

## *16-Bits Stereo Audio DAC*

### *Low Power Consumption*

### *Low Voltage, Excellent PSRR*

#### FEATURES

- Operation range: 2.7V~6.5V.
- Excellent Power Supply Rejection Ratio(PSRR).
- Low power consumption
- Low distortion.
- No zero crossing distortion.
- Wide dynamic range(16-bit resolution).
- Voltage Output .
- Cost efficient.
- Fast setting time permits 2\*, 4\*, and 8\* oversampling (serial input) or double speed operation at 4\* oversampling .
- Output voltage swing is proportional to supply voltage ( $V_{OPP}=V_{DD}/2$ ).
- Audio Format : Right Justified.
- Space saving package SOP8.
- Cost efficient

#### APPLICATIONS

- Multimedia system
- MP3, PDA, Portable Digital Audio.

#### DESCRIPTION

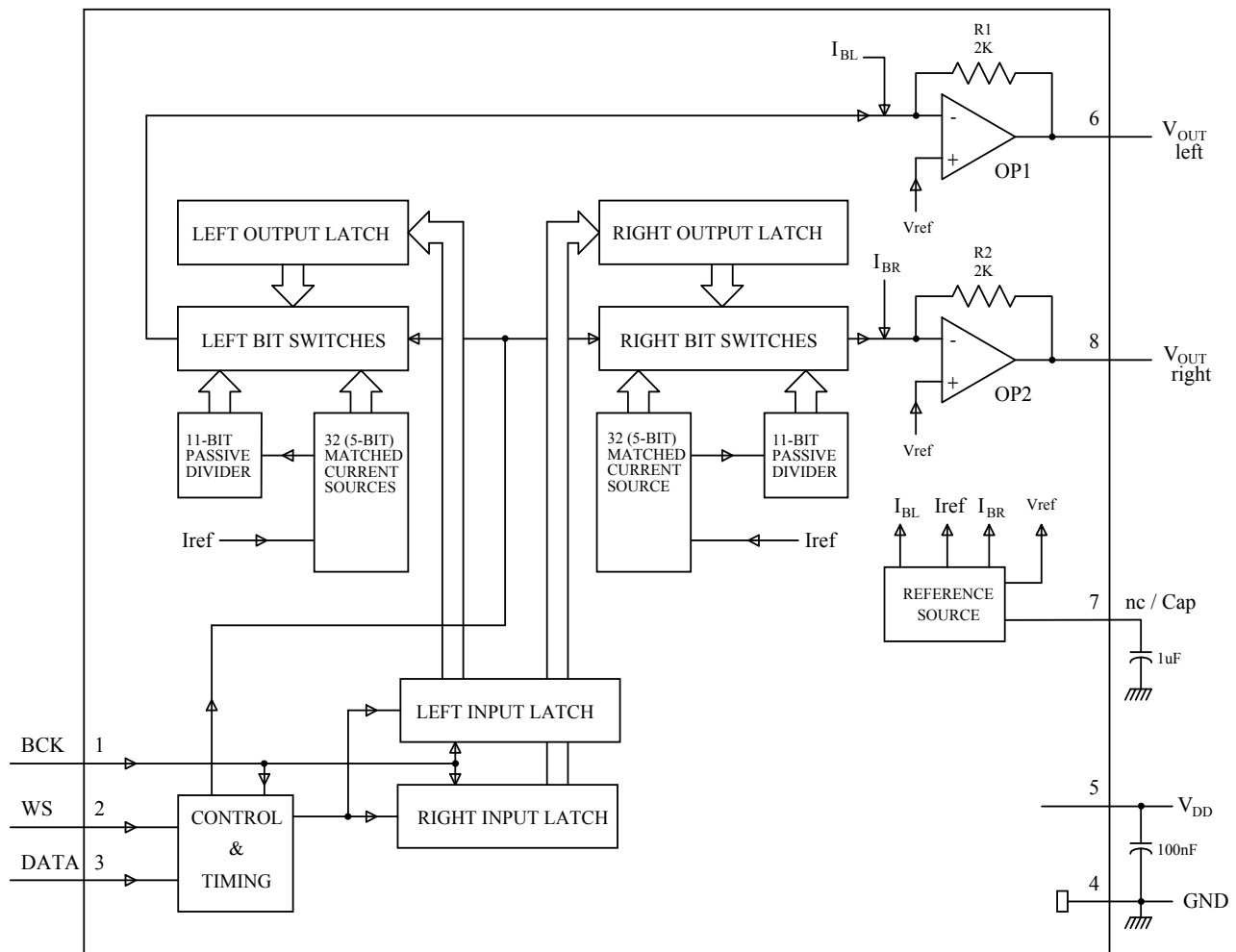
The MS6313 is a 16-bit voltage-output Digital-to-Analog Converter(DAC). The MS6313 is with excellent Power Supply Rejection Ratio(PSRR). It is fabricated in a 0.8 $\mu$ m CMOS process and features extremely low power dissipation, small package size and easy application. The accuracy of the matched coarse current sources, combined with the unique symmetrical decoding method, preclude zero-crossing distortion and ensures high quality audio reproduction. These unique features, combined with its exceptional performance, make the MS6313 ideally suited for use in digital audio equipment. MS6313 is pin and function compatible with the Philips, TDA1311.

#### PIN CONFIGURATION

| Symbol          | Pin | Description             |
|-----------------|-----|-------------------------|
| BCK             | 1   | bit clock input         |
| WS              | 2   | word select input       |
| DATA            | 3   | data input              |
| GND             | 4   | ground                  |
| V <sub>DD</sub> | 5   | positive supply voltage |
| V <sub>OL</sub> | 6   | left channel output     |
| Cap             | 7   | Cap                     |
| V <sub>OR</sub> | 8   | right channel output    |

**Pin configuration**

## BLOCK DIAGRAM



**Fig.1 Block diagram.**

## ORDERING INFORMATION

| Package               | Part number | Marking   | Transport Media          |
|-----------------------|-------------|-----------|--------------------------|
| 8-Pin SOP (lead free) | MS6313ASGTR | MS6313ASG | 2.5k Units Tape and Reel |
| 8-Pin SOP (lead free) | MS6313ASGU  | MS6313ASG | 100 Units Tube           |

RoHS Compliance

## LIMITING VALUES

| Symbol            | Parameter                                                       | Rating        | Unit |
|-------------------|-----------------------------------------------------------------|---------------|------|
| V <sub>DD</sub>   | Positive Supply Voltage                                         | 6.5           | 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   |
| T <sub>ESD</sub>  | Electrostatic Handling                                          | -2000 to 2000 | V    |
| R <sub>THJA</sub> | Thermal Resistance from Junction to Ambient in Free Air<br>SOP8 | 210           | °C/W |

## OPERATING RATINGS

| Symbol          | Parameter      | Min | Typ | Max | Unit |
|-----------------|----------------|-----|-----|-----|------|
| V <sub>DD</sub> | Supply Voltage | 2.7 | -   | 6.5 | V    |

## 5V ELECTRICAL CHARACTERISTICS

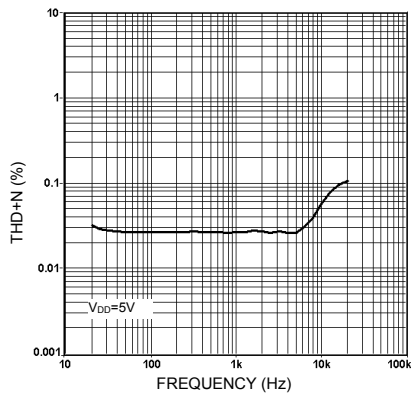
(T<sub>a</sub>=25°C, V<sub>DD</sub>=5V, f=1kHz, Cap=1uF; unless otherwise specified)

| Symbol                    | Parameter                            | Conditions                          | Min  | Typ  | Max  | Unit            |
|---------------------------|--------------------------------------|-------------------------------------|------|------|------|-----------------|
| <b>DC Characteristics</b> |                                      |                                     |      |      |      |                 |
| V <sub>DC</sub>           | Output DC level                      |                                     | 2.45 | 2.5  | 2.55 | V               |
| V <sub>FS</sub>           | Full scale output voltage            | V <sub>FS</sub> =0.4V <sub>DD</sub> | 1.8  | 2.0  | 2.2  | V <sub>pp</sub> |
| I <sub>Q</sub>            | Quiescent current                    | At code 0000H                       | 5.9  | 7    | 8.1  | mA              |
| I <sub>FS</sub>           | Maximum operation current            | V <sub>FS</sub> =0.4V <sub>DD</sub> | 6.1  | 7.2  | 8.4  | mA              |
| CS                        | Channel separation                   |                                     | 80   | 85   | -    | dB              |
| I d I o I                 | Unbalance Between Outputs            | note 1                              | -    | 0.2  | 0.3  | dB              |
| I t d I                   | Time Delay Between Outputs           |                                     | -    | ±0.2 | -    | µs              |
| <b>AC Characteristics</b> |                                      |                                     |      |      |      |                 |
| Res                       | Resolution                           |                                     | -    | -    | 16   | bits            |
| THD+N                     | Total harmonic distortion plus noise |                                     | -    | -68  | -63  | dB              |
|                           |                                      |                                     | -    | 0.04 | 0.07 | %               |
| S/N                       | Signal-to-noise ratio                | a-weighted at code 0000H            | 86   | 92   | -    | dB              |

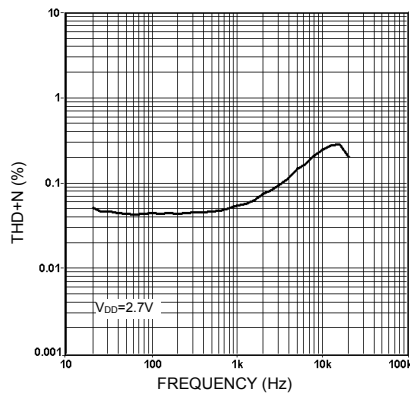
**Note :** 1.Measured with 1kHz sinewave generated at sampling rate of 192 kHz.

## TYPICAL PERFORMANCE CHARACTERISTICS

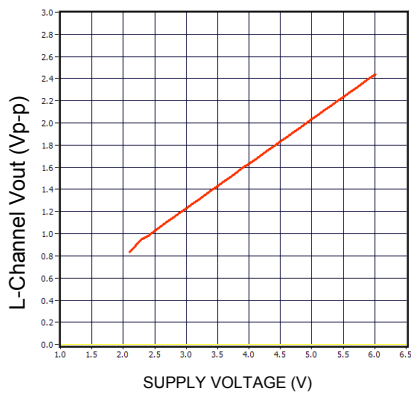
( $T_a=25^{\circ}\text{C}$ ,  $f=1\text{kHz}$ ,  $\text{Cap}=1\mu\text{F}$ , sampling rate=4fs; unless otherwise specified, )



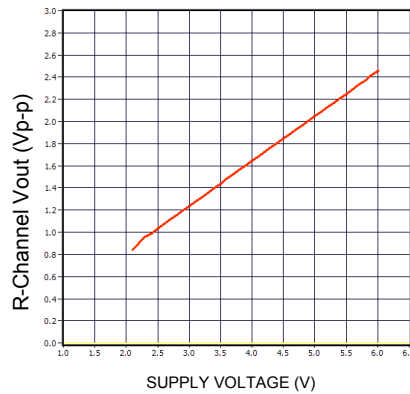
THD+N vs. frequency



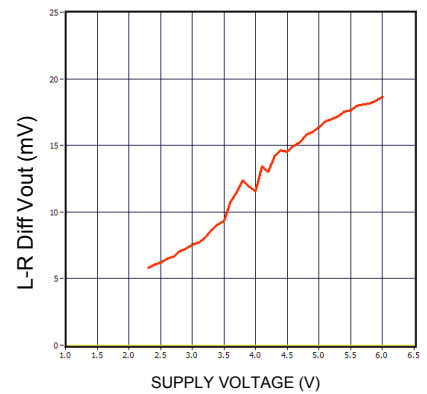
THD+N vs. frequency



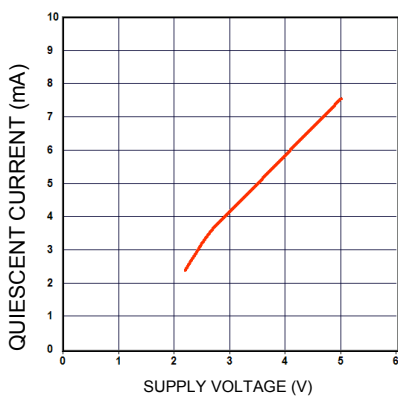
L-Vo vs supply voltage



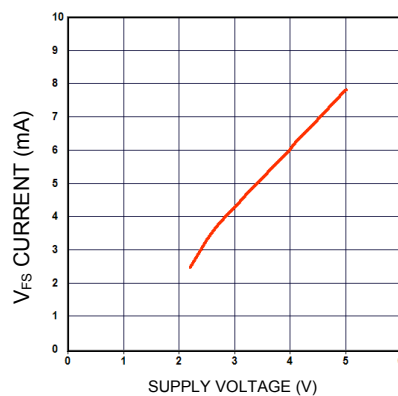
R-Vo vs supply voltage



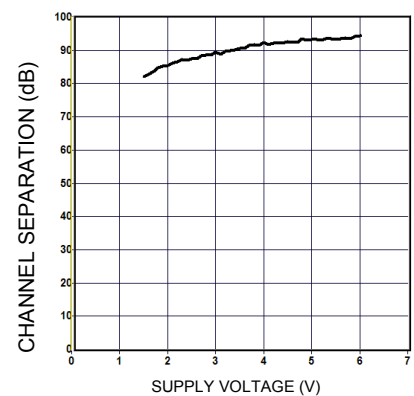
L-R Diff vs. supply voltage



Quiescent current vs. supply voltage



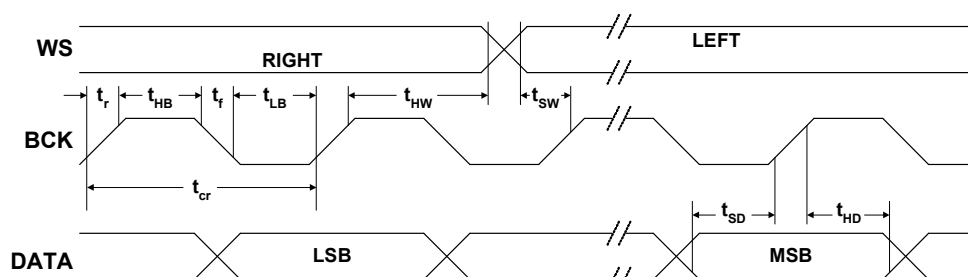
$V_{FS}$  current vs. supply voltage



Channel separation vs. supply voltage

## TIMING AND DATA FORMAT

The MS6313 accepts input serial data formats of 16-bit word length. Left and right data words are time multiplexed. The MSB (bit 1) must always be first. The format of data input is shown in Figs. 2 and 3. With a HIGH level on the word select input (WS), data is placed in the left input register and with LOW level on the WS input, data is placed in the right register (Fig. 1). The data in the input registers are simultaneously latched in the output registers which control the bit switches. Internal bias currents  $I_{BL}$  and  $I_{BR}$  are each added to the full scale output current  $I_{FS}$  in order to achieve the maximum dynamic range at the outputs of OP1 and OP2(Fig. 1). The reference voltage  $V_{ref}$  (Fig. 1) is approximately  $2/3 V_{DD}$ . In this way the maximum dynamic range is achieved over the entire power supply range.



**Fig.2 Timing and input signals.**

### Data format (BCK, WS, DATA)

| Symbol    | Parameter                   | Conditions   | Min | Typ. | Max  | Unit    |
|-----------|-----------------------------|--------------|-----|------|------|---------|
| $V_{IL}$  | Input LOW level             |              | -   | -    | 0.8  | V       |
| $V_{IH}$  | Input HIGH level            |              | 2   | -    | -    | V       |
| $I_{IL}$  | Input Leakage Current LOW   | $V_I = 0.8V$ | -   | -    | 10   | $\mu A$ |
| $I_{IH}$  | Input Leakage Current HIGH  | $V_I = 2.4V$ | -   | -    | 10   | $\mu A$ |
| $f_{BCK}$ | Input Clock Frequency       |              | -   | -    | 18.4 | MHz     |
| BR        | Bit Rate Data Input         |              | -   | -    | 18.4 | Mbits/s |
| $f_{WS}$  | Word Select Input           |              | -   | -    | 384  | kHz     |
| $t_r$     | Rise Time                   |              | -   | -    | 12   | ns      |
| $t_f$     | Fall Time                   |              | -   | -    | 12   | ns      |
| $t_{cr}$  | Bit Clock Cycle Time        |              | 54  | -    | -    | ns      |
| $t_{HB}$  | Bit Clock High Time         |              | 15  | -    | -    | ns      |
| $t_{LB}$  | Bit Clock Low Time          |              | 15  | -    | -    | ns      |
| $t_{SD}$  | Data Set-up Time            |              | 12  | -    | -    | ns      |
| $t_{HD}$  | Data Hold Time to Bit Clock |              | 2   | -    | -    | ns      |
| $t_{HW}$  | Word Select Hold Time       |              | 2   | -    | -    | ns      |
| $t_{SW}$  | Word Select Set-up Time     |              | 12  | -    | -    | ns      |

## Right justified format

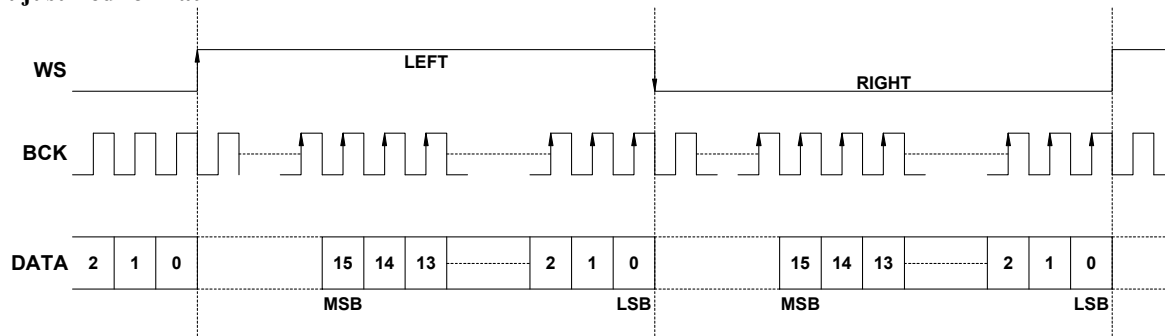


Fig.3 Right justified format

## APPLICATION INFORMATION

### MP3 digital to analog converting solution

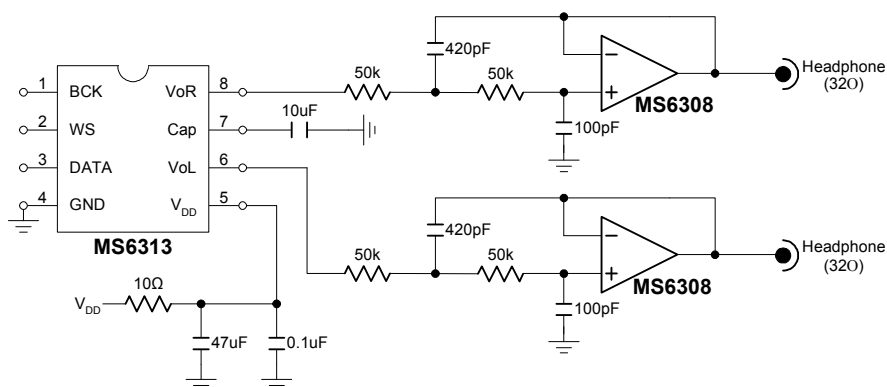


Fig.4 Example of a 2nd order filter application.

### MP3 digital to analog converting solution.

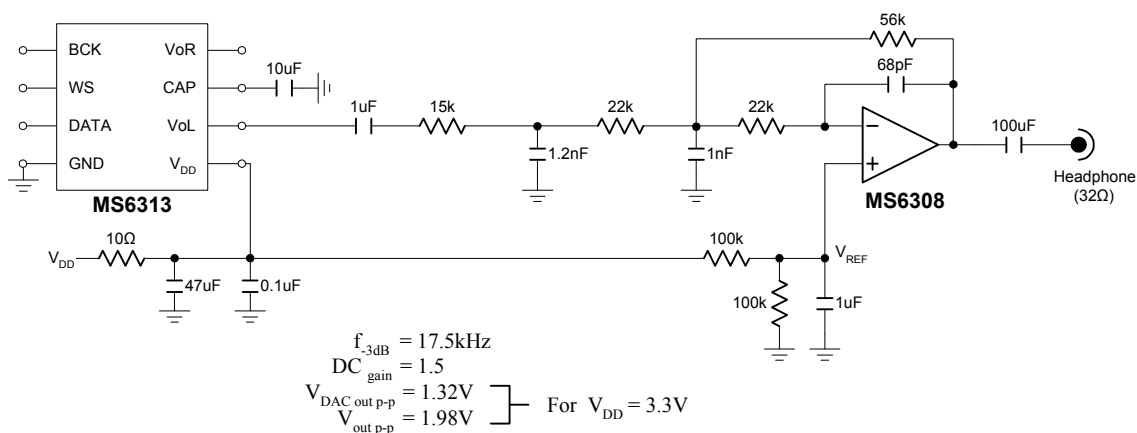
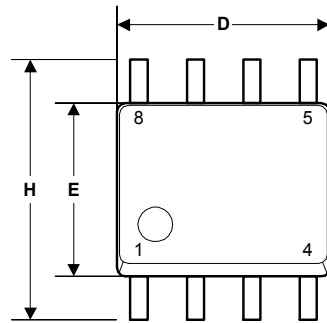
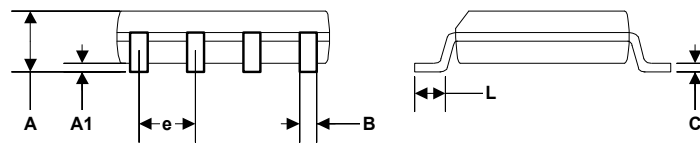


Fig.5 A third order lowpass filter ( Smoothing filter ) for DAC output

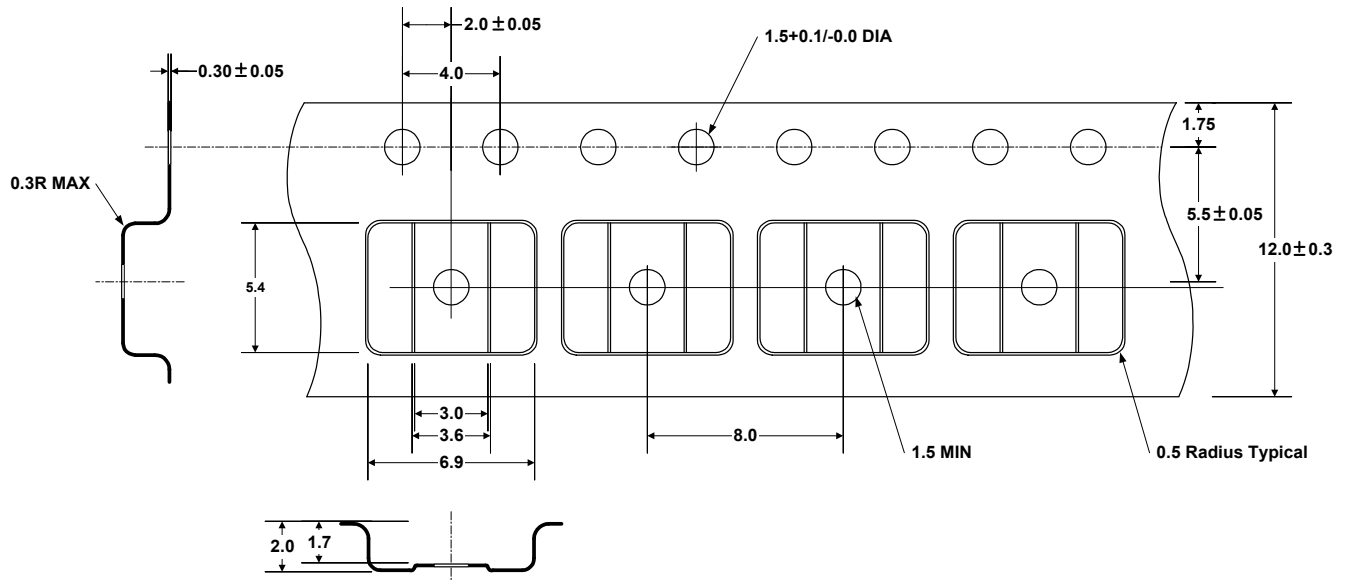
## EXTERNAL DIMENSIONS



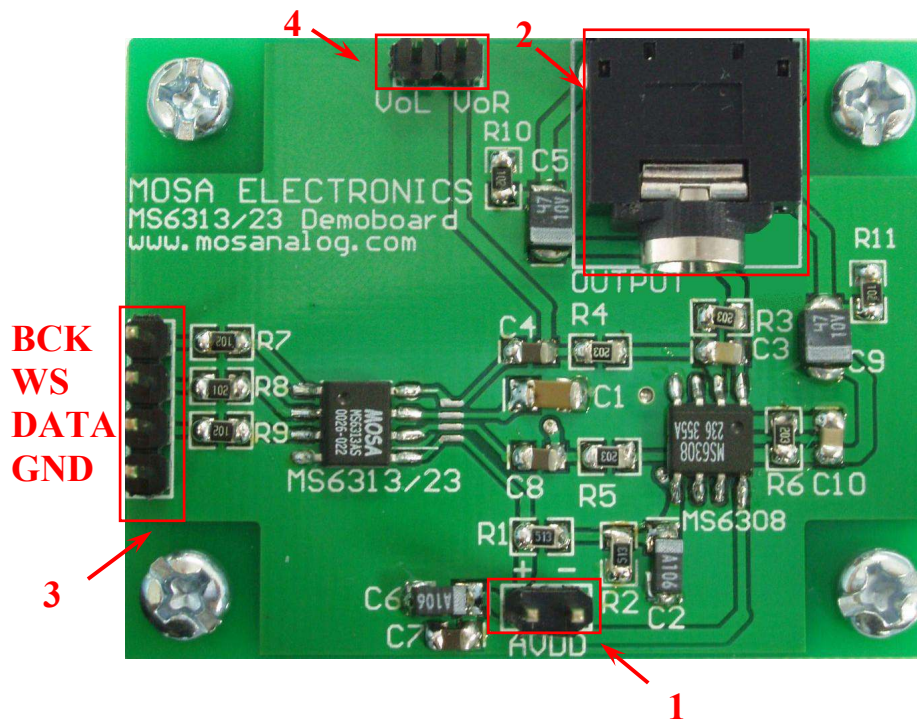
| Symbol | Dimension in mm |      | Dimension in inch |        |
|--------|-----------------|------|-------------------|--------|
|        | Min             | Max  | Min               | Max    |
| A      | 1.35            | 1.75 | 0.0532            | 0.0688 |
| A1     | 0.10            | 0.25 | 0.0040            | 0.0098 |
| B      | 0.33            | 0.51 | 0.013             | 0.020  |
| C      | 0.19            | 0.25 | 0.0075            | 0.0098 |
| e      | 1.27 BSC        |      | 0.050 BSC         |        |
| D      | 4.80            | 5.00 | 0.1890            | 0.1968 |
| H      | 5.80            | 6.20 | 0.2284            | 0.2440 |
| E      | 3.80            | 4.00 | 0.1497            | 0.1574 |
| L      | 0.40            | 1.27 | 0.016             | 0.050  |



## TAPE AND REEL (Unit : mm)



## Demoboard



### Function description

Label 1: Supply Input  
Supply voltage range is 2.7V to 6.5V.

Label 2: Headphone Jack  
Used 3.5mm diameter of headphone with 32ohm

Label 3: Digital Signal Inputs  
Connected to digital audio formats as Right Justified.

Label 4: MS6313 output  
Test point.

### Circuit

