

## Description

The TL432 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  $0.2\Omega$ . 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  $50\text{ppm}/^\circ\text{C}$  typical
- Temperature compensated for operation over full temperature range
- Low output noise voltage
- Fast turn on response

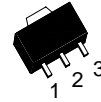
## Ordering Information

Package	$V_{REF}$ 1.24V $\pm$ 2%	$V_{REF}$ 1.24V $\pm$ 1%	$V_{REF}$ 1.24V $\pm$ 0.5%	$V_{REF}$ 1.25V $\pm$ 2%	$V_{REF}$ 1.25V $\pm$ 1%	$V_{REF}$ 1.25V $\pm$ 0.5%
SOT-23	TL432AN	TL432BN	TL432CN	TL432DN	TL432EN	TL432FN
SOT-89	TL432AM	TL432BM	TL432CM	TL432DM	TL432EM	TL432FM
TO-92	TL432AA	TL432BA	TL432CA	TL432DA	TL432EA	TL432FA

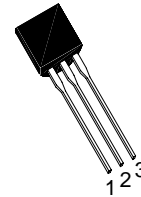
### TL432 Series Pin Assignment



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



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



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

## Absolute Maximum Ratings

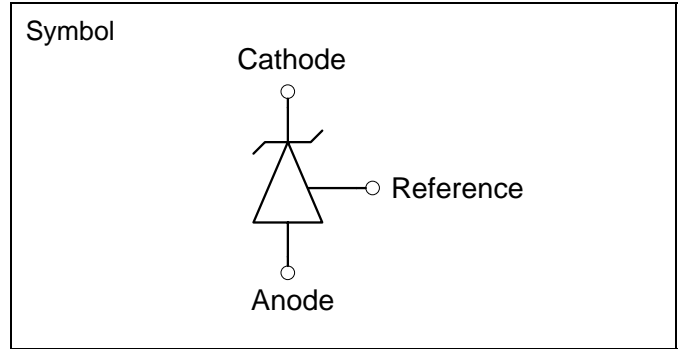
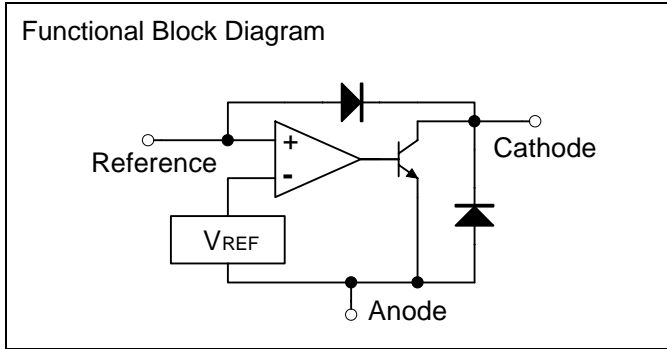
(Operating temperature range applies unless otherwise specified)

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	$^\circ\text{C}$
Junction Temperature	$T_J$	150	$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	-65~+150	$^\circ\text{C}$

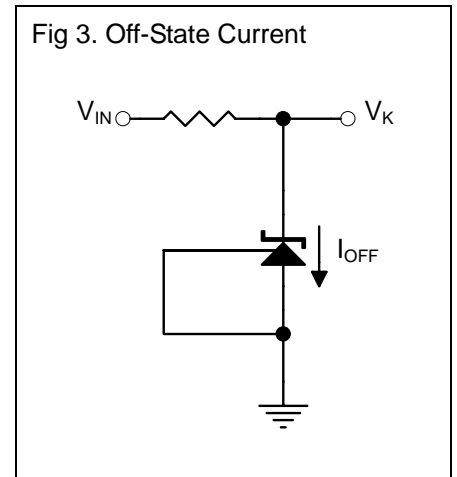
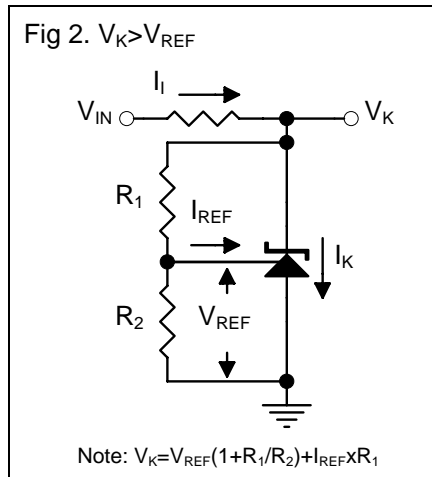
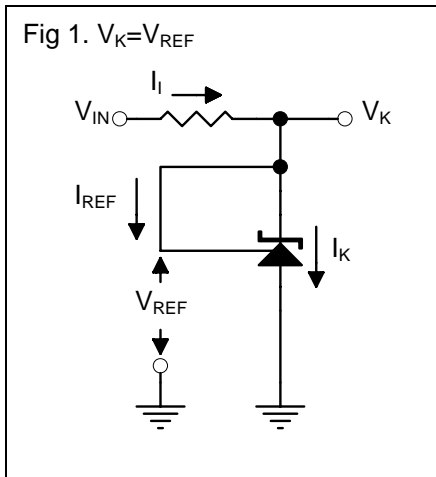
## Operating Conditions

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

## Functional Block Diagram & Symbol



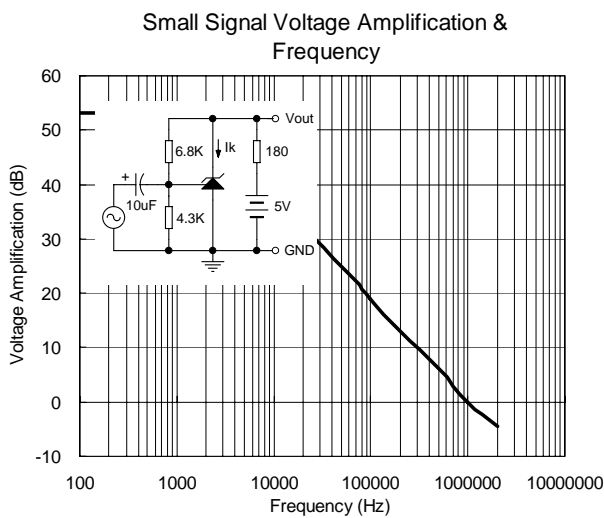
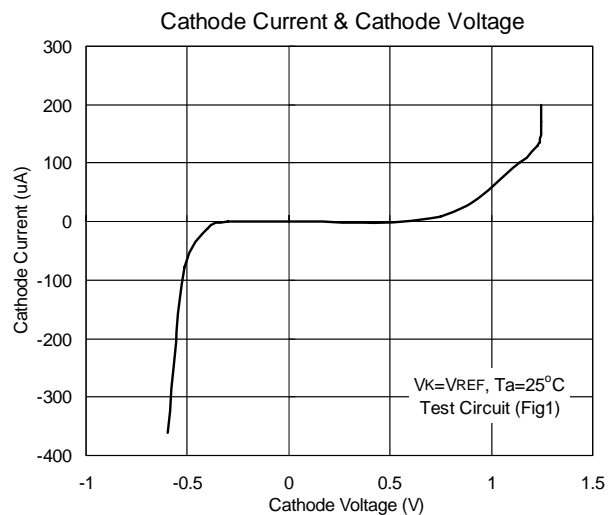
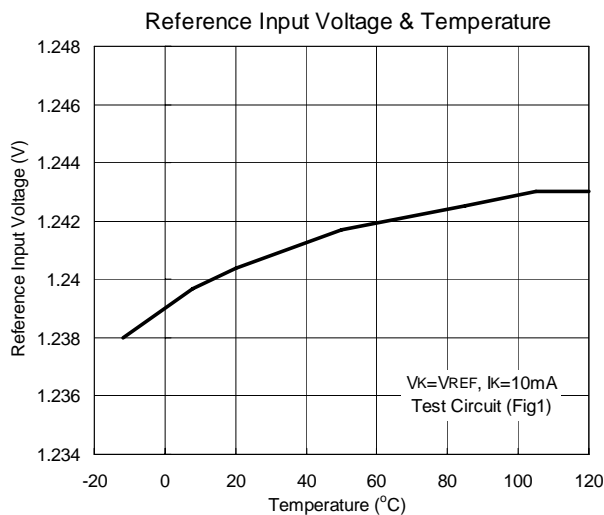
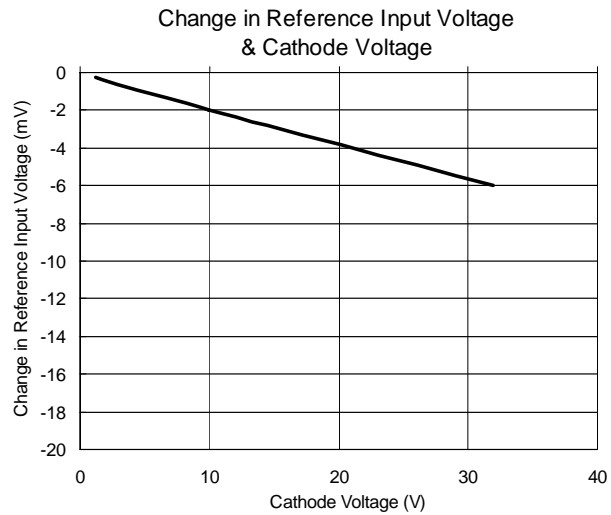
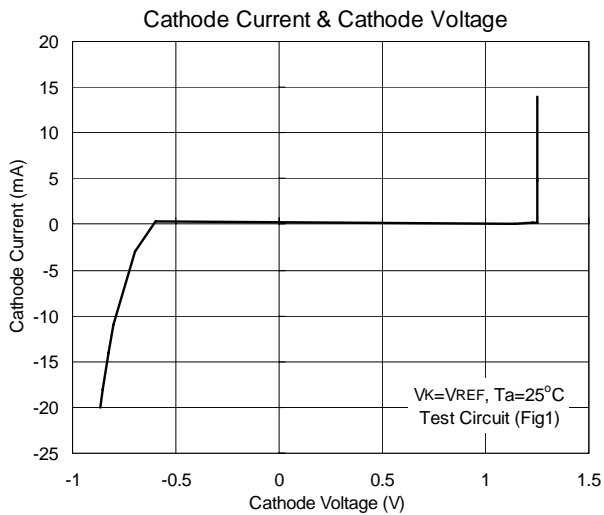
## Test Circuits



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

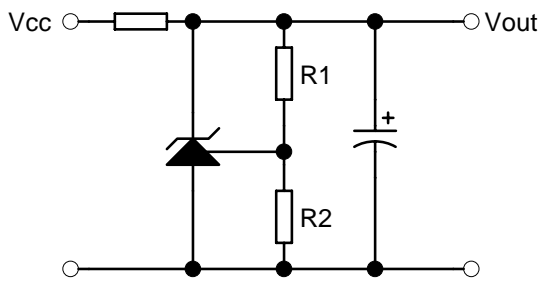
Characteristics	Symbol	Test Conditions	Min	Typ	Max	Unit
Reference Input Voltage <sup>(Fig1)</sup>	$V_{REF}$	$V_K = V_{REF}, I_K = 10\text{mA}$	1.215	1.24	1.265	V
			1.228	1.24	1.252	
			1.234	1.24	1.246	
			1.225	1.25	1.275	
			1.238	1.25	1.262	
			1.244	1.25	1.256	
Deviation of Reference Input Voltage Over-Temperature <sup>(Fig1)</sup>	$V_{REF(\text{dev})}$	$V_K = V_{REF}, I_K = 10\text{mA}$ $T_{\text{min}} \leq T_a \leq T_{\text{max}}$	-	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>	$I_{REF(\text{dev})}$	$I_K = 10\text{mA}, R_1 = 10\text{k}\Omega, R_2 = \infty, T_a = \text{Full Range}$	-	0.4	1.2	$\mu\text{A}$
Minimum Cathode Current for Regulation <sup>(Fig1)</sup>	$I_{K(\text{min})}$	$V_K = V_{REF}$	-	0.4	1	mA
Off-State Cathode Current <sup>(Fig3)</sup>	$I_{K(\text{off})}$	$V_K = 30\text{V}, V_{REF} = 0$	-	0.1	1	$\mu\text{A}$

# Characteristics Curve



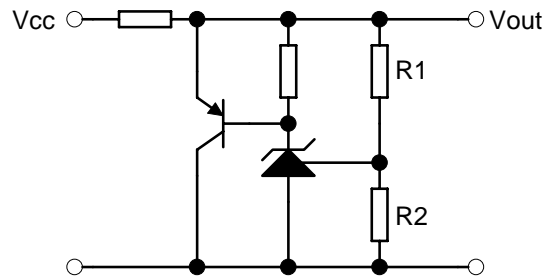
# Typical Application

Fig 4. Shunt Regulator



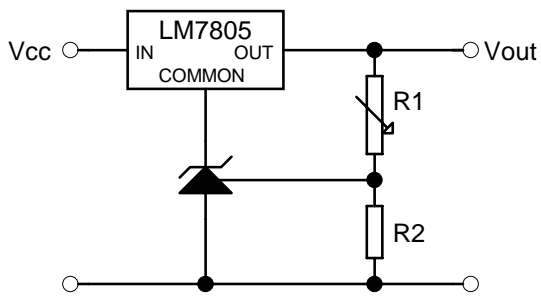
$$V_{out} = (1 + R_1/R_2)V_{REF}$$

Fig 5. High Current Shunt Regulator



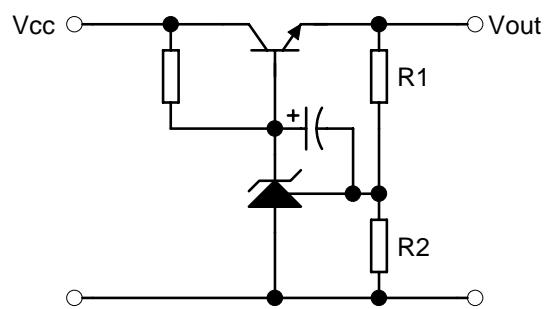
$$V_{out} = (1 + R_1/R_2)V_{REF}$$

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



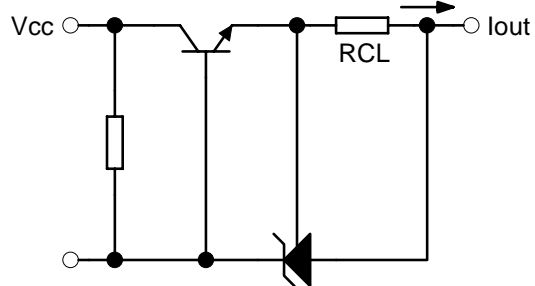
$$V_{out} = (1 + R_1/R_2)V_{REF}; V_{out(min)} = V_{REF} + 5V$$

Fig 7. Series Pass Regulator



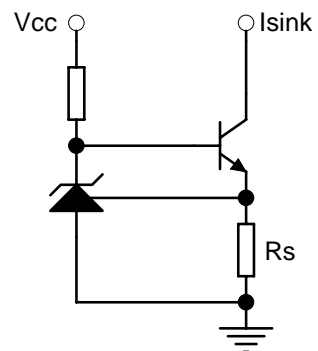
$$V_{out} = (1 + R_1/R_2)V_{REF}; V_{out(min)} = V_{REF} + V_{BE}$$

Fig 8. Current Limiter or Current Source



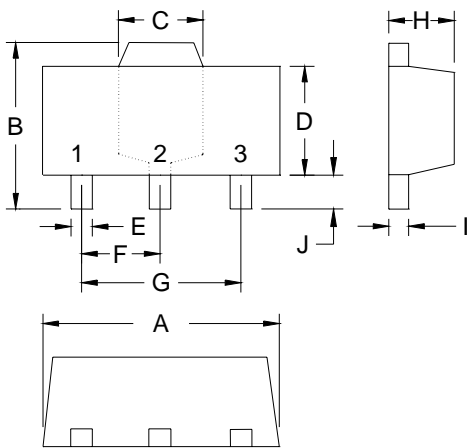
$$I_{out} = V_{REF}/R_{CL}$$

Fig 9. Constant Current Sink



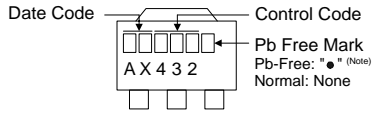
$$I_{sink} = V_{REF}/R_S$$

# SOT-89 Dimension



3-Lead SOT-89 Plastic Surface Mounted Package  
AVANTICS Package Code: M

### Marking:



Note: Green label is used for pb-free packing

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

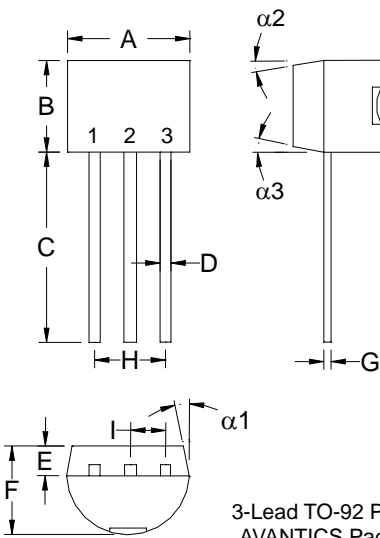
### Material:

- 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	4.40	4.60
B	4.05	4.25
C	1.50	1.70
D	2.40	2.60
E	0.36	0.51
F	*1.50	-
G	*3.00	-
H	1.40	1.60
I	0.35	0.41

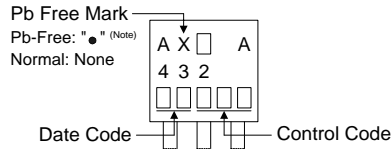
\*: Typical, Unit: mm

# TO-92 Dimension



3-Lead TO-92 Plastic Package  
AVANTICS Package Code: A

### Marking:



Note: Green label is used for pb-free packing

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

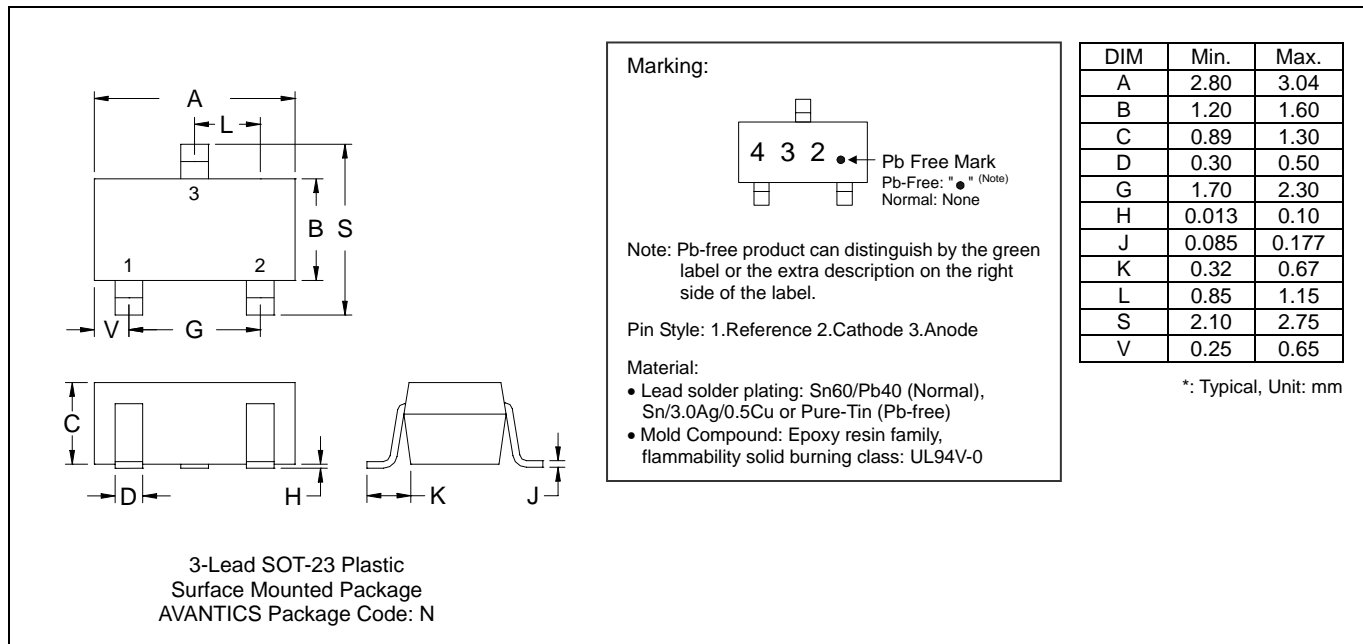
### Material:

- 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	4.33	4.83
B	4.33	4.83
C	12.70	-
D	0.36	0.56
E	-	*1.27
F	3.36	3.76
G	0.36	0.56
H	-	*2.54
I	-	*1.27
α1	-	*5°
α2	-	*2°
α3	-	*2°

\*: Typical, Unit: mm

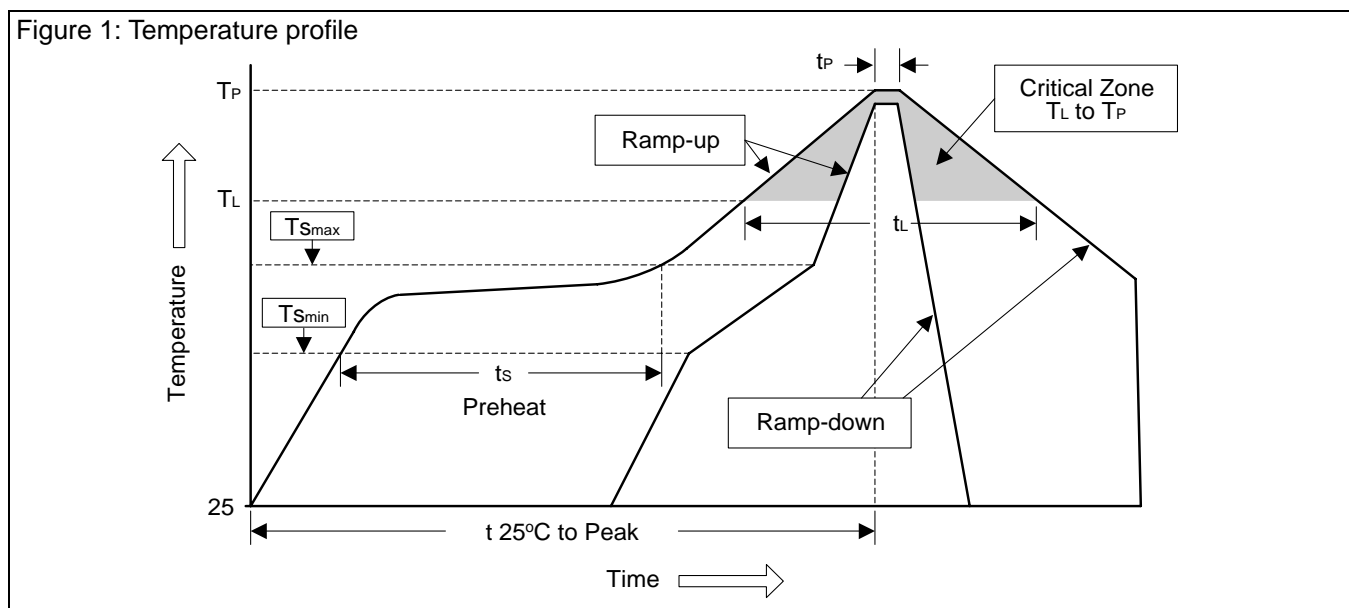
## SOT-23 Dimension



## Soldering Methods for AVANTICS's Products

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

Figure 1: Temperature profile



Profile Feature	Sn-Pb Eutectic Assembly	Pb-Free Assembly
Average ramp-up rate (T <sub>L</sub> to T <sub>P</sub> )	<3°C/sec	<3°C/sec
Preheat		
- Temperature Min (T <sub>Smin</sub> )	100°C	150°C
- Temperature Max (T <sub>Smax</sub> )	150°C	200°C
- Time (min to max) (t <sub>s</sub> )	60~120 sec	60~180 sec
T <sub>Smax</sub> to T <sub>L</sub>		
- Ramp-up Rate	<3°C/sec	<3°C/sec
Time maintained above:		

- Temperature (T <sub>L</sub> )	183°C	217°C
- Time (t <sub>L</sub> )	60~150 sec	60~150 sec
Peak Temperature (T <sub>P</sub> )	240°C +0/-5°C	260°C +0/-5°C
Time within 5°C of actual Peak Temperature (t <sub>P</sub> )	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