



## PA3428

CMOS IC

### 2W STEREO AUDIO AMPLIFIER

#### DESCRIPTION

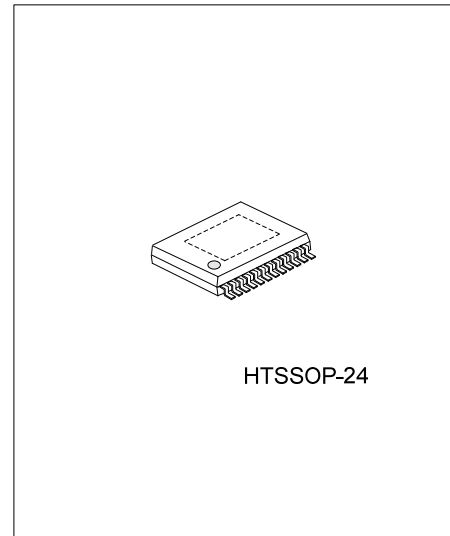
As a stereo audio speaker which is operating on a single 5V supply, the UTC **PA3428** is capable of delivering 2W of output power per channel into 4Ω loads with less than 1% THD+N.

Way of two terminals (GAIN0 and GAIN1) can configured and control the amplifier gain. It also provide gain settings of 2, 6, 12, and 24V/V.

Other features include internal gain control which requires few external components, an active-low shutdown mode input and thermal shutdown protection.

#### FEATURES

- \* Internal Depop circuitry
- \* Output power at 1% THD+N
  - Supply voltage:5V
  - Delivering 2.0W into a 4Ω load
  - Delivering 1.2W into a 8Ω load
- \* Tow mode:
  - Bridge-tied Load (BTL),
  - Single-ended (SE)
- \* Stereo input signal
- \* Fully differential input
- \* Gain control Internally
- \* Differential Input fully



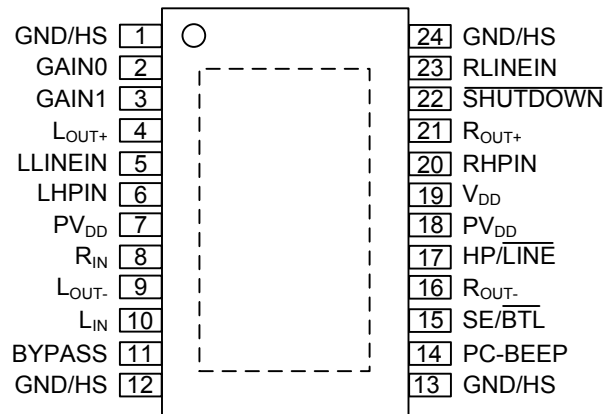
Lead-free: PA3428L  
Halogen-free: PA3428G

#### ORDERING INFORMATION

| Ordering Number |               |               | Package  | Packing   |
|-----------------|---------------|---------------|----------|-----------|
| Normal          | Lead Free     | Halogen Free  |          |           |
| PA3428-N24-R    | PA3428L-N24-R | PA3428G-N24-R | TSSOP-24 | Tape Reel |
| PA3428-N24-T    | PA3428L-N24-T | PA3428G-N24-T | TSSOP-24 | Tube      |

|                      |   |   |
|----------------------|---|---|
| <p>PA3428L-N24-R</p> | <p>(1) Packing Type<br/>(2) Package Type<br/>(3) Lead Plating</p> | <p>(1) R: Tape Reel, T: Tube<br/>(2) N24: HTSSOP-24<br/>(3) G: Halogen Free, L: Lead Free,<br/>Blank: Pb/Sn</p> |
|----------------------|---|---|

## ■ PIN CONFIGURATION



## ■ PIN DESCRIPTION

| PIN NO     | PIN NAME          | I/O | DESCRIPTION   |
|------------|-------------------|-----|---|
| 1,12,13,24 | GND/HS            |     | Ground, connected to thermal pad directly.  |
| 11         | BYPASS            |     | Connected to voltage divider  |
| 2          | GAIN0             | I   | For gain control: Bit 0   |
| 3          | GAIN1             | I   | For gain control: Bit 1   |
| 5          | LLINEIN           | I   | Line input for Left channel, available when pin17 is held low.  |
| 6          | LPHIN             | I   | Headphone input Left channel, available when pin17 is held high.  |
| 7,18       | PV <sub>DD</sub>  | I   | Supply voltage  |
| 8          | R <sub>IN</sub>   | I   | Differential input for Right channel. And for single-ended inputs is also AC ground.  |
| 10         | L <sub>IN</sub>   | I   | Differential input for Left channel. And for single-ended inputs is also AC ground.   |
| 14         | PC-BEEP           | I   | PC-BEEP mode input. When at least eight continuous > 1-V <sub>PP</sub> square waves is input to this pin, PC-BEEP is enabled. |
| 15         | SE/BTL            | I   | Low for BTL mode, high for SE mode.   |
| 17         | HP/LINE           | I   | Input of MUX control. Being high to select the inputs of Pin6, 20, and low to select inputs of PIN 5, 23.                     |
| 19         | V <sub>DD</sub>   |     | Analog V <sub>DD</sub> Supply voltage   |
| 20         | RHPIN             | I   | Right channel headphone input, selected when HP/LINE pin is held high.  |
| 22         | SHUTDOWN          | I   | in shutdown mode when held low, expect PC-BEEP remains active.  |
| 23         | RLINEIN           | I   | Headphone input right channel, available when pin17 is held low.  |
| 4          | L <sub>OUT+</sub> | O   | Positive output for Left channel in BTL mode, positive output in SE mode.   |
| 9          | L <sub>OUT-</sub> | O   | Negative output for Left channel, and high impedance in SE mode.  |
| 16         | R <sub>OUT-</sub> | O   | Negative output for Right channel, and high impedance in SE mode.   |
| 21         | R <sub>OUT+</sub> | O   | Positive output for right channel in BTL mode, positive output in SE mode.  |

### ■ ABSOLUTE MAXIMUM RATING

| PARAMETER                                     | SYMBOL    | RATINGS  | UNIT             |
|---|-----------|----------|------------------|
| Supply Voltage                                | $V_{CC}$  | 6        | V                |
| Power Dissipation $T_A \leq 25^\circ\text{C}$ | $P_D$     | 2.7      | W                |
| Operating Free-Air Temperature Range          | $T_A$     | -40~+85  | $^\circ\text{C}$ |
| Operating Junction Temperature Range          | $T_J$     | 150      | $^\circ\text{C}$ |
| Storage Temperature Range                     | $T_{STG}$ | -65~+150 | $^\circ\text{C}$ |

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

### ■ ELECTRICAL CHARACTERISTICS ( $T_A = 25^\circ\text{C}$ )

| PARAMETER  | SYMBOL          | TEST CONDITIONS   | MIN | TYP  | MAX | UNIT               |
|--|-----------------|---|-----|------|-----|--------------------|
| <b>DC ELECTRICAL CHARACTERISTICS</b>   |                 |   |     |      |     |                    |
| Supply voltage   | $V_{DD}$        |   | 4.5 | 5    | 5.5 | V                  |
| High-Level Input voltage   | $V_{IH}$        | SHUTDOWN, SE/BTL, HP/LINE, GAIN0, GAIN1                         | 3.5 |      |     | V                  |
| Low-Level Input voltage  | $V_{IL}$        | SHUTDOWN, SE/BTL, HP/LINE, GAIN0, GAIN1                         |     |      | 1   | V                  |
| DC Differential Output Voltage   | $V_{OUT(DIFF)}$ | $V_{DD} = 5V, \text{Gain} = 2V/V$                               |     | 5    | 50  | mV                 |
| Supply Current in Mute Mode  | $I_{DD}$        | $V_{DD} = 5V, \text{Stereo BTL}$                                |     | 7.5  | 13  | mA                 |
|  |                 | $V_{DD} = 5V, \text{Stereo SE}$                                 |     | 4    | 7   |                    |
| Supply Current, Shutdown Mode  | $I_{DD(SD)}$    | $V_{DD} = 5V$   |     | 160  | 300 | $\mu\text{A}$      |
| <b>AC ELECTRICAL CHARACTERISTICS</b> $V_{DD} = 5.0V, R_L = 4\Omega$ , unless otherwise specified |                 |   |     |      |     |                    |
| Output Power   | $P_{OUT}$       | THD = 1%, BTL, $R_L = 4\Omega, G = 2V/V$                        |     | 2    |     | W                  |
|  |                 | THD = 1%, BTL, $R_L = 8\Omega, G = 2V/V$                        |     | 1.25 |     |                    |
|  |                 | THD = 10%, BTL, $R_L = 4\Omega, G = 2V/V$                       |     | 2.5  |     |                    |
|  |                 | THD = 10%, BTL, $R_L = 8\Omega, G = 2V/V$                       |     | 1.6  |     |                    |
|  |                 | THD = 0.1%, SE, $R_L = 32\Omega$                                |     | 85   |     | mW                 |
| Total Harmonic Distortion Plus Noise   | THD+N           | $P_{OUT} = 1.6W, \text{BTL}, R_L = 4\Omega, G = 2V/V$           |     | 100  |     | m%                 |
|  |                 | $P_{OUT} = 1W, \text{BTL}, R_L = 8\Omega, G = 2V/V$             |     | 60   |     |                    |
|  |                 | $P_{OUT} = 75mW, \text{SE}, R_L = 32\Omega$                     |     | 80   |     |                    |
|  |                 | $V_I = 1V, \text{BTL}, R_L = 10k\Omega, \text{SE}$              |     | 30   |     |                    |
| Max Output Power Bandwidth   | $B_{OM}$        | THD = 5%  |     | 15   |     | kHz                |
| Power Supply Ripple Rejection  | PSRR            | $F = 1\text{kHz}, \text{BTL}, G = 2V/V, C_{BYP} = 1\mu\text{F}$ |     | 68   |     | V/V                |
| Channel-to-Channel Output Separation   |                 | $F = 1\text{kHz}$   |     | 80   |     | V/V                |
| Line/HP Input Separation   |                 |   |     | 80   |     | V/V                |
| BTL Attenuation (SE mode)  |                 |   |     | 85   |     | V/V                |
| Signal-to-Noise Ratio  | SNR             | $P_{OUT} = 500mW, \text{BTL}, G = 2V/V$                         |     | 90   |     | V/V                |
| Output Noise Voltage   | eN              | BTL, $G = 2V/V, A$ Weighted filter                              |     | 45   |     | $\mu\text{V(rms)}$ |

Note: Output power is measured at the output terminals of the IC at 1kHz.

## ■ APPLICATION INFORMATION

### Shutdown Mode Operating

| INPUT   |        |          | AMPLIFIER |        |
|---------|--------|----------|-----------|--------|
| HP/LINE | SE/BTL | SHUTDOWN | INPUT     | OUTPUT |
| X       | X      | L        | X         | MUTE   |
| L       | L      | H        | LINE      | BTL    |
| L       | H      | H        | LINE      | SE     |
| H       | L      | H        | HEADPHONE | BTL    |
| H       | H      | H        | HEADPHONE | SE     |

X: Ignore

L: Low

H: High

### C<sub>i</sub> (Input Capacitor)

The value of C<sub>i</sub> is important to consider as it directly affects the bass performance of the application circuit. When C<sub>i</sub> is required to allow the amplifier to bias the input signal to the proper dc level for optimum operation, its value can be calculate by this equation:

$$C_i = 1 / (2\pi R_i F_c)$$

R<sub>i</sub>: Input Impedance

F<sub>c</sub>: High-pass Filter's Frequency

The low leakage tantalum or ceramic capacitors are suggested to be used as the input coupling capacitors, because of the small leakage current of the input ca-pacitors will cause the dc offset voltage at the input to the amplifier that reduces the operation headroom, especially at the high gain applications. It is important to let the positive side connecting to the higher dc level of the application when using the polarized capacitors.

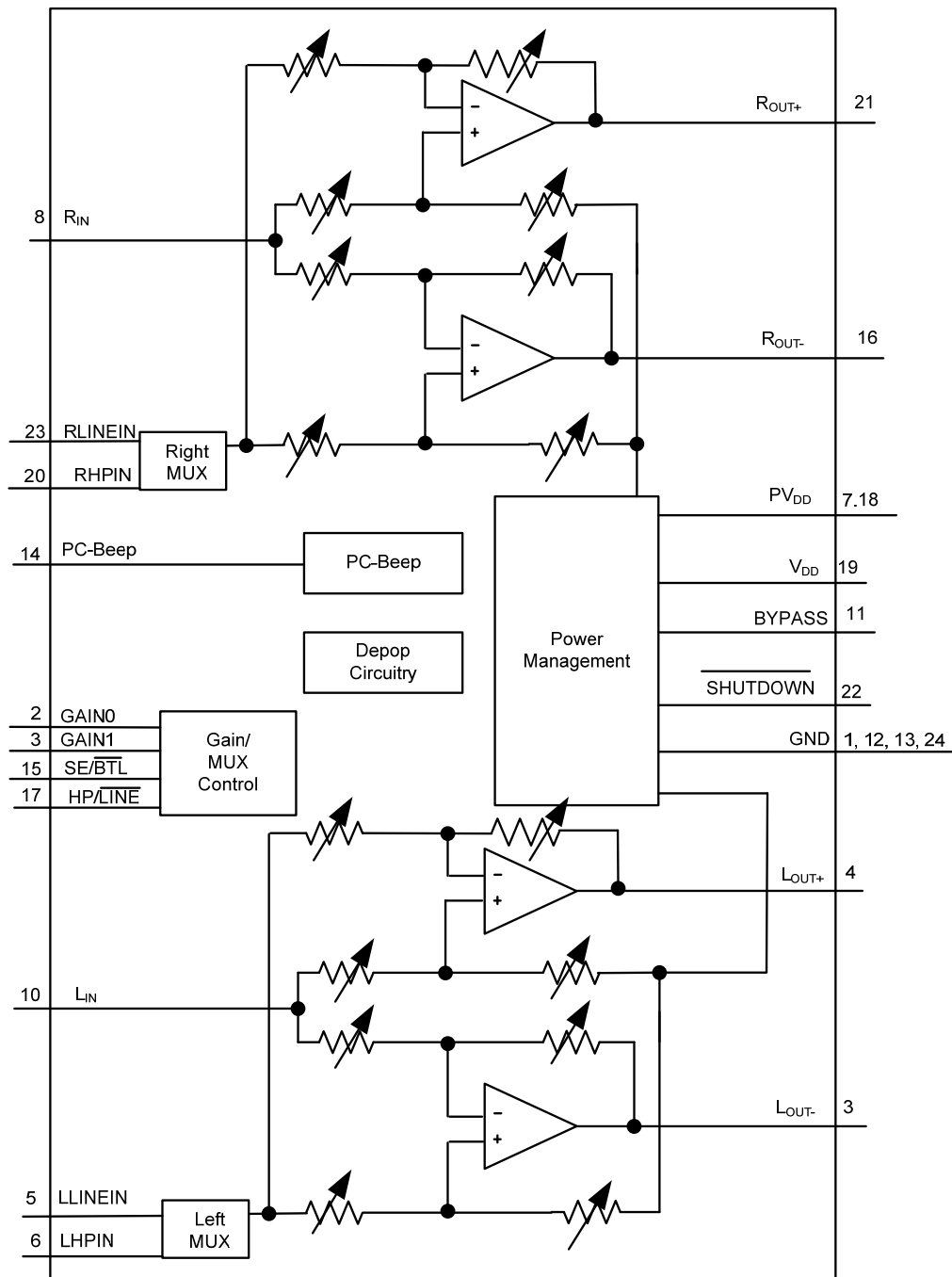
### Gain setting (Vs Gain0, Gain1 and R<sub>i</sub>, SE/BTL)

Gain setting is determined by GAIN0 and GAIN1. The gains listed in the next table are realized by changing the taps on the input resistors inside the amplifier which will cause the internal input impedance(R<sub>i</sub>) to be dependent on the gain setting as we can see listed in the next table.

| A <sub>v</sub> (V/V) | GAIN0 | GAIN1 | SE/BTL | R <sub>i</sub> (kΩ) |
|----------------------|-------|-------|--------|---------------------|
| 2                    | 0     | 0     | 0      | 90                  |
| 6                    | 0     | 1     | 0      | 45                  |
| 12                   | 1     | 0     | 0      | 30                  |
| 24                   | 1     | 1     | 0      | 15                  |
| 1                    | X     | X     | 1      |                     |

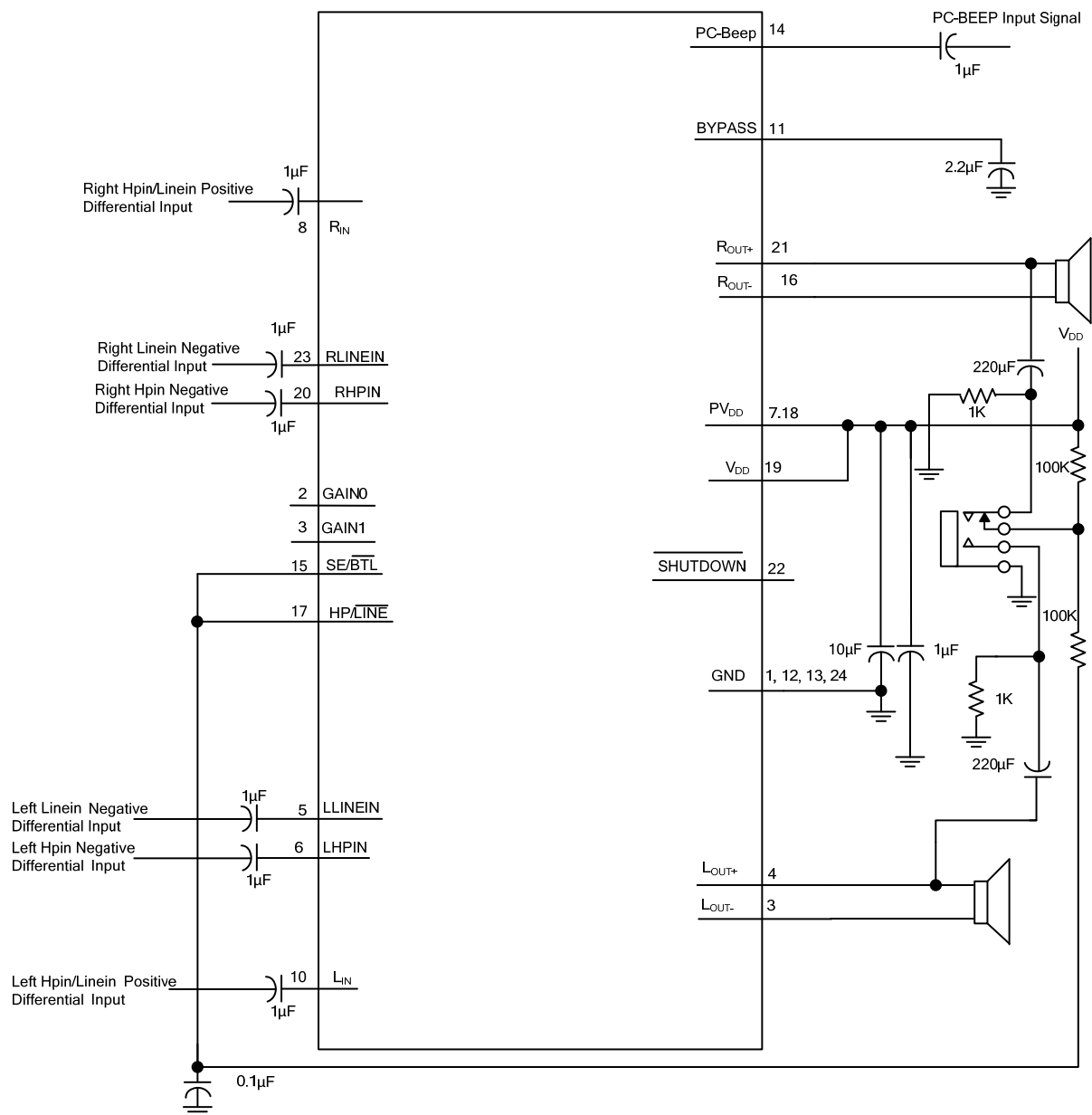
X: Ignore

■ BLOCK



## TYPICAL APPLICATION CIRCUIT

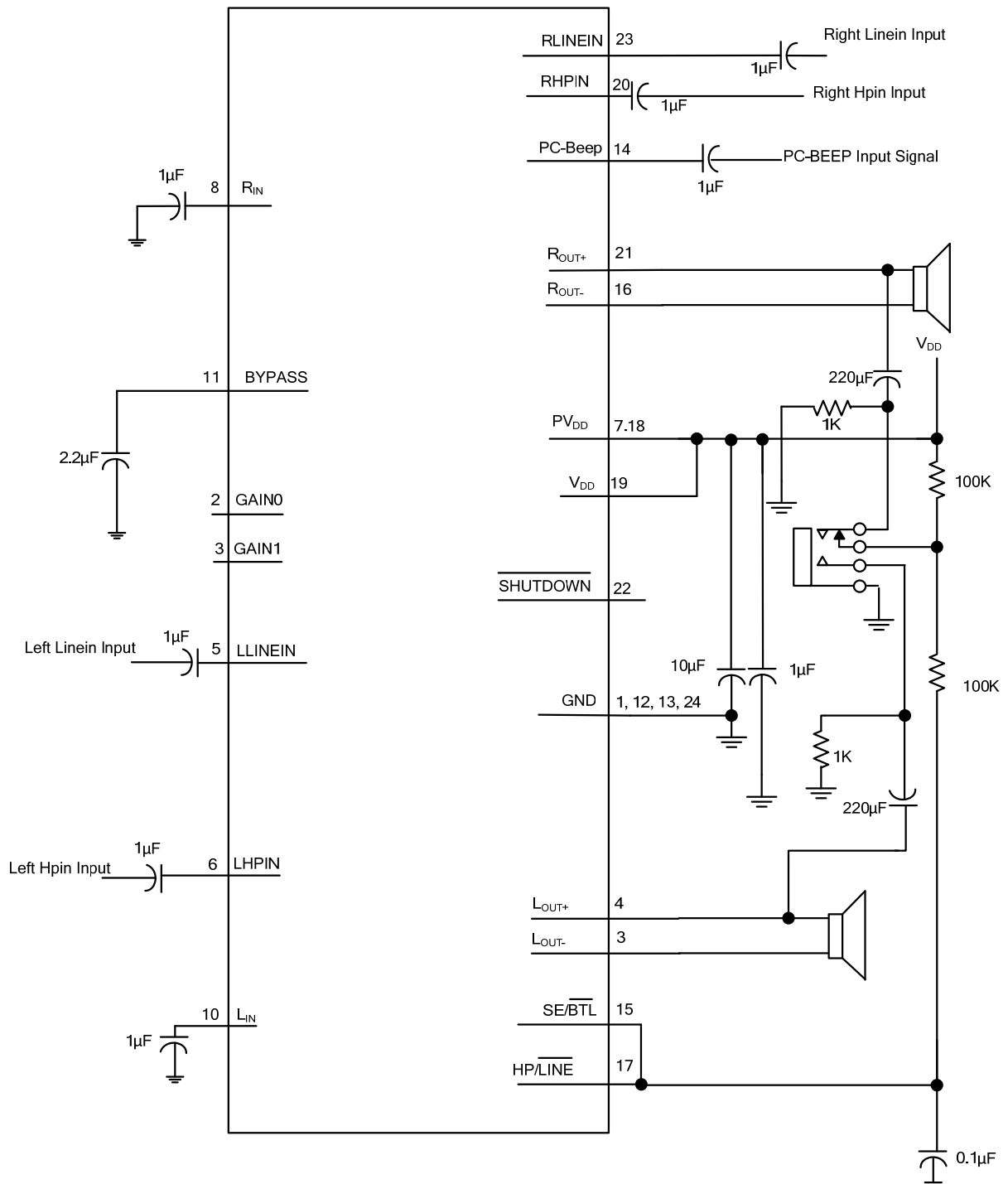
### FOR DIFFERENTIAL INPUTS



Note: A 0.1µF ceramic capacitor must be placed much closely to the IC. For filtering lower frequency noise signals, a larger electrolytic capacitor of 10µF or greater should be placed as close as possible to the audio power amplifier.

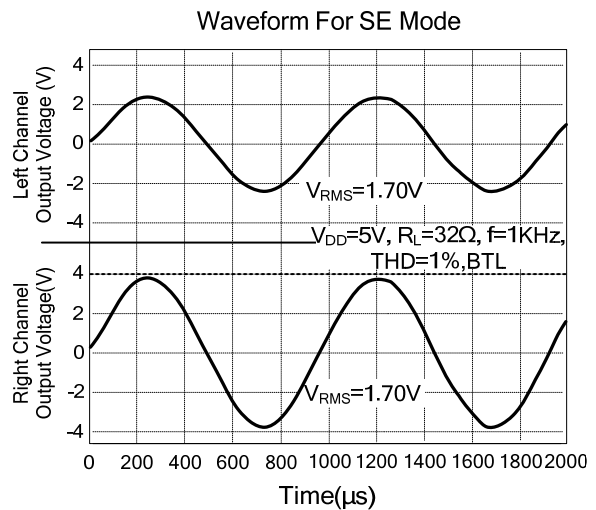
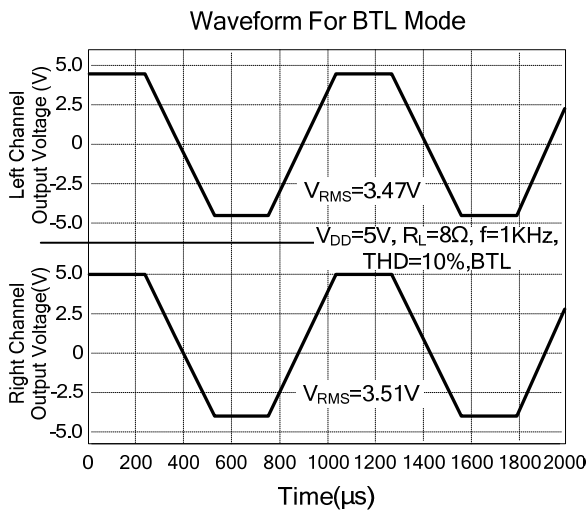
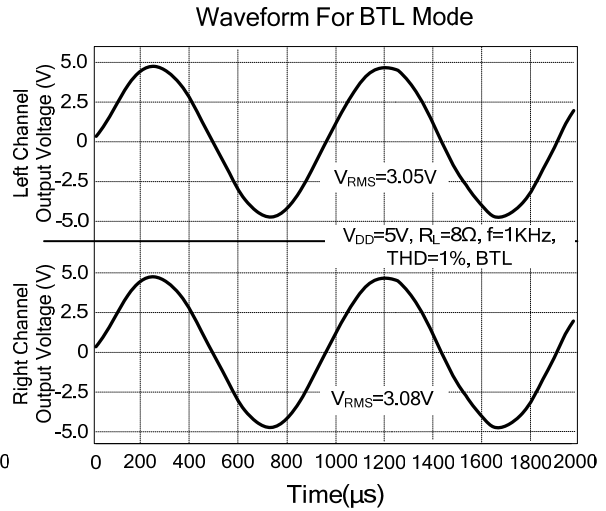
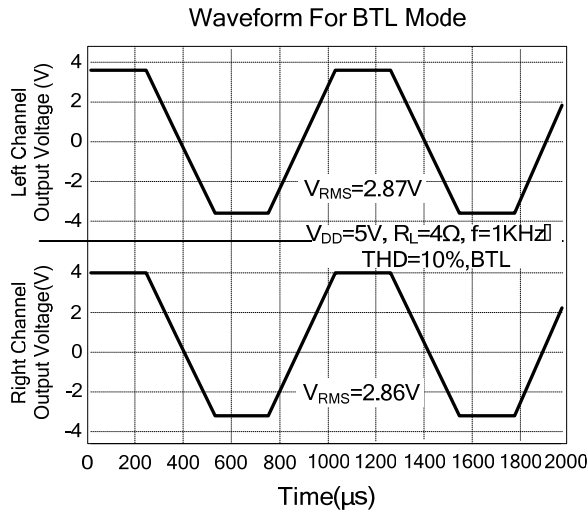
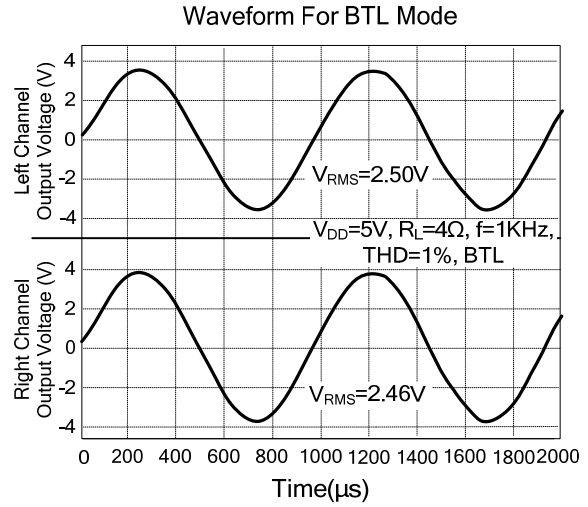
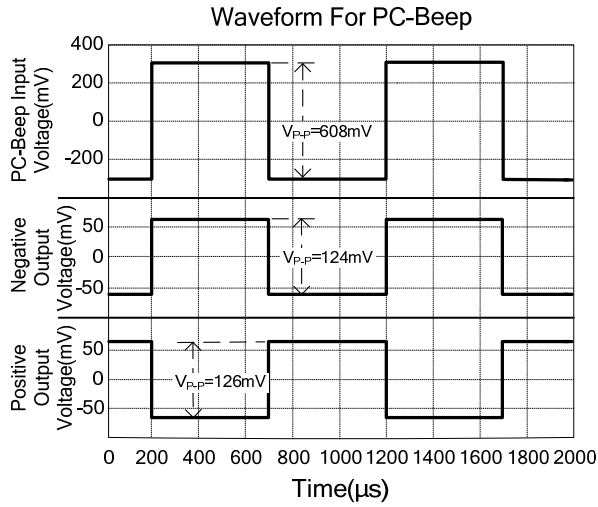
## ■ TYPICAL APPLICATION CIRCUIT(Cont.)

### FOR SINGLE-ENDED INPUTS



Note: 1μF ceramic capacitor should be placed as close as possible to the IC to filter the higher-frequency noise.

■ TYPICAL CHARACTERISTICS





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