

# Mono 1.1W, Fully Differential Input Excellent PSRR, Low Voltage Operation Selectable Shutdown Logic Level

## FEATURES

- PSRR at 217Hz, 80dB at 5V
- Operation range: 2.5V~5.5V
- Shutdown Current 0.1uA at 5V
- Output power, THD+N=1%  
R<sub>L</sub>=8Ω, 1.1W at 5V, 0.4W at 3.3V, 200mW at 2.5V
- Unity-gain stable
- Space-saving MSOP10, enhance thermal pad

## APPLICATIONS

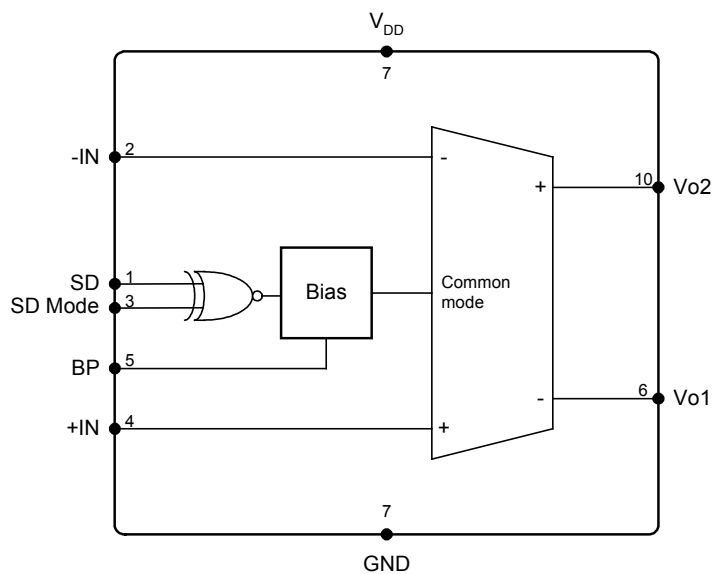
- Portable electronic devices
- PDAs
- Communication headsets
- Cross-reference:  
LM4894

## DESCRIPTION

The MS6894 is a fully differential power amplifier that can drive 1.1W of continuous average power into a mono 8Ω bridged-tied load (BTL). Operation with 2.5V supply, it can drive 200mw into a mono 8Ω. The shutdown may be enabled by either logic high or logic low that depending on shutdown mode selection. The BTL configuration eliminates the need for external coupling capacitors on the output in most applications. The MS6894 is unity-gain stable and can be configured by external gain-setting resistors.

The MS6894 has good feature for portable equipment, these features include the fully differential input, low voltage operation, micropower consumption shutdown mode, enhance thermal pad and small package MSOP10, make the MS6894 ideally suited for use in portable electronic equipments.

## BLOCK DIAGRAM



| Shutdown control |    |          |
|------------------|----|----------|
| SD Mode          | SD | Status   |
| 0                | 0  | Shutdown |
| 0                | 1  | On       |
| 1                | 0  | On       |
| 1                | 1  | Shutdown |

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## PIN CONFIGURATION

| Symbol          | Pin | Description   |
|-----------------|-----|---|
| SD              | 1   | Shutdown places the entire device in shutdown mode depending on SD Mode selection. TTL compatible input. SD Mode = 0, the device enters shutdown when SD is logic low. SD Mode = 1, the device enters shutdown when SD is logic high. |
| -IN             | 2   | Negative differential input   |
| SD Mode         | 3   | The shutdown mode controls the shutdown logic level of the SD pin1. TTL compatible input  |
| +IN             | 4   | Positive differential input   |
| BP              | 5   | Bypass is the cap to the voltage divider for internal mid-supply bias. This terminal should be connected to a 0.1- $\mu$ F to 10- $\mu$ F capacitor $C_{BP}$ .  |
| Vo1             | 6   | Negative BTL output   |
| GND             | 7   | Ground  |
| NC              | 8   | No connected  |
| V <sub>DD</sub> | 9   | Supply voltage  |
| Vo2             | 10  | Positive BTL output   |

**MSOP10**

## ORDERING INFORMATION

| Package                 | Part number | Packaging Marking | Transport Media          |
|-------------------------|-------------|-------------------|--------------------------|
| 10-Pin MSOP (lead free) | MS6894MGTR  | 6894G             | 3.5k Units Tape and Reel |
| 10-Pin MSOP (lead free) | MS6894MGU   | 6894G             | 80 Units Tube            |

RoHS Compliance

## ABSOLUTE MAXIMUM RATINGS

| Symbol            | Parameter  | Rating     | Unit |
|-------------------|--|------------|------|
| V <sub>DD</sub>   | Supply voltage   | 6          | V    |
| V <sub>ESD</sub>  | Electrostatic handling   | 3500       | V    |
| T <sub>STG</sub>  | Storage temperature range  | -65 to 150 | °C   |
| T <sub>A</sub>    | Operating ambient temperature range  | -40 to 85  | °C   |
| T <sub>J</sub>    | Maximum junction temperature   | 150        | °C   |
| T <sub>S</sub>    | Soldering temperature, 10 seconds  | 260        | °C   |
| R <sub>THJA</sub> | Thermal resistance from junction to ambient in free air MSOP10 (enhance thermal pad) | 50         | °C/W |

## OPERATING RATINGS

| Symbol          | Parameter      | Min | Typ | Max | Unit |
|-----------------|----------------|-----|-----|-----|------|
| V <sub>DD</sub> | Supply voltage | 2.5 | 5   | 5.5 | V    |

## 5V ELECTRICAL CHARACTERISTICS

T<sub>a</sub> = 25°C, V<sub>DD</sub>=5V, f=1kHz, BW<30kHz, unless otherwise specified.

| Symbol            | Parameter                            | Conditions  | Min | Typ | Max   | Unit |
|-------------------|--------------------------------------|---|-----|-----|-------|------|
| I <sub>Q</sub>    | Quiescent current                    | V <sub>IN</sub> =0V, I <sub>O</sub> =0A           | -   | 2.7 | -     | mA   |
| I <sub>SHDN</sub> | Shutdown current                     | V <sub>SHDN</sub> =0V                             | -   | 0.1 | -     | uA   |
| V <sub>SDH</sub>  | Shutdown input voltage high          |   | 2.0 | -   | -     | V    |
| V <sub>SDL</sub>  | Shutdown input voltage low           |   | -   | -   | 0.8   | V    |
| V <sub>SDMH</sub> | SD Mode input voltage high           |   | 2.0 | -   | -     | V    |
| V <sub>SDML</sub> | SD Mode input voltage low            |   | -   | -   | 0.8   | V    |
| PSRR              | Power supply rejection ratio         | R <sub>L</sub> =8Ω, C <sub>BP</sub> =1uF, f=217Hz | -   | 80  | -     | dB   |
| THD+N             | Total harmonic distortion plus noise | R <sub>L</sub> =8Ω, 1.1W                          | -   | -60 | -55   | dB   |
|                   |                                      |   | -   | 0.1 | 0.178 | %    |
| S/N               | Signal-to-noise ratio                | R <sub>L</sub> =8Ω, 1.1W                          | 90  | 103 | -     | dB   |
| P <sub>o</sub>    | Output power                         | R <sub>L</sub> =8Ω, THD+N = 1%                    | 1.1 | 1.3 | -     | W    |

## 3.3V ELECTRICAL CHARACTERISTICS

T<sub>a</sub> = 25°C, V<sub>DD</sub>=3.3V, f=1kHz, BW<30kHz, unless otherwise specified.

| Symbol          | Parameter                            | Conditions  | Min | Typ | Max   | Unit |
|-----------------|--------------------------------------|---|-----|-----|-------|------|
| I <sub>Q</sub>  | Quiescent current                    | V <sub>IN</sub> =0V, I <sub>O</sub> =0A           | -   | 2.4 | -     | mA   |
| I <sub>SD</sub> | Shutdown current                     | V <sub>SHDN</sub> =0V                             | -   | 0.1 | -     | uA   |
| PSRR            | Power supply rejection ratio         | R <sub>L</sub> =8Ω, C <sub>BP</sub> =1uF, f=217Hz | -   | 70  | -     | dB   |
| THD+N           | Total harmonic distortion plus noise | R <sub>L</sub> =8, 0.4W                           | -   | -60 | -55   | dB   |
|                 |                                      |   | -   | 0.1 | 0.178 | %    |
| S/N             | Signal-to-noise ratio                | R <sub>L</sub> =8Ω, 0.4W                          | 90  | 100 | -     | dB   |
| P <sub>o</sub>  | Output power                         | R <sub>L</sub> =8Ω, THD+N = 1%                    | 0.4 | 0.5 | -     | W    |

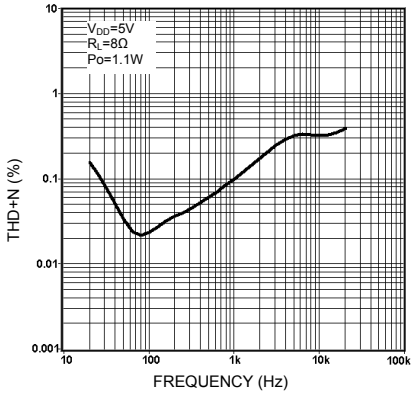
## 2.5V ELECTRICAL CHARACTERISTICS

T<sub>a</sub> = 25°C, V<sub>DD</sub>=2.5V, f=1kHz, BW<30kHz, unless otherwise specified.

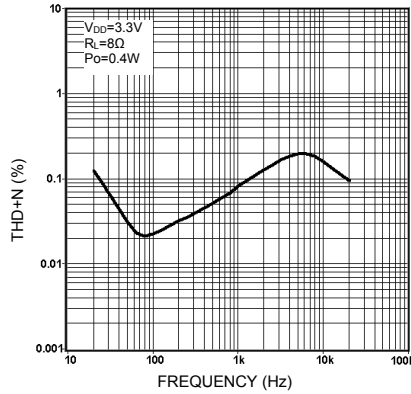
| Symbol          | Parameter                            | Conditions  | Min | Typ  | Max   | Unit |
|-----------------|--------------------------------------|---|-----|------|-------|------|
| I <sub>Q</sub>  | Quiescent current                    | V <sub>IN</sub> =0V, I <sub>O</sub> =0A           | -   | 2.2  | -     | mA   |
| I <sub>SD</sub> | Shutdown current                     | V <sub>SHDN</sub> =0V                             | -   | 0.1  | -     | uA   |
| PSRR            | Power supply rejection ratio         | R <sub>L</sub> =8Ω, C <sub>BP</sub> =1uF, f=217Hz | -   | 60   | -     | dB   |
| THD+N           | Total harmonic distortion plus noise | R <sub>L</sub> =8Ω, 0.2W                          | -   | -60  | -55   | dB   |
|                 |                                      |   | -   | 0.1  | 0.178 | %    |
| S/N             | Signal-to-noise ratio                | R <sub>L</sub> =8Ω, 0.2W                          | 90  | 98   | -     | dB   |
| P <sub>o</sub>  | Output power                         | R <sub>L</sub> =8Ω, THD+N = 1%                    | 0.2 | 0.28 | -     | W    |

## TYPICAL PERFORMANCE CHARACTERISTICS

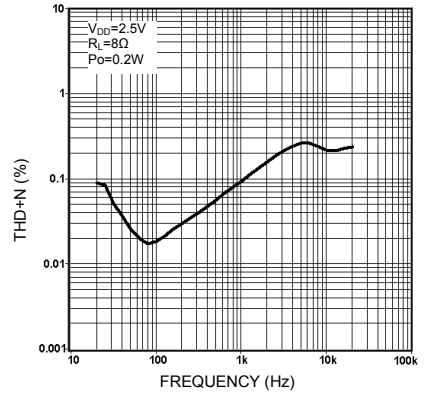
Ta = 25°C, BW < 30kHz, unless otherwise specified.



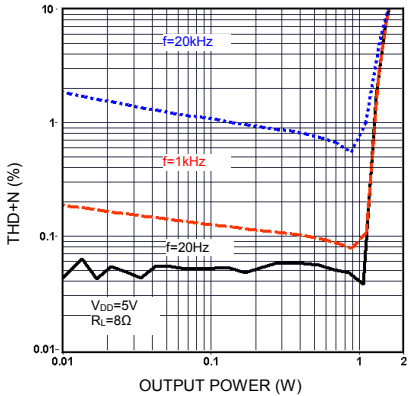
THD+N vs. frequency



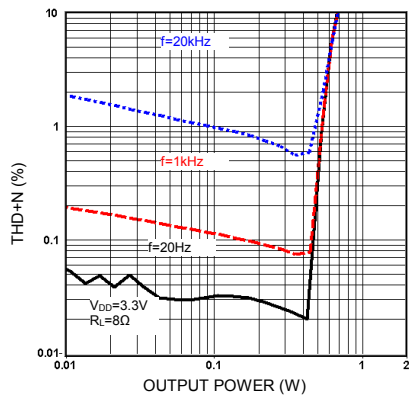
THD+N vs. frequency



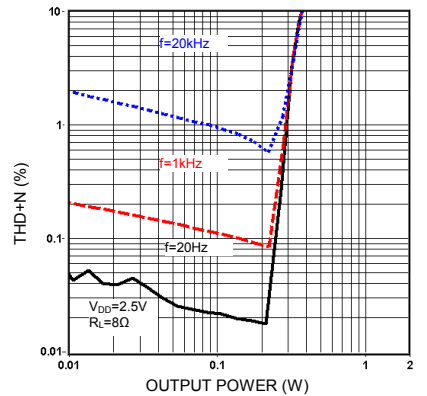
THD+N vs. frequency



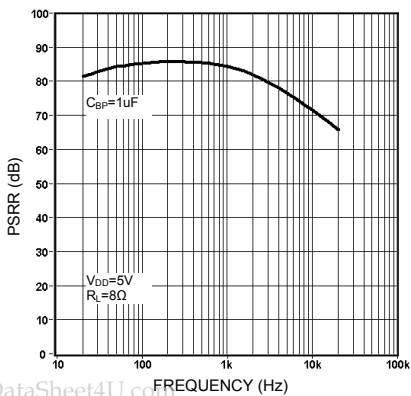
THD+N vs. output power



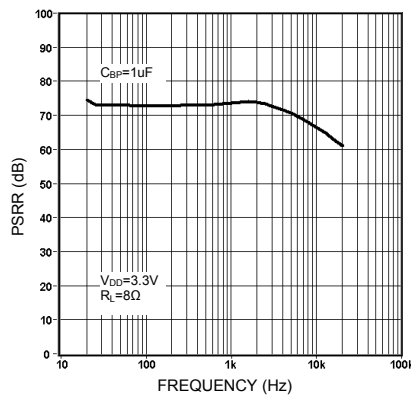
THD+N vs. output power



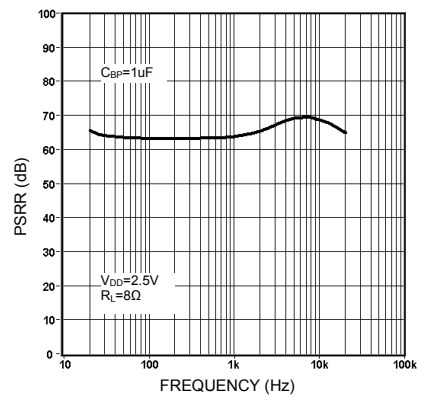
THD+N vs. output power



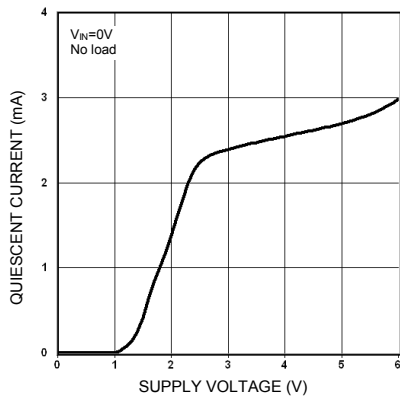
PSRR vs. frequency



PSRR vs. frequency



PSRR vs. frequency



Quiescent current vs. supply voltage

APPLICATION INFORMATION

Basic application example

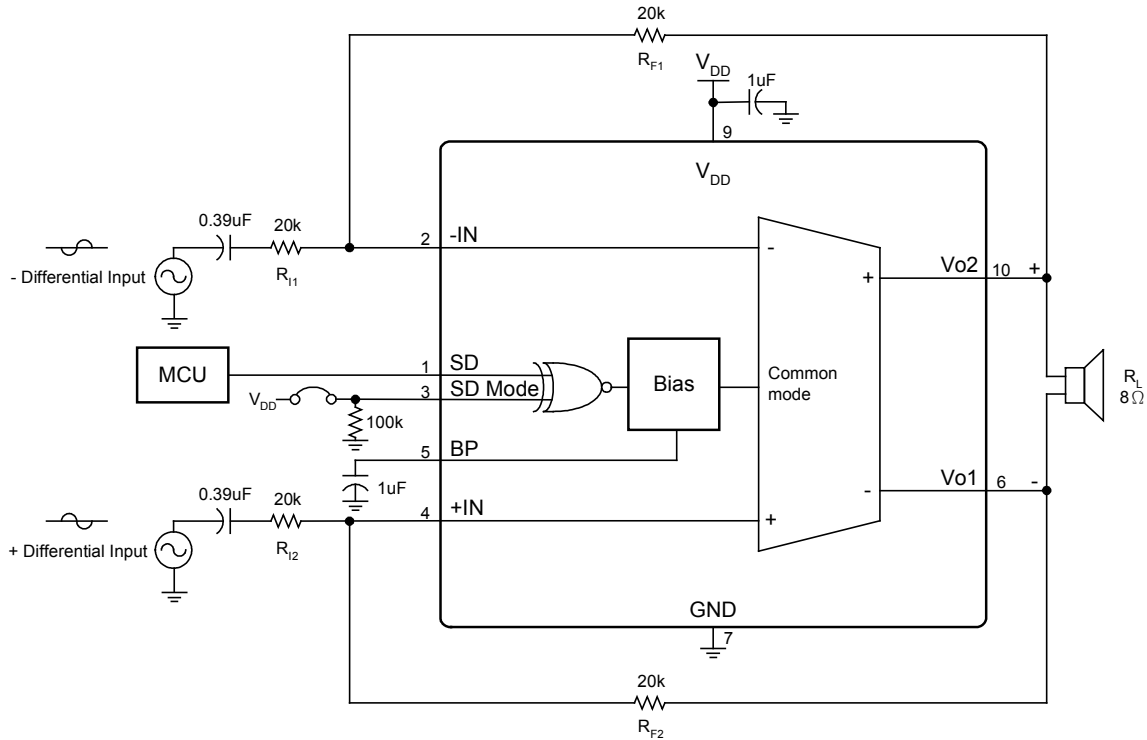


Fig.1 A audio amplifier application circuit.

Shutdown Control

The shutdown may be enabled by either logic high or logic low that depending on shutdown mode selection. Both the SD pin and the SD Mode pin are TTL compatible input. The SD Mode is logic low, the device enters shutdown when SD is logic low. The SD Mode is logic high, the device enters shutdown when SD is logic high.

| Shutdown control |    |          |
|------------------|----|----------|
| SD Mode          | SD | Status   |
| 0                | 0  | Shutdown |
| 0                | 1  | On       |
| 1                | 0  | On       |
| 1                | 1  | Shutdown |

External gain-setting

As shown in Fig.1,  $R_{11} = R_{12}$  and  $R_{F1} = R_{F2}$ , the respective closed-loop gain is set at  $-R_F/R_I$ . It is important to match input resistors and feedback resistors to each other. The outputs are used to drive the mono bridged-tied load (BTL).

High Pass Filter

The input capacitor  $C_{IN}$  and resistor  $R_{IN}$  are decided the cut-off frequency of the HPF. The equation is as follows:

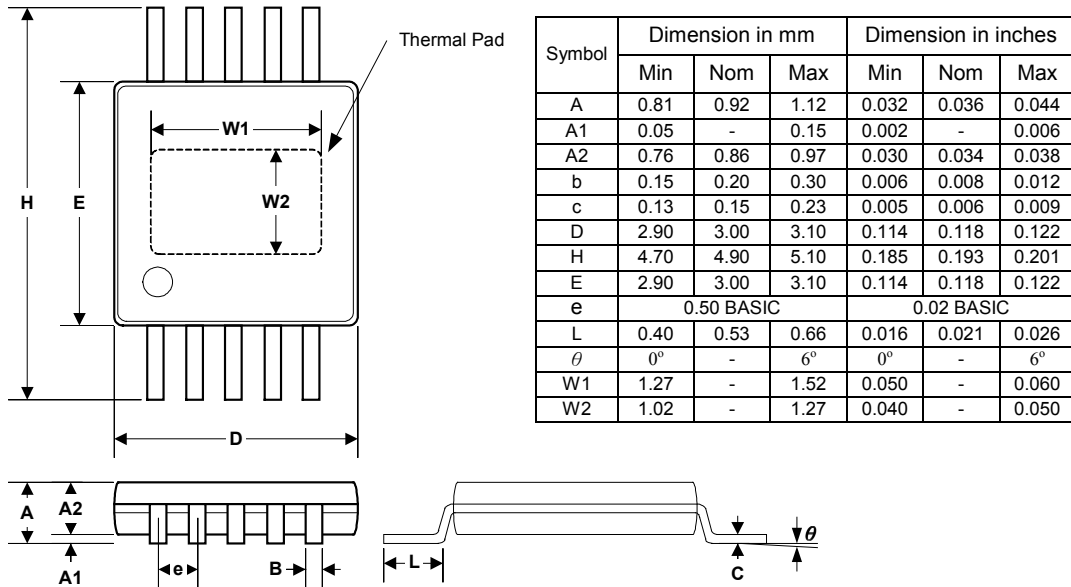
$$f_{cut-off} = 1 / (2 \pi * R_{IN} * C_{IN})$$

Thermal pad considerations

The thermal pad must be connected to ground. The package with thermal pad of the MS6894 requires special attention on thermal design. The thermal pad on the bottom of the MS6894 should be soldered down to a copper pad on the circuit board. Heat can be conducted away from the thermal pad through the copper plane to ambient. If the copper plane is not on the top surface of the circuit board, 9 vias of 13 mil or smaller in diameter should be used to thermally couple the thermal pad to the bottom plane. For good thermal conduction, the vias must be plated through and solder filled.

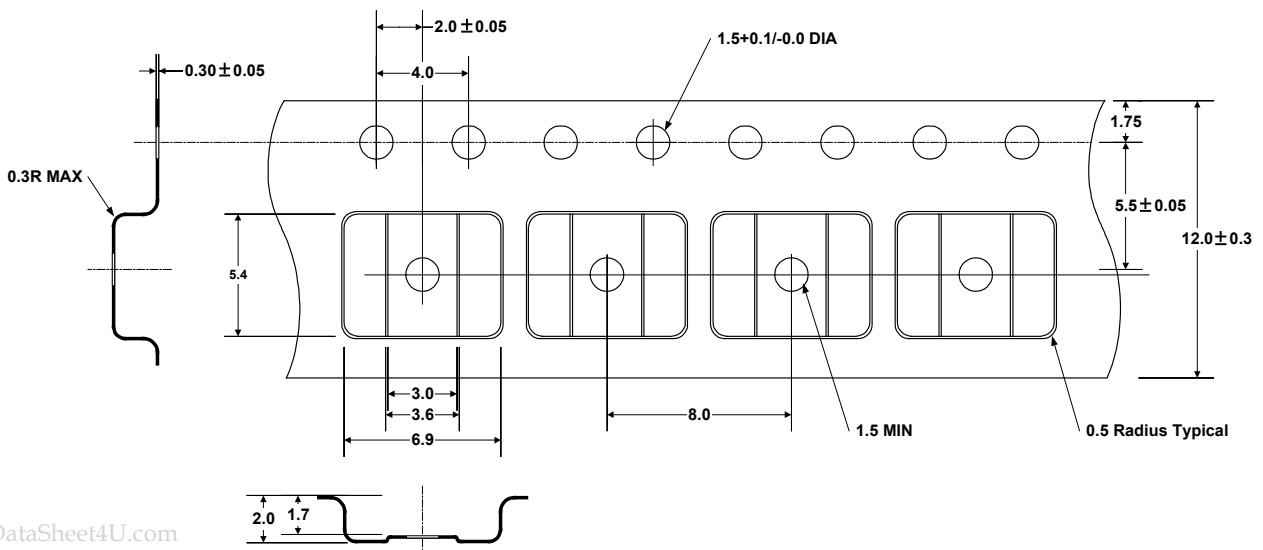
## EXTERNAL DIMENSIONS

### MSOP10 (Thermal Pad)

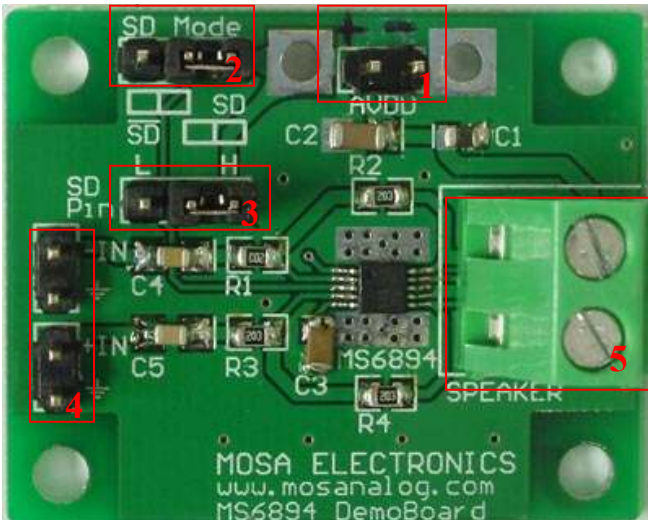


### TAPE AND REEL (Unit : mm)

#### MSOP10



## DEMO BOARD



### Function description

#### Label 1: Supply Voltage

Supply voltage range is 2.5V to 5.5V, the left of jump is positive and the right of jump is negative.

#### Label 2: Shutdown mode selection (SD Mode)

The shutdown mode is low logic level shutdown mode when the jump is placed left position ( $\overline{SD}$ ), the SD Mode is connected to GND. On the other hand, the chip is high logic level shutdown mode when the jump is placed right position (SD), the SD Mode is connected to  $V_{DD}$ .

#### Label 3: Shutdown pin (SD pin)

The shutdown may be enabled by either logic high or logic low that depending on shutdown mode selection. The SD Mode is placed left position ( $\overline{SD}$ ), the chip enters shutdown when SD pin is placed left position (L), the SD Mode is connected to GND. On the other hand, the SD Mode is placed right position (SD), the chip enters shutdown when SD pin is placed right position (H), the SD Mode is connected to  $V_{DD}$ .

#### Label 4: Signal Input

Connected to audio signals.

#### Label 5: Speaker Output

Connected to speaker with 8ohm or 4 ohm.



### Circuit

