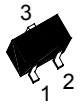
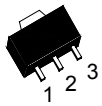
# AX431 Series

Adjustable Shunt Regulator

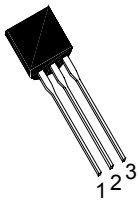
AX431 Series Pin Assignment



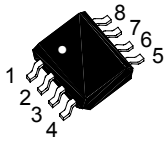

3-Lead Plastic **SOT-23**
Package Code: N
Pin 1: Reference
Pin 2: Cathode
Pin 3: Anode




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




3-Lead Plastic **SO-8**
Package Code: S
Pin 1: Cathode
Pin 2/3/6/7: Anode
Pin 4/5: NC
Pin 8: Reference

## Description

The AX431 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 2.495 volts) and 36 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 | $V_{REF}$: 2.495±2% | $V_{REF}$: 2.495±1% | $V_{REF}$: 2.495±0.5% |
|---|---|---|---|
| SOT-23 | AX431AN | AX431BN | AX431CN |
| SOT-89 | AX431AM | AX431BM | AX431CM |
| TO-92 | AX431AA | AX431BA | AX431CA |
| SO-8 | AX431AS | AX431BS | AX431CS |

## Absolute Maximum Ratings

(Operating temperature range applies unless otherwise specified)

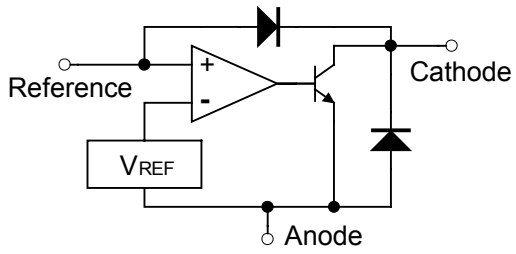
| Characteristics | Symbol | Value | | Unit |
|---|---|---|---|---|
| Cathode Voltage | $V_{KA}$ | 36 | | V |
| Cathode Current Range (Continuous) | $I_K$ | -100~+150 | | mA |
| Reference Input Current Range | $I_{REF}$ | 0.05~+10 | | mA |
| Power Dissipation | $P_D$ | SOT-23 | 280 | mW |
| | | SOT-89 | 770 | |
| | | TO-92 | 770 | |
| | | SO-8 | 770 | |
| Operating Temperature Range | $T_{opr}$ | 0~+70 | | °C |
| Storage Temperature Range | $T_{stg}$ | -65~+150 | | °C |

## Operating Conditions

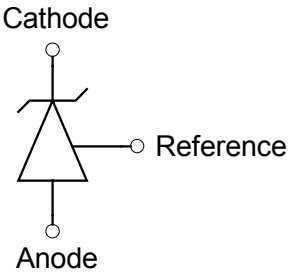
| Characteristics | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Cathode Voltage | $V_{KA}$ | $V_{REF}$ | 36 | V |
| Cathode Current Range (Continuous) | $I_K$ | 1 | 100 | mA |

## Functional Block Diagram & Symbol

Functional Block Diagram




Symbol




## Test Circuits

Fig 1. $V_K=V_{REF}$

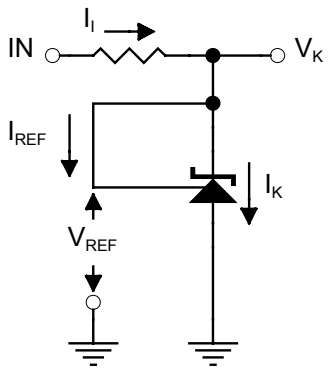
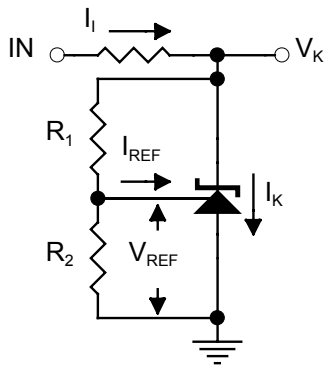
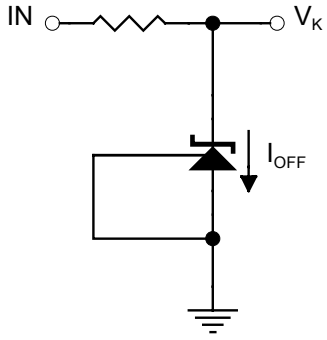



Fig 2. $V_K>V_{REF}$




Note: $V_K=V_{REF}(1+R_1/R_2)+I_{REF}xR_1$

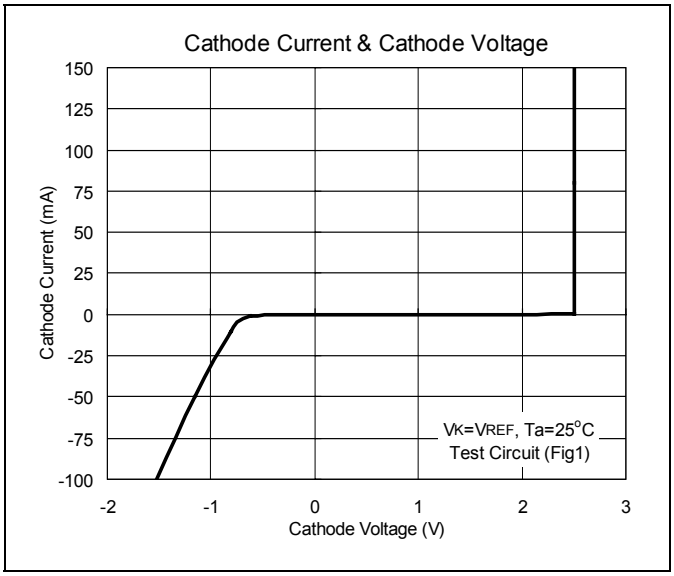
Fig 3. Off-State Current

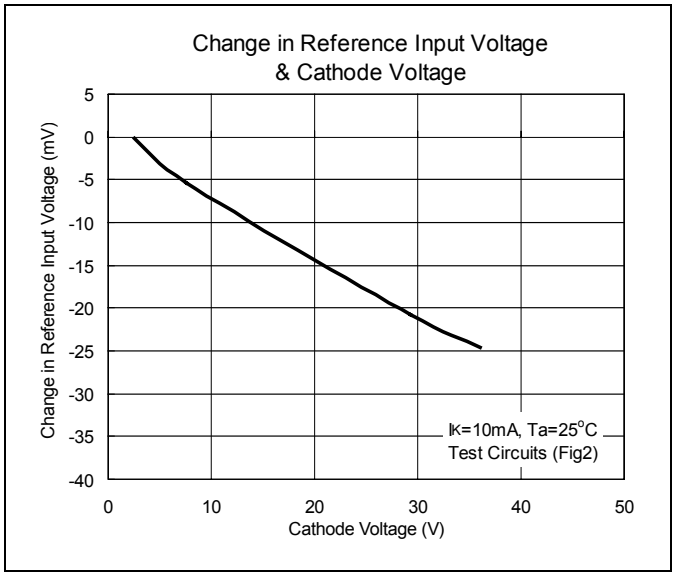


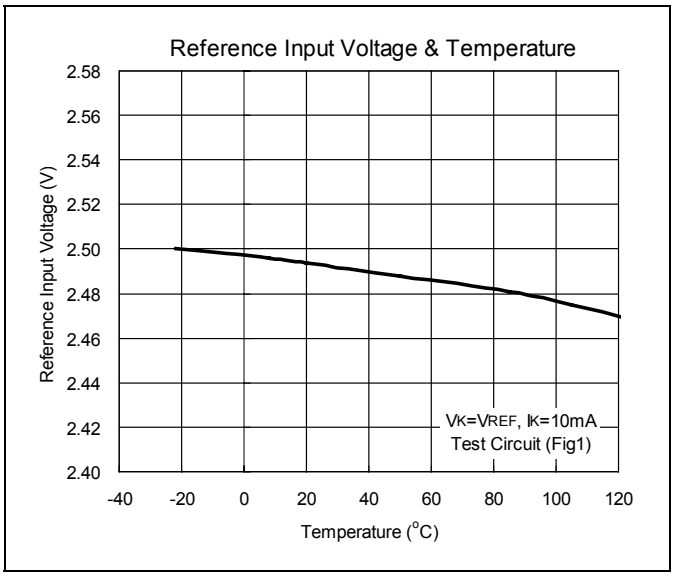

## Electrical Characteristics ($T_A$=25°C unless otherwise specified)

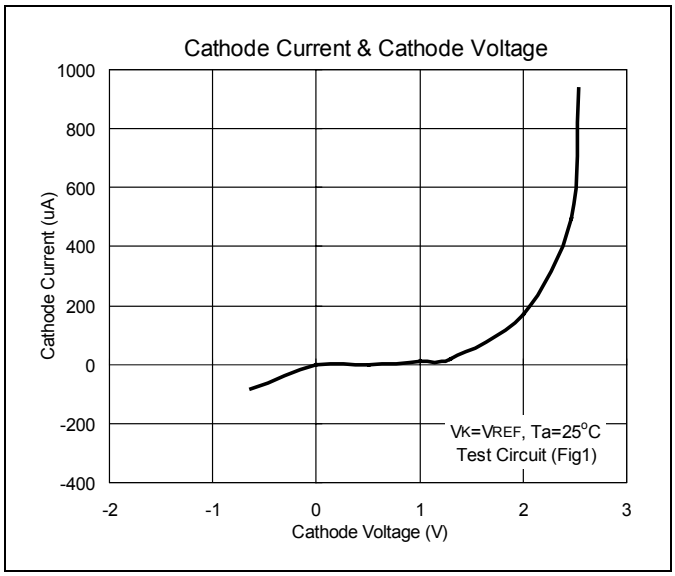
| Characteristics | | Symbol | Test Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Reference Input Voltage (Fig1) | AX431AN/AM/AA/AS | $V_{REF}$ | $V_K=V_{REF}$, $I_K$=10mA | 2.445 | 2.495 | 2.545 | V |
| | AX431BN/BM/BA/BS | | | 2.470 | 2.495 | 2.520 | |
| | AX431CN/CM/CA/CS | | | 2.483 | 2.495 | 2.507 | |
| Deviation of Reference Input Voltage Over-Temperature (Fig1) | | $V_{REF(dev)}$ | $V_K=V_{REF}$, $I_K$=10mA<br>$T_{min}\le T_a\le T_{max}$ | - | 4 | 17 | mV |
| Ratio of Change in Reference Input Voltage to the Change in Cathode Voltage (Fig2) | | $\Delta V_{REF}$ / $\Delta V_K$ | $I_K$=10mA,<br>$\Delta V_K$=10V to $V_{REF}$ | - | -1.4 | -2.7 | mV/V |
| | | | $I_K$=10mA,<br>$\Delta V_K$=36V to 10V | - | -1.0 | -2.0 | mV/V |
| Reference Input Current (Fig2) | | $I_{REF}$ | $I_K$=10mA, $R_1$=10kΩ,<br>$R_2$=∞ | - | 2 | 4 | uA |
| Deviation of Reference Input Current Over Full Temperature Range (Fig2) | | $I_{REF(dev)}$ | $I_K$=10mA, $R_1$=10kΩ,<br>$R_2$=∞, $T_a$=Full Range | - | 0.4 | 1.2 | uA |
| Minimum Cathode Current for Regulation (Fig1) | | $I_{K(min)}$ | $V_K=V_{REF}$ | - | 0.4 | 1.0 | mA |
| Off-State Cathode Current (Fig3) | | $I_{K(off)}$ | $V_K$=36V, $V_{REF}$=0 | - | 0.1 | 1.0 | uA |
| Dynamic Output Impedance (Fig1) | | $Z_K$ | $V_K=V_{REF}$, f≤1kHz<br>$I_K$=1 to 100mA | - | 0.2 | 0.5 | Ω |

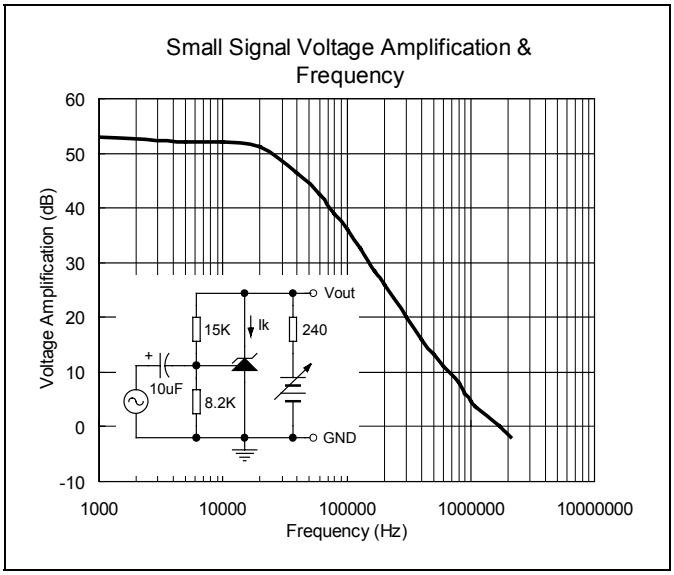
## Characteristics Curve



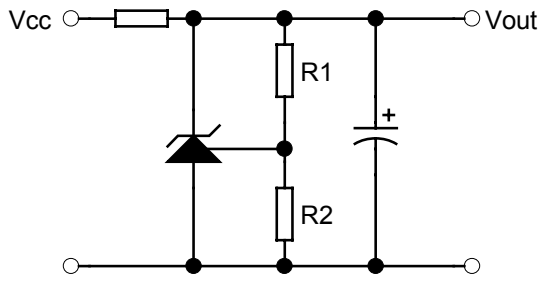



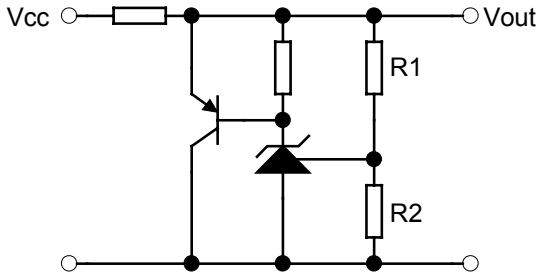
## Typical Application

Fig 4. Shunt Regulator



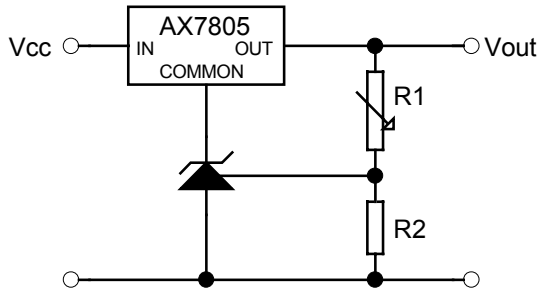

$Vout=(1+R_1/R_2)V_{REF}$

Fig 5. High Current Shunt Regulator



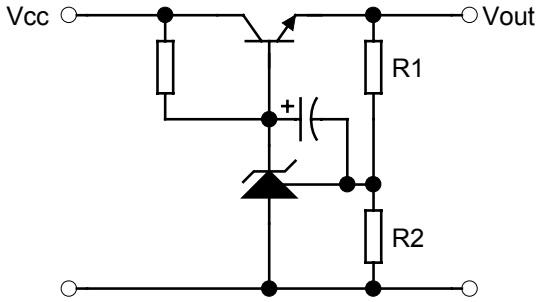

$Vout=(1+R_1/R_2)V_{REF}$

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



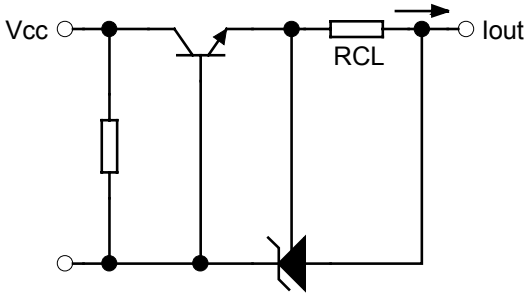

$Vout=(1+R_1/R_2)V_{REF}$; $V_{out(min)}=V_{REF}+5V$

Fig 7. Series Pass Regulator



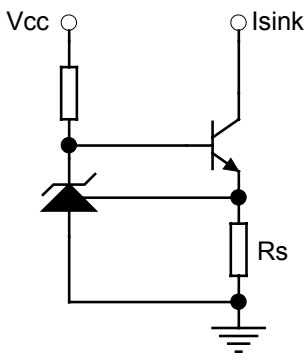

$Vout=(1+R_1/R_2)V_{REF}$; $V_{out(min)}=V_{REF}+V_{BE}$

Fig 8. Current Limiter or Current Source



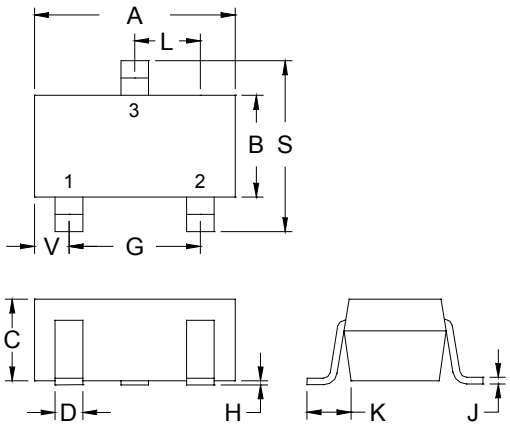

$Iout=V_{REF}/R_{CL}$

Fig 9. Constant Current Sink



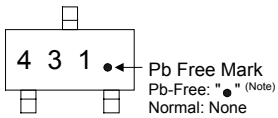

$Isink=V_{REF}/R_S$

## SOT-23 Dimension




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

Marking:




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

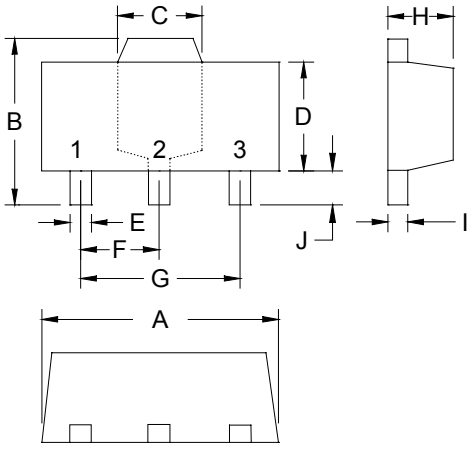
Pin Style: 1.Reference 2.Cathode 3.Anode

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 |

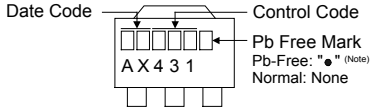
*: Typical, Unit: mm

## 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

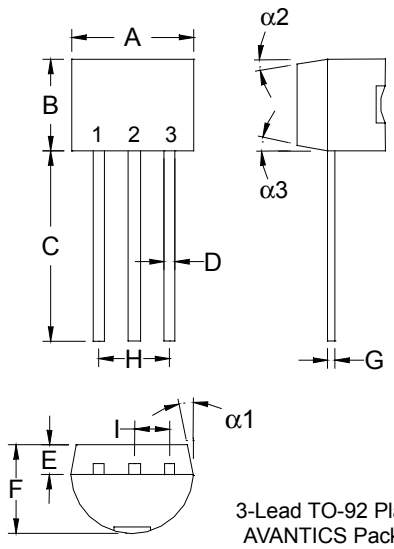
Pin Style: 1.Reference 2.Anode 3.Cathode

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 |

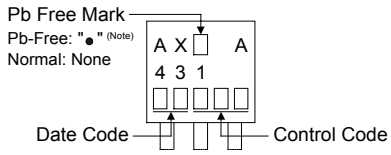
*: Typical, Unit: mm

## TO-92 Dimension




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

Marking:




Note: Green label is used for pb-free packing

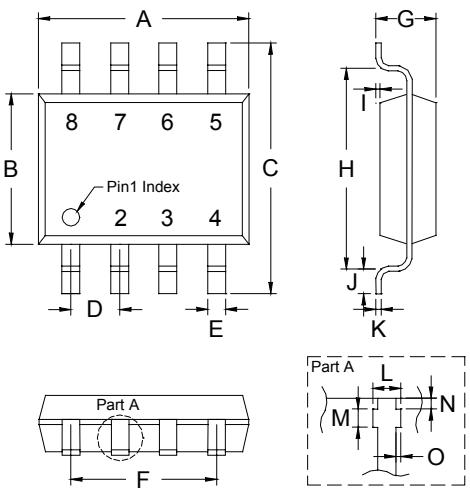
Pin Style: 1.Reference 2.Anode 3.Cathode

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° |

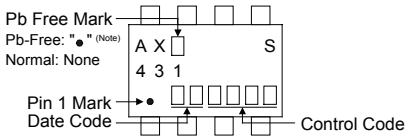
*: Typical, Unit: mm

## SO-8 Dimension




8-Lead SO-8 Plastic
Surface Mounted Package
AVANTICS Package Code: S

Marking:




Note: Green label is used for pb-free packing

Pin Style: 1.Cathode 2/3/6/7.Anode 4/5.NC
8.Reference

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 | 4.85 | 5.10 |
| B | 3.85 | 3.95 |
| C | 5.80 | 6.20 |
| D | 1.22 | 1.32 |
| E | 0.37 | 0.47 |
| F | 3.74 | 3.88 |
| G | 1.45 | 1.65 |
| H | 4.80 | 5.10 |
| I | 0.05 | 0.20 |
| J | 0.30 | 0.70 |
| K | 0.19 | 0.25 |
| L | 0.37 | 0.52 |
| M | 0.23 | 0.28 |
| N | 0.08 | 0.13 |
| O | 0.00 | 0.15 |

*: Typical, Unit: mm

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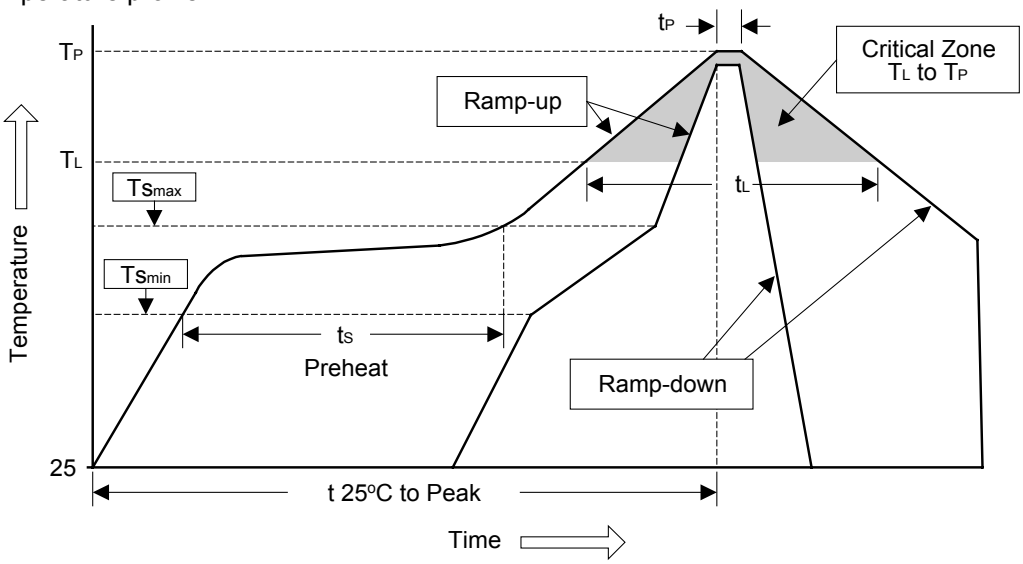
***Head Office:***
- AVANTICS Microelectronics Corp: No. 255, Cai Lun Rd. Zhangjiang Technology Industrial Park Pudong, Shanghai, China
  Tel: 86-021-58955599 Fax: 86-021-58558038

# Soldering Methods for AVANTICS's Products

1. Storage environment: Temperature=10°C~35°C Humidity=65%±15%

2. Reflow soldering of surface-mount devices

Figure 1: Temperature profile




| 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<br>- Temperature Min ($Ts_{min}$)<br>- Temperature Max ($Ts_{max}$)<br>- Time (min to max) (ts) | <br>100°C<br>150°C<br>60~120 sec | <br>150°C<br>200°C<br>60~180 sec |
| Tsmax to $T_L$<br>- Ramp-up Rate | <br><3°C/sec | <br><3°C/sec |
| Time maintained above:<br>- Temperature ($T_L$)<br>- Time ($t_L$) | <br>183°C<br>60~150 sec | <br>217°C<br>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 |