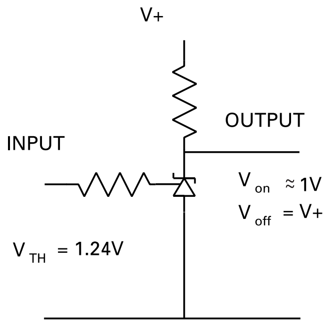
$$Vout = \left(1 + \frac{R1}{R2}\right) Vref$$

OUTPUT CONTROL OF A
THREE TERMINAL FIXED REGULATOR

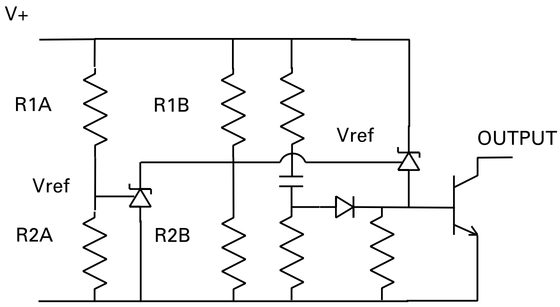


$$Vout = \left(1 + \frac{R1}{R2}\right) Vref$$

SERIES REGULATOR



SINGLE SUPPLY COMPARATOR
WITH TEMPERATURE
COMPENSATED THRESHOLD

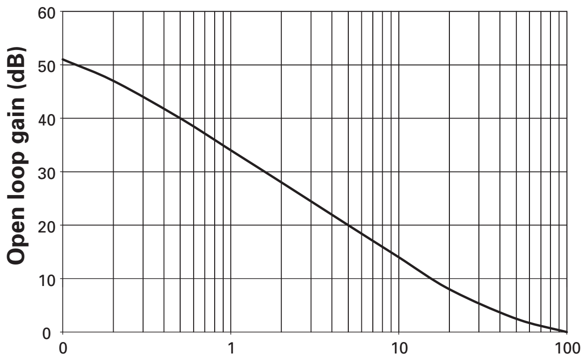


$$\text{Low limit} = \left(1 + \frac{R1B}{R2B}\right) Vref$$

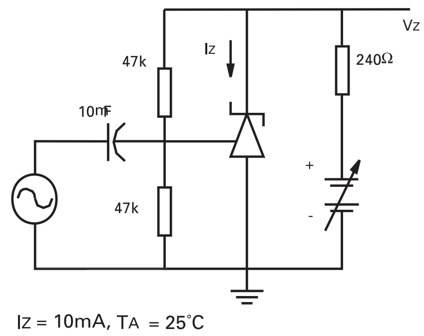
$$\text{High limit} = \left(1 + \frac{R1A}{R2A}\right) Vref$$

OVER VOLTAGE / UNDER VOLTAGE
PROTECTION CIRCUIT

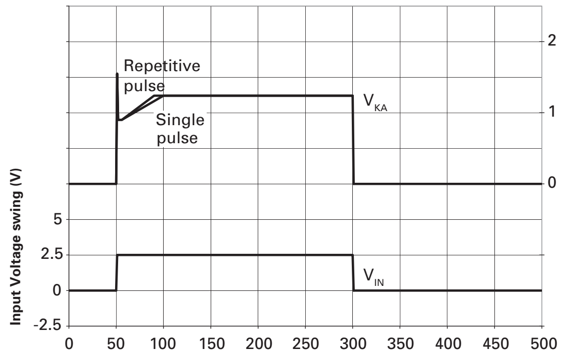
Typical characteristics



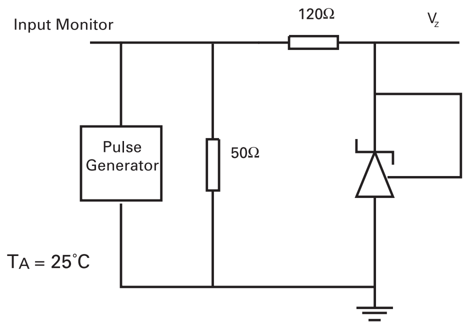
Open loop gain vs frequency



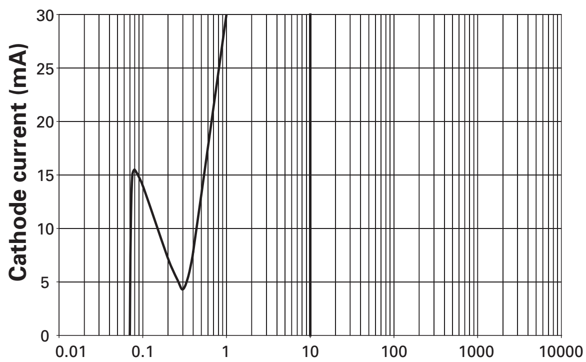
Test Circuit for Open Loop Voltage Gain



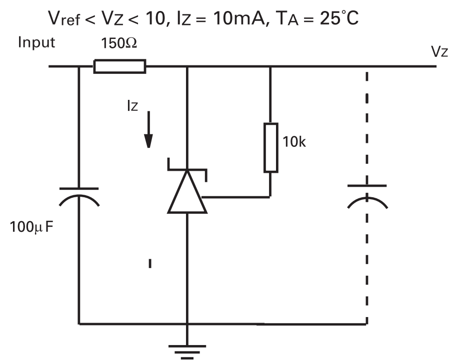
Pulse response



Test Circuit for Pulse Response

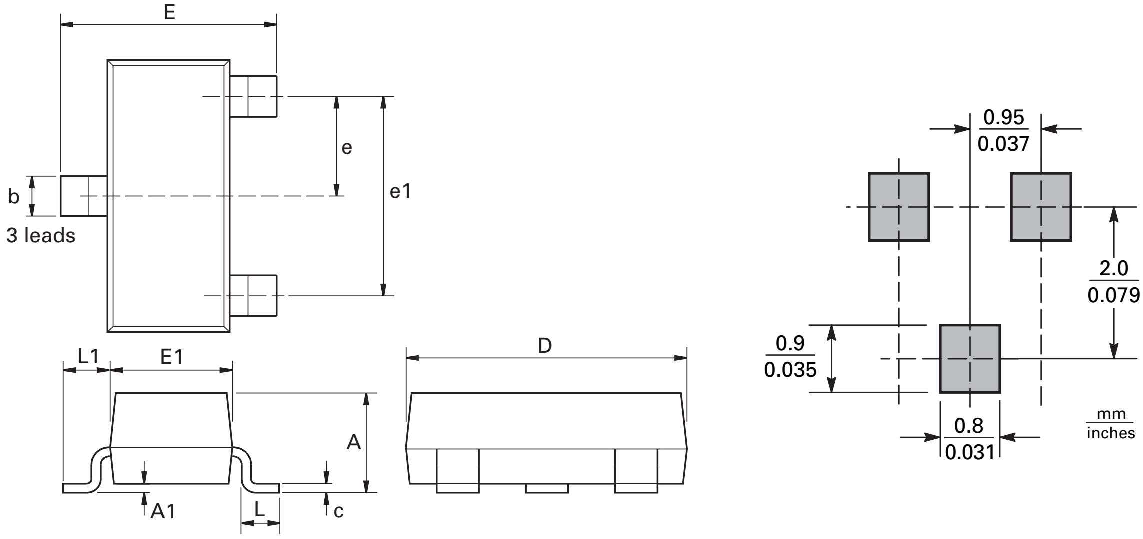


Stability boundary conditions



Test Circuit for Stability Boundary Conditions

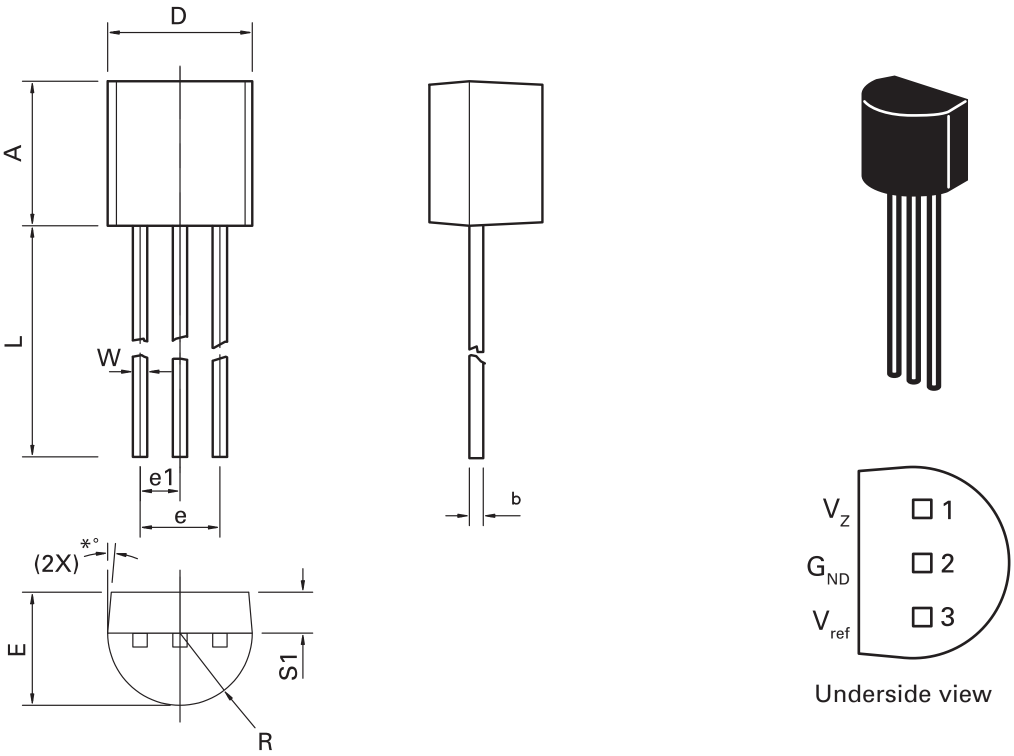
SOT23 Package outline and pad layout details



Dim.	Millimeters		Inches		Dim.	Millimeters		Inches	
	Min.	Max.	Min.	Max.		Min.	Max.	Min.	Max.
A	-	1.12	-	0.044	e1	1.90 NOM		0.075 NOM	
A1	0.01	0.10	0.0004	0.004	E	2.10	2.64	0.083	0.104
b	0.30	0.50	0.012	0.020	E1	1.20	1.40	0.047	0.055
c	0.085	0.20	0.003	0.008	L	0.25	0.60	0.0098	0.0236
D	2.80	3.04	0.110	0.120	L1	0.45	0.62	0.018	0.024
e	0.95 NOM		0.037 NOM		-	-	-	-	-

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

TO92 Package outline



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

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"Not recommended for new designs"	Device is still in production to support existing designs and production
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