



PA7382A

Preliminary

CMOS IC

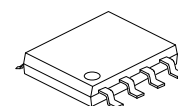
3.0W AUDIO POWER AMPLIFIER WITH ACTIVE-LOW SHUTDOWN MODE

■ DESCRIPTION

The UTC **PA7382A** is a Class-AB audio power amplifier. As a power amplifier which is operating on a single 5V supply, the UTC **PA7382A** is capable of delivering 3.0W of output power into 3Ω BTL load with less than 10% distortion.

The UTC **PA7382A** does not require output coupling capacitors or bootstrap capacitors, and therefore is ideally suited for mobile phone and other low voltage applications where minimal power consumption is a primary requirement.

The UTC **PA7382A** features a low-power consumption shutdown mode. The UTC **PA7382A** contains advanced pop & click circuitry which eliminates noise which would otherwise occur during turn-on and turn-off transitions. The UTC **PA7382A** is unity-gain stable and can be configured by external gain-setting resistors



SOP-8

■ FEATURES

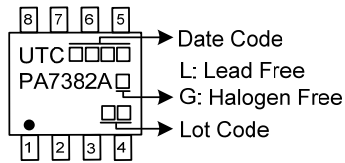
- * Operating voltage: 2.2 ~ 5.5V
- * Power Output at 5.0V, 10% THD+N, 3Ω 3.0W (Typ.)
- * Power Output at 5.0V, 10% THD+N, 4Ω 2.5W (Typ.)
- * Power Output at 5.0V, 10% THD+N, 8Ω 1.5W (Typ.)
- * Shutdown Current 0.6μA (Typ.)
- * No output coupling capacitors, snubber networks or bootstrap capacitors required
- * External gain configuration capability
- * Shutdown mode when a low level is applied on shutdown

■ ORDERING INFORMATION

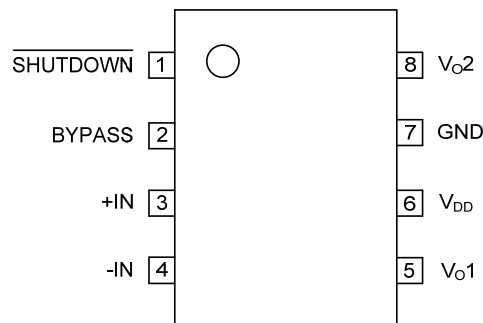
| Ordering Number | | Package | Packing |
|-----------------|----------------|---------|-----------|
| Lead Free | Halogen Free | | |
| PA7382AL-S08-R | PA7382AG-S08-R | SOP-8 | Tape Reel |

| | | |
|----------------|---|---|
| PA7382AG-S08-R | (1) Packing Type (2) Package Type (3) Green Package | (1) R: Tape Reel (2) S08: SOP-8 (3) G: Halogen Free and Lead Free, L: Lead Free |
|----------------|---|---|

MARKING



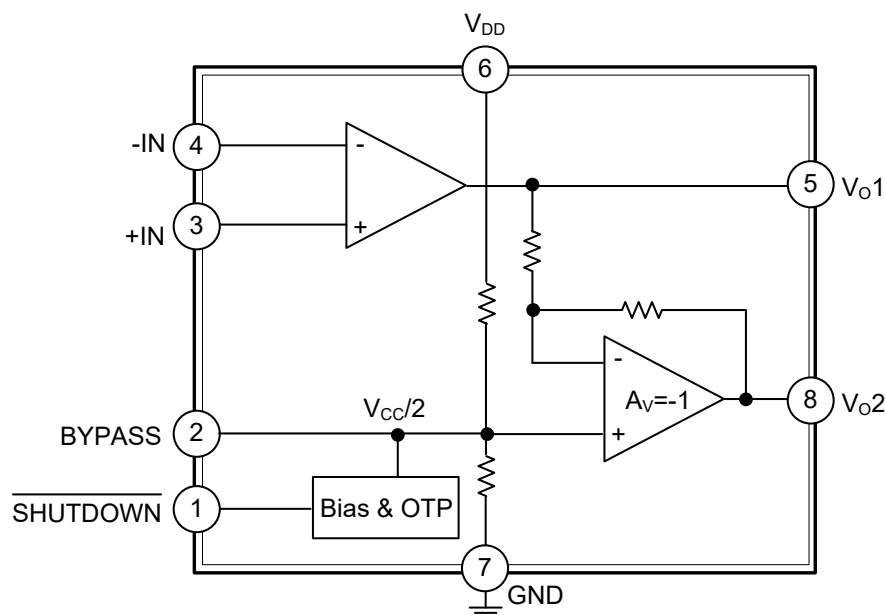
PIN CONFIGURATION



PIN DESCRIPTION

| PIN NO. | PIN NAME | DESCRIPTION |
|---------|-----------------|--|
| 1 | SHUTDOWN | Shutdown control input pin. The device enters in shutdown mode when a low level is applied on this pin |
| 2 | BYPASS | Connected to a bypass capacitor |
| 3 | +IN | Positive input |
| 4 | -IN | Negative input |
| 5 | V _{O1} | Negative output |
| 6 | V _{DD} | Supply voltage |
| 7 | GND | Ground |
| 8 | V _{O2} | Positive output |

BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING

| PARAMETER | SYMBOL | RATINGS | UNIT |
|----------------------|-----------|----------------|------|
| Supply Voltage | | 6 | V |
| Input Voltage | | GND ~ V_{DD} | V |
| Junction Temperature | T_J | +150 | °C |
| Storage Temperature | T_{STG} | -65 ~ +150 | °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.

■ THERMAL DATA

| PARAMETER | SYMBOL | RATINGS | UNIT |
|---------------------|---------------|---------|------|
| Junction to Ambient | θ_{JA} | 220 | °C/W |
| Junction to Case | θ_{JC} | 60 | °C/W |

■ ELECTRICAL CHARACTERISTICS ($V_{DD}=5V$, $f=1kHz$, $T_A=25^\circ C$, unless otherwise specified)

| PARAMETER | SYMBOL | TEST CONDITIONS | MIN | TYP | MAX | UNIT |
|--------------------------------|-----------|-------------------------------------|-----|------|-----|---------|
| Quiescent Power Supply Current | I_{DD} | $V_{IN}=0V$, $I_O=0A$, No load | | 3.5 | 10 | mA |
| Shutdown Current | I_{OFF} | $V_{PIN1}=0V$ | | 0.6 | | μA |
| Output Offset Voltage | V_{OS} | $V_{IN}=0V$ | | 8.0 | 50 | mV |
| Output Power | P_O | THD=1%, $f=1kHz$, $R_L=8\Omega$ | | 1.2 | | W |
| | | THD=1%, $f=1kHz$, $R_L=4\Omega$ | | 2.0 | | W |
| | | THD=1%, $f=1kHz$, $R_L=3\Omega$ | | 2.4 | | W |
| | | THD=10%, $f=1kHz$, $R_L=8\Omega$ | | 1.5 | | W |
| | | THD=10%, $f=1kHz$, $R_L=4\Omega$ | | 2.5 | | W |
| | | THD=10%, $f=1kHz$, $R_L=3\Omega$ | | 3.0 | | W |
| Minimum Harmonic Distortion | THD | $f=1kHz$, $R_L=8\Omega$, $P_O=1W$ | | 0.15 | | % |
| | | $f=1kHz$, $R_L=3\Omega$, $P_O=2W$ | | 0.3 | | % |
| Power Supply Rejection Ratio | PSRR | $V_{CC}=4.9V \sim 5.1V$ | | 60 | | dB |

■ TYPICAL APPLICATION CIRCUIT

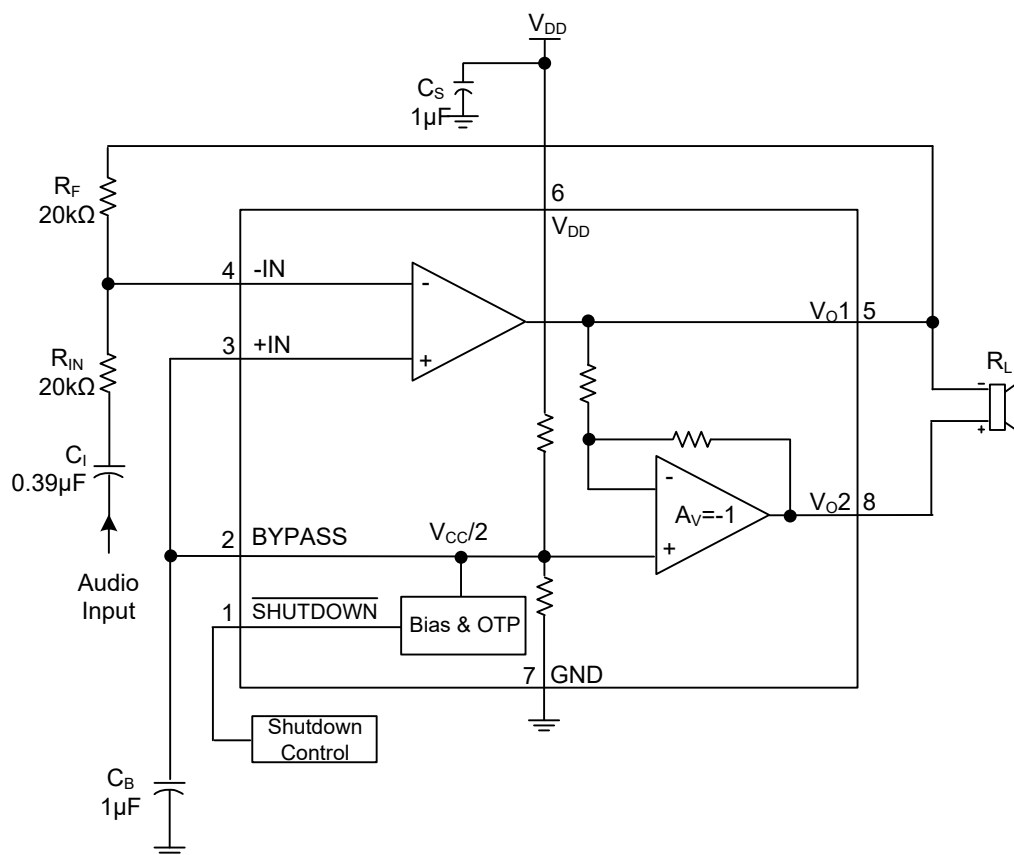


Fig 1. Typical Application Schematic

■ TYPICAL APPLICATION CIRCUIT (Cont.)

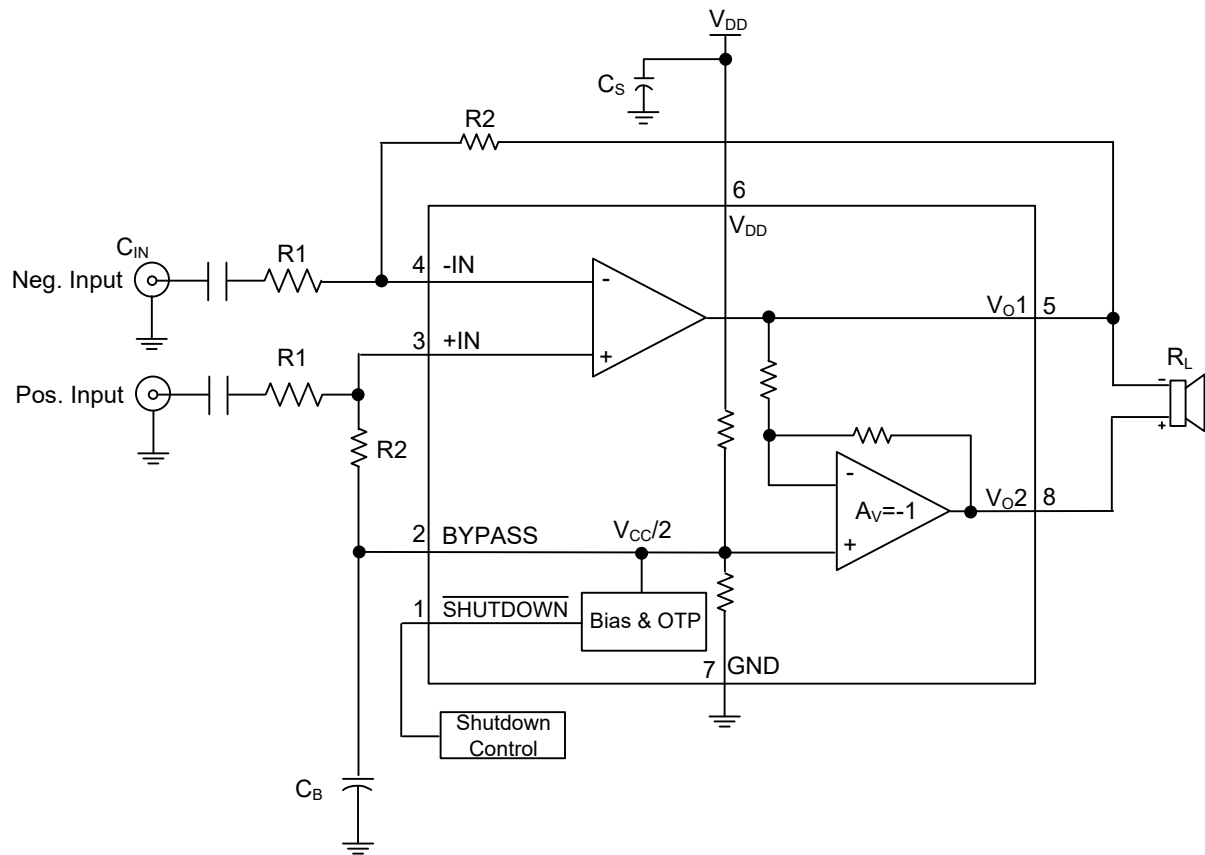


Fig 2. Differential Input Amplifier Configuration

■ BRIDGE CONFIGURATION EXPLANATION

The **PA7382A** has two internal operational amplifiers as shown in the Figure 1. The first amplifier's gain is externally configurable, while the second amplifier is internally fixed in a unity-gain, inverting configuration. The closed-loop gain of the first amplifier is set by selecting the ratio of R_F to R_{IN} . In the Figure 1, shows that the output of first amplifier one serves as the input to second amplifier two which results in both amplifiers producing generating signals identical in magnitude, but out of phase by 180° . The differential gain for the IC is

$$A_{VD} = 2 \times \frac{R_F}{R_{IN}}$$

■ SELECTION OF INPUT CAPACITOR SIZE

The click and pop performance is by the size of the input coupling capacitor C_{IN} . This charge comes from the output via the feedback and is apt to create pops upon device enable. A larger input coupling capacitor requires more charge to reach its quiescent DC voltage (nominally $1/2 V_{DD}$). Thus, by minimizing the capacitor size based on necessary low frequency response, turn-on pops can be minimized.

In addition to minimizing the input capacitor size, the bypass capacitor value is be also considered carefully. Bypass capacitor C_B , is the most critical component to minimize turn-on pops because it determines how fast the **PA7382A** turns on. The slower the **PA7382A**'s outputs ramp to their quiescent DC voltage (nominally $1/2 V_{DD}$), the smaller the turn-on pop. The device will function properly, (no oscillations or motorboating), with C_B equal to $0.1\mu F$, but it will be much more susceptible to turn-on clicks and pops. Choosing C_B equal to $1.0\mu F$ along with a small value of C_{IN} (in the range of $0.1\mu F$ to $0.39\mu F$), should produce a virtually clickless and popless shutdown function. Thus, a value of C_B equal to $1.0\mu F$ is recommended only if the most cost sensitive designs.

■ AUDIO POWER AMPLIFIER DESIGN

A 1W/8Ω Audio Amplifier

Given:

| | |
|------------------|---------------------------|
| Power Output: | 1Wrms |
| Load Impedance: | 8Ω |
| Input Level: | 1Vrms |
| Input Impedance: | 20kΩ |
| Bandwidth: | 100Hz-20kHz ± 0.25 dB |

5V is a standard voltage in most applications, it is chosen for the supply rail. Extra supply voltage creates headroom that allows the **PA7382A** to reproduce peaks in excess of 1W without producing audible distortion. At this time, the designer must make sure that the power supply choice along with the output impedance does not violate the conditions in the power dissipation.

Once the power dissipation equations have been addressed, the required differential gain can be determined from Equation.

$$A_{VD} \geq \frac{\sqrt{(P_O R_L)}}{V_{IN}} = \frac{V_{ORMS}}{V_{INRMS}}$$

$$\frac{R_F}{R_{IN}} = \frac{A_{VD}}{2}$$

From Equation, the minimum A_{VD} is 2.83; use $A_{VD} = 3$. Since the desired input impedance was $20k\Omega$, and with a A_{VD} impedance of 2, a ratio of 1.5:1 of R_F to R_{IN} results in an allocation of $R_{IN} = 20k\Omega$ and $R_F = 30k\Omega$. The final design step is to make sure the bandwidth requirements which must be stated as a pair of -3dB frequency points. Five times away from a -3dB point is 0.17dB down from passband response which is better than the required ± 0.25 dB specified.

$$f_L = \frac{100\text{Hz}}{5} = 20\text{Hz}$$

$$f_H = 20\text{kHz} \times 5 = 100\text{kHz}$$

■ AUDIO POWER AMPLIFIER DESIGN (Cont.)

R_{IN} in conjunction with C_{IN} create a highpass filter.

$$C_{IN} \geq \frac{1}{2\pi \times 20k\Omega \times 20Hz} = 0.397\mu F$$

Use 0.39 μ F. The high frequency pole is determined by the product of the desired frequency pole, f_H , and the differential gain, A_{VD} . With a $A_{VD}=3$ and $f_H= 100kHz$, the resulting GBWP=300kHz which is much smaller than the **PA7382A** GBWP of 2.5MHz. The above description displays that if a designer has a need to design an amplifier with a higher differential gain, the **PA7382A** can still be used without running into bandwidth limitations.

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