

# AX432 Series

Adjustable Shunt Regulator

## Description

The AX432 series are three-terminal adjustable regulators with guaranteed thermal stability over applicable temperature ranges. The output voltage may be set to any value between  $V_{REF}$  (approximately 1.24 or 1.25 volts) and 30 volts with two external resistors. These devices have a typical dynamic output impedance of 0.2Ω. Active output circuitry provides a very sharp turn-on characteristic, making these devices excellent replacement for zener diodes in many applications.

## Features

- Programmable output voltage
- Temperature coefficient is 50ppm/°C typical
- Temperature compensated for operation over full temperature range
- Low output noise voltage
- Fast turn on response

## Ordering Information

Package	$V_{REF}$ 1.24V±2%	$V_{REF}$ 1.24V±1%	$V_{REF}$ 1.24V±0.5%	$V_{REF}$ 1.25V±2%	$V_{REF}$ 1.25V±1%	$V_{REF}$ 1.25V±0.5%
SOT-23	AX432AN	AX432BN	AX432CN	AX432DN	AX432EN	AX432FN
SOT-89	AX432AM	AX432BM	AX432CM	AX432DM	AX432EM	AX432FM
TO-92	AX432AA	AX432BA	AX432CA	AX432DA	AX432EA	AX432FA

## Absolute Maximum Ratings

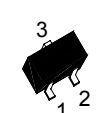
(Operating temperature range applies unless otherwise specified)

Characteristics	Symbol	Value	Unit
Cathode Voltage	$V_{KA}$	30	V
Cathode Current Range (Continuous)	$I_K$	50	mA
Reference Input Current Range	$I_{REF}$	0.05~+10	mA
Power Dissipation	$P_D$	SOT-23	280
		SOT-89	770
		TO-92	770
Operating Temperature Range	$T_{opr}$	0~+70	°C
Junction Temperature	$T_J$	150	°C
Storage Temperature Range	$T_{stg}$	-65~+150	°C

## Operating Conditions

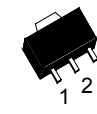
Characteristics	Symbol	Min.	Typ.	Max.	Unit
Cathode Voltage	$V_{KA}$	$V_{REF}$	-	30	V
Cathode Current Range (Continuous)	$I_K$	1	10	-	mA

### AX432 Series Pin Assignment



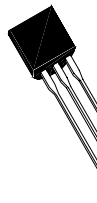
3  
1 2

3-Lead Plastic **SOT-23**  
Package Code: N  
Pin 1: Reference  
Pin 2: Cathode  
Pin 3: Anode



1 2 3

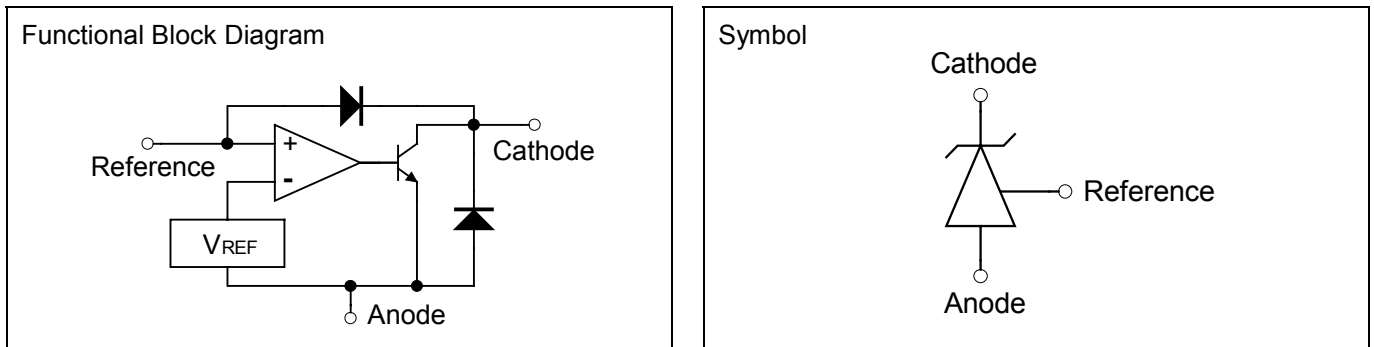
3-Lead Plastic **SOT-89**  
Package Code: M  
Pin 1: Reference  
Pin 2: Anode  
Pin 3: Cathode



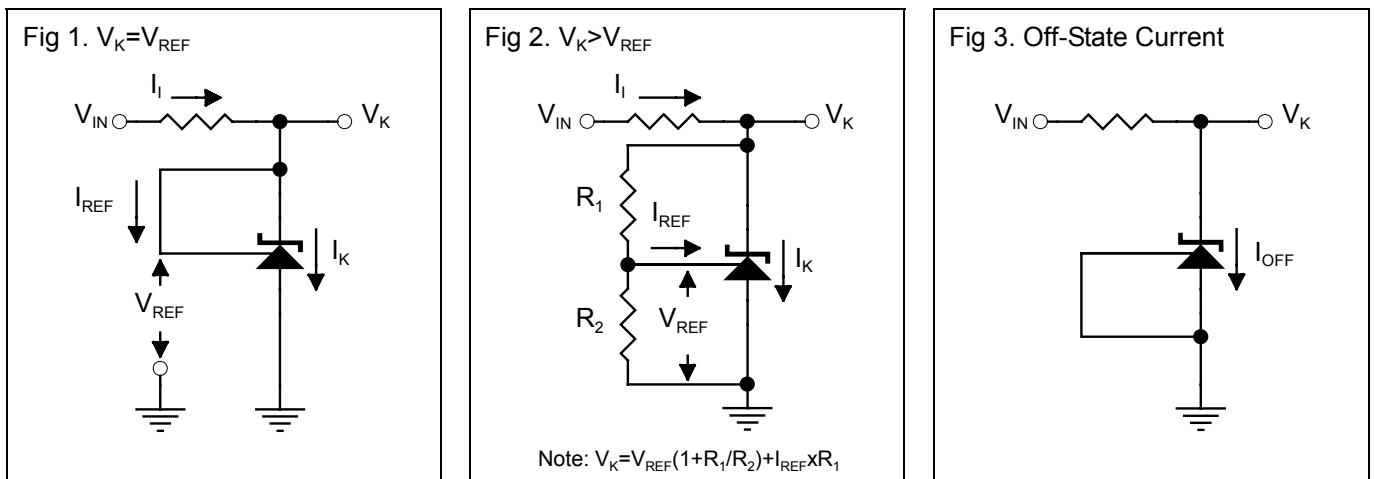
1 2 3

3-Lead Plastic **TO-92**  
Package Code: A  
Pin 1: Reference  
Pin 2: Anode  
Pin 3: Cathode

## Functional Block Diagram & Symbol



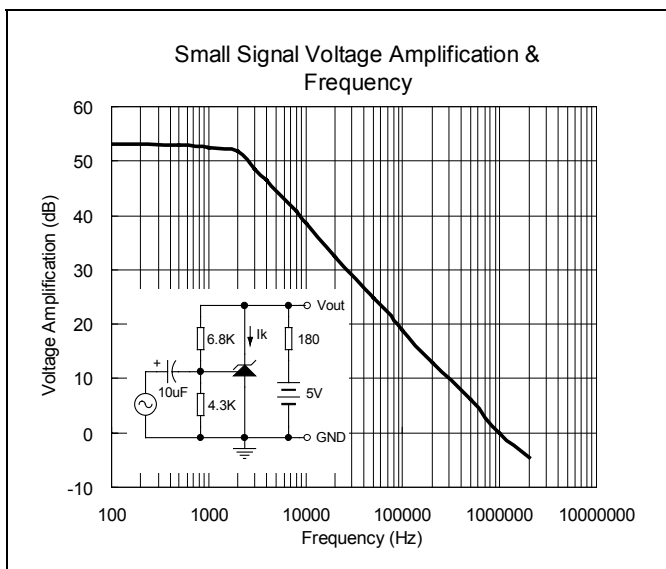
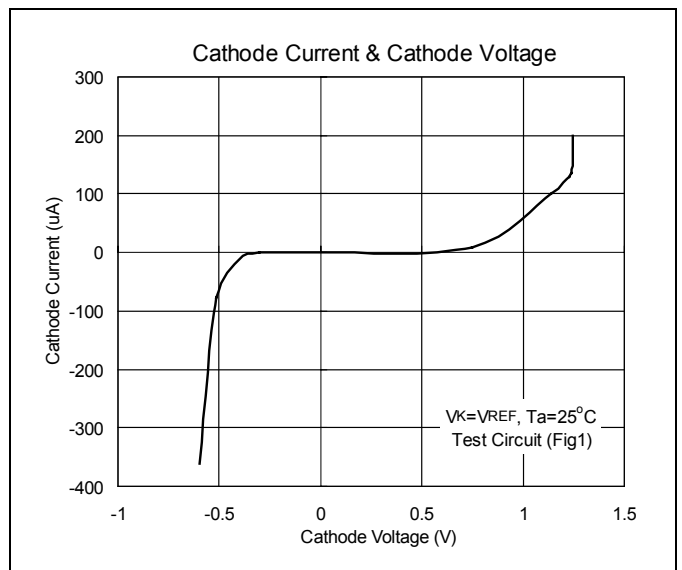
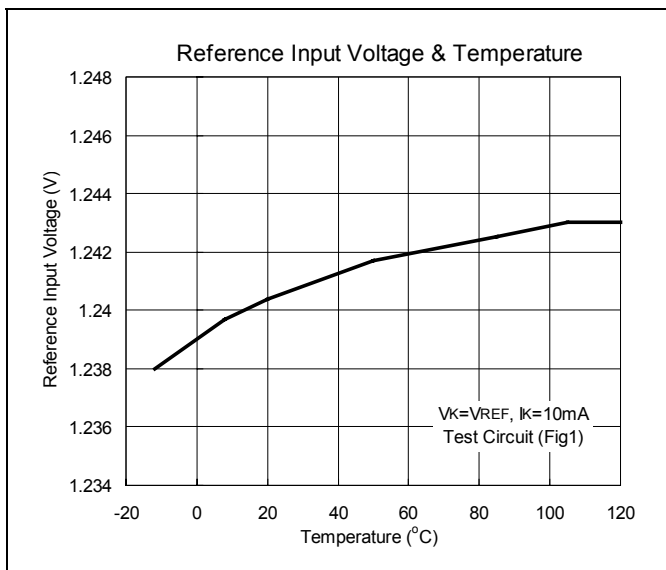
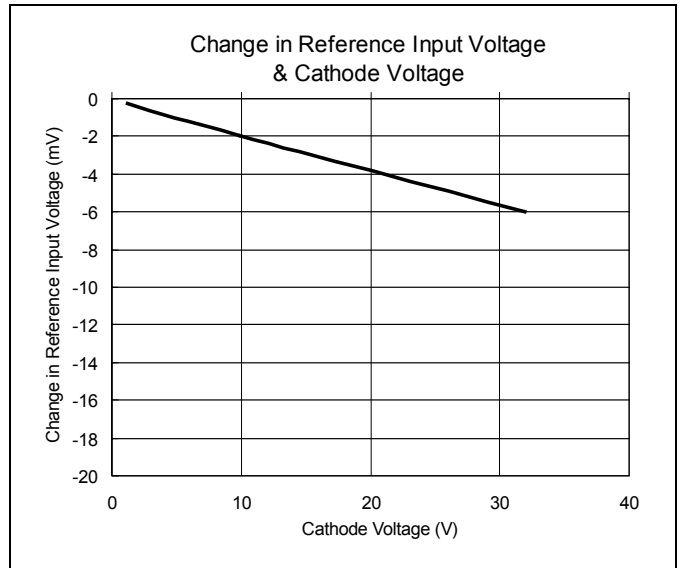
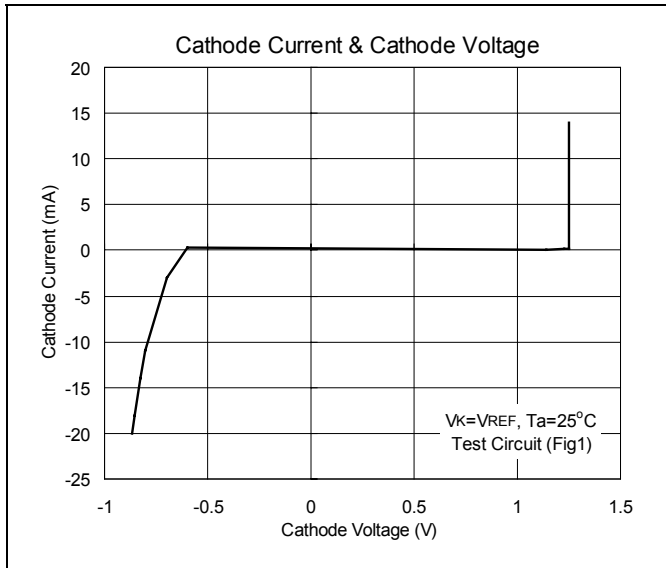
## Test Circuits



## Electrical Characteristics ( $T_A = 25^\circ\text{C}$ unless otherwise specified)

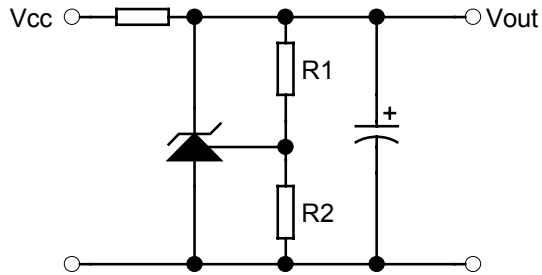
Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit	
Reference Input Voltage <sup>(Fig1)</sup>	$V_{REF}$	$V_K = V_{REF}, I_K = 10\text{mA}$	1.215	1.24	1.265	V	
			AX432BN/BM/BA	1.228	1.24		1.252
			AX432CA/CM/CA	1.234	1.24		1.246
			AX432DN/DM/DA	1.225	1.25		1.275
			AX432EN/EM/EA	1.238	1.25		1.262
			AX432FN/FM/FA	1.244	1.25		1.256
Deviation of Reference Input Voltage Over-Temperature <sup>(Fig1)</sup>	$V_{REF(dev)}$	$V_K = V_{REF}, I_K = 10\text{mA}$ $T_{min} \leq T_a \leq T_{max}$	-	4	17	mV	
Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage <sup>(Fig2)</sup>	$\Delta V_{REF} / \Delta V_K$	$I_K = 10\text{mA}, \Delta V_K = 10\text{V to } V_{REF}$	-	-1.4	-2.7	mV/V	
		$I_K = 10\text{mA}, \Delta V_K = 30\text{V to } 10\text{V}$	-	-1	-2	mV/V	
Reference Input Current <sup>(Fig2)</sup>	$I_{REF}$	$I_K = 10\text{mA}, R_1 = 10\text{k}\Omega, R_2 = \infty$	-	1	4	$\mu\text{A}$	
Deviation of Reference Input Current Over Full Temperature Range <sup>(Fig2)</sup>	$I_{REF(dev)}$	$I_K = 10\text{mA}, R_1 = 10\text{k}\Omega, R_2 = \infty, T_a = \text{Full Range}$	-	0.4	1.2	$\mu\text{A}$	
Minimum Cathode Current for Regulation <sup>(Fig1)</sup>	$I_{K(min)}$	$V_K = V_{REF}$	-	0.4	1	mA	
Off-State Cathode Current <sup>(Fig3)</sup>	$I_{K(off)}$	$V_K = 30\text{V}, V_{REF} = 0$	-	0.1	1	$\mu\text{A}$	

## Characteristics Curve



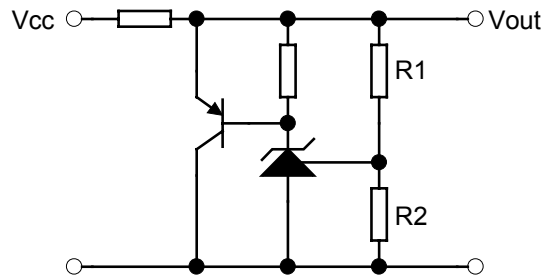
## Typical Application

Fig 4. Shunt Regulator



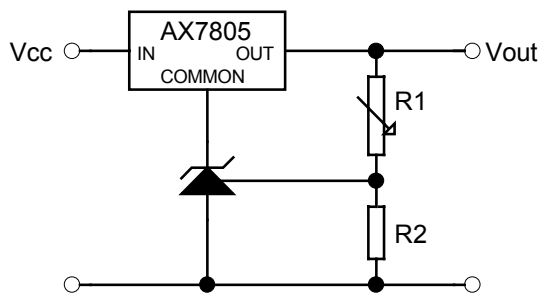
$$V_{out} = (1 + R_1/R_2)V_{REF}$$

Fig 5. High Current Shunt Regulator



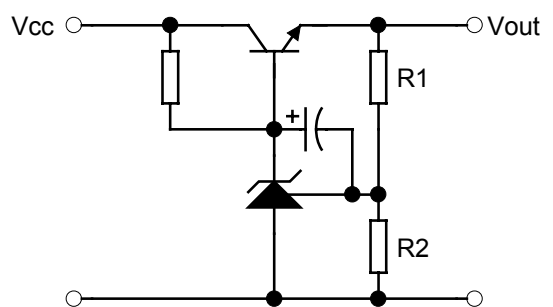
$$V_{out} = (1 + R_1/R_2)V_{REF}$$

Fig 6. Output Control of a Three-Terminal Fixed Regulator



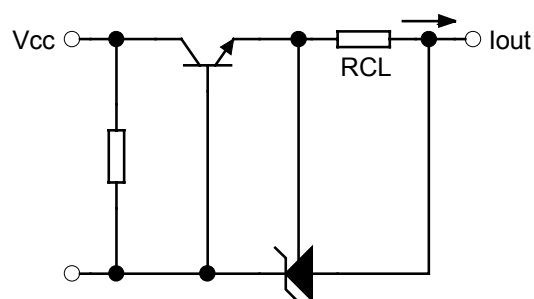
$$V_{out} = (1 + R_1/R_2)V_{REF}; V_{out(min)} = V_{REF} + 5V$$

Fig 7. Series Pass Regulator



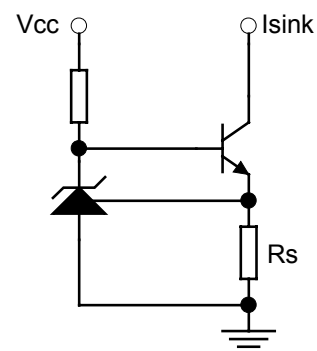
$$V_{out} = (1 + R_1/R_2)V_{REF}; V_{out(min)} = V_{REF} + V_{BE}$$

Fig 8. Current Limiter or Current Source



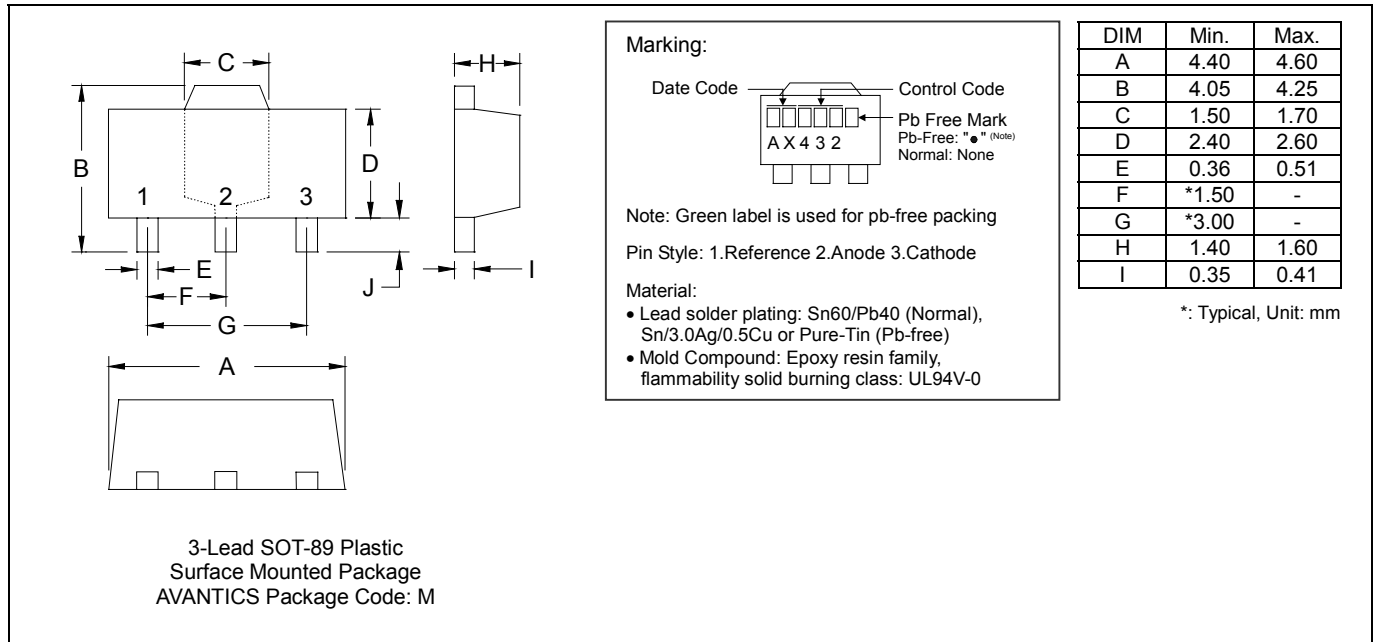
$$I_{out} = V_{REF}/R_{CL}$$

Fig 9. Constant Current Sink

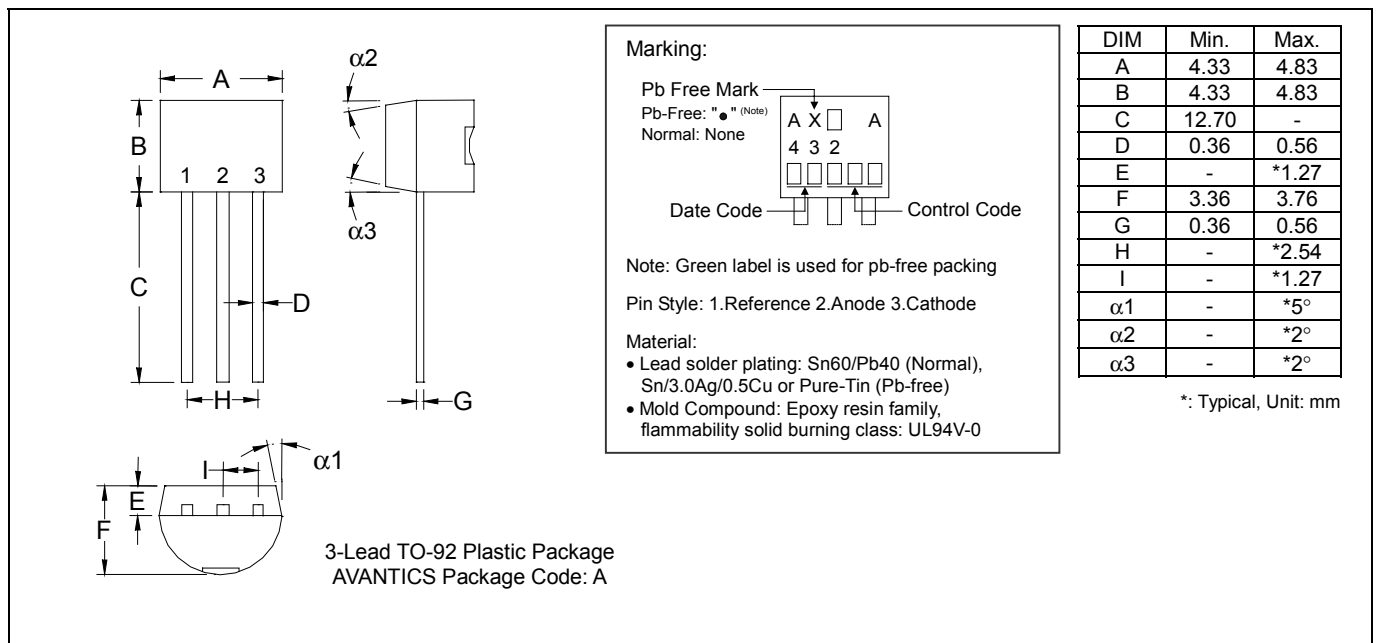


$$I_{sink} = V_{REF}/R_S$$

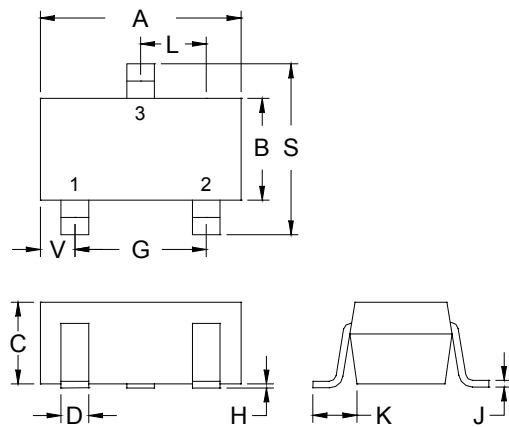
## SOT-89 Dimension



## TO-92 Dimension

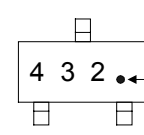


## SOT-23 Dimension



3-Lead SOT-23 Plastic  
Surface Mounted Package  
AVANTICS Package Code: N

**Marking:**



Pb Free Mark  
Pb-Free: "●" (Note)  
Normal: None

Note: Pb-free product can distinguish by the green label or the extra description on the right side of the label.

Pin Style: 1.Reference 2.Cathode 3.Anode

Material:

- Lead solder plating: Sn60/Pb40 (Normal), Sn/3.0Ag/0.5Cu or Pure-Tin (Pb-free)
- Mold Compound: Epoxy resin family, flammability solid burning class: UL94V-0

DIM	Min.	Max.
A	2.80	3.04
B	1.20	1.60
C	0.89	1.30
D	0.30	0.50
G	1.70	2.30
H	0.013	0.10
J	0.085	0.177
K	0.32	0.67
L	0.85	1.15
S	2.10	2.75
V	0.25	0.65

\*: Typical, Unit: mm

### Important Notice:

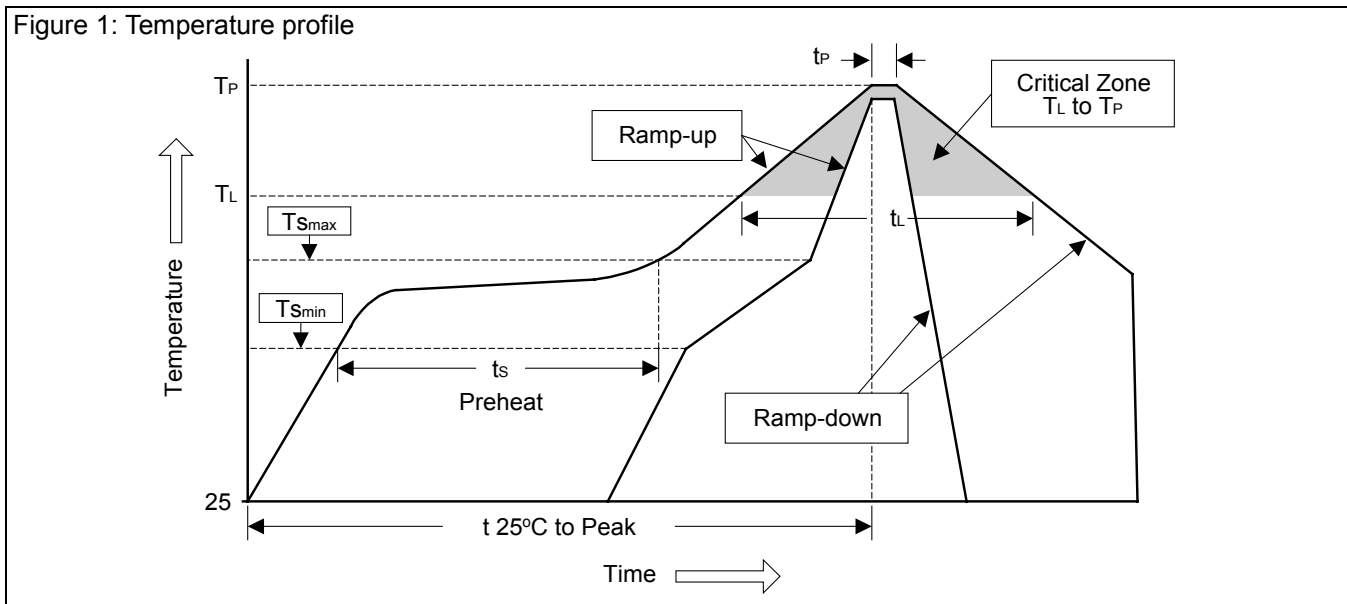
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## Soldering Methods for AVANTICS's Products

1. Storage environment: Temperature=10°C~35°C Humidity=65%±15%
2. Reflow soldering of surface-mount devices



Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate ( $T_L$ to $T_P$ )	<3°C/sec	<3°C/sec
Preheat		
- Temperature Min ( $T_{Smin}$ )	100°C	150°C
- Temperature Max ( $T_{Smax}$ )	150°C	200°C
- Time (min to max) ( $t_s$ )	60~120 sec	60~180 sec
$T_{Smax}$ to $T_L$		
- Ramp-up Rate	<3°C/sec	<3°C/sec
Time maintained above:		
- Temperature ( $T_L$ )	183°C	217°C
- Time ( $t_L$ )	60~150 sec	60~150 sec
Peak Temperature ( $T_P$ )	240°C +0/-5°C	260°C +0/-5°C
Time within 5°C of actual Peak Temperature ( $t_p$ )	10~30 sec	20~40 sec
Ramp-down Rate	<6°C/sec	<6°C/sec
Time 25°C to Peak Temperature	<6 minutes	<8 minutes

### 3. Flow (wave) soldering (solder dipping)

Products	Peak temperature	Dipping time
Pb devices.	245°C ±5°C	5sec ±1sec
Pb-Free devices.	260°C +0/-5°C	5sec ±1sec