

AP432/AP432A

Adjustable Precision Shunt Regulator

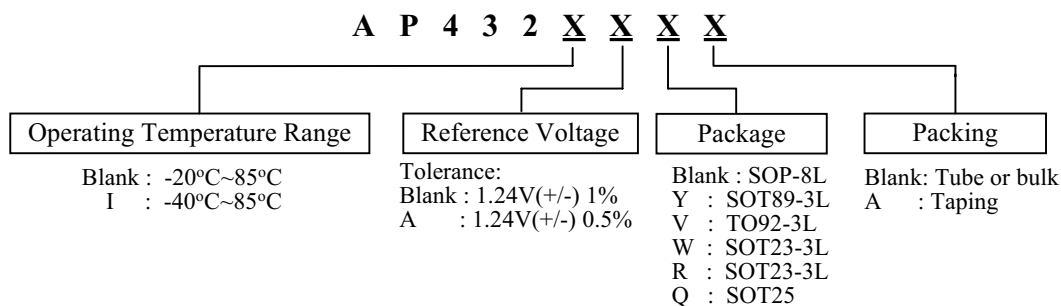
■ Features

- Precision reference voltage
 AP432 : $1.24V \pm 1\%$
 AP432A : $1.24V \pm 0.5\%$
- Sink current capability: 200mA.
- Minimum cathode current for regulation: $150 \mu A$
- Equivalent full-range temp. coefficient: $30 \text{ ppm}/^\circ\text{C}$
- Fast turn-on Response.
- Low dynamic output impedance: 0.2Ω
- Programmable output voltage to 20v
- Low output noise
- Packages: SOT89, SOT23, SOT25, SOP8 and TO92

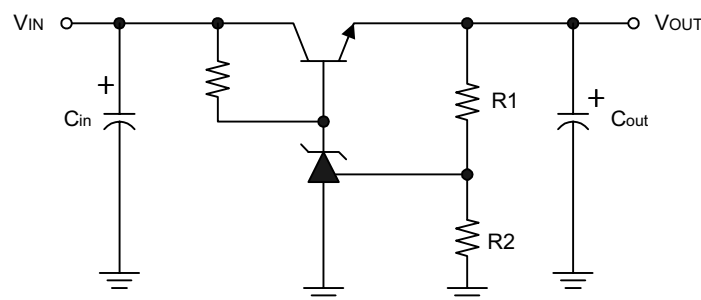
■ General Description

The AP432/432A are 3-terminal adjustable precision shunt regulators with guaranteed temperature stability 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 0.2Ω . Active output circuitry provides a 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 AP432/432A 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.

■ Ordering Information



■ Typical Application Circuit



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

Precision Regulator

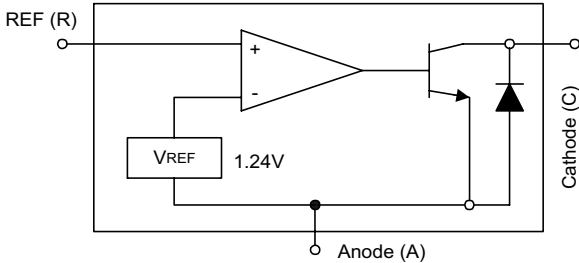
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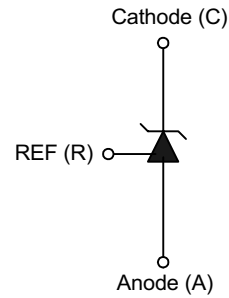
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■ Block Diagram



■ Symbol



■ Pin Configuration

Order Number	Pin Configuration (Top View)	Order Number	Pin Configuration (Top View)
AP432Y AP432AY AP432IY AP432IAY (SOT89)		AP432R AP432AR AP432IR AP432IAR (SOT23)	
AP432V AP432AV AP432IV AP432IAV (TO92)		AP432W AP432AW AP432IW AP432IAW (SOT23)	
AP432 AP432A AP432I AP432IA (SOP)		AP432Q AP432AQ AP432IQ AP432IAQ (SOT25)	

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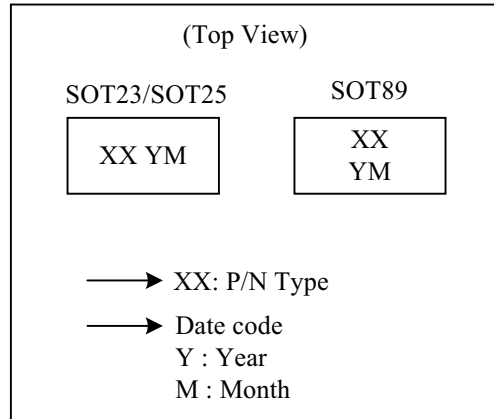
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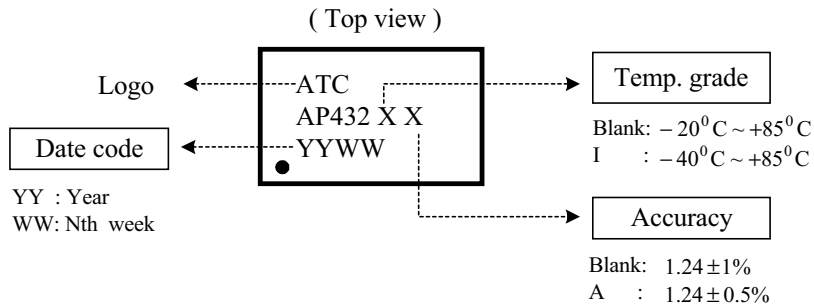
■ Marking Information

(1) SOT23 / SOT25 / SOT89

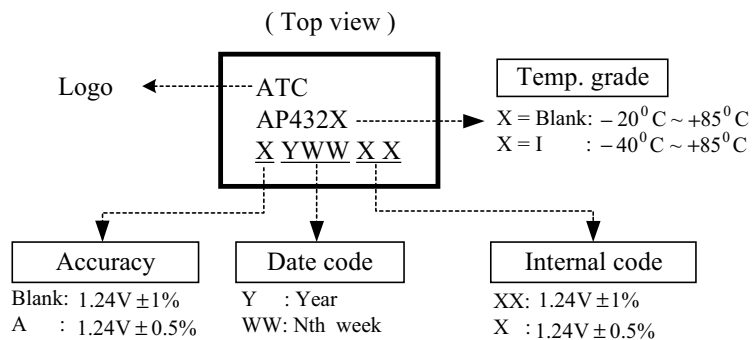
P/N Type	:	X X
AP432Y	:	B1
AP432AY	:	B2
AP432IY	:	BA
AP432IAY	:	BB
AP432W	:	B3
AP432AW	:	B4
AP432IW	:	BC
AP432IAW	:	BD
AP432R	:	B5
AP432AR	:	B6
AP432IR	:	BE
AP432IAR	:	BF
AP432Q	:	B7
AP432AQ	:	B8
AP432IQ	:	BG
AP432IAQ	:	BH



(2) SOP



(2) TO92



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■ Absolute Maximum Ratings

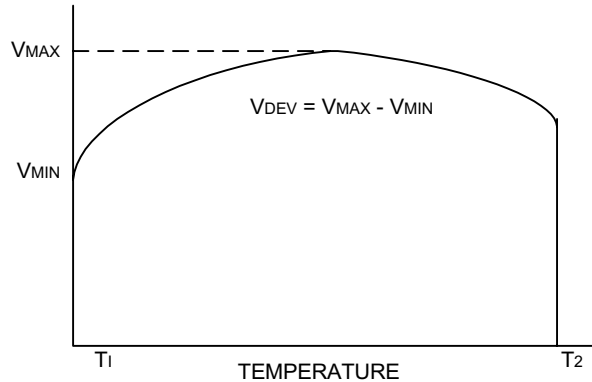
Cathode voltage	20V
Continuous cathode current	-10mA ~ 250mA
Reference input current range	10mA
Operating temperature range (AP432).....	-20°C~85°C
(AP432I).....	-40°C~85°C
Lead Temperature.....	260°C
Storage Temperature	-65°C ~ 150°C
Power Dissipation (Notes 1, 2)	
SOT89	0.80W
TO92	0.78W
SOT23	0.23W
SOT25	0.23W
SOP	0.6W

Note 1: T_J, max =150°C. .

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

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

Parameter	Test conditions	Symbol	Min.	Typ.	Max.	Unit
Reference voltage	V _{KA} = V _{ref} , I _{KA} = 10mA (Fig.1)	AP432	1.227	1.24	1.252	V
		AP432A	1.233		1.246	
Deviation of reference input voltage over temperature (Note 3)	V _{KA} = V _{REF} , I _{KA} = 10mA, T _a = 0°C ~ + 70°C (Fig.1)	V _{REF}		3.0	20	mV
Ratio of the change in reference voltage to the change in cathode voltage	I _{KA} = 10mA (Fig.2)	V _{KA} = 20 ~ V _{REF} $\frac{\Delta V_{REF}}{\Delta V_{KA}}$		-1.4	-2.0	mV/V
Reference input current	R1 = 10KΩ, R2 = ∞ I _{KA} = 10mA (Fig.2)	I _{REF}		1.4	3.5	μA
Deviation of reference input current over temperature	R1 = 10KΩ, R2 = ∞ I _{KA} = 10mA T _a = Full range (Fig.2)	α I _{REF}		0.4	1.2	μA
Minimum cathode current for regulation	V _{KA} = V _{REF} (Fig.1)	I _{KA(min)}		0.15	0.3	mA
Off-state current	V _{KA} = 20V, V _{REF} = 0V (Fig.3)	I _{KA(off)}		0.1	1.0	μA
Dynamic output impedance (Note 4)	V _{KA} = V _{REF} ΔI _{KA} = 1mA ~ 100mA Frequency ≤ 1KHz (Fig.1)	Z _{KA}		0.2	0.5	Ω



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 αV_{REF} is defined as:

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

Where:

$T_2 - T_1$ = full temperature change.

αV_{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:

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

■ Test Circuits

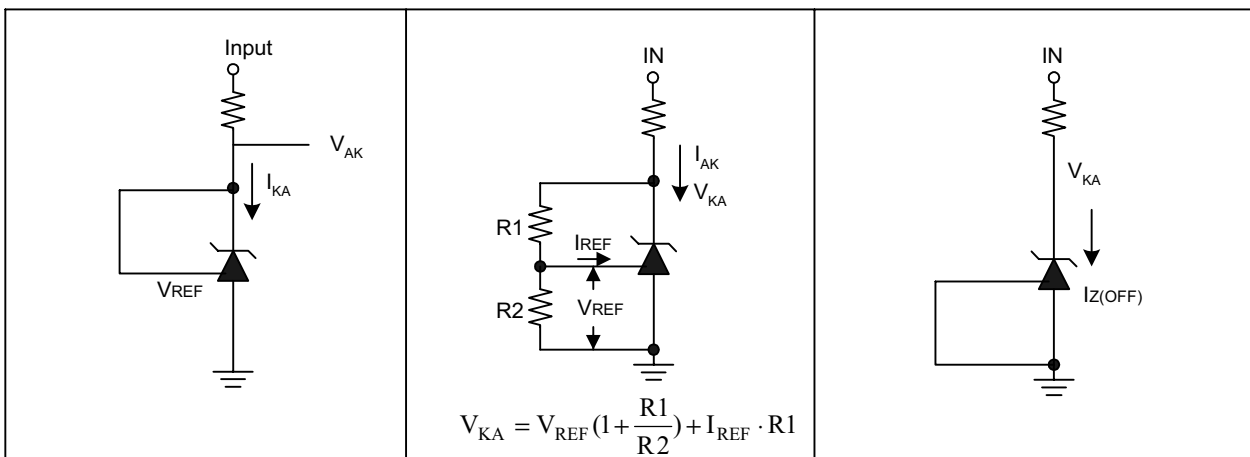


Fig1. Test Circuit for $V_{KA} = V_{REF}$

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

Fig3. Test Circuit for off-state Current

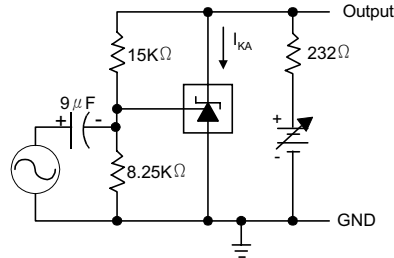
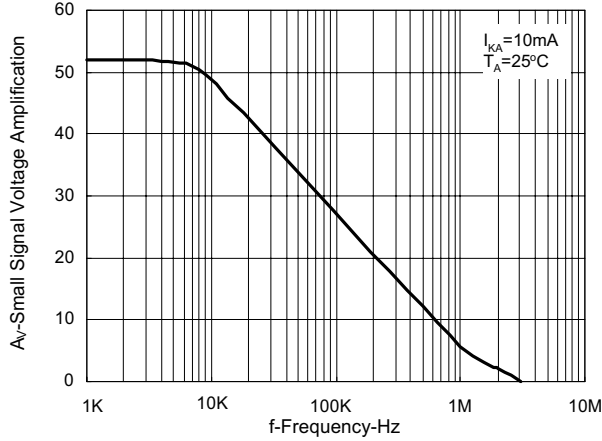
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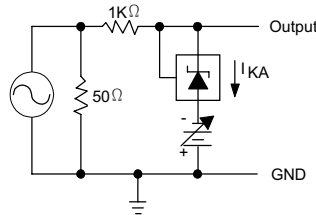
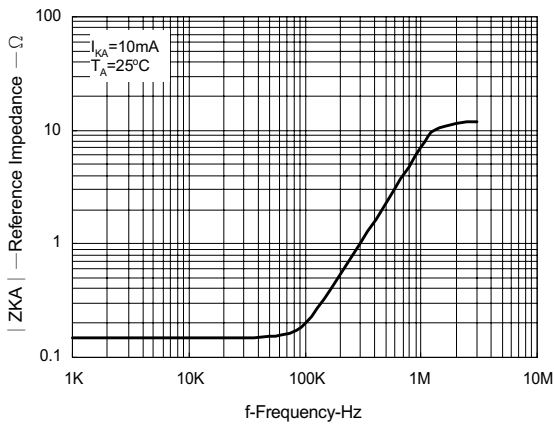
Typical Performance Characteristics

SMALL-SIGNAL VOLTAGE AMPLIFICATION vs. FREQUENCY



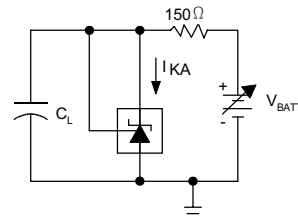
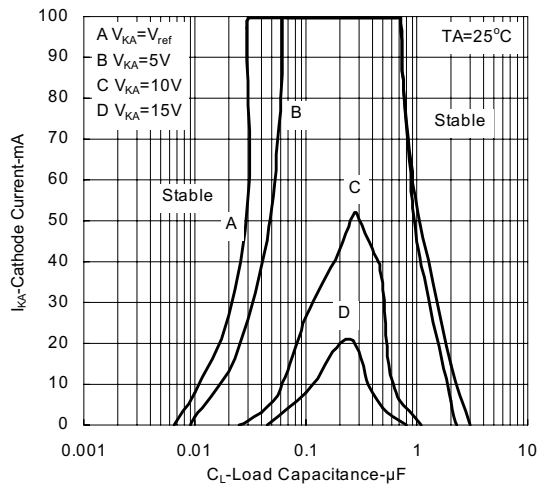
TEST CIRCUIT FOR VOLTAGE AMPLIFICATION

REFERENCE IMPEDANCE vs. FREQUENCY

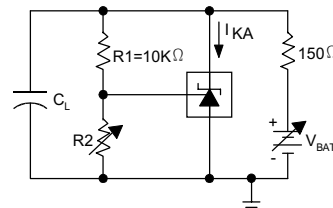


TEST CIRCUIT FOR REFERENCE IMPEDANCE

STABILITY BOUNDARY CONDITIONS†



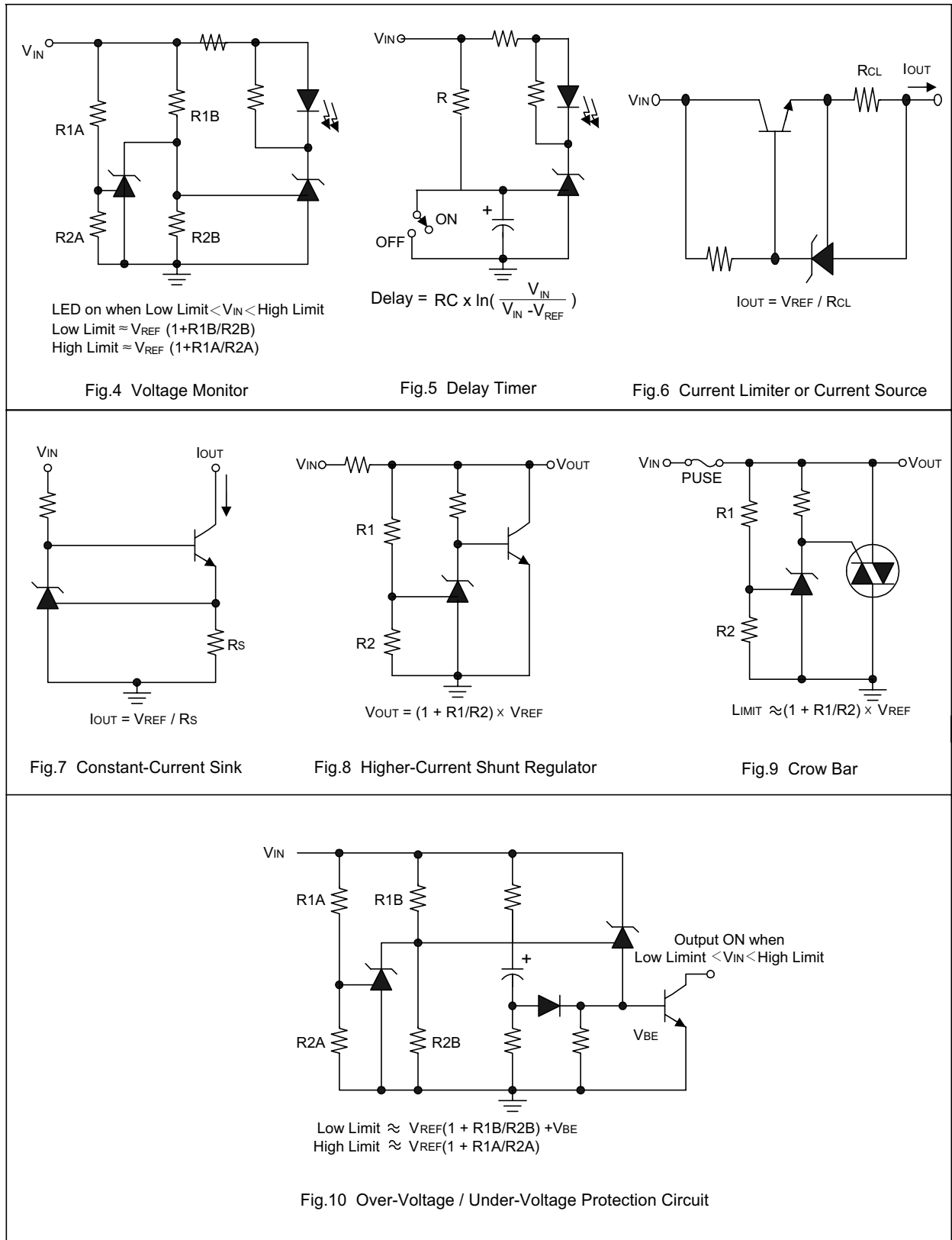
TEST CIRCUIT FOR CURVE A



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 $C_L=0.0. V_{BATT}$ and C_L were then adjusted to determine the ranges of stability.

Application Examples



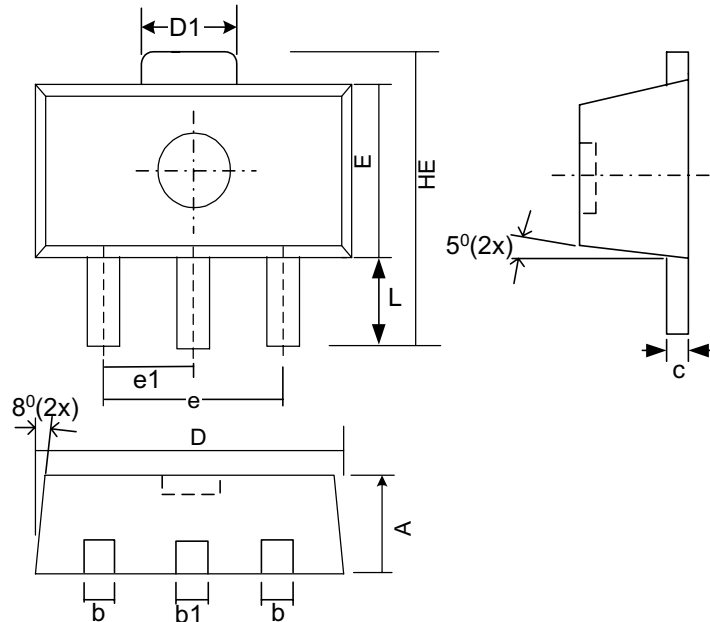
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■ Package Diagrams

(1) SOT89-3L Package Outline Dimension



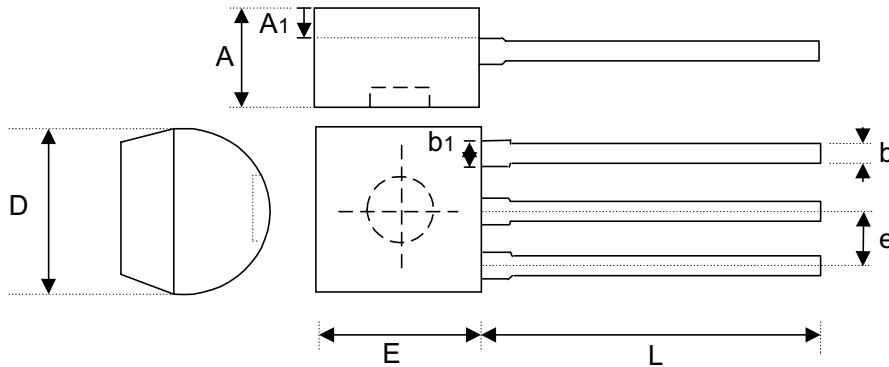
SYMBLOS	DIMENSIONS IN MILLMETER			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.40	1.50	1.60	0.055	0.059	0.063
B	0.36	0.42	0.48	0.014	0.016	0.018
b1	0.41	0.47	0.53	0.016	0.043	0.051
C	0.38	0.40	0.43	0.014	0.015	0.017
D	4.40	4.50	4.60	0.173	0.177	0.181
D1	1.40	1.60	1.75	0.055	0.062	0.069
E	2.90	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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(2) TO92-3L Package Outline Dimension



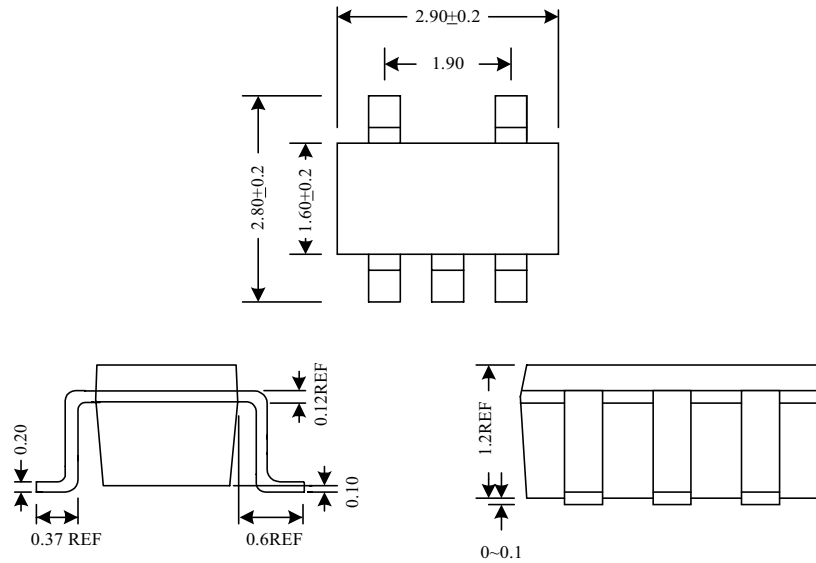
SYMBLOS	DIMENSIONS IN MILLMETER			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	3.302	3.556	3.810	0.130	0.140	0.150
A1	1.016	-----	-----	0.040	-----	-----
b	0.330	0.381	0.432	0.013	0.015	0.017
b1	0.406	0.457	0.506	0.016	0.018	0.020
D	4.445	4.572	4.699	0.175	0.180	0.185
E	4.445	4.572	4.699	0.175	0.180	0.185
L	13.00	-----	15.50	0.512	-----	0.610
e	1.150	-----	1.390	0.045	-----	0.055

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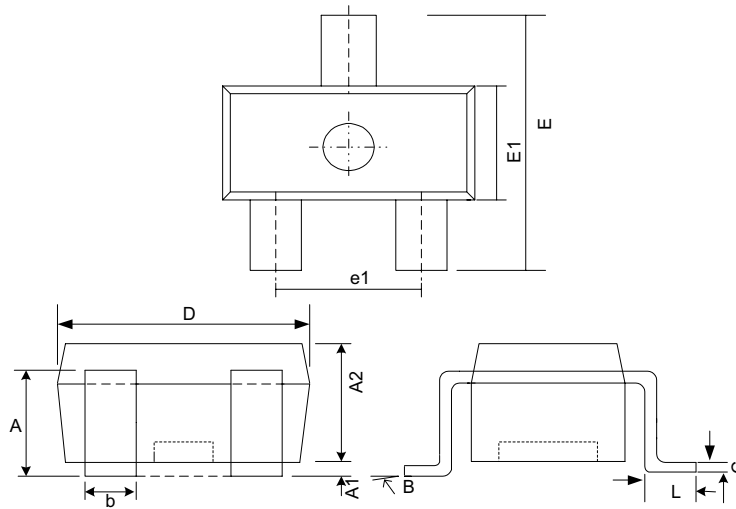


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(3) SOT23-5L Package Outline Dimension



(4) SOT23-3L Package Outline Dimension



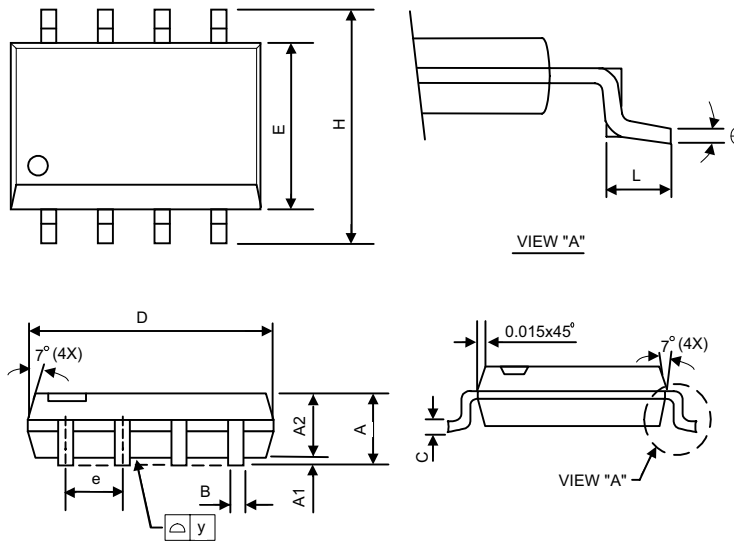
SYMBOLS	DIMENSIONS IN MILLIMETER			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	0.70	0.80	0.90	0.028	0.031	0.035
A1	0.00	-----	0.10	0.000	-----	0.004
A2	1.00	1.15	1.30	0.039	0.045	0.051
b	0.35	-----	0.50	0.014	-----	0.020
C	0.10	0.175	0.25	0.004	0.007	0.010
D	2.70	2.90	3.10	0.106	0.114	0.122
E1	1.40	1.60	1.80	0.055	0.063	0.071
e1	1.70	1.90	2.10	0.067	0.075	0.083
E	2.80	2.90	3.00	0.110	0.114	0.118
L	0.35	0.45	0.55	0.014	0.018	0.022
B	0°	5°	9°	0°	5°	9°

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(5) SOP-8L Package Outline Dimension



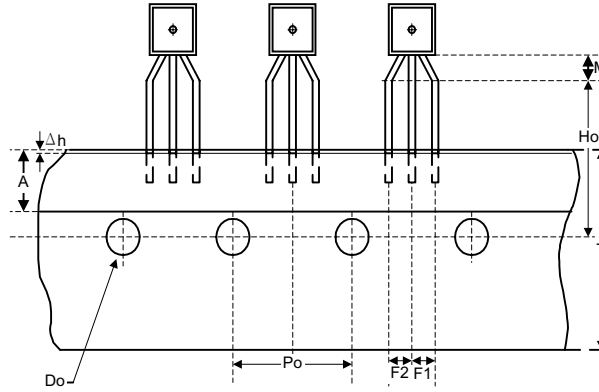
SYMBOLS	DIMENSIONS IN MILLIMETERS			DIMENSIONS IN INCHES		
	MIN	NOM	MAX	MIN	NOM	MAX
A	1.40	1.60	1.75	0.055	0.063	0.069
A1	0.10	—	0.25	0.040	—	0.100
A2	1.30	1.45	1.50	0.051	0.057	0.059
B	0.33	0.41	0.51	0.013	0.016	0.020
C	0.19	0.20	0.25	0.0075	0.008	0.010
D	4.80	4.85	5.05	0.189	0.191	0.199
E	3.80	3.91	4.00	0.150	0.154	0.157
e	—	1.27	—	—	0.050	—
H	5.79	5.99	6.20	0.228	0.236	0.244
L	0.38	0.71	1.27	0.015	0.028	0.050
y	—	—	0.10	—	—	0.004
θ	0°	—	8°	0°	—	8°

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■ Taping Information



	MILLIMETERS		
	MIN	TYP	MAX
Po	12.4	12.7	13.0
M	2.0	2.5	3.0
Ho	15.5	16.0	16.5
D	-	4.0	-
A	-	6.0	-
Δh	0.0	-	1.0
T	-	18.0	-
F1	2.4	2.5	2.9
F2	2.4	2.5	2.9

