

## Description

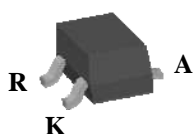
The SJ432 series are 3-terminal precision shunt regulators that are programmable over a wide voltage range of 1.24V to 16V with  $\pm 0.5\%$ ,  $\pm 1.0\%$  tolerance. The SJ432 series have a low dynamic impedance of  $0.25\ \Omega$ . These features make the SJ432 series an excellent replacement for zener diodes in numerous applications circuits that require a precision reference voltage.

## Features

- Programmable output voltage from 1.24V to 16V
- Voltage reference tolerance :  $\pm 0.5\%$ ,  $\pm 1.0\%$
- Cathode current capability of  $80\ \mu\text{A}$  to 30mA
- High quality ESD protected : ESD rating – Typ. 4kV(HBM Mode)  
– Typ. 400V(MM Mode)

## ◆ Pin Assignment

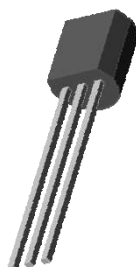
(Top View)



PKG : SOT-23

Apply Device : SJ432xS

(Marking Side View)

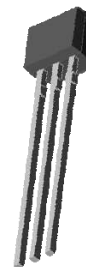


R A K

PKG : TO-92

Apply Device : SJ432x

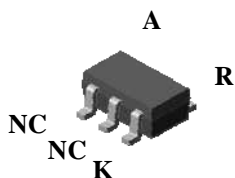
(Marking Side View)



R A K

PKG : TO-92M

Apply Device : SJ432xM

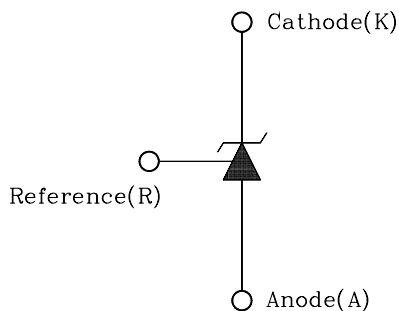


PKG : SOT-25

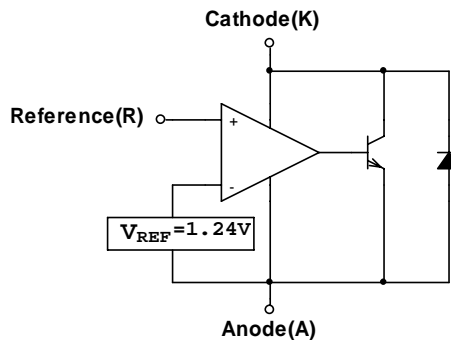
Apply Device : SJ432xN

[ K : Cathode, A: Anode, R : Reference ]

**Symbol**



**Functional block diagram**



**◆ Ordering Information**

Vref Tolerance	PKG Type	Device Name	Marking
± 1%	TO-92	SJ432A	SJ432A
	TO-92M	SJ432AM	SJ432A
	SOT-23	SJ432AS	2GA□ <sup>1)</sup>
	SOT-25	SJ432AN	2NA□ <sup>1)</sup>
± 0.5%	TO-92	SJ432B	SJ432B
	TO-92M	SJ432BM	SJ432B
	SOT-23	SJ432BS	2GB□ <sup>1)</sup>
	SOT-25	SJ432BN	2NB□ <sup>1)</sup>

Note 1) □ : Year & Week Code

## Absolute maximum ratings

[Ta=25°C]

Characteristic		Symbol	Rating	Unit
Cathode to Anode voltage		$V_{KA}$	20	V
Cathode current		$I_K$	30	mA
Reference input current		$I_{ref}$	3	mA
Power Dissipation	SOT-23(Note1)	$P_D$	350	mW
	TO-92M(Note2)		400	mW
	SOT-25(Note1)		400	mW
	TO-92(Note2)		625	mW
Junction Temperature		$T_J$	150	°C
Operating temperature range		$T_{opr}$	-40 ~ +85	°C
Storage temperature range		$T_{stg}$	-55 ~ +150	°C

Note 1 : Mounted on a glass epoxy PCB board (20 × 20mm).  $T_A=25^\circ\text{C}$

Note 2 :  $T_A=25^\circ\text{C}$

## Recommended operating conditions

Characteristic	Symbol	Rating		Unit
		Min.	Max.	
Cathode to Anode voltage	$V_{KA}$	$V_{ref}$	18	V
Cathode current	$I_K$	0.1	25	mA

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

Characteristic	Symbol	Condition	Min.	Typ.	Max.	Unit	
Reference voltage (Fig.1)	$V_{ref}$	$V_{KA}=V_{ref}, I_K=10\text{mA}$	SJ432Bx	1.234	1.240	1.246	V
			SJ432Ax	1.228		1.252	
Reference input voltage deviation over temperature (Fig.1, Note1,2)	$\Delta V_{ref}$	$V_{KA}=V_{ref}, I_K=10\text{mA}$ @ $-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$	-	10	20	mV	
Ratio of delta reference input voltage to delta cathode voltage (Fig.2)	$\frac{\Delta V_{ref}}{\Delta V_{KA}}$	$I_K=10\text{mA}$ $V_{ref} \leq V_{KA} \leq 16\text{V}$	-	-1.0	-2.7	mV/V	
		$\Delta V_{ref}=V_{ref(16V)}-V_{ref}$ $\Delta V_{KA}=V_{KA(16V)}-V_{ref}$					
Reference current (Fig.2)	$I_{ref}$	$I_K=10\text{mA}$ $R1=10\text{K}\Omega, R2=\infty$	-	1.0	1.5	$\mu\text{A}$	
Reference input current deviation over temperature (Fig.2, Note 1,2)	$\Delta I_{ref}$	$I_K=10\text{mA}$ $R1=10\text{K}\Omega, R2=\infty$ @ $-40^\circ\text{C} \leq T_a \leq 85^\circ\text{C}$	-	0.04	0.08	$\mu\text{A}$	
Minimum cathode current for regulation	$I_{K(MIN)}$	$V_{KA}=V_{ref}$	-	55	80	$\mu\text{A}$	
Off-state cathode current (Fig.3)	$I_{K(off)}$	$V_{KA}=16\text{V}, V_{ref}=0\text{V}$	-	5	50	nA	
Dynamic impedance (Fig.1, Note3)	$Z_{KA}$	$V_{KA}=V_{ref}, f \leq 1.0\text{KHz}$ $0.1\text{mA} \leq I_K \leq 25\text{mA}$	-	0.25	0.4	$\Omega$	

Fig. 1 Test circuit for  $V_{KA}=V_{ref}$

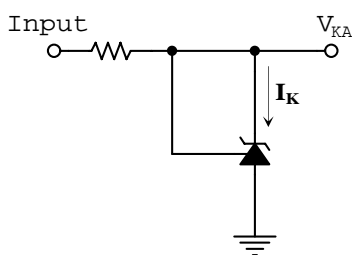


Fig. 2 Test circuit for  $V_{KA}>V_{ref}$

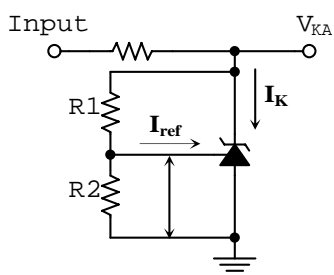
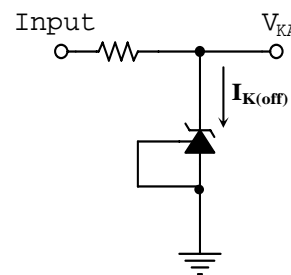


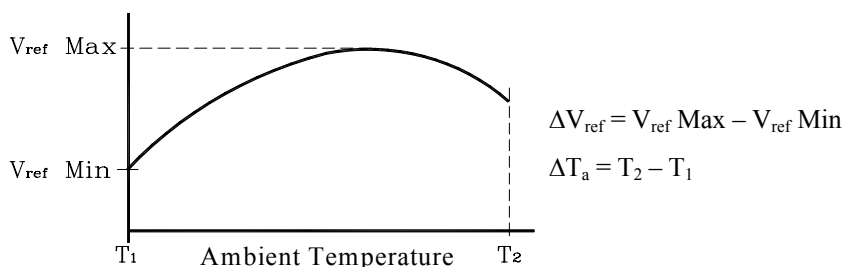
Fig. 3 Test circuit for  $I_{K(off)}$



$$V_{KA} = V_{ref} \times \left(1 + \frac{R_1}{R_2}\right) + I_{ref} \times R_1$$

Note.

1. Ambient temperature range:  $T_{LOW} = -40^{\circ}C$ ,  $T_{High} = 85^{\circ}C$
2. The deviation parameters  $\Delta V_{ref}$  and  $\Delta I_{ref}$  are defined as the difference between the maximum value and minimum value obtained over the full operating ambient temperature range that applied.



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

$$\alpha V_{ref} \left(\frac{\text{ppm}}{^{\circ}C}\right) = \frac{\left(\frac{\Delta V_{ref}}{V_{ref}(T_a = 25^{\circ}C)} \times 10^6\right)}{\Delta T_a}$$

$\alpha V_{ref}$  can be positive or negative depending on whether  $V_{ref} \text{ Min}$  or  $V_{ref} \text{ Max}$  occurs at the lower ambient temperature, refer to Fig. 8

Example :  $\Delta V_{ref} = 10\text{mV}$  and the slope is positive,

$$\Delta V_{ref} @ 25^{\circ}C = 1.24V$$

$$\Delta T_a = 125^{\circ}C$$

$$\alpha V_{ref} \left(\frac{\text{ppm}}{^{\circ}C}\right) = \frac{\left(\frac{0.010}{1.241}\right) \times 10^6}{125} = 65\text{ppm}/^{\circ}C$$

3. The dynamic impedance  $Z_{KA}$  is defined as:

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

When the device is operating with two external resistors, R1 and R2, (refer to Fig.2) the total dynamic impedance of the circuit is given by:

$$|Z_{KA}'| = |Z_{KA}| \times \left(1 + \frac{R_1}{R_2}\right)$$

Electrical Characteristics Curves (Continue)

Fig.4  $I_K$  vs  $V_{KA}$  (1)

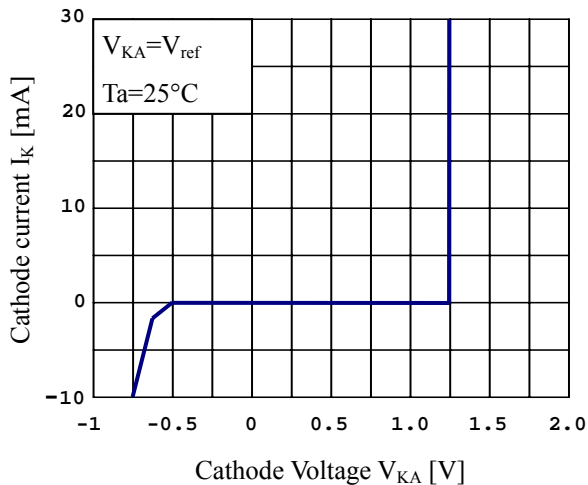


Fig.5  $I_K$  vs  $V_{KA}$  (2)

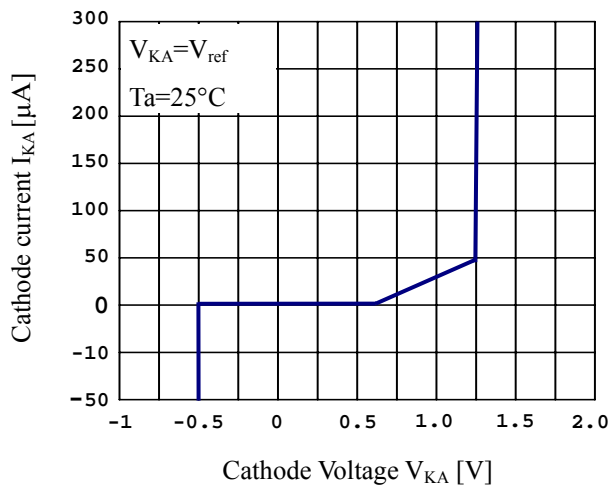


Fig.6  $I_{K(off)}$  vs  $V_{KA}$

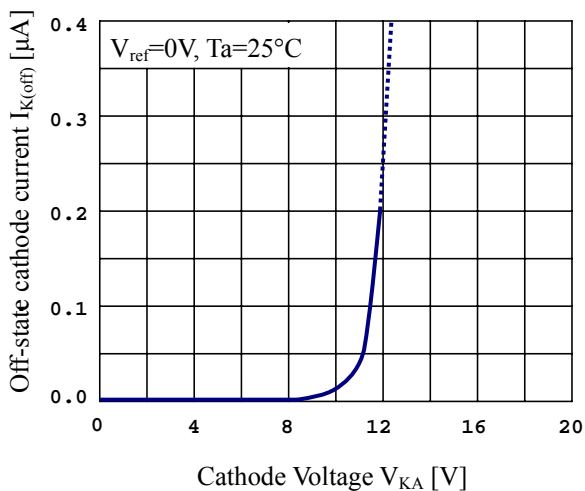


Fig.7  $\Delta V_{ref} / \Delta V_{KA}$  vs  $T_a$

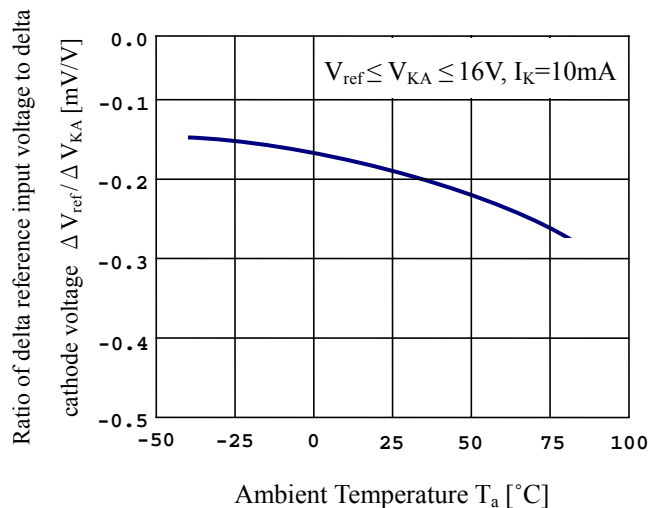


Fig.8  $V_{ref}$  vs  $T_a$

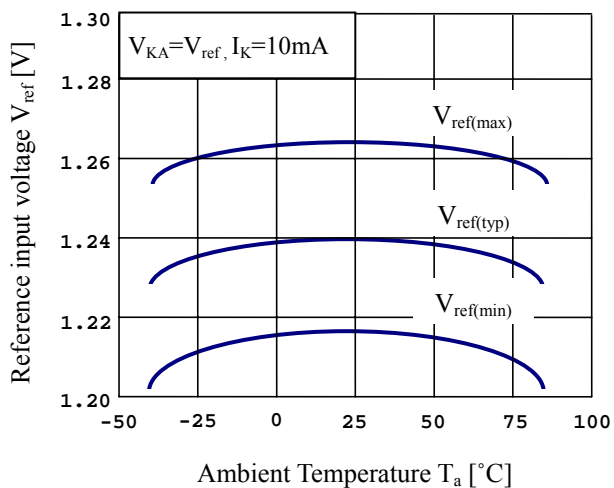
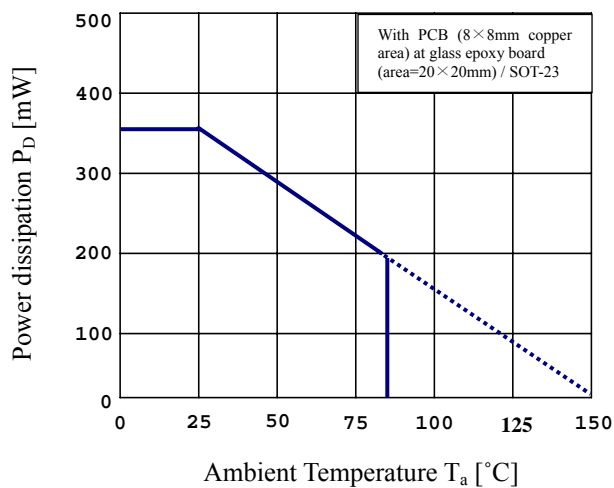


Fig.9  $P_D$  vs  $T_a$



Electrical Characteristics Curves

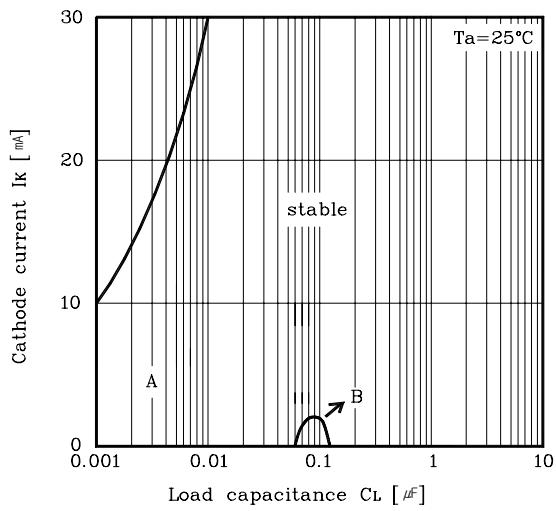
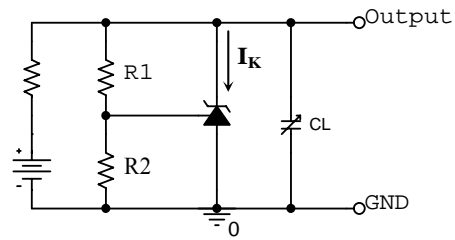


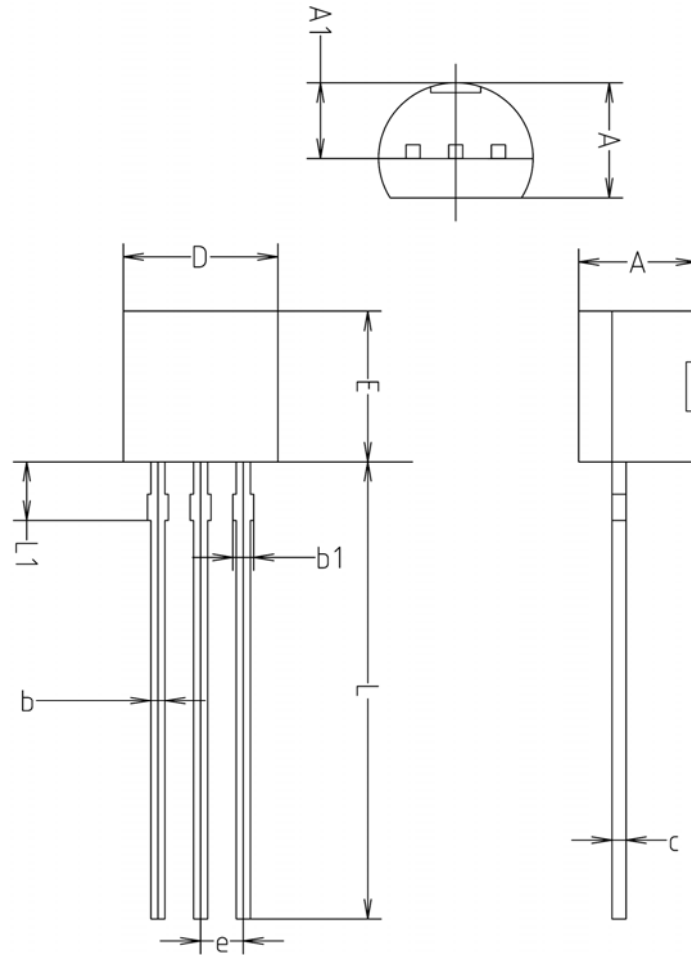
Fig.10 Stability Boundary Conditions



Unstable Regions	$V_{KA}$	$R_1$ [K $\Omega$ ]	$R_2$ [K $\Omega$ ]
A, B	$V_{ref}$	0	$\infty$
A	10V	10	1.415

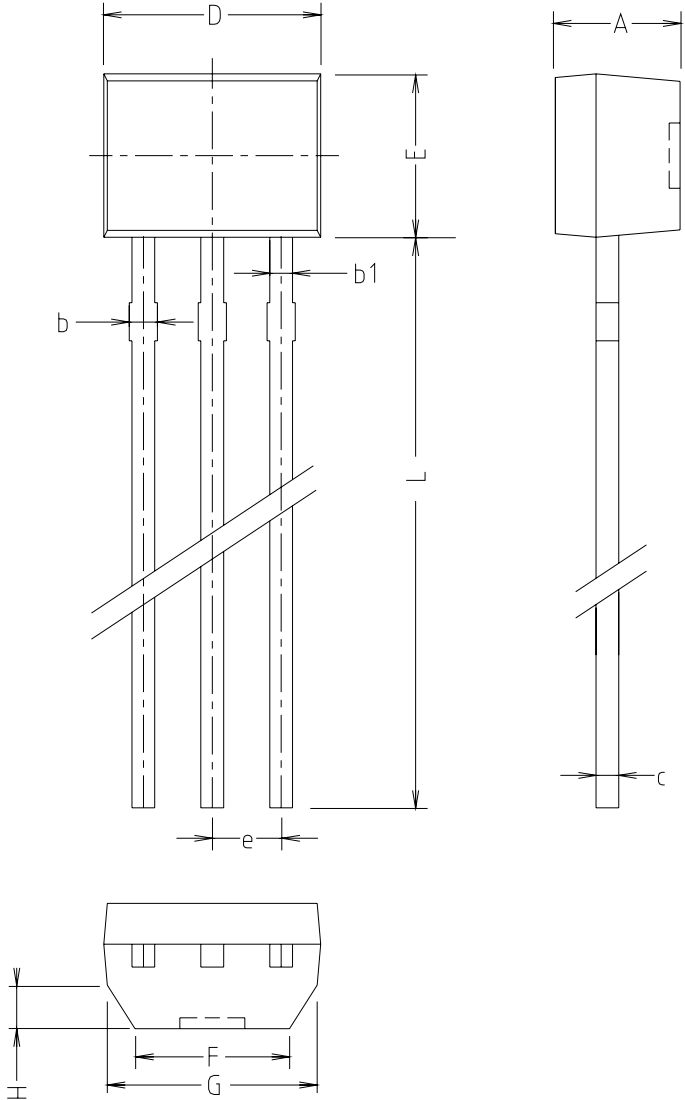
Fig.11 Test circuit for Fig. 10

◆ TO-92 Outline Dimension(mm)



SYMBOL	MILLMETERS(mm)		
	MINIMUM	NOMINAL	MAXIMUM
A	3.40	3.50	3.66
A1	2.46	2.51	2.59
b	0.39	0.44	0.53
b1	0.39	—	0.63
c	0.35	0.42	0.47
D	4.48	4.60	4.70
E	4.48	4.60	4.70
e	1.17	1.27	1.37
L	13.70	14.00	14.77
L1	1.55	1.70	2.15

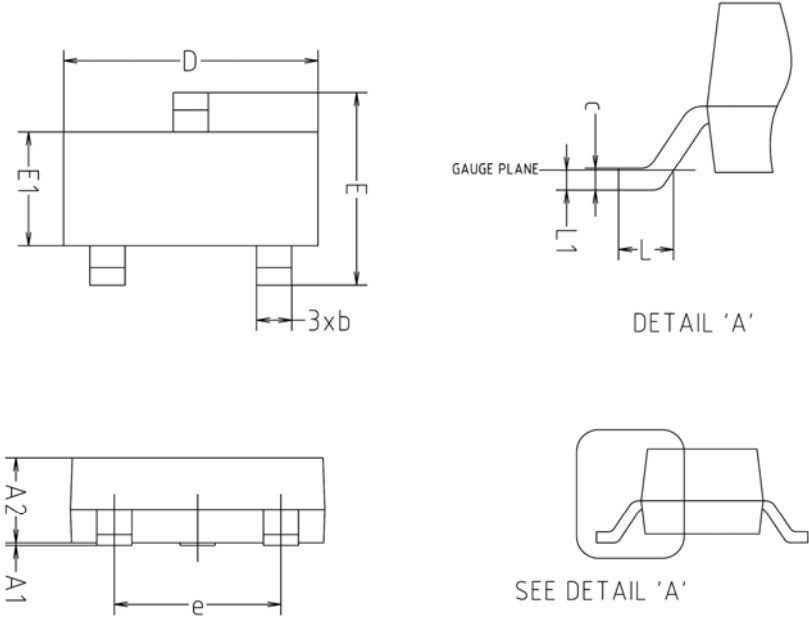
◆ TO-92M Outline Dimension (unit : mm)



SYMBOL	MILLMETERS(mm)		
	MINIMUM	NOMINAL	MAXIMUM
A	2.20	2.30	2.40
b	—	0.50	—
b1	—	0.44	—
c	—	0.42	—
D	3.90	4.00	4.10
E	2.90	3.00	3.10
e	—	1.27	—
L	—	14.50	15.00
F	2.80	2.85	2.90
G	3.80	—	—
H	—	0.70	—

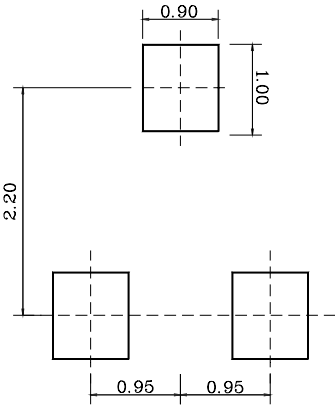


◆ SOT-23 Outline Dimension (unit : mm)

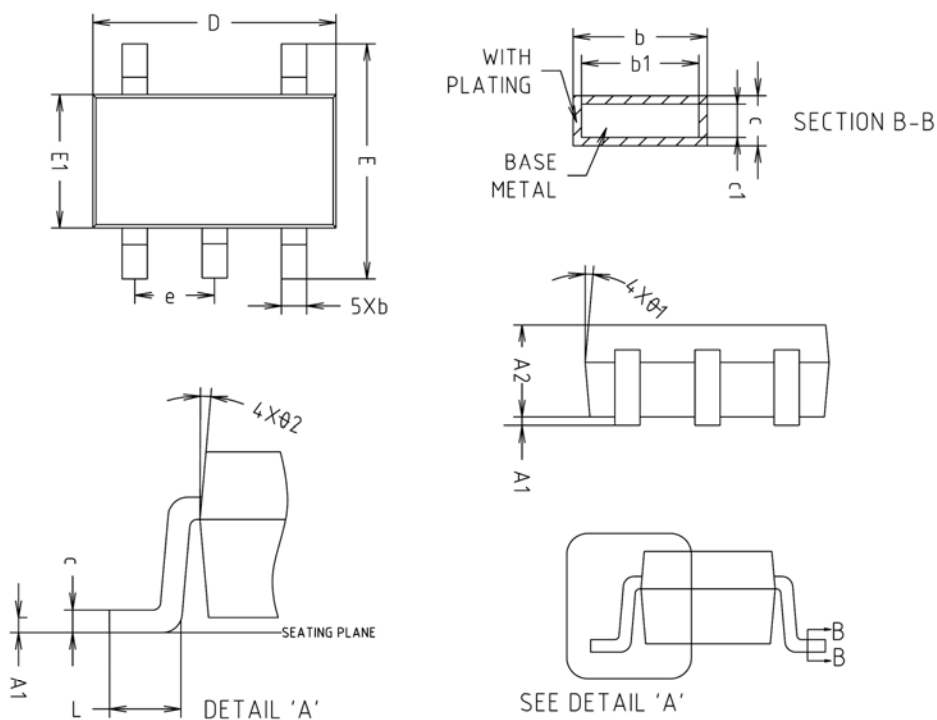


SYMBOL	MILLIMETERS			NOTE
	MINIMUM	NOMINAL	MAXIMUM	
A1	0.00	-	0.10	
A2	0.82	-	1.02	
b	0.39	0.42	0.45	
c	0.09	0.12	0.15	
D	2.80	2.90	3.00	
E	2.20	2.40	2.60	
E1	1.20	1.30	1.40	
e	1.90BSC			
L	0.20	-	-	
L1	0.12BSC			

※ Recommend PCB solder land [Unit: mm]

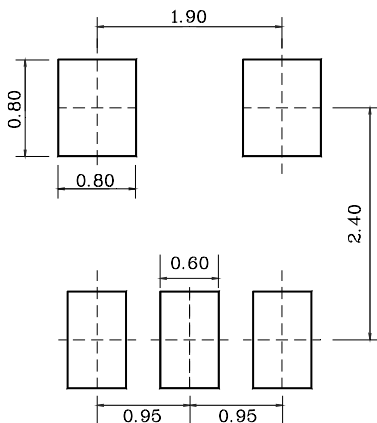


◆ SOT-25 Outline Dimension (unit : mm)



SYMBOL	MILLIMETERS			NOTE
	MINIMUM	NOMINAL	MAXIMUM	
A1	0.000	0.050	0.100	
A2	1.000	1.100	1.200	
b	-	0.400	0.450	
b1	-	0.375	0.425	
c	0.110	0.150	0.190	
c1	0.085	0.125	0.165	
D	2.800	2.900	3.000	
E	2.600	2.800	3.000	
E1	1.500	1.600	1.700	
e	0.930	0.950	0.970	
L	0.400	-	-	
θ1	5° REF			
θ2	5° REF			

※ Recommend PCB solder land [Unit: mm]



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