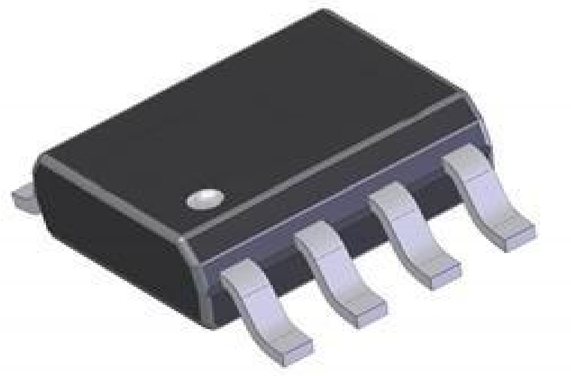
Description:

- The SL8002A is a Class AB, single-channel bridge audio power amplifier with shutdown mode. It provides a maximum driving power of 3W (4 ohm load, THD <10%) and 2W (4 ohm load, THD <1%) at 5V operating voltage with a 1kHz input signal. Total harmonic distortion and noise within the audio frequency range are less than 1% (20 Hz to 20 kHz). The SL8002A application circuit is simple, requiring only a minimal number of external components to deliver high-quality output power. The SL8002A output does not require external coupling capacitors, bootstrap capacitors, buffer networks, or feedback resistors.
- The SL8002A comes in a SOP package, perfect for low-power, compact portable systems. It offers a sleep mode to reduce power consumption and includes built-in overheating auto-shutdown protection. Operating reliably with stable unit gain, its amplifier voltage gain can be adjusted using external resistors for added application flexibility. It's a highly regarded and widely used chip in the market.

SOP-8



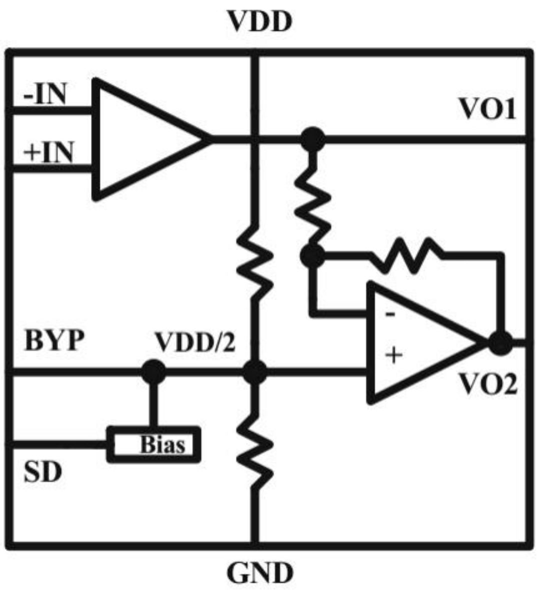
Applications:

- Personal computers
- Portable consumer electronic products
- Passive loudspeakers
- Toys and gaming consoles

Features:

- High output power (4.1 kHz frequency), THD +N < 10% (3W); THD +N < 1% (2W).
- Low standby power dissipation: 16 μA (typical).
- SOP8 package.
- External gain adjustable.
- Wide operating voltage range: 2.2V to 5.5V.
- No need for driving output coupling capacitors, bootstrap capacitors, or buffering networks.
- Stable unit gain.
- The chip operates normally with SHUTDOWN pin floating.
- Pin 3 of the chip is non-functional.

Internal schematic of the SL8002A:



Typical application diagram

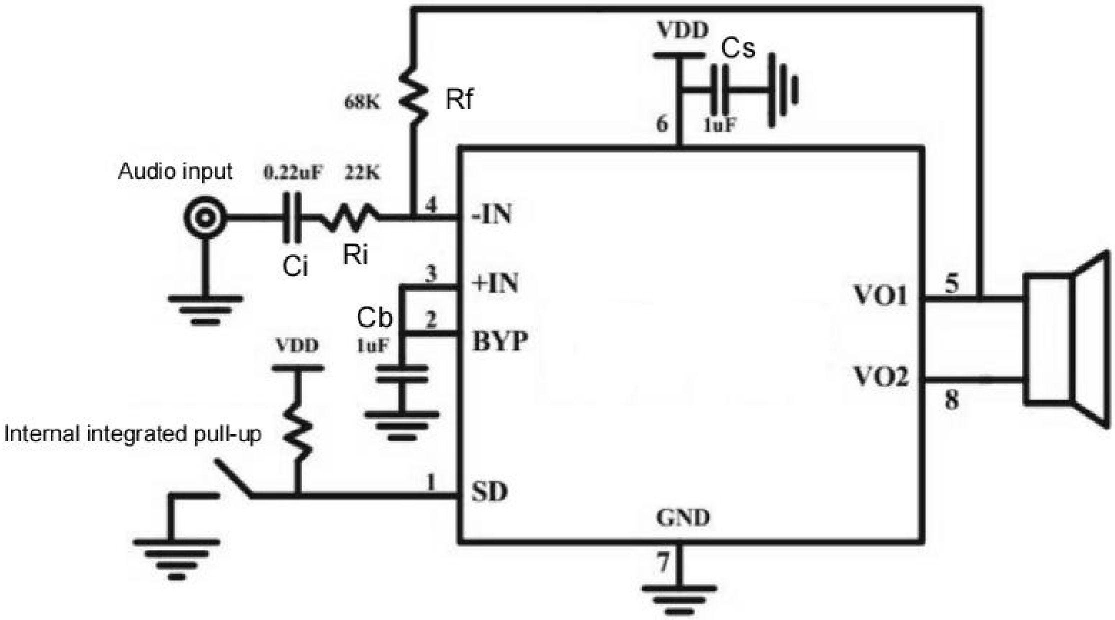


Fig.1 SL8002A Typical Application Diagram

SL8002A package pin diagram

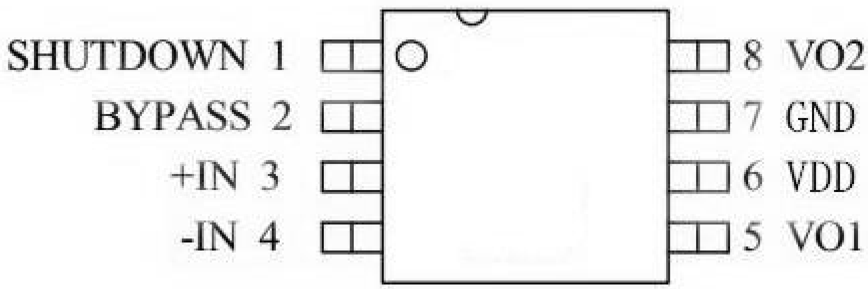


Fig.2 SL8002A SOP-8 Package Pin Layout

SL8002A pin description

Pin	Symbol	Description
1	SD(shutdown)	the high level chip stops working, and the low level chip works normally
2	BYP(bypass)	internal common mode, pressure bypass capacitor
3	+IN	NC
4	-IN	analog input inverting terminal
5	V_{O1}	analog output 1
6	V_{CC}	voltage
7	GND	ground
8	V_{O2}	analog output 2

Peripheral components description:

Components	Description
1. R_i	Together with R_f, it sets the input resistance of the closed-loop gain and also forms a high-pass filter with CI, with $f_C = 1/(2\pi R_I C_I)$.
2. C_i	The input coupling capacitor is mainly used to isolate the DC voltage at the input of the op amp. It also forms a high-pass filter with the input resistor R_I, $f_C = 1/(2\pi R_I C_I)$.
3. R_f	Together with R_i, it sets the feedback resistor for the closed-loop gain.
4. C_s	Provide power supply bypass capacitors for the power supply filter. Refer to the "Application Information" section to set and select appropriate bypass capacitors.
5. C_B	V_{DD} /2 Reference voltage Bypass pin filter capacitor, refer to the "Application Information" section to set and select the appropriate bypass capacitor.

Application Information:

1. Bridge output structure description

According to the circuit schematic of the SL8002A chip, it consists of two pairs of amplifiers with slight structural differences. The gain of the input operational amplifier can be externally set, while the output operational amplifier inverts with unity gain internally set. The closed-loop gain of the input op-amp is determined by R_f and R_I, whereas the gain of the output op-amp is fixed by two internal 20kΩ resistors. As shown in Figure 2, the output of the front-stage op-amp serves as the input to the subsequent op-amp, resulting in consistent output signal magnitudes between the two stages but with a phase difference of 180 degrees. Therefore, the overall gain of the chip should be calculated as follows:

$$A_{VD} = 2 * (R_f / R_i)$$

When different loads are connected between outputs V_{O1} and V_{O2}, the operational amplifier establishes a "bridge mode." The operation in bridge mode differs from the typical single-ended mode where one end of the load is grounded. In bridge operation, the amplifier design also varies, such as in its ability to drive loads, where the output magnitude is twice the input voltage. Consequently, under the same conditions, it can deliver four times the output power compared to single-ended mode, enhancing output power without limiting current or compromising clarity of sound. For selecting an appropriate closed-loop gain and avoiding additional horn systems using high-frequency sensor circuits, refer to the "Audio Amplifier Design" section.

The bridge configuration, applied in headphone audio amplifiers, offers advantages over single-ended operation. This is because the outputs V_{O1} and V_{O2} have a center voltage level of $V_{DD}/2$, eliminating any DC voltage between them and ground. It also eliminates the need for output coupling capacitors required in single-ended single-supply (single-ended output) configurations. Without an output coupling capacitor in a single-ended amplifier, the $V_{DD}/2$ voltage directly across the load to ground would increase internal chip power consumption and potentially damage speakers. A larger output coupling capacitor (e.g., 470uF) combined with an 8Ω load forms a high-pass filter to prevent low-frequency response. This structure does not respond to signals below 20Hz, balancing considerations between PCB size, system cost, and low-frequency response.

2.Power loss

Power loss is a primary concern when designing a successful operational amplifier (whether bridge or single-ended). A direct consequence of the increased power output of a bridge amplifier is the rise in internal chip power consumption. Equation (1) illustrates the maximum power dissipation of a bridge amplifier driving a specified output load under a given supply voltage.

$$P_{DMAX}=4 *(V_{DD})2/(2\pi^2R_L) \qquad (1)$$

Because the SL8002A operates two operational amplifiers within the same chip package, its internal maximum power consumption is four times that of a single operational amplifier. Even with increased power consumption, the SL8002A does not require a heatsink. According to Equation (1), assuming a 5V supply and an 8Ω load, its maximum power dissipation is 625mW. The maximum power calculated from Equation (1) should not exceed the power derived from Equation (2).

$$P_{DMAX}=(T_{JMAX}-T_A)/\theta_{JA} \qquad (2)$$

For the surface-mount package of the SL8002A, θ_{JA} = 140℃/W and T_{JMAX} = 150℃. Depending on the ambient temperature T_A of the system operation, Equation (2) can be used to calculate the maximum internal power dissipation that the chip package can withstand. If the result from Equation (1) exceeds that of Equation (2), it is necessary to either reduce the supply voltage or increase the load resistance. In a typical application with a 5V supply and 8Ω load, and assuming no other factors affecting maximum junction temperature, the device operates with a maximum ambient temperature approaching 62.5℃ at maximum power dissipation. Since power dissipation is a function of output power, operating below maximum power during typical operation allows for a higher ambient temperature if needed.

3.Power supply bypassing

Proper power supply bypassing is critical for achieving low noise performance and effective filtering of high-frequency power supply noise in any amplifier design. The placement of BYPASS and power pin capacitors should be as close to the chip as possible. Increasing the size of power supply bypass capacitors can enhance THD+N at low frequencies, attributed to improved power supply stability due to the increased capacitance.

Typical practice involves using 10uF and 0.1uF bypass capacitors on a 5V supply to enhance power supply stability, a principle applicable beyond just the SL8002A's power supply bypassing. Capacitor selection for bypassing, particularly the value of C, depends on balancing considerations of low-frequency THD+N, system cost, and size.

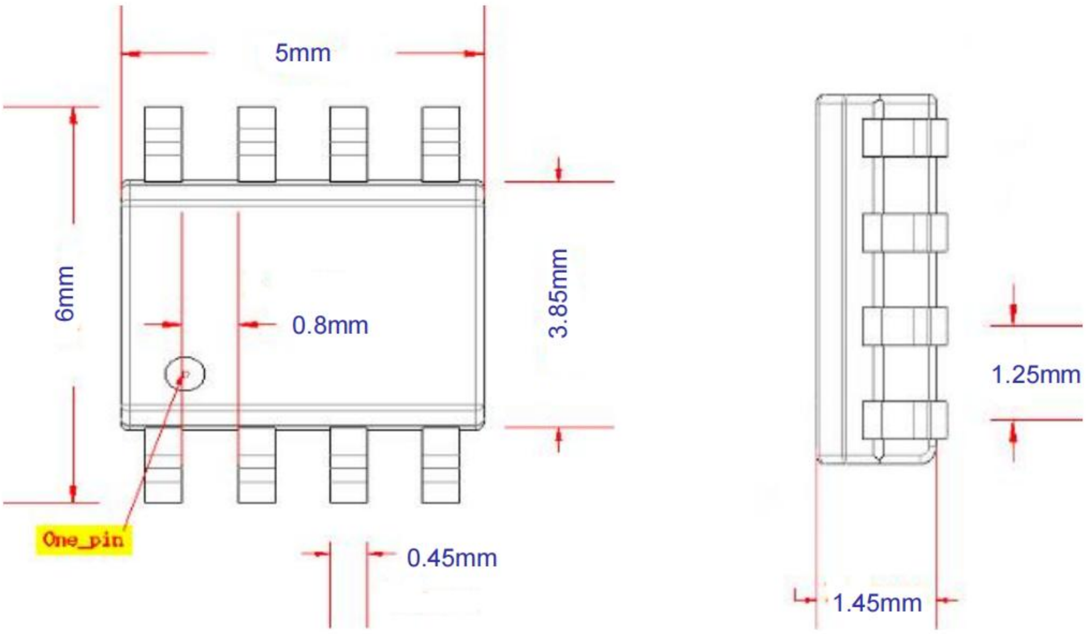
4.Shutdown function

To reduce power consumption when the chip is not in use, the SL8002A includes a SHUTDOWN pin to disable the amplifier's bias circuitry. Applying a logic high to the SHUTDOWN pin initiates the shutdown sequence, disconnecting the output from the speaker immediately. When the supply voltage is applied to the SHUTDOWN pin, the typical shutdown static current is 16uA. In most applications, an external input signal typically controls this pin via a microcontroller, ensuring rapid and smooth transitions. Another method involves using a single-pole, single-throw switch and a pull-up resistor: closing the switch grounds the SHUTDOWN signal, allowing the chip to operate normally, while opening the switch pulls the SHUTDOWN signal to the supply voltage through a 47kΩ resistor, causing the chip to enter shutdown mode. The SL8002A does not include an internal pull-up resistor on the SHUTDOWN pin, so the voltage on this pin must be externally set, or the internal logic gate should be left floating to prevent improper amplifier operation.

Leaving the SHUTDOWN pin of the 8002A floating allows the chip to operate normally.

Package dimensions:

SOP-8



Unless otherwise specified, all dimensions are: (mm).