

## Adjustable Precision Shunt Regulator

### ■ Features

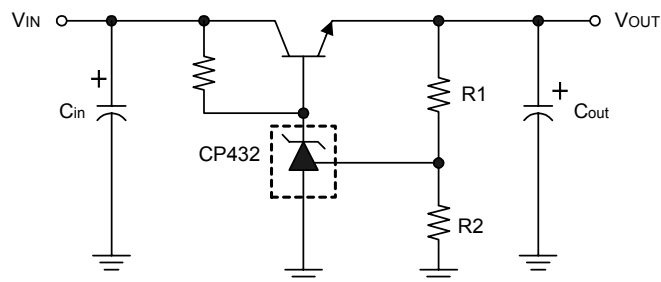
- Precision reference voltage
  - CP432 :  $1.24V \pm 1\%$
  - CP432A :  $1.24V \pm 0.5\%$
- Sink current capability: 200mA.
- Minimum cathode current for regulation:  $150\mu A$
- Equivalent full-range temp coefficient:  $30 \text{ ppm}/^\circ C$
- Fast turn-on Response.
- Low dynamic output impedance:  $0.2\Omega$
- Programmable output voltage to 20v
- Low output noise
- Packages: SOT89, SOT23, TO92

### ■ General Description

The CP432/432A are 3-terminal adjustable precision shunt regulators with guaranteed stable temperature over the applicable extended commercial temperature range. The output voltage may be set at any level greater than  $1.24V (V_{REF})$  up to 20V merely by selecting two external resistors that act as a voltage divider network. These devices have a typical output impedance of  $0.2\Omega$ . Active output circuitry provides very sharp turn-on characteristics, making these devices excellent improved replacements for Zener diodes in many applications.

The precise  $\pm 1\%$  reference voltage tolerance of the CP432/432A make it possible in many applications to avoid the use of a variable resistor, consequently saving cost and eliminating drift and reliability problems associated with it.

### ■ Typical Application Circuit



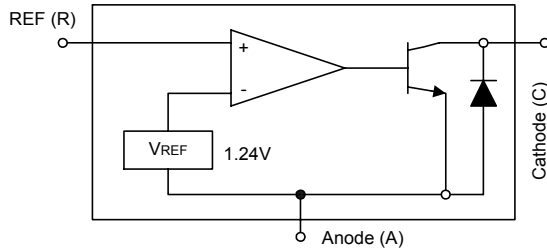
$$V_{OUT} = (1 + R1/R2)V_{REF}$$

Precision Regulator

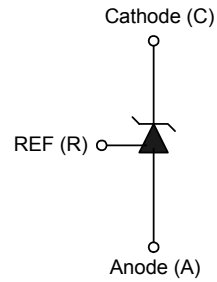
\* All specs and applications shown above subject to change without prior notice.

## Adjustable Precision Shunt Regulator

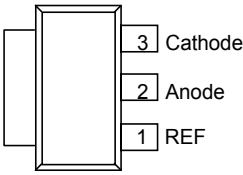
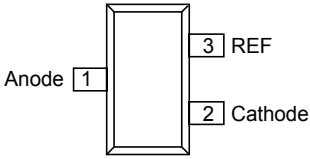
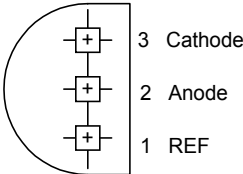
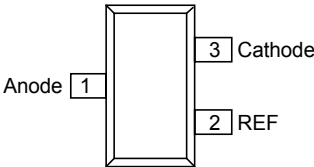
### ■ Block Diagram



### ■ Symbol



### ■ Pin Configuration

Order Number	Pin Configuration (Top View)	Order Number	Pin Configuration (Top View)
CP432Y CP432AY (SOT89)		CP432R CP432AR (SOT23)	
CP432V CP432AV (TO92)		CP432W CP432AW (SOT23)	

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## Adjustable Precision Shunt Regulator

### ■ Absolute Maximum Ratings

		Cathode
voltage .....		20V
Continuous cathode current .....		-10mA ~ 250mA
Reference input current range .....		10mA
Operating temperature range (CP432) .....		-20°C ~ 85°C
(CP432I).....		-40°C~85°C
Lead Temperature.....		260°C
Storage Temperature .....		-65°C ~ 150°C
Power Dissipation (Notes 1. 2)	SOT89 .....	0.80W
	TO92 .....	0.78W
	SOT23 .....	0.23W

Note 1: T<sub>J</sub>, max =150°C. .

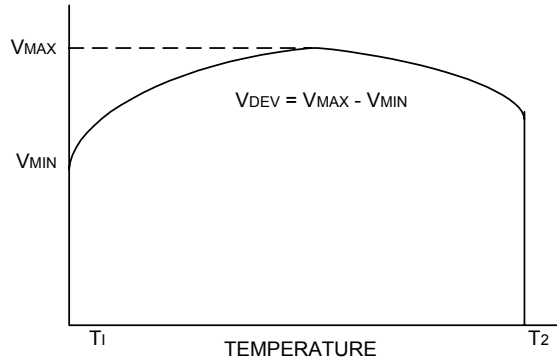
Note 2: Ratings apply to ambient temperature at 25°C.

### ■ Electrical Characteristics (Ta=25°C, unless otherwise specified.)

Parameter	Test conditions	Symbol	Min.	Typ.	Max.	Unit
Reference voltage	V <sub>KA</sub> = V <sub>REF</sub> , I <sub>KA</sub> = 10mA (Fig.1)	CP432	1.227	1.24	1.252	V
		CP432A	1.233		1.246	
Deviation of reference input voltage over temperature (Note 3)	V <sub>KA</sub> = V <sub>REF</sub> , I <sub>KA</sub> = 10mA, Ta = full range (Fig.1)	V <sub>REF</sub>		3.0	20	mV
Ratio of the change in reference voltage to the change in cathode voltage	I <sub>KA</sub> = 10mA (Fig.2) V <sub>KA</sub> = 20 ~V <sub>REF</sub>	$\frac{\Delta V_{REF}}{\Delta V_{KA}}$		-1.4	-2.0	mV/V
Reference input current	R1 = 10KΩ, R2 = ∞ I <sub>KA</sub> = 10mA (Fig.2)	I <sub>REF</sub>		1.4	3.5	μA
Deviation of reference input current over temperature	R1 = 10KΩ, R2 = ∞ I <sub>KA</sub> = 10mA Ta = Full range (Fig.2)	αI <sub>REF</sub>		0.4	1.2	μA
Minimum cathode current for regulation	V <sub>KA</sub> = V <sub>REF</sub> (Fig.1)	I <sub>KA(min)</sub>		0.15	0.3	mA
Off-state current	V <sub>KA</sub> = 20V, V <sub>REF</sub> = 0V (Fig.3)	I <sub>KA(off)</sub>		0.1	1.0	μA
Dynamic output impedance (Note 4)	V <sub>KA</sub> = V <sub>REF</sub> ΔI <sub>KA</sub> = 0.1mA ~ 15mA Frequency ≤ 1KHz (Fig.1)	Z <sub>KA</sub>		0.2	0.5	Ω

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## Adjustable Precision Shunt Regulator



Note 3. Deviation of reference input voltage,  $V_{DEV}$ , is defined as the maximum variation of the reference over the full temperature range.

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

$$|\alpha V_{REF}| = \frac{\left(\frac{V_{DEV}}{V_{REF(25^\circ C)}}\right) \times 10^6}{T_2 - T_1} \dots\dots\dots (\text{ppm}/^\circ\text{C})$$

Where:

$T_2 - T_1$  = full temperature change.

$\alpha V_{REF}$  can be positive or negative depending on whether the slope is positive or negative.

Note 4. The dynamic output impedance,  $R_Z$ , is defined as:

$$|Z_{KA}| = \frac{\Delta V_{KA}}{\Delta I_{KA}}$$

When the device is programmed with two external resistors  $R_1$  and  $R_2$  (see Figure 2.), the dynamic output impedance of the overall circuit, is defined as:

$$|Z_{KA}'| = \frac{\Delta V}{\Delta I} \approx |Z_{KA}| \left(1 + \frac{R_1}{R_2}\right)$$

### ■ Test Circuits

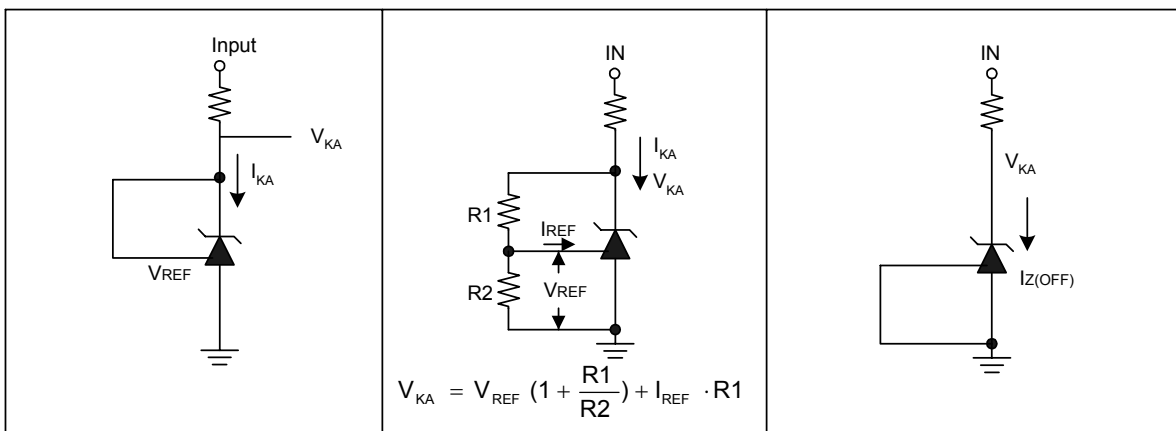


Fig1. Test Circuit for  $V_{KA} = V_{REF}$

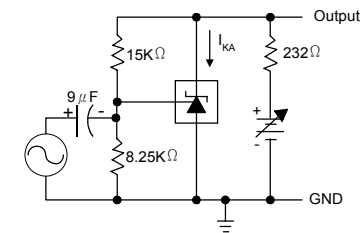
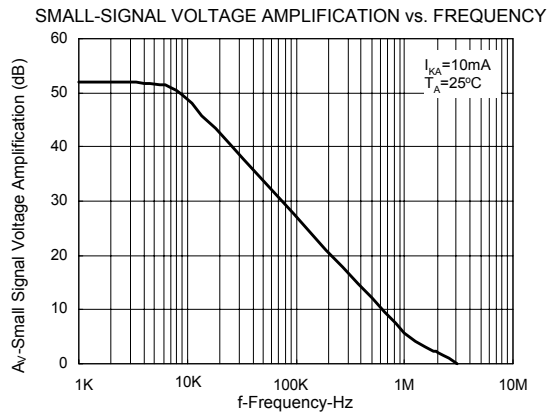
Fig2. Test circuit for  $V_{KA} > V_{REF}$

Fig3. Test Circuit for off-state Current

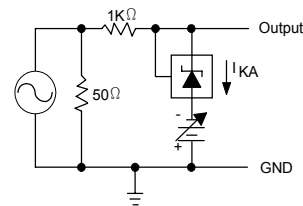
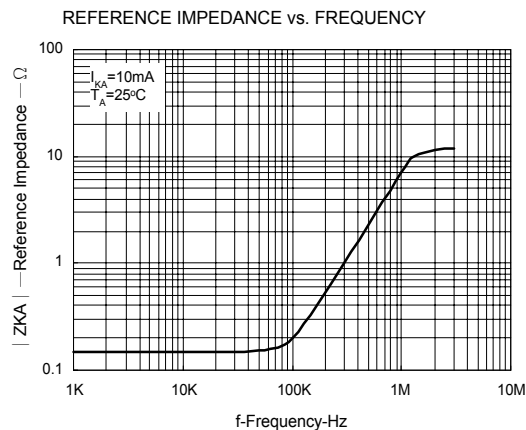
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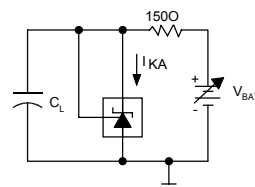
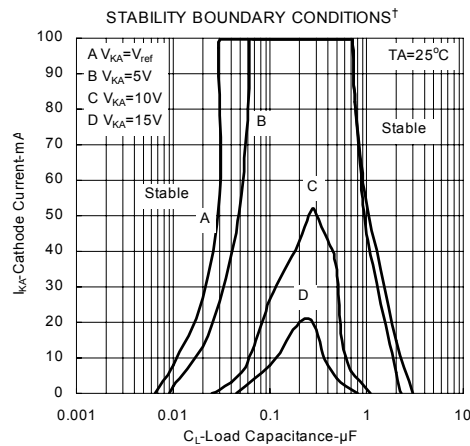
### Typical Performance Characteristics



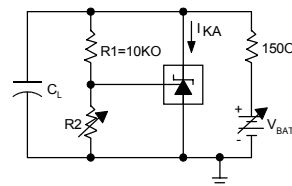
TEST CIRCUIT FOR VOLTAGE AMPLIFICATION



TEST CIRCUIT FOR REFERENCE IMPEDANCE



TEST CIRCUIT FOR CURVE A



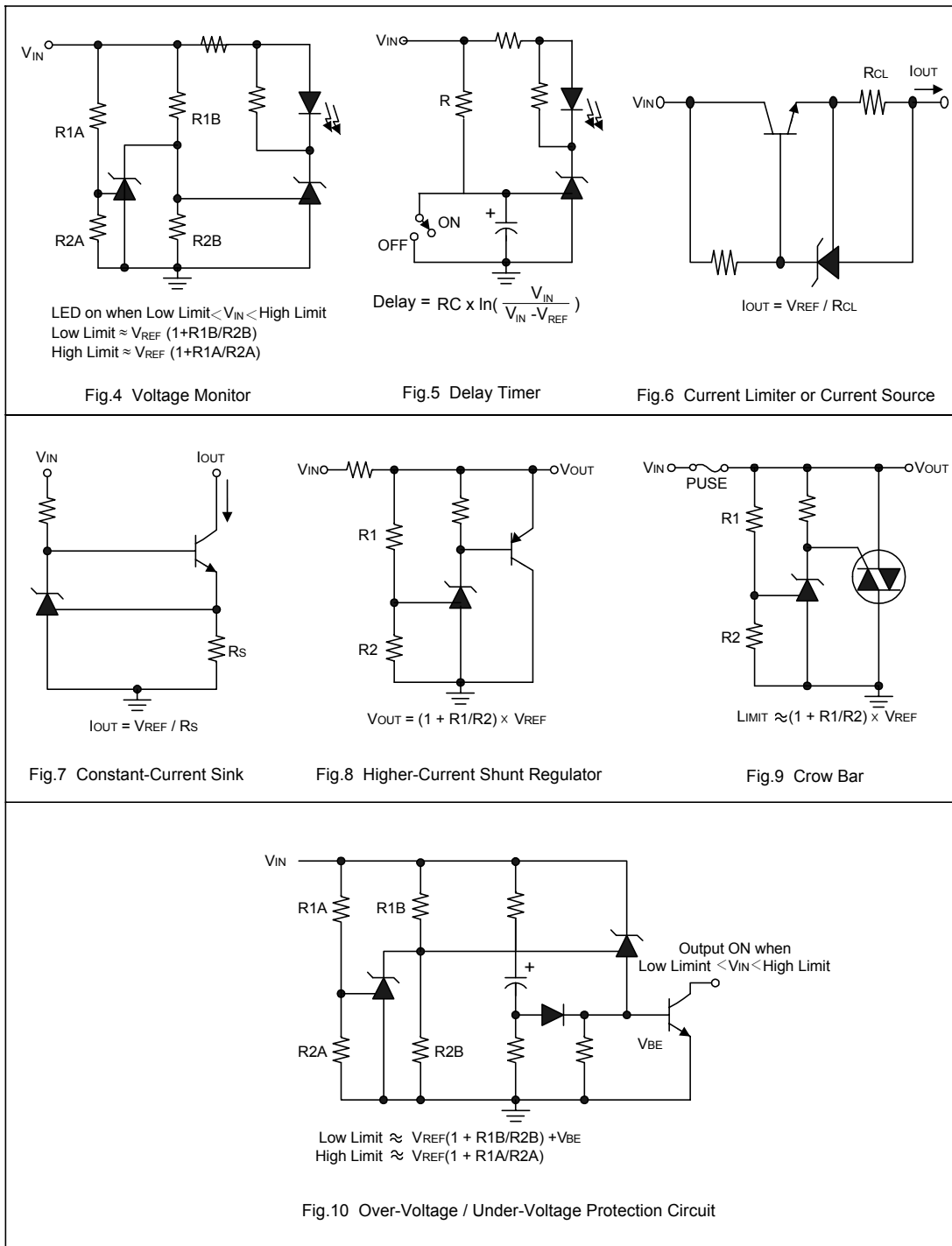
TEST CIRCUIT FOR CURVE B, C, AND D

† The areas under the curves represent conditions that may cause the device to oscillate. For curves B, C, and D, R2 and V+ were adjusted to establish the initial  $V_{KA}$  and  $I_{KA}$  conditions with  $C_L=0$ ,  $V_{BATT}$  and  $C_L$  were then adjusted to determine the ranges of stability.

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### Application Examples

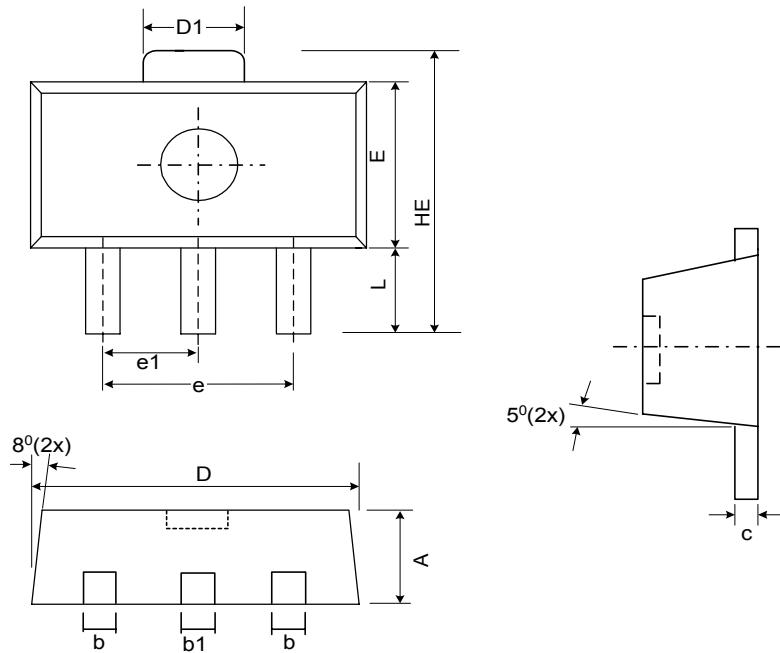


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## Adjustable Precision Shunt Regulator

### ■ Package Diagrams

#### (1) SOT89-3L Package Outline Dimension

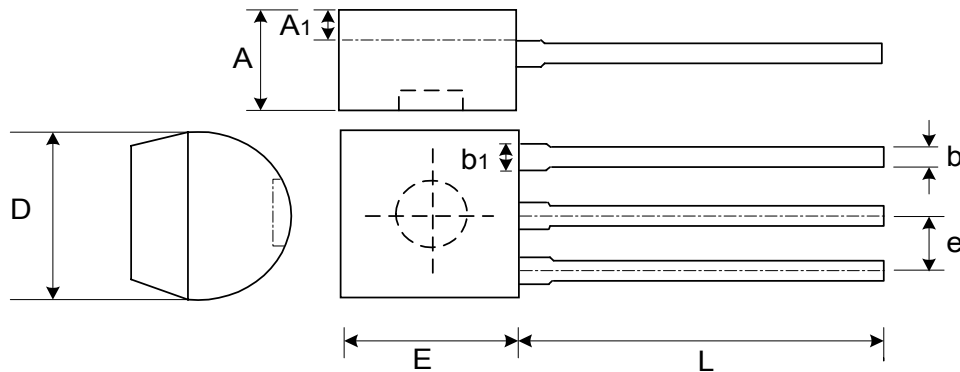


Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.40	1.50	1.60	0.055	0.059	0.063
b	0.36	0.42	0.48	0.014	0.016	0.018
b1	0.41	0.47	0.53	0.016	0.043	0.051
C	0.35	0.39	0.43	0.014	0.015	0.017
D	4.40	4.50	4.60	0.173	0.177	0.181
D1	1.40	1.60	1.75	0.055	0.062	0.069
e	2.90	3.00	3.10	0.114	0.118	0.122
e1	1.45	1.50	1.55	0.057	0.059	0.061
E	2.40	2.50	2.60	0.094	0.098	0.102
HE	3.94	-	4.25	0.155	-	0.167
L	0.80	-	1.20	0.031	-	0.047

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## Adjustable Precision Shunt Regulator

### (2) TO92-3L Package Outline Dimension



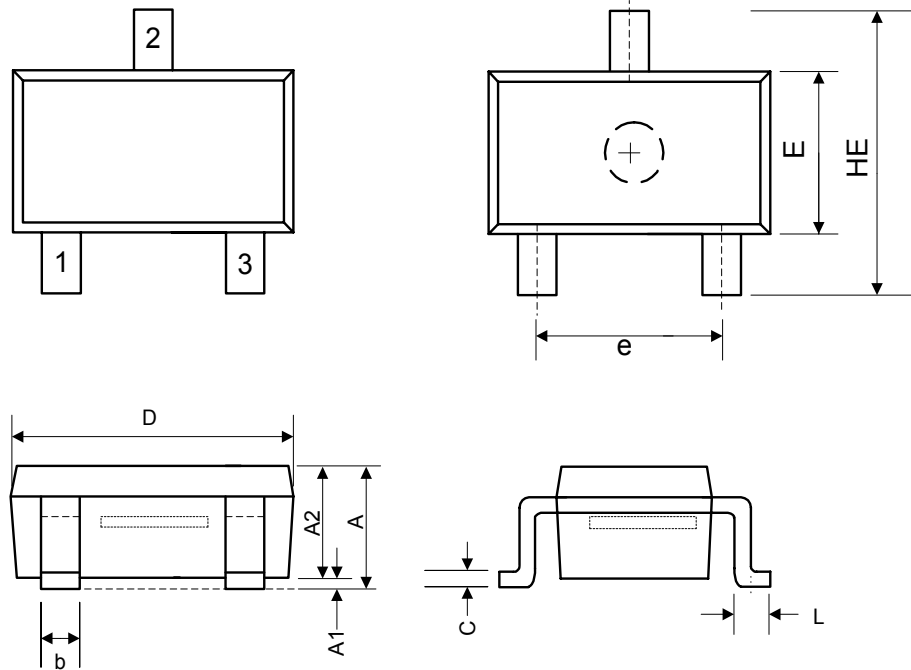
Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	3.302	3.556	3.810	0.130	0.140	0.150
A1	1.016	-	-	0.040	-	-
b	0.330	0.381	0.432	0.013	0.015	0.017
b1	0.406	0.457	0.506	0.016	0.018	0.020
D	4.445	4.572	4.699	0.175	0.180	0.185
E	4.445	4.572	4.699	0.175	0.180	0.185
L	13.00	-	15.500	0.512	-	0.610
e	1.150	1.270	1.390	0.045	0.050	0.055

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## Adjustable Precision Shunt Regulator

### (4) SOT23-3L Package Outline Dimension

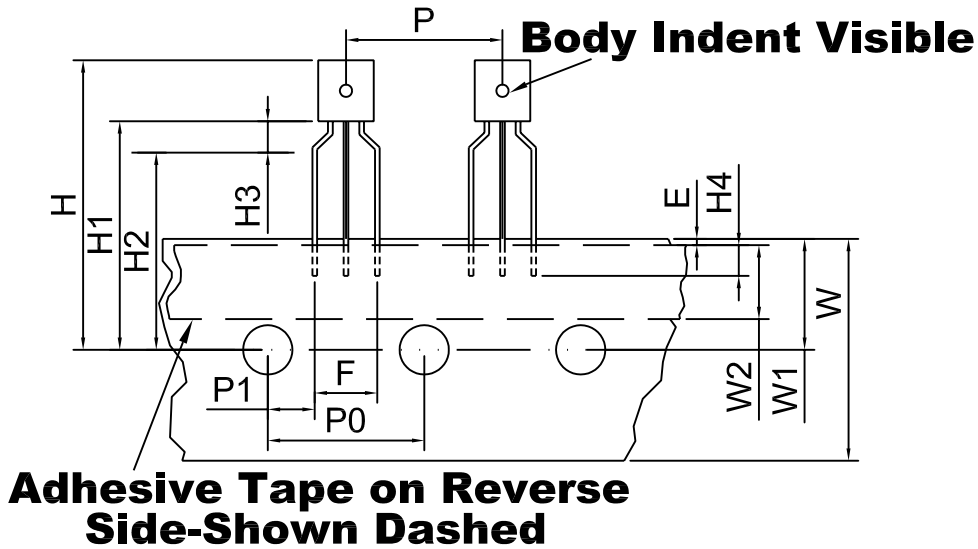


Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.00	1.20	1.40	0.039	0.047	0.055
A1	0.00	-	0.10	0.000	-	0.004
A2	1.00	1.15	1.30	0.039	0.045	0.051
b	0.35	-	0.50	0.014	-	0.020
C	0.10	0.175	0.25	0.004	0.007	0.010
D	2.70	2.90	3.10	0.106	0.114	0.122
E	1.40	1.60	1.80	0.055	0.063	0.071
e	1.70	2.00	2.30	0.067	0.079	0.091
HE	2.40	2.70	3.00	0.094	0.106	0.118
L	0.35	0.45	0.55	0.014	0.018	0.022

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Taping Specifications For TO-92 package



SYMBOL	SPECIFICATIONS (mm)	SPECIFICATIONS (inch)
P	12.7 ± 1.0	0.50 ± 0.07
P0	12.7 ± 1.0	0.50 ± 0.07
P1	3.81 ± 0.4	0.15 ± 0.016
H	21.0~26.0	0.828~1.024
H1	17.0~21.0	0.669~0.828
H2	14.0~18.0	0.551~0.709
H3	3.4 max.	0.125 max.
H4	2.5 min.	0.098 min.
F	5.08 ± 0.2	0.2 ± 0.008
W	18.0 ± 0.5	0.708 ± 0.020
W1	9.0 ± 0.5	0.354 ± 0.020
W2	6.0 ± 0.5	0.236 ± 0.020
ΦD0	4.0 ± 0.2	0.157 ± 0.008
E	0.5 max.	0.020 max.

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