

## 16-Bits Stereo Audio DAC

### Low Power Consumption

### Low Voltage, Excellent PSRR

#### FEATURES

- Operation range: 2.7V~5.5V
- Excellent Power Supply Rejection Ratio(PSRR)
- Low operating current
- Low power consumption  
8mW at  $V_{DD}=3.3V$  (Full scale output )
- Low distortion
- No zero crossing distortion
- Wide dynamic range(16-bit resolution)
- Voltage Output
- Fast setting time permits 2\*, 4\*, and 8\* oversampling (serial input) or double speed operation at 4\* oversampling
- Compatible with most of the Japanese input formats; time multiplexed, two's complement, CMOS input level
- Output voltage swing is proportional to supply voltage ( $V_{OPP}=V_{DD}/2$ )
- Cost efficient
- Space saving package SOP8, MSOP8

#### APPLICATIONS

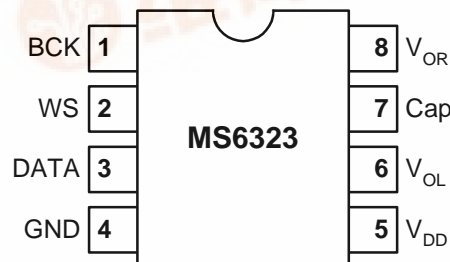
- Multimedia system
- MP3, PDA, Portable Digital Audio.

#### DESCRIPTION

The MS6323 is a 16-bit voltage-output Digital-to-Analog Converter(DAC). It gives the excellent Power Supply Rejection Ratio(PSRR). It features extremely low power dissipation, small package size and easy application. The accuracy of the weight 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 MS6323 ideally suited for use in portable audio equipment. MS6323 is pin and function compatible with MS6313.

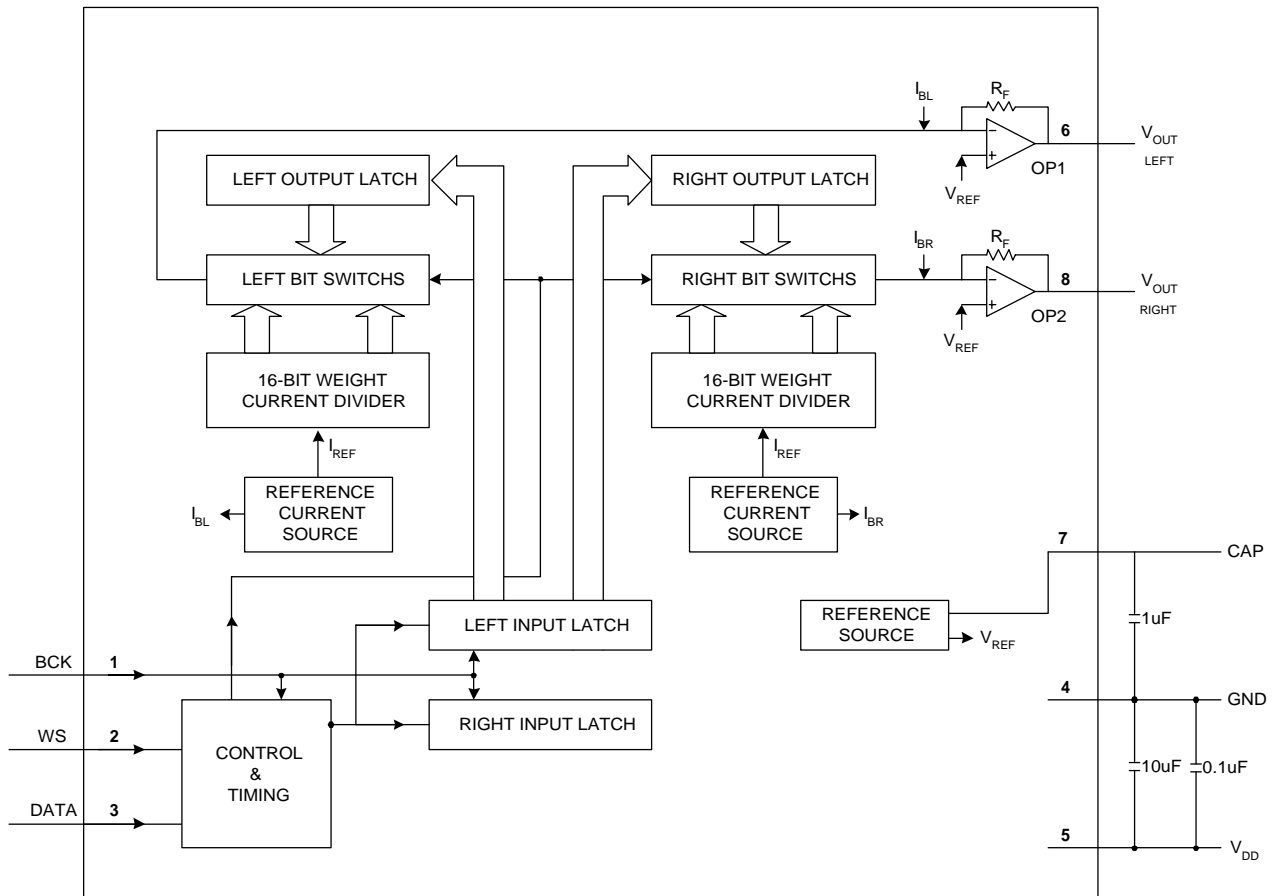
#### PIN CONFIGURATION

Symbol	Pin	Description
BCK	1	Bit clock input
WS	2	Word select input
DATA	3	Data input
GND	4	Ground
$V_{DD}$	5	Positive supply voltage
$V_{OL}$	6	Left channel output
Cap	7	Cap
$V_{OR}$	8	Right channel output



Pin 7 : Capacitor = 1 $\mu$ F (ripple rejection)

## BLOCK DIAGRAM



**Fig.1** Block diagram.

## ORDERING INFORMATION

Package	Part number	Packaging Marking	Transport Media
8-Pin SOP	MS6323ASTR	MS6323AS	2.5k Units Tape and Reel
8-Pin SOP	MS6323ASU	MS6323AS	100 Units Tube
8-Pin SOP (lead free)	MS6323ASGTR	MS6323ASG	2.5k Units Tape and Reel
8-Pin SOP (lead free)	MS6323ASGU	MS6323ASG	100 Units Tube
8-Pin MSOP	MS6323ASMTR	6323	3.5k Units Tape and Reel
8-Pin MSOP	MS6323ASMU	6323	80 Units Tube
8-Pin MSOP (lead free)	MS6323ASMGTR	6323G	3.5k Units Tape and Reel
8-Pin MSOP (lead free)	MS6323ASMGU	6323G	80 Units Tube

## ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Rating	Unit
V <sub>DD</sub>	Positive Supply Voltage	6	V
V <sub>ESD</sub>	Electrostatic Handling	-2000 to 2000	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 SOP8 MSOP8	210 235	°C/W

## OPERATING RATINGS

Symbol	Parameter	Min	Typ	Max	Unit
V <sub>DD</sub>	Supply Voltage	2.7	-	5.5	V

## 3.3V ELECTRICAL CHARACTERISTICS

(T<sub>a</sub>=25°C, V<sub>DD</sub>=3.3V, V<sub>SS</sub>=0V, f=1kHz, Cap=1uF; unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>DC Characteristics</b>						
V <sub>CAP</sub>	Voltage at CAP		1.60	1.65	1.70	V
V <sub>DC</sub>	Output DC level		1.60	1.65	1.70	V
V <sub>FS</sub>	Full scale output voltage	V <sub>FS</sub> =0.5V <sub>DD</sub>	1.5	1.65	1.8	V <sub>pp</sub>
I <sub>Q</sub>	Quiescent current	At code 0000H	-	2.0	2.3	mA
PSRR	Power supply rejection ratio	CAP=1uF, f=100Hz	45	50	-	dB
		CAP=10uF, f=100Hz	63	68	-	dB
CS	Channel separation		78	84	-	dB
<b>AC Characteristics</b>						
Res	Resolution		-	-	16	bits
THD+N	Total harmonic distortion plus noise		-	-66	-62	dB
			-	0.05	0.08	%
S/N	Signal-to-noise ratio		86	92	-	dB

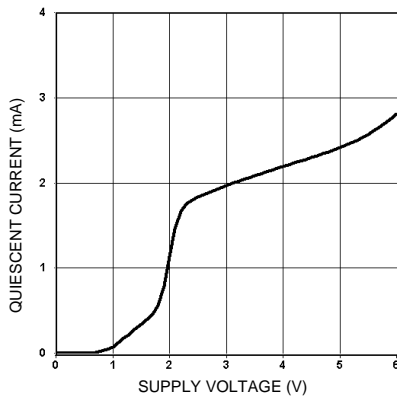
## 2.7V ELECTRICAL CHARACTERISTICS

( $T_a=25^{\circ}\text{C}$ ,  $V_{DD}=2.7\text{V}$ ,  $V_{SS}=0\text{V}$ ,  $f=1\text{kHz}$ ,  $\text{Cap}=1\mu\text{F}$ ; unless otherwise specified)

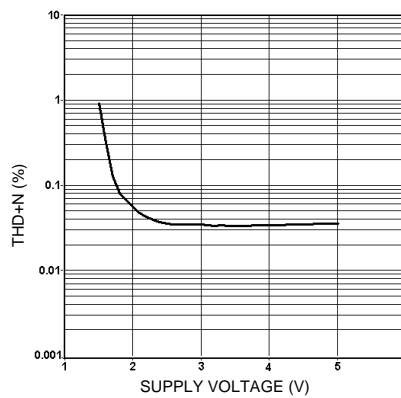
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
<b>DC Characteristics</b>						
$V_{CAP}$	Voltage at CAP		1.30	1.35	1.40	V
$V_{DC}$	Output DC level	$V_{FS}=0.5V_{DD}$	1.30	1.35	1.40	V
$V_{FS}$	Full scale output voltage		1.2	1.35	1.5	V <sub>pp</sub>
$I_Q$	Quiescent current	At code 0000H	-	1.9	2.2	mA
PSRR	Power supply rejection ratio	CAP=1 $\mu\text{F}$ , f=100Hz	45	49	-	dB
		CAP=10 $\mu\text{F}$ , f=100Hz	63	68	-	dB
CS	Channel separation		77	83	-	dB
<b>AC Characteristics</b>						
Res	Resolution		-	-	16	bits
THD+N	Total harmonic distortion plus noise		-	-66	-62	dB
			-	0.05	0.08	%
S/N	Signal-to-noise ratio		84	90	-	dB

## TYPICAL PERFORMANCE CHARACTERISTICS

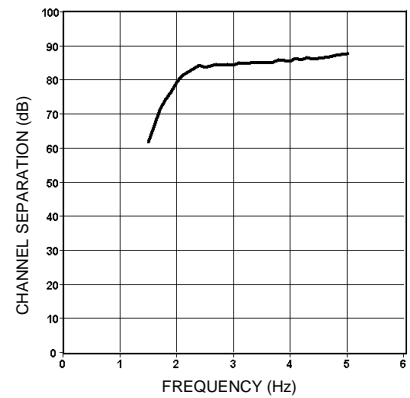
( $T_a=25^{\circ}\text{C}$ ,  $f=1\text{kHz}$ ,  $\text{Cap}=1\mu\text{F}$ ; unless otherwise specified)



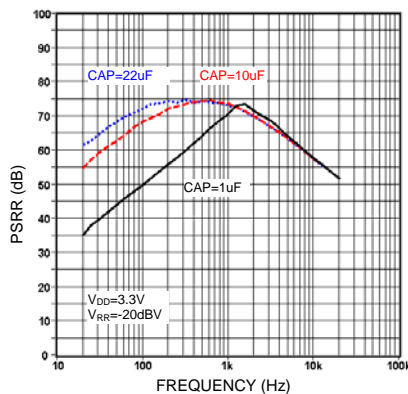
Quiescent current vs. supply voltage



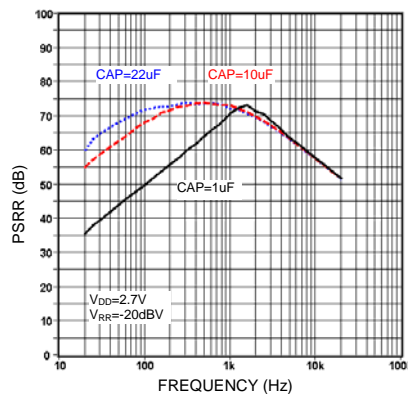
THD+N vs. supply voltage



Channel separation vs. frequency



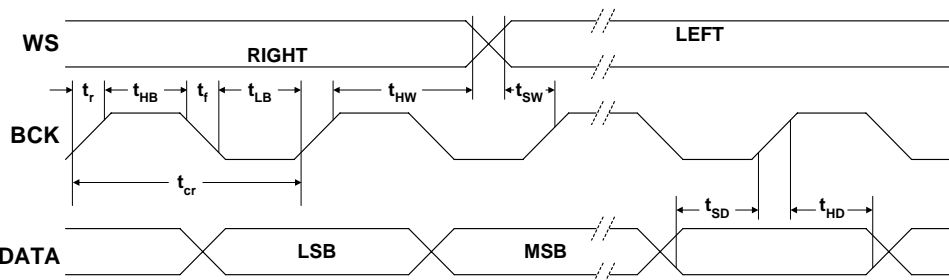
PSRR vs. frequency



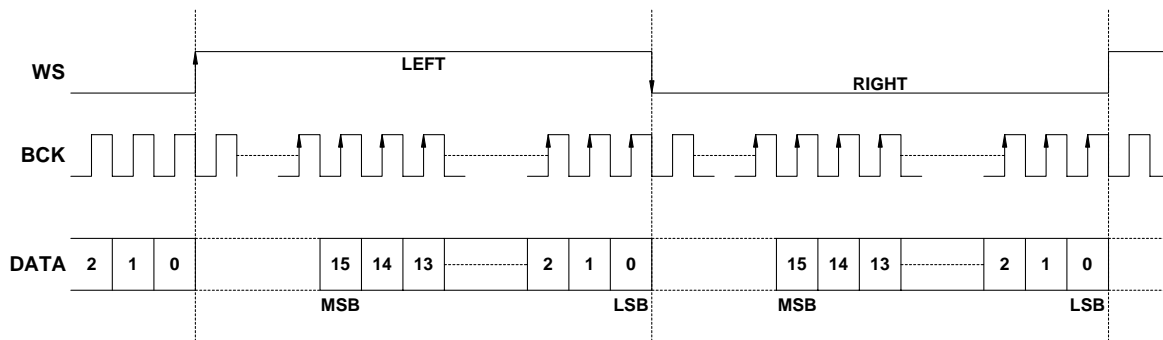
PSRR vs. frequency

## TIMING AND DATA FORMAT

The MS6323 accepts input serial data formats of 16-bit word length. Left and right data words are time multiplexed. The MSB 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). In this way the maximum dynamic range is achieved over the entire power supply range.



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



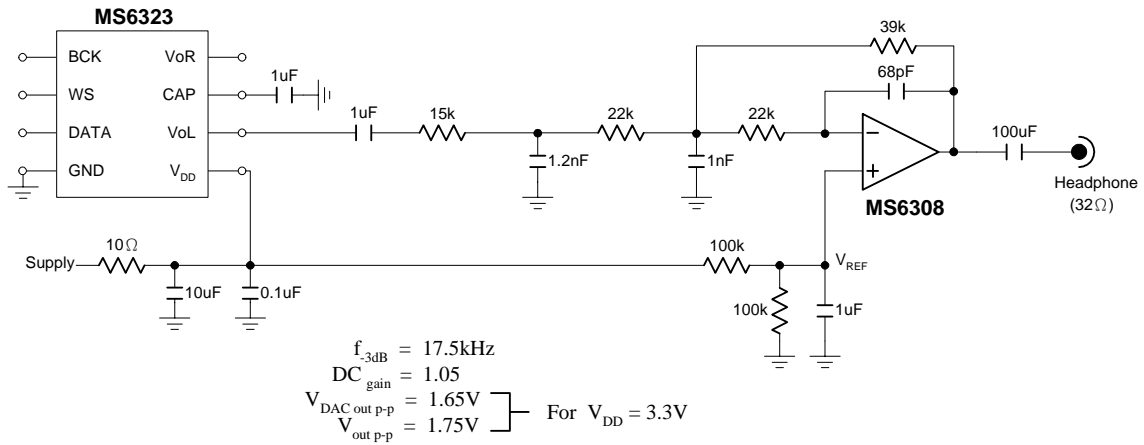
**Fig.3 Format of input signals.**

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

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
$V_{IL}$	Input LOW level		-	-	$0.3V_{DD}$	V
$V_{IH}$	Input HIGH level		$0.7V_{DD}$	-	-	V
$I_{IL}$	Input Leakage Current LOW		-	-	10	$\mu A$
$I_{IH}$	Input Leakage Current HIGH		-	-	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

## APPLICATION INFORMATION

### MP3 digital to analog converting solution

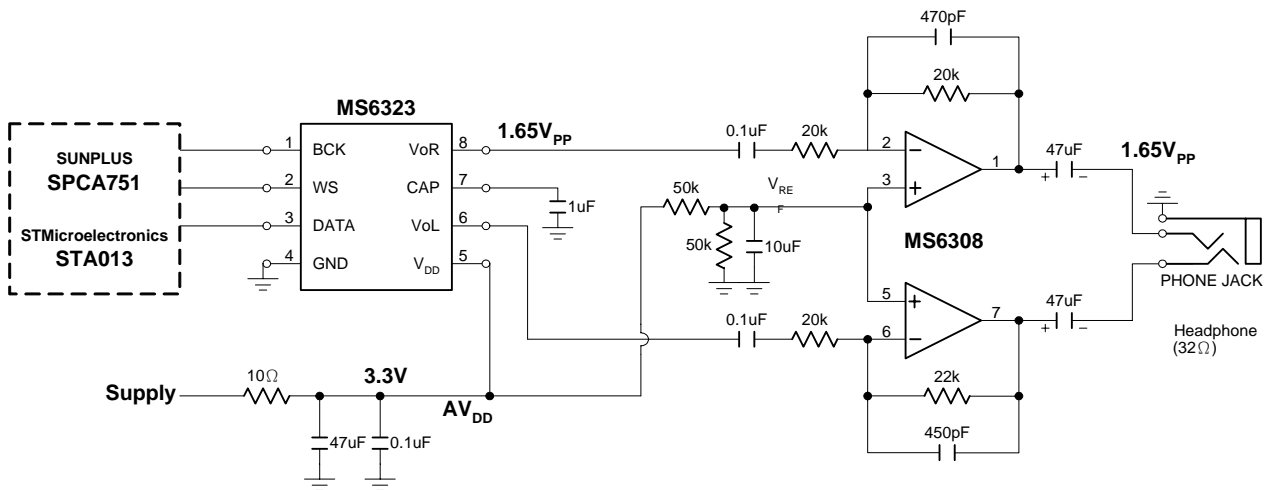


**Fig.4** A third order lowpass filter ( Smoothing filter ) for DAC output.

### MP3 DECODER

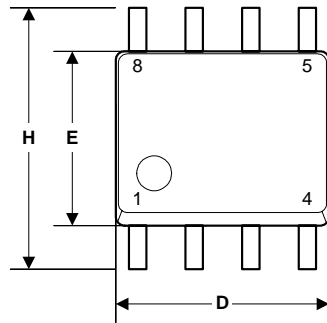
### DAC

### Headphone Driver

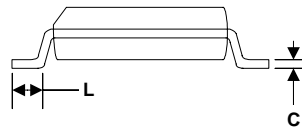
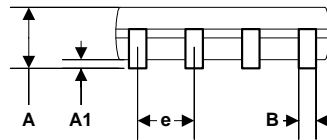


**Fig.5** A first order lowpass filter for DAC output.

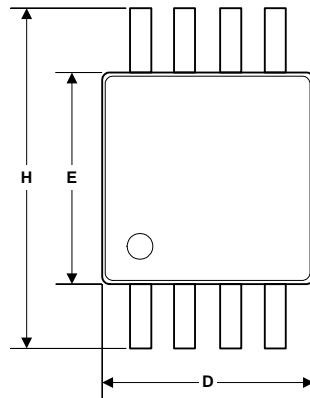
## EXTERNAL DIMENSIONS



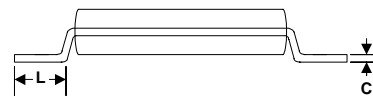
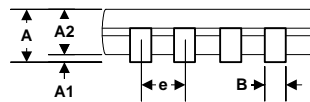
Symbol	Dimension in mm		Dimension in inch	
	Min	Max	Min	Max
A	1.35	1.75	0.0532	0.0688
A1	0.10	0.25	0.0040	0.0098
B	0.33	0.51	0.013	0.020
C	0.19	0.25	0.0075	0.0098
D	4.80	5.00	0.1890	0.1968
H	5.80	6.20	0.2284	0.2440
E	3.80	4.00	0.1497	0.1574
e	1.27 BSC		0.050 BSC	
L	0.40	1.27	0.016	0.050



**SOP8**

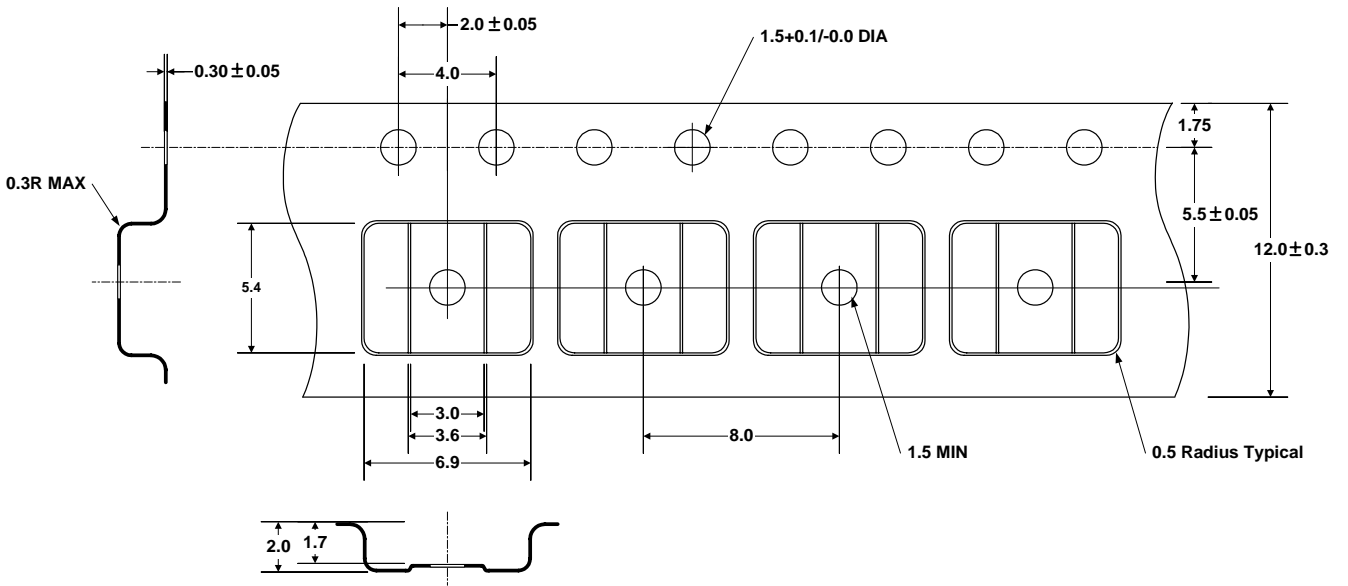


Symbol	Dimension in mm		Dimension in inch	
	Min	Max	Min	Max
A	0.81	1.12	0.032	0.048
A1	0.05	0.15	0.002	0.006
A2	0.76	0.86	0.030	0.038
B	0.28	0.38	0.011	0.015
C	0.13	0.23	0.005	0.009
D	2.90	3.10	0.114	0.122
H	4.70	5.10	0.185	0.201
E	2.90	3.10	0.114	0.122
e	0.65		0.026	
L	0.40	0.66	0.016	0.026

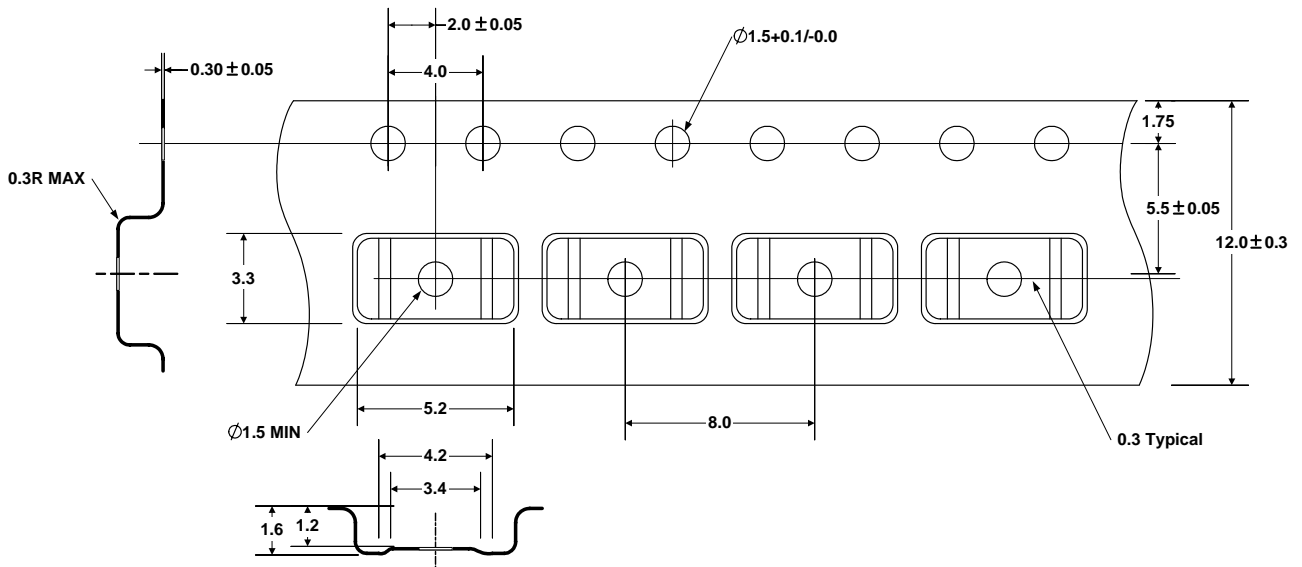


**MSOP8**

**TAPE AND REEL** (Unit : mm)



**SOP8**



**MSOP8**