Class AB Stereo Headphone Driver

## Features

- **Operating Voltage**
  - **Single Supply, 3V to 6V**
  - **Dual Supply, ±1.5V to ± 3.0V**
- **High Signal-to-Noise Ratio, 100dB**
- **Low Distortion, -65dB**
- **Large Output Voltage Swing**
- **Excellent Power Supply Ripple Rejection**
- **Low Power Consumption**
- **Short-Circuit Elimination**
- **Wide Temperature Range**
- **No Switch ON/OFF Clicks**
- **Available in 8 pin SOP or DIP Packages**
- **Lead Free and Green Devices Available (RoHS Compliant)**

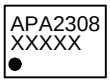
## Gereral Description

The APA2308 is an integrated class AB stereo headphone driver contained in an SOP-8 and a DIP-8 plastic packages. The APA2308 is capable of delivering 280mW of max. Output power to an 8Ω load or 110mW to a 32Ω load with less than 10% (THD+N) from a 5V power supply. The device is fabricated in a CMOS process and has been primarily developed for portable digital audio applications.

## Applications

- **Portable Digital Audio**

## Ordering and Marking Information

| | |
|---|---|
| APA2308 □□-□□□<br>Assembly Material<br>Handling Code<br>Temperature Range<br>Package Code | Package Code<br>J : DIP - 8 K : SOP - 8<br>Temperature Range<br>I : - 40 to 85 °C<br>Handling Code<br>TU : Tube TR : Tape & Reel<br>Assembly Material<br>L : Lead Free Device G : Halogen and Lead Free Device |
| APA2308 J :  | XXXXX - Date Code |
| APA2308 K :  | XXXXX - Date Code |

Note : ANPEC lead-free products contain molding compounds/die attach materials and 100% matte tin plate termination finish; which are fully compliant with RoHS. ANPEC lead-free products meet or exceed the lead-free requirements of IPC/JEDEC J-STD-020C for MSL classification at lead-free peak reflow temperature. ANPEC defines “Green” to mean lead-free (RoHS compliant) and halogen free (Br or Cl does not exceed 900ppm by weight in homogeneous material and total of Br and Cl does not exceed 1500ppm by weight).

## Absolute Maximum Ratings

| Symbol | Parameter | Rating | Unit |
|---|---|---|---|
| $V_{DD}$ | Supply Voltage | 7 | V |
| $T_{SC(O)}$ | Output Short-Circuit Duration, at $T_A$=25°C, $P_{TOT}$=1W | 20 | S |
| $T_A$ | Operating Ambient Temperature Range | -40 to 85 | °C |
| $T_J$ | Maximum Junction Temperature | 150 | °C |
| $T_{STG}$ | Storage Temperature Range | -65 to +150 | °C |
| $T_S$ | Maximum Lead Soldering Temperature, 10 Seconds | 260 | °C |

## Thermal Characteristics

| Symbol | Parameter | Typical Value | Unit |
|---|---|---|---|
| $\theta_{JA}$ | Thermal Resistance from Junction to Ambient in Free Air (Note 1) | | °C/W |
| | DIP-8 | 109 | |
| | SOP-8 | 210 | |

Note 1: $\theta_{JA}$ is measured with the component mounted on a high effective thermal conductivity test board in free air.

## Electrical Characteristics

$V_{DD}$=5V , $V_{SS}$=0V , $T_A$=25°C , $f_i$=1kHz , $R_L$=32Ω ( unless otherwise noted)

| Symbol | Parameter | Test Conditions | APA2308 | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| **SUPPLY** | | | | | | |
| $V_{DD}$ | Supply Voltage | | - | - | - | V |
| | Single | | 3.0 | 5.0 | 6.0 | |
| | Dual | | ±1.5 | ±2.5 | ±3.0 | |
| $V_{SS}$ | Negative Supply Voltage | | -1.5 | -2.5 | -3.0 | V |
| $I_{DD}$ | Supply Current | No Load | - | 2.5 | 5 | mA |
| $P_{TOT}$ | Total Power Dissipation | No Load | - | 12.5 | 25 | mW |
| **DC CHARACTERISTICS** | | | | | | |
| $V_{I(OS)}$ | Input Offset Voltage | | - | 5 | - | mV |
| $I_{BIAS}$ | Input Bias Current | | - | 10 | - | pA |
| $V_{CM}$ | Common Mode Voltage | | 0 | - | 3.5 | V |
| $G_V$ | Open-loop Voltage Gain | $R_L$=5kΩ | - | 75 | - | dB |
| $I_O$ | Maximum Output Current | THD+N<0.1% | - | 140 | - | mA |
| $R_O$ | Output Resistance | | - | 0.25 | - | Ω |
| **AC CHARACTERISTICS** | | | | | | |
| $V_O$ | Output Voltage Swing | $R_L$=32Ω (Note 2) | 0.25 | - | 4.75 | V |
| | | $R_L$=16Ω (Note 2) | 0.5 | - | 4.5 | |
| PSRR | Power Supply Rejection Ratio | $F_i$=100Hz<br>$V_{RIPPLE(P-P)}$ =100mV | - | 65 | - | dB |

## Electrical Characteristics (Cont.)

$V_{DD}$=5V , $V_{SS}$=0V , $T_A$=25°C , $f_i$=1kHz , $R_L$=32Ω ( unless otherwise noted)

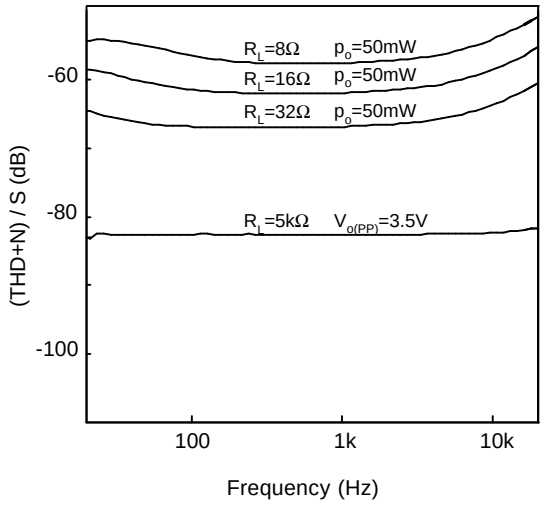
| Symbol | Parameter | Test Conditions | APA2308 | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| **AC CHARACTERISTICS (CONT.)** | | | | | | |
| Crosstalk | Channel Separation | $R_L$=32Ω | - | 95 | - | dB |
| $C_L$ | Load Capacitance | | - | - | 200 | pF |
| (THD+N)/S | Total Harmonic Distortion Plus Noise to Signal Ratio | $R_L$=32Ω (Note 3) | - | -65 | -60 | dB |
| | | | - | 0.05 | 0.1 | % |
| S/N | Signal to Noise Ratio | | 90 | 100 | - | dB |
| $F_G$ | Unity Gain Frequency | $R_L$=5kΩ | - | 5 | - | MHz |
| $P_O$ | Maximum Output Power | THD+N<0.1% | - | 84 | - | mW |
| $C_I$ | Input Capacitance | | - | 3 | - | pF |
| B | Power Bandwidth | Unity Gain Inverting | - | 20 | - | kHz |

Note 2 : Values are proportional to $V_{DD}$ ; THD+N< 0.1%

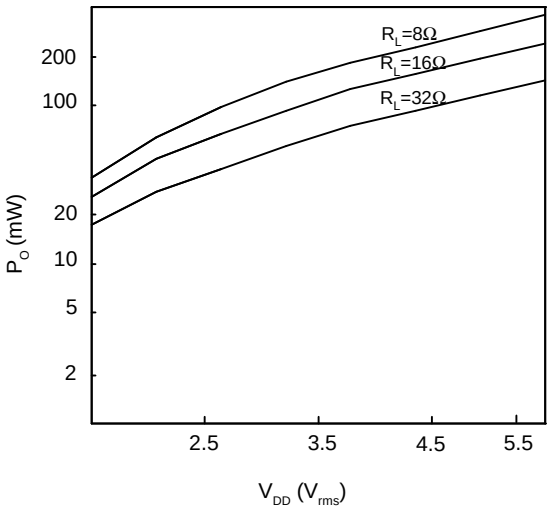
Note 3 : $V_{DD}$=5.0V ; $V_{O(P-P)}$=3.5V (at 0 dB)

## Typical Operating Characteristics

**Total Harmonic Distortion Plus Noise-to-Signal Ratio as a Function of Input Frequency**

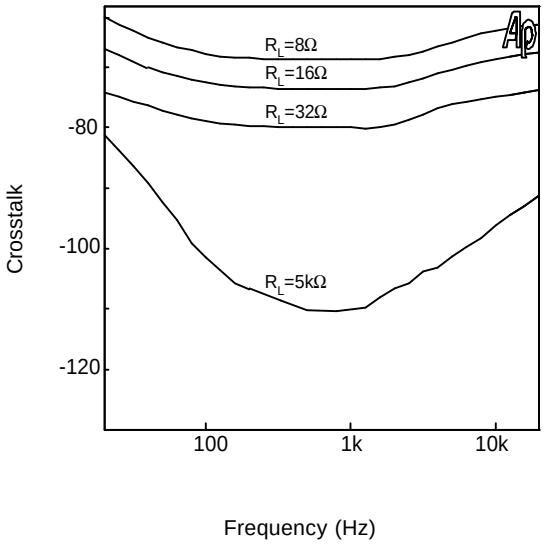



**Output Power as a Function of Supply Voltage**

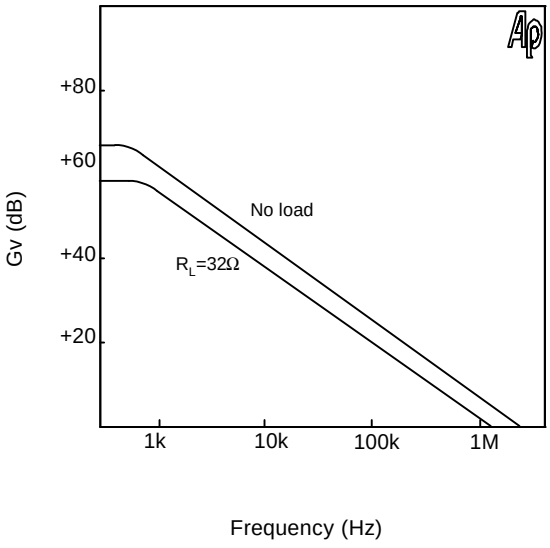


## Typical Operating Characteristics (Cont.)

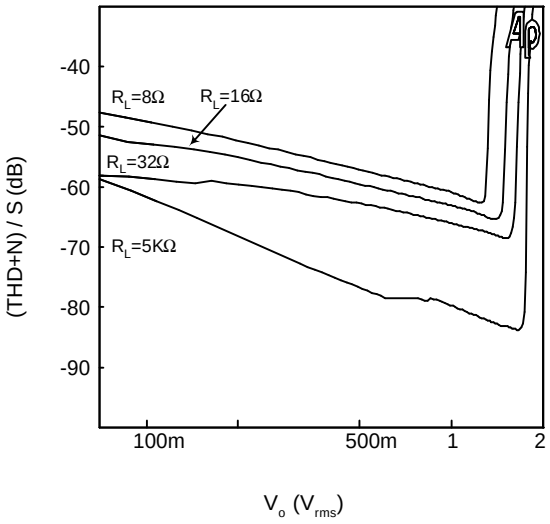
**Crosstalk as a Function of Input Frequency**



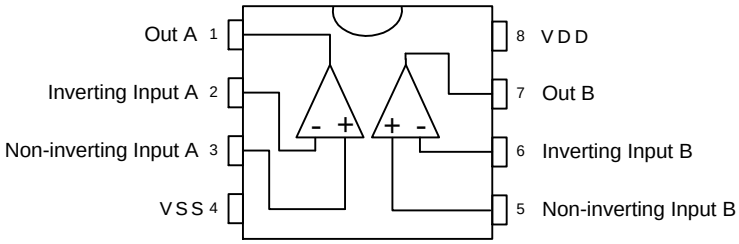

**Open Loop Gain as a Function of Input Frequency**




**Total Harmonic Distortion Plus Noise-to-Signal Ratio as a Function of output Voltage**

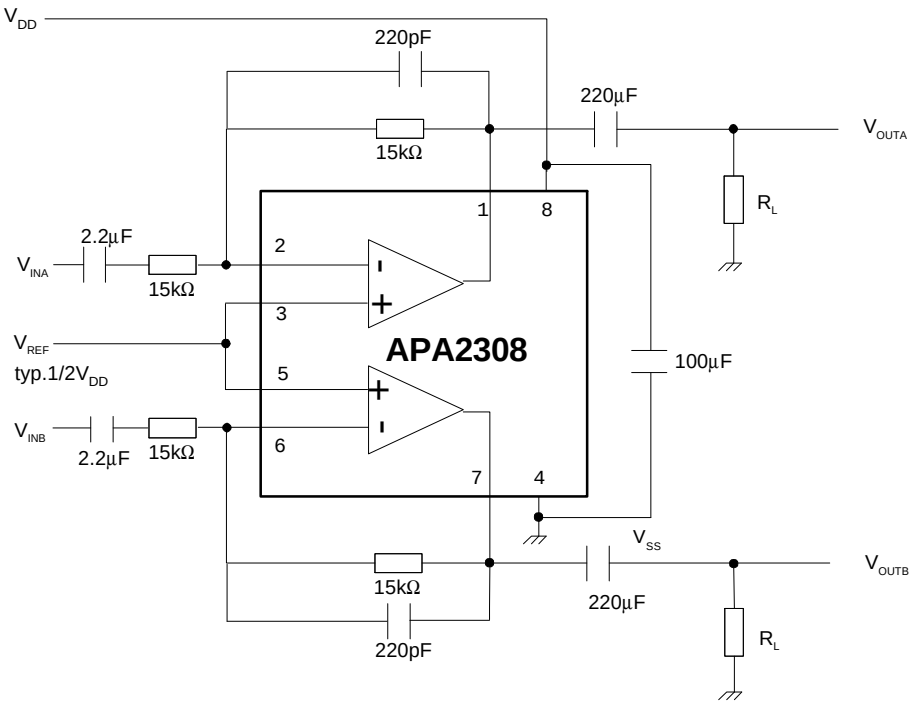


## Block Diagram



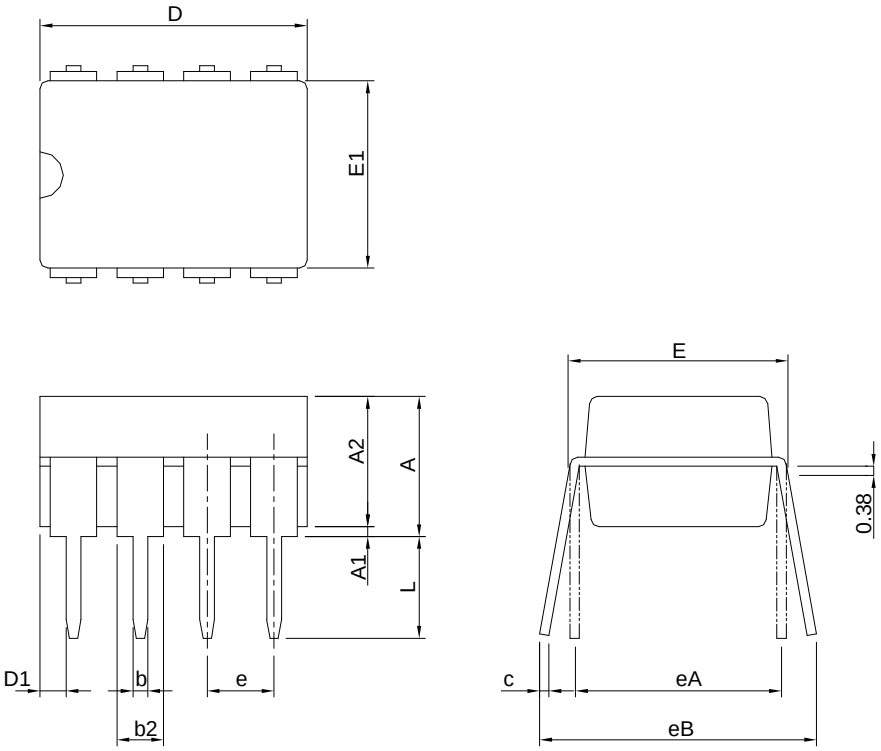

**APA2308**

## Typical Application Circuit



## Package Information

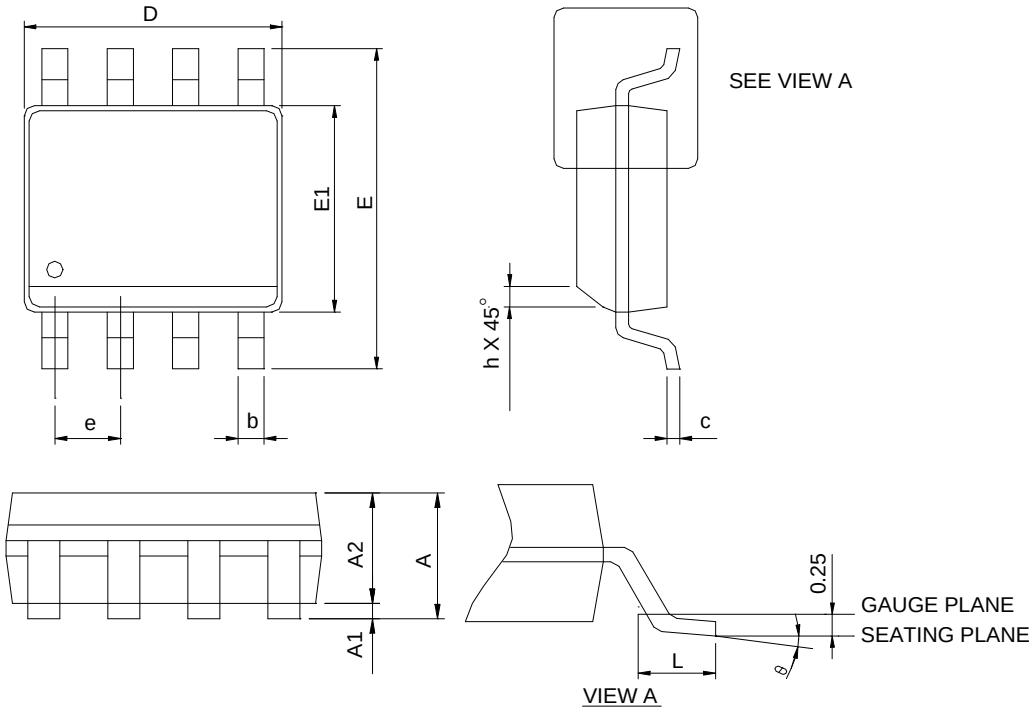
**DIP-8**




| SYMBOL | DIP-8 | | | |
|---|---|---|---|---|
| | MILLIMETERS | | INCHES | |
| | MIN. | MAX. | MIN. | MAX. |
| A | | 5.33 | | 0.210 |
| A1 | 0.38 | | 0.015 | |
| A2 | 2.92 | 4.95 | 0.115 | 0.195 |
| b | 0.36 | 0.56 | 0.014 | 0.022 |
| b2 | 1.14 | 1.78 | 0.045 | 0.070 |
| c | 0.20 | 0.35 | 0.008 | 0.014 |
| D | 9.01 | 10.16 | 0.355 | 0.400 |
| D1 | 0.13 | | 0.005 | |
| E | 7.62 | 8.26 | 0.300 | 0.325 |
| E1 | 6.10 | 7.11 | 0.240 | 0.280 |
| e | 2.54 BSC | | 0.100 BSC | |
| eA | 7.62 BSC | | 0.300 BSC | |
| eB | | 10.92 | | 0.430 |
| L | 2.92 | 3.81 | 0.115 | 0.150 |

## Package Information

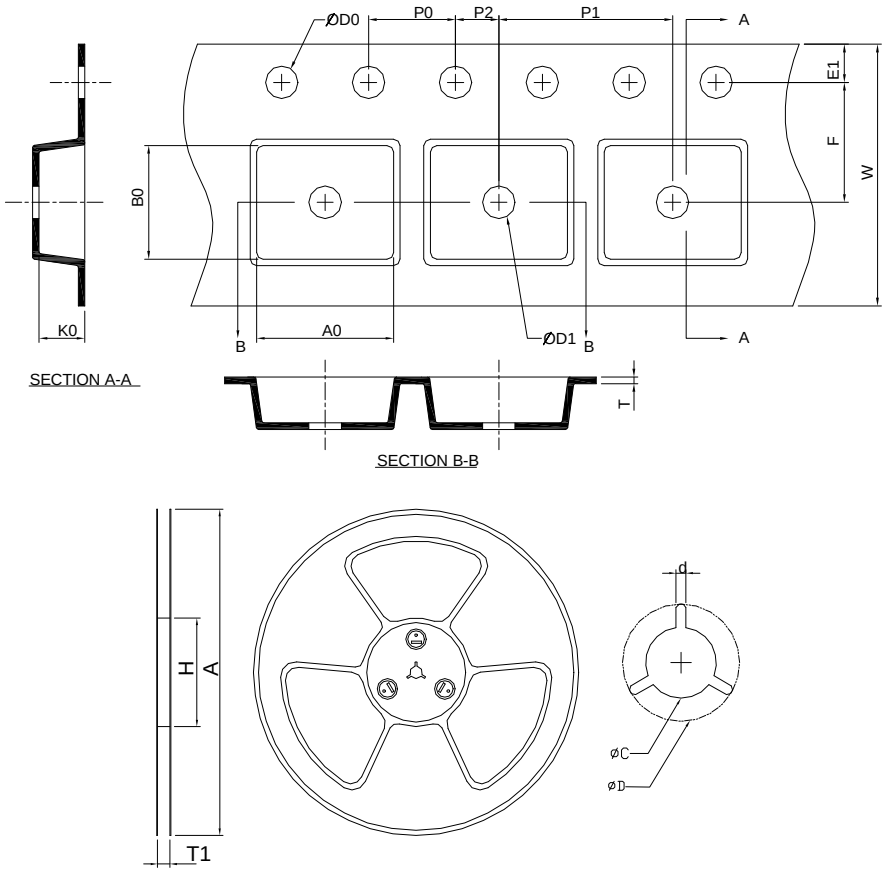
**SOP-8**




| SYMBOL | SOP-8 | | | |
|---|---|---|---|---|
| | MILLIMETERS | | INCHES | |
| | MIN. | MAX. | MIN. | MAX. |
| A | | 1.75 | | 0.069 |
| A1 | 0.10 | 0.25 | 0.004 | 0.010 |
| A2 | 1.25 | | 0.049 | |
| b | 0.31 | 0.51 | 0.012 | 0.020 |
| c | 0.17 | 0.25 | 0.007 | 0.010 |
| D | 4.80 | 5.00 | 0.189 | 0.197 |
| E | 5.80 | 6.20 | 0.228 | 0.244 |
| E1 | 3.80 | 4.00 | 0.150 | 0.157 |
| e | 1.27 BSC | | 0.050 BSC | |
| h | 0.25 | 0.50 | 0.010 | 0.020 |
| L | 0.40 | 1.27 | 0.016 | 0.050 |
| θ | 0° | 8° | 0° | 8° |

Note: 1. Follow JEDEC MS-012 AA.
2. Dimension “D” does not include mold flash, protrusions or gate burrs. Mold flash, protrusion or gate burrs shall not exceed 6 mil per side.
3. Dimension “E” does not include inter-lead flash or protrusions. Inter-lead flash and protrusions shall not exceed 10 mil per side.

## Carrier Tape & Reel Dimensions




| Application | A | H | T1 | C | d | D | W | E1 | F |
|---|---|---|---|---|---|---|---|---|---|
| SOP-8 | 330.0±2.00 | 50 MIN. | 12.4+2.00 -0.00 | 13.0+0.50 -0.20 | 1.5 MIN. | 20.2 MIN. | 12.0±0.30 | 1.75±0.10 | 5.5±0.05 |
| | **P0** | **P1** | **P2** | **D0** | **D1** | **T** | **A0** | **B0** | **K0** |
| | 4.0±0.10 | 8.0±0.10 | 2.0±0.05 | 1.5+0.10 -0.00 | 1.5 MIN. | 0.6+0.00 -0.40 | 6.40±0.20 | 5.20±0.20 | 2.10±0.20 |

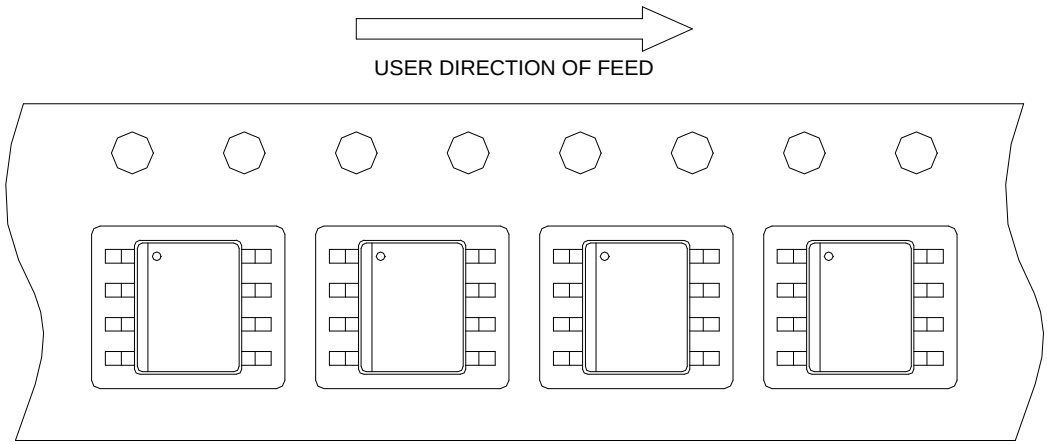
(mm)

## Devices Per Unit

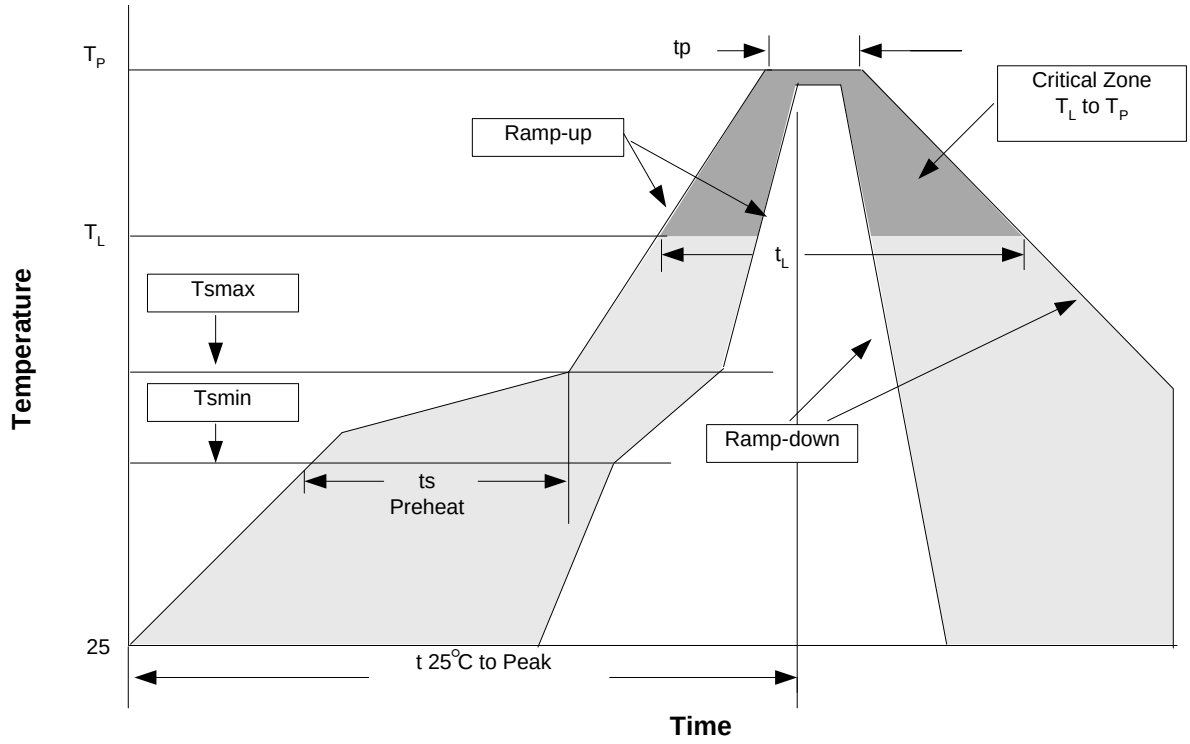
| Package Type | Unit | Quantity |
|---|---|---|
| **SOP-8** | Tape & Reel | 2500 |

## Taping Direction Information

**SOP-8**




## Reflow Condition (IR/Convection or VPR Reflow)




## Reliability Test Program

| Test item | Method | Description |
|---|---|---|
| SOLDERABILITY | MIL-STD-883D-2003 | 245°C, 5 sec |
| HOLT | MIL-STD-883D-1005.7 | 1000 Hrs Bias @125°C |
| PCT | JESD-22-B,A102 | 168 Hrs, 100%RH, 121°C |
| TST | MIL-STD-883D-1011.9 | -65°C~150°C, 200 Cycles |
| ESD | MIL-STD-883D-3015.7 | VHBM > 2KV, VMM > 200V |
| Latch-Up | JESD 78 | 10ms, $1_{tr}$ > 100mA |

## Classification Reflow Profiles

| Profile Feature | Sn-Pb Eutectic Assembly | Pb-Free Assembly |
|---|---|---|
| Average ramp-up rate ($T_L$ to $T_P$) | 3°C/second max. | 3°C/second max. |
| Preheat<br>- Temperature Min (Tsmin)<br>- Temperature Max (Tsmax)<br>- Time (min to max) (ts) | 100°C<br>150°C<br>60-120 seconds | 150°C<br>200°C<br>60-180 seconds |
| Time maintained above:<br>- Temperature ($T_L$)<br>- Time ($t_L$) | 183°C<br>60-150 seconds | 217°C<br>60-150 seconds |
| Peak/Classification Temperature (Tp) | See table 1 | See table 2 |
| Time within 5°C of actual Peak Temperature (tp) | 10-30 seconds | 20-40 seconds |
| Ramp-down Rate | 6°C/second max. | 6°C/second max. |
| Time 25°C to Peak Temperature | 6 minutes max. | 8 minutes max. |

Note: All temperatures refer to topside of the package. Measured on the body surface.

Table 1. SnPb Eutectic Process – Package Peak Reflow Temperatures

| Package Thickness | Volume $mm^3$ <350 | Volume $mm^3$ ³350 |
|---|---|---|
| <2.5 mm | 240 +0/-5°C | 225 +0/-5°C |
| ≥2.5 mm | 225 +0/-5°C | 225 +0/-5°C |

Table 2. Pb-free Process – Package Classification Reflow Temperatures

| Package Thickness | Volume $mm^3$ <350 | Volume $mm^3$ 350-2000 | Volume $mm^3$ >2000 |
|---|---|---|---|
| <1.6 mm | 260 +0°C* | 260 +0°C* | 260 +0°C* |
| 1.6 mm – 2.5 mm | 260 +0°C* | 250 +0°C* | 245 +0°C* |
| ≥2.5 mm | 250 +0°C* | 245 +0°C* | 245 +0°C* |

* Tolerance: The device manufacturer/supplier **shall** assure process compatibility up to and including the stated classification temperature (this means Peak reflow temperature +0°C. For example 260°C+0°C) at the rated MSL level.

## Customer Service

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