



## DESCRIPTION

The A2327 is a 2.6W high efficiency filter-free class-D audio power amplifier that requires only three external components.

Features like 88% efficiency, -75dB PSRR, and improved RF-rectification immunity make the A2327 ideal for cellular handsets. In cellular handsets, the earpiece, speaker phone, and melody ringer can each be driven by the A2327.

The A2327 is available in MSOP8, SOP8 and DFN8 packages.

## ORDERING INFORMATION

| Package Type                   | Part Number                               |            |
|--------------------------------|-------------------------------------------|------------|
| MSOP8<br>SPQ: 3,000pcs/Reel    | MS8                                       | A2327MS8R  |
|                                |                                           | A2327MS8VR |
| SOP8<br>SPQ: 2,500pcs/Reel     | M8                                        | A2327M8R   |
|                                |                                           | A2327M8VR  |
| DFN8<br>SPQ: 3,000pcs/Reel     | J8                                        | A2327J8R   |
|                                |                                           | A2327J8VR  |
| Note                           | V: Halogen free Package<br>R: Tape & Reel |            |
| AiT provides all RoHS products |                                           |            |

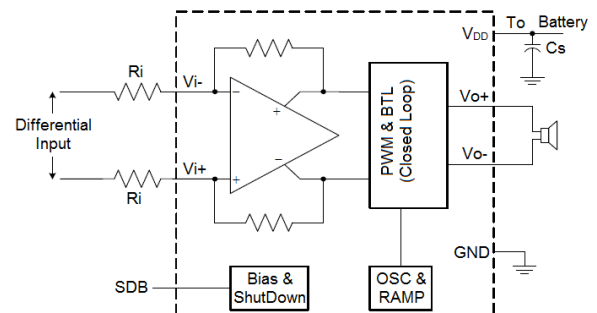
## FEATURES

- Efficiency With an 8Ω Speaker:  
88% @ 400mW  
80% @ 100mW
- 3.8mA Quiescent Current
- 0.4μA Shutdown Current
- Optimized PWM Output Stage Eliminates LC Output Filter
- Internally Generated 250kHz Switching Frequency Eliminates Capacitor and Resistor
- Improved PSRR (-75dB) and Wide Supply Voltage (2.5V to 5.5V) Eliminates Need for a Voltage Regulator
- Fully Differential Design Reduces RF Rectification and Eliminates Bypass Capacitor
- Improved CMRR Eliminates Two Input Coupling Capacitors
- Available in MSOP8, SOP8 and DFN8 packages

## APPLICATION

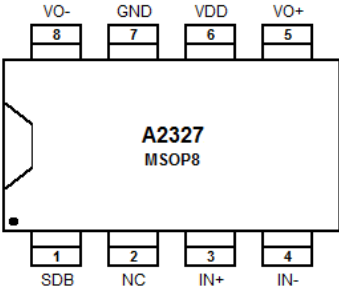
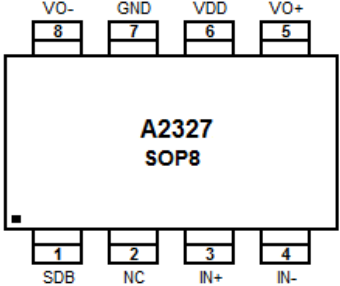
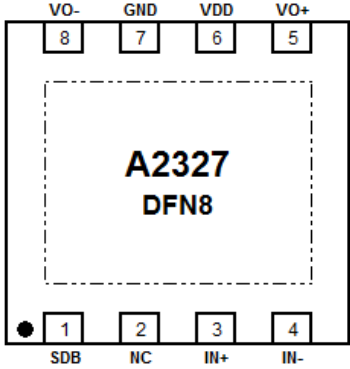
- Mobile phone、PDA、MID
- MP3/4、PMP
- Portable electronic devices

## TYPICAL APPLICATION





## PIN DESCRIPTION

|  <p><b>A2327</b><br/>MSOP8</p> <p>Top View</p> |                 |                                |  <p><b>A2327</b><br/>SOP8</p> <p>Top View</p> |  |  |  <p><b>A2327</b><br/>DFN8</p> <p>Top View</p> |  |  |
|---------------------------------------------------------------------------------------------------------------------------------|-----------------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------|--|--|----------------------------------------------------------------------------------------------------------------------------------|--|--|
| Pin #                                                                                                                           | Symbol          | Function                       |                                                                                                                                |  |  |                                                                                                                                  |  |  |
| 1                                                                                                                               | SDB             | Shutdown terminal (low active) |                                                                                                                                |  |  |                                                                                                                                  |  |  |
| 2                                                                                                                               | NC              | NC (No internal connection)    |                                                                                                                                |  |  |                                                                                                                                  |  |  |
| 3                                                                                                                               | IN+             | Positive differential input    |                                                                                                                                |  |  |                                                                                                                                  |  |  |
| 4                                                                                                                               | IN-             | Negative differential input    |                                                                                                                                |  |  |                                                                                                                                  |  |  |
| 5                                                                                                                               | VO+             | Positive BTL output            |                                                                                                                                |  |  |                                                                                                                                  |  |  |
| 6                                                                                                                               | V <sub>DD</sub> | Power Supply                   |                                                                                                                                |  |  |                                                                                                                                  |  |  |
| 7                                                                                                                               | GND             | Power Ground                   |                                                                                                                                |  |  |                                                                                                                                  |  |  |
| 8                                                                                                                               | VO-             | Negative BTL output            |                                                                                                                                |  |  |                                                                                                                                  |  |  |



## ABSOLUTE MAXIMUM RATINGS

|                             |                       |
|-----------------------------|-----------------------|
| Supply Voltage              | -0.3V ~ 6V            |
| Input Voltage               | -0.3V ~ $V_{DD}+0.3V$ |
| Storage Temperature         | -65°C ~ +150°C        |
| Operating Temperature Range | -40°C ~ +85°C         |

Stress beyond above listed "Absolute Maximum Ratings" may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## ELECTRICAL CHARACTERISTICS

The following specifications apply for the circuit shown in Figure 1.

$T_A = 25^\circ\text{C}$ , unless otherwise specified.

| Parameter                          | Symbol       | Conditions                                                                                       | Min.               | Typ.               | Max.               | Unit          |
|------------------------------------|--------------|--------------------------------------------------------------------------------------------------|--------------------|--------------------|--------------------|---------------|
| Shutdown Current                   | $I_{SD}$     | $V_{IN}=0V$ , $V_{SDB}=0V$ , No Load                                                             | -                  | 0.4                | 2                  | uA            |
| Quiescent Current                  | $I_Q$        | $V_{DD}=2.5V$ , $V_{IN}=0V$ , No Load                                                            | -                  | 2.2                | 3.2                | mA            |
|                                    |              | $V_{DD}=3.6V$ , $V_{IN}=0V$ , No Load                                                            | -                  | 2.6                | -                  |               |
|                                    |              | $V_{DD}=5.5V$ , $V_{IN}=0V$ , No Load                                                            | -                  | 3.8                | 8                  |               |
| Output Offset Voltage              | $ V_{OS} $   | $V_{IN}=0V$ , $A_V=2V/V$ ,<br>$V_{DD}=2.5V$ to $5.5V$                                            | -                  | 2                  | 25                 | mV            |
| Power Supply Rejection Ratio       | PSRR         | $V_{DD}=2.5V$ to $5.5V$                                                                          | -                  | -75                | -                  | dB            |
| Common Mode Rejection Ratio        | CMRR         | $V_{DD}=2.5V$ to $5.5V$ ,<br>$V_{IC}=V_{DD}/2$ to $0.5V$ ,<br>$V_{IC}=V_{DD}/2$ to $V_{DD}-0.8V$ | -                  | -68                | -                  | dB            |
| Modulation Frequency               | $F_{SW}$     | $V_{DD}=2.5V$ to $5.5V$                                                                          | 200                | 250                | 300                | kHz           |
| Voltage Gain                       | $A_V$        | $V_{DD}=2.5V$ to $5.5V$                                                                          | $\frac{270k}{R_L}$ | $\frac{300k}{R_L}$ | $\frac{330k}{R_L}$ | $\frac{V}{V}$ |
| Resistance from SDB to GND         | $R_{SDB}$    |                                                                                                  | -                  | 300                | -                  | kΩ            |
| Input Impedance                    | $Z_I$        |                                                                                                  | 135                | 150                | 165                | kΩ            |
| Wake-up Time from Shutdown         | $T_{WU}$     | $V_{DD}=3.6V$                                                                                    | -                  | 32                 | -                  | ms            |
| Drain-Source Resistance (on-state) | $R_{DS(ON)}$ | $V_{DD}=2.5V$                                                                                    | -                  | 700                | -                  | mΩ            |
|                                    |              | $V_{DD}=3.6V$                                                                                    | -                  | 500                | -                  |               |
|                                    |              | $V_{DD}=5.5V$                                                                                    | -                  | 400                | -                  |               |
| Shutdown Voltage Input High        | $V_{SDIH}$   |                                                                                                  | 1.3                | -                  | -                  | V             |
| Shutdown Voltage Input Low         | $V_{SDIL}$   |                                                                                                  | -                  | -                  | 0.4                | V             |



## OPERATING CHARACTERISTICS

$V_{DD}=5V$ ,  $R_I=150k\Omega$ ,  $T_A=25^\circ C$ , unless otherwise specified.

| Parameter                         | Symbol | Conditions                                     | Min. | Typ. | Max. | Unit |
|-----------------------------------|--------|------------------------------------------------|------|------|------|------|
| Output Power                      | $P_O$  | THD+N=10%, f=1kHz, $R_L=4\Omega$               | -    | 2.60 | -    | W    |
|                                   |        | THD+N=1%, f=1kHz, $R_L=4\Omega$                | -    | 2.10 | -    |      |
|                                   |        | THD+N=10%, f=1kHz, $R_L=8\Omega$               | -    | 1.60 | -    |      |
|                                   |        | THD+N=1%, f=1kHz, $R_L=8\Omega$                | -    | 1.30 | -    |      |
| Total Harmonic Distortion + Noise | THD+N  | $P_O=1.0W_{rms}$ , f=1kHz, $R_L=8\Omega$       | -    | 0.21 | -    | %    |
| Signal-to-Noise Ratio             | SNR    | $V_{DD}=5V$ , $P_O=1.0W_{rms}$ , $R_L=8\Omega$ | -    | 91   | -    | dB   |

$V_{DD}=3.6V$ ,  $R_I=150k\Omega$ ,  $T_A=25^\circ C$ , unless otherwise specified.

| Parameter                         | Symbol    | Conditions                                                                                   | Min.         | Typ. | Max. | Unit          |
|-----------------------------------|-----------|----------------------------------------------------------------------------------------------|--------------|------|------|---------------|
| Output Power                      | $P_O$     | THD+N=10%, f=1kHz, $R_L=4\Omega$                                                             | -            | 1.35 | -    | W             |
|                                   |           | THD+N=1%, f=1kHz, $R_L=4\Omega$                                                              | -            | 1.08 | -    |               |
|                                   |           | THD+N=10%, f=1kHz, $R_L=8\Omega$                                                             | -            | 0.85 | -    |               |
|                                   |           | THD+N=1%, f=1kHz, $R_L=8\Omega$                                                              | -            | 0.69 | -    |               |
| Total Harmonic Distortion + Noise | THD+N     | $P_O=0.5W_{rms}$ , f=1kHz, $R_L=8\Omega$                                                     | -            | 0.21 | -    | %             |
| Supply Ripple Rejection Ratio     | $K_{SVR}$ | $V_{DD}=3.6V$ , input ac-grounded with $C_I=2\mu F$ , f=217Hz, V(Ripple)=200mV <sub>PP</sub> | -            | -65  | -    | dB            |
| Output Voltage Noise              | $V_n$     | $V_{DD}=3.6V$ , input ac-grounded with $C_I=2\mu F$ , f=20~20kHz                             | No weighting | 100  | -    | $\mu V_{RMS}$ |
|                                   |           |                                                                                              | A weighting  | 75   | -    |               |
| Common Mode Rejection Ratio       | CMRR      | $V_{DD}=3.6V$ , $V_{IC}=1V_{PP}$ , f=217Hz                                                   | -            | -70  | -    | dB            |

$V_{DD}=2.5V$ ,  $R_I=150k\Omega$ ,  $T_A=25^\circ C$ , unless otherwise specified.

| Parameter                         | Symbol | Conditions                               | Min. | Typ. | Max. | Unit |
|-----------------------------------|--------|------------------------------------------|------|------|------|------|
| Output Power                      | $P_O$  | THD+N=10%, f=1kHz, $R_L=4\Omega$         | -    | 0.60 | -    | W    |
|                                   |        | THD+N=1%, f=1kHz, $R_L=4\Omega$          | -    | 0.51 | -    |      |
|                                   |        | THD+N=10%, f=1kHz, $R_L=8\Omega$         | -    | 0.40 | -    |      |
|                                   |        | THD+N=1%, f=1kHz, $R_L=8\Omega$          | -    | 0.33 | -    |      |
| Total Harmonic Distortion + Noise | THD+N  | $P_O=0.2W_{rms}$ , f=1kHz, $R_L=8\Omega$ | -    | 0.21 | -    | %    |



## TEST CIRCUIT

Figure1. A2327 test set up circuit

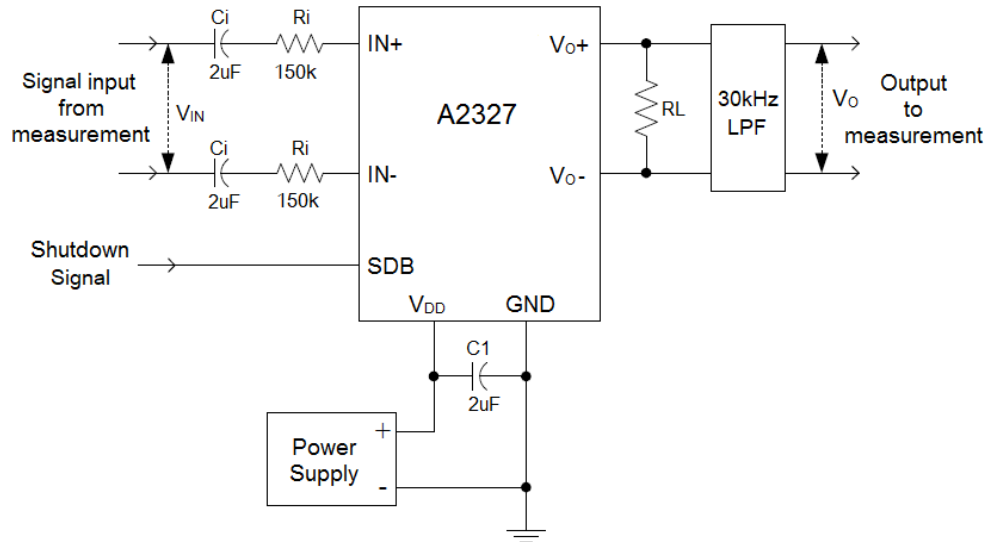
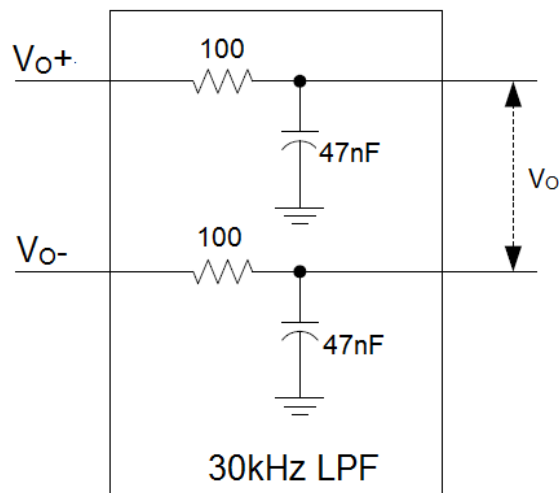


Figure2. 30kHz LPF for A2327 test



NOTE1:  $C_S$  should be placed as close as possible to  $V_{DD}/GND$  pad of the device

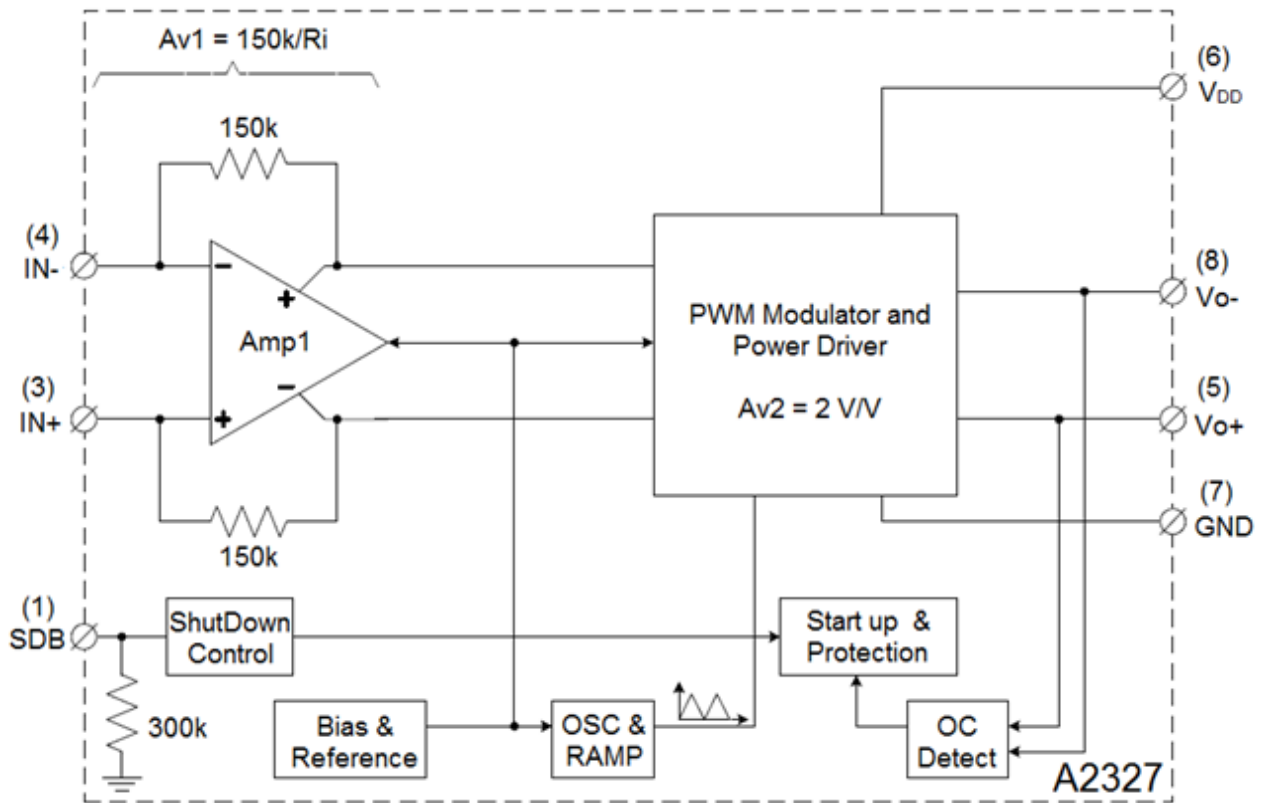
NOTE2:  $C_i$  should be shorted for any Common-Mode input voltage measurement

NOTE3: A 33uH inductor should be used in series with  $R_L$  for efficiency measurement

NOTE4: The 30kHz LPF (shown in figure 1) is required even if the analyzer has an internal LPF



## BLOCK DIAGRAM



NOTE: Total Voltage Gain =  $Av1 \times Av2 = 2 \times \frac{150k}{Ri}$



## DETAILED INFORMATION

### Application Circuit

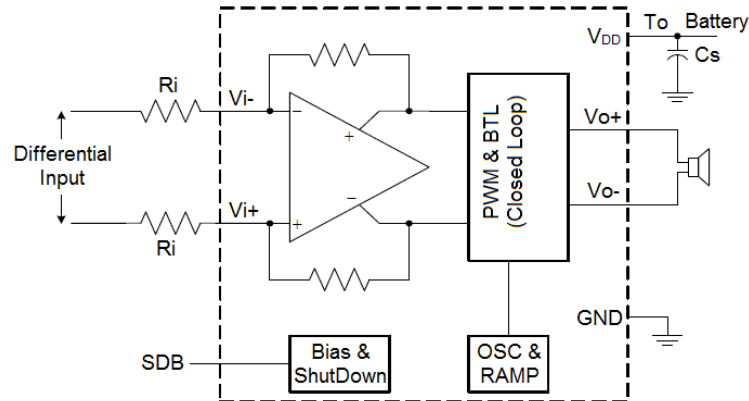


Figure 3. A2327 Application Schematic With Differential Input

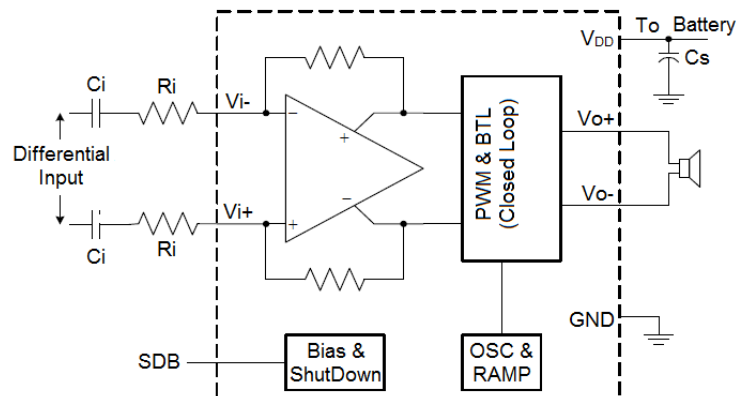


Figure 4. A2327 Application Schematic With Differential Input and Input Capacitors

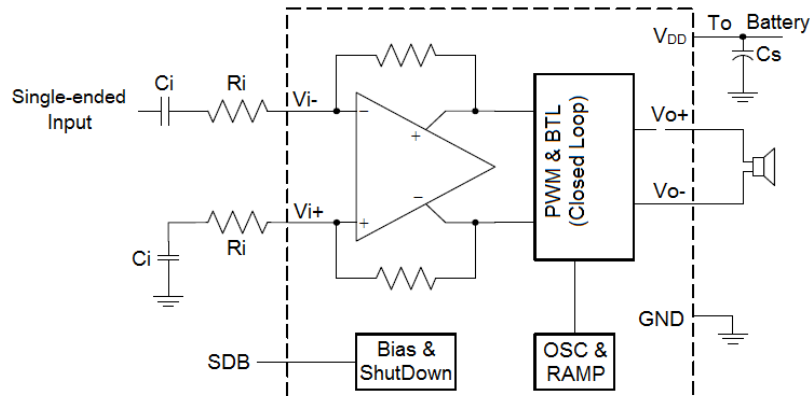


Figure 5. A2327 Application Schematic With Single-Ended Input



### Component Recommended

Due to the weak noise immunity of the single-ended input application, the differential input application should be used whenever possible. The typical component values are listed in the table:

| $R_i$ | $C_i$ | $C_s$ |
|-------|-------|-------|
| 150k  | 3.3nF | 2uF   |

- (1)  $C_i$  should have a tolerance of  $\pm 10\%$  or better to reduce impedance mismatch.
- (2) Use 1% tolerance resistors or better to keep the performance optimized, and place the  $R_i$  close to the device to limit noise injection on the high-impedance nodes.

### Input Resistors ( $R_i$ ) & Capacitors ( $C_i$ )

The input resistors ( $R_i$ ) set the total voltage gain of the amplifier according to *Formula 1*.

$$\text{Gain} = \frac{2 \times 150\text{k}\Omega}{R_i} \left( \frac{V}{V} \right) \quad \text{Formula 1}$$

The input resistor matching directly affects the CMRR, PSRR, and the second harmonic distortion cancellation. If a differential signal source is used, and the signal is biased from  $0.5V \sim V_{DD}-0.8V$  (shown in Figure3), the input capacitor ( $C_i$ ) is not required.

If the input signal is not biased within the recommended common-mode input range in differential input application (shown in Figure4), or in a single-ended input application (shown in Figure5), the input coupling capacitors are required.

If the input coupling capacitors are used, the  $R_i$  and  $C_i$  form a high-pass filter (HPF). The corner frequency ( $f_c$ ) of the HPF can be calculated by *Formula 2*

$$f_c = \frac{1}{2\pi \times R_i \times C_i} (\text{Hz}) \quad \text{Formula 2}$$

### Decoupling Capacitor ( $C_s$ )

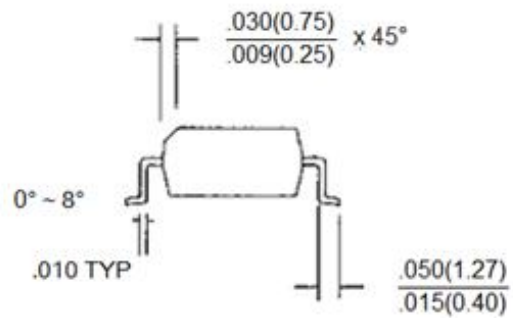
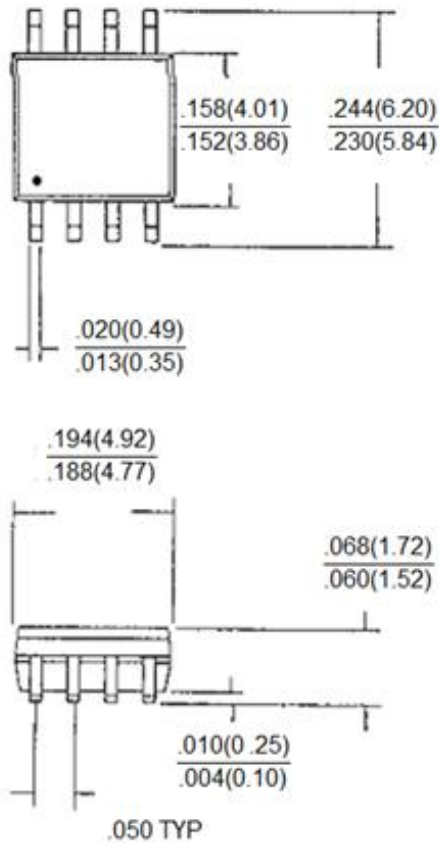
A good low equivalent-series-resistance (ESR) ceramic capacitor ( $C_s$ ), used as power supply decoupling capacitor ( $C_s$ ), is required for high power supply rejection (PSRR), high efficiency and low total harmonic distortion (THD).  $C_s$  is 2uF, placed as close as possible to the device  $V_{DD}$  pin.





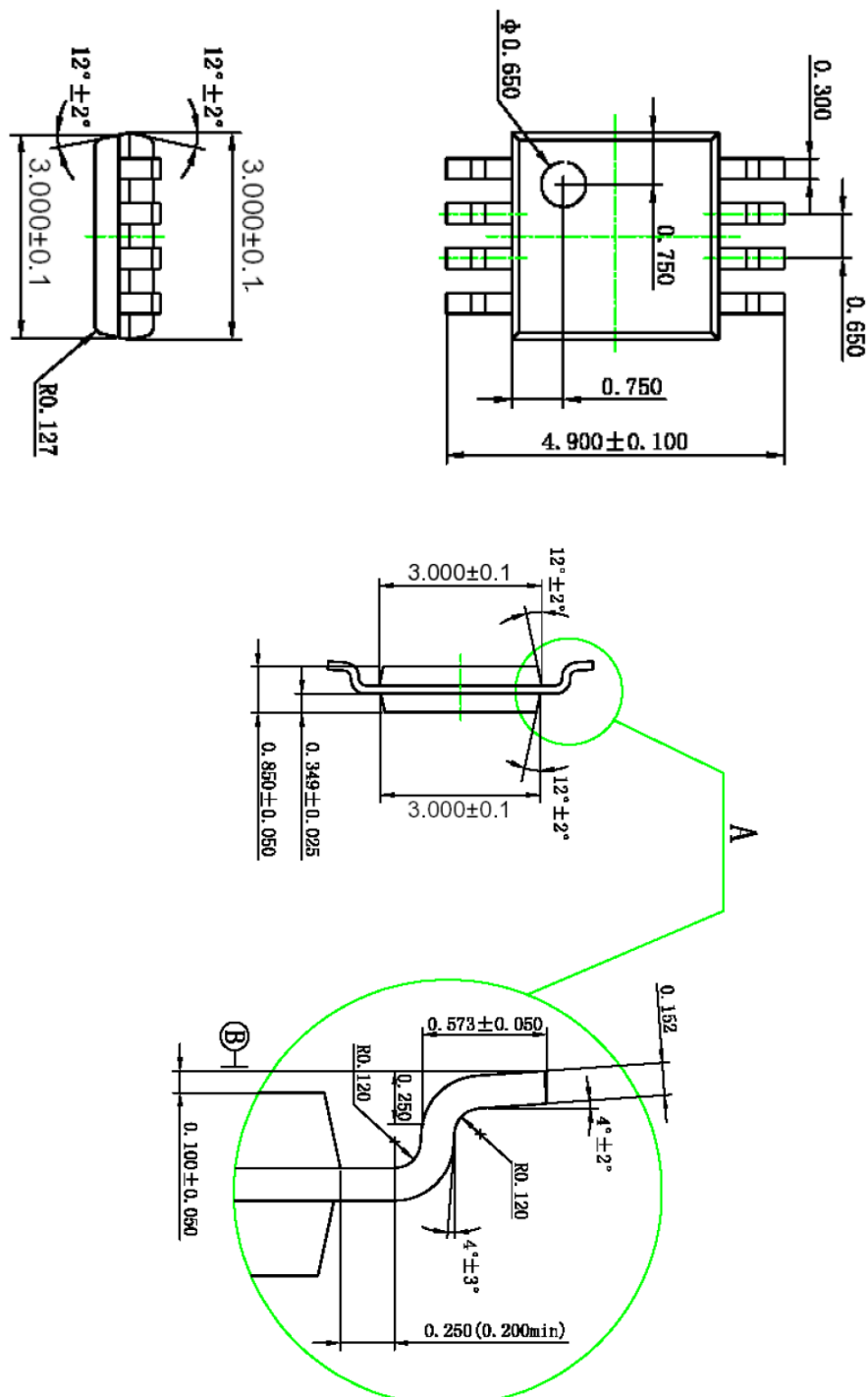
## PACKAGE INFORMATION

Dimension in SOP8 (Unit: mm)



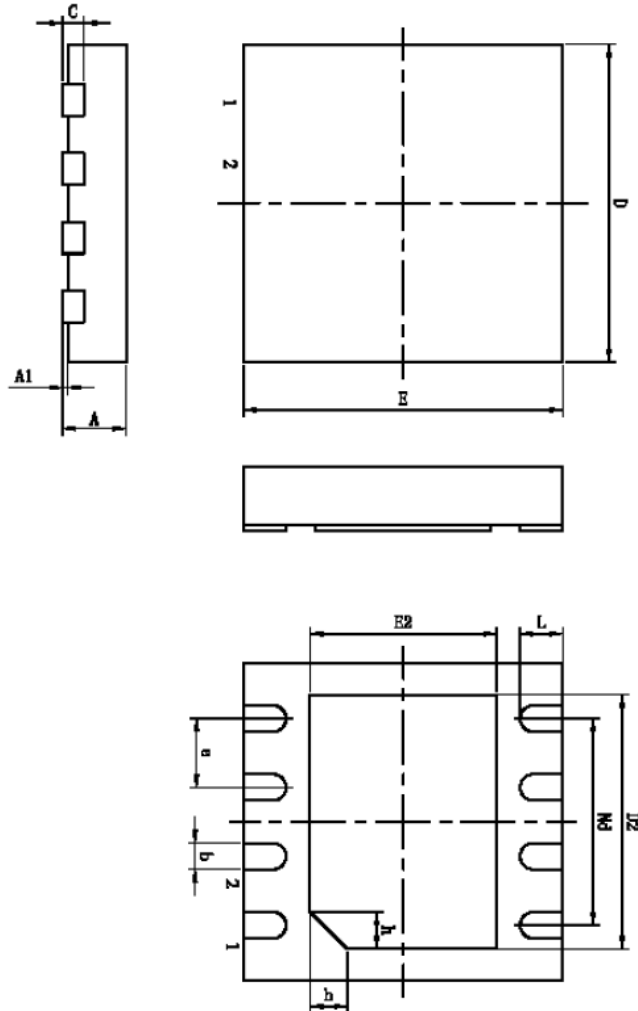


## AUDIO AMPLIFIER





Dimension in DFN8 (Unit: mm)



| Symbol | Min     | Max  |
|--------|---------|------|
| A      | 0.70    | 0.80 |
| A1     | -       | 0.05 |
| b      | 0.25    | 0.35 |
| c      | 0.18    | 0.25 |
| D      | 2.90    | 3.10 |
| D2     | 2.50REF |      |
| e      | 0.65BSC |      |
| Nd     | 1.95BSC |      |
| E      | 2.90    | 3.10 |
| E2     | 1.55REF |      |
| L      | 0.30    | 0.50 |
| h      | 0.20    | 0.30 |



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