16-Bits Stereo Audio DAC
Low Power Consumption
Low Voltage, Excellent PSRR

FEATURES

- Operation range: 2.5V~6.5V.
- 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 .
- 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).
- The minimum HIGH voltage of digital clocks (WS,DATA and BCK)and the control inputs can be 1.8V at Vdd = 5V.
- As the power is up, the initial registers of the DAC are 0000Hex, so the DAC output will beVdd/2.
- Audio Format：I2S(MS6324)
  Right Justified(MS6326)
- Space saving package SOP8, MSOP8, DFN8

APPLICATIONS

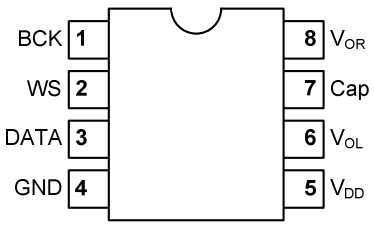
- Multimedia system
- MP3, PDA, Portable Digital Audio.
- Set top box.

DESCRIPTION

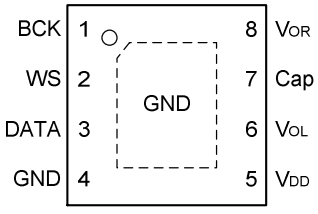
The MS6324/26 is a 16-bit voltage-output Digital-to-Analog Converter(DAC). It gives the excellent Power Supply Rejection Ratio(PSRR). It features extremely low power dissipation, small package size and easy application. The accuracy of the weight current sources, combined with the unique symmetrical decoding method, preclude zero-crossing distortion and ensures high quality audio reproduction. As the power is up, the initial registers of the DAC are 0000Hex, so the DAC output will beVdd/2. These unique features, combined with its exceptional performance, make the MS6324/26 ideally suited for use in portable audio equipment. MS6326 is pin and function compatible with MS6323.

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



SOP8/MSOP8



DFN8

BLOCK DIAGRAM

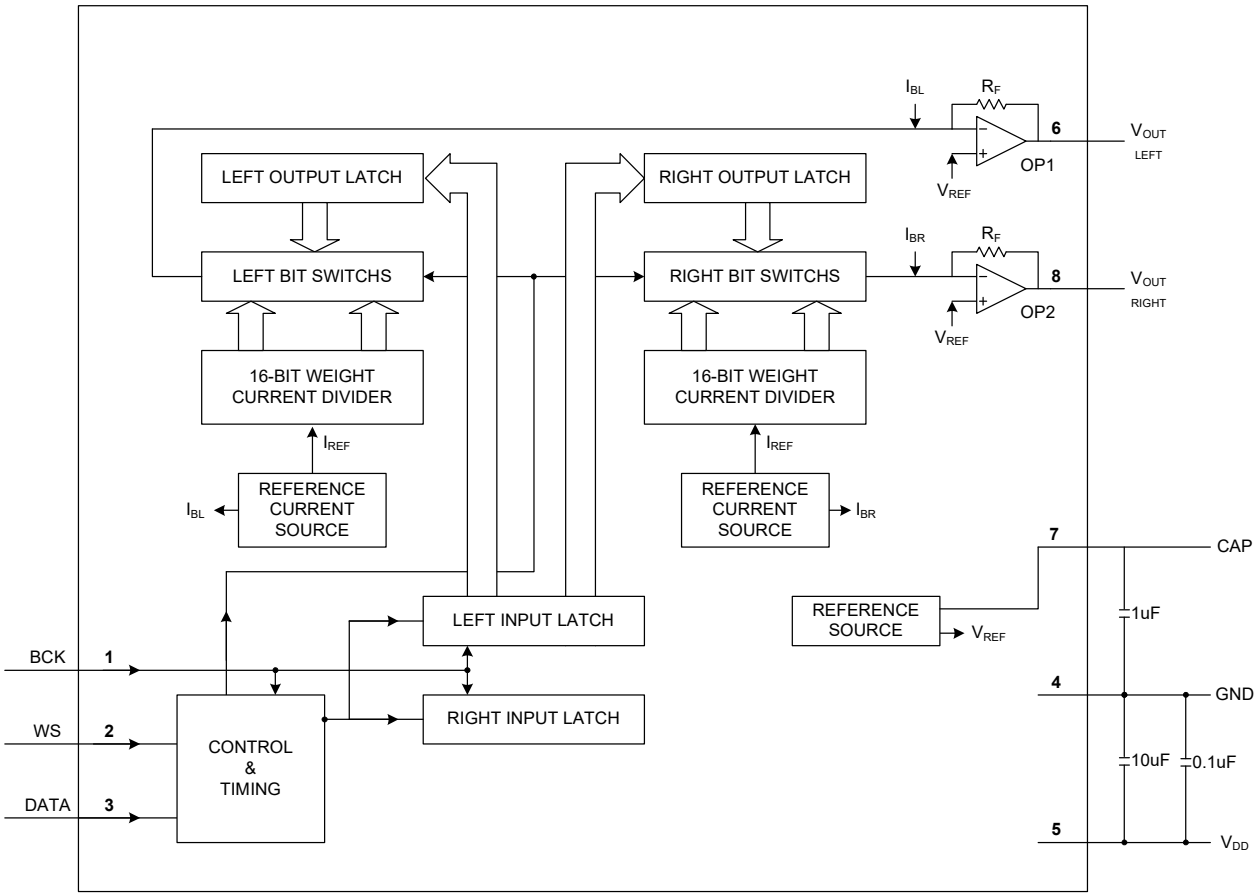


Fig.1 Block diagram.

ORDERING INFORMATION

Package	Part number	Marking	Transport Media
8-Pin SOP (lead free)	MS6324GTR	MS6324G	2.5k Units Tape and Reel
8-Pin SOP (lead free)	MS6324GU	MS6324G	100 Units Tube
8-Pin MSOP (lead free)	MS6324MGTR	6324G	3.5k Units Tape and Reel
8-Pin MSOP (lead free)	MS6324MGU	6324G	80 Units Tube
8-Pin DFN (lead free)	MS6324DGTR	MS6324	5k Units Tape and Reel
8-Pin SOP (lead free)	MS6326GTR	MS6326G	2.5k Units Tape and Reel
8-Pin SOP (lead free)	MS6326GU	MS6326G	100 Units Tube
8-Pin MSOP (lead free)	MS6326MGTR	6326G	3.5k Units Tape and Reel
8-Pin MSOP (lead free)	MS6326MGU	6326G	80 Units Tube
8-Pin DFN (lead free)	MS6326DGTR	MS6326	5k Units Tape and Reel

RoHS Compliance

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Rating	Unit
V_{DD}	Positive Supply Voltage	6.5	V
V_{ESD}	Electrostatic Handling	-2000 to 2000	V
T_{STG}	Storage Temperature Range	-65 to 150	℃
T_A	Operating Ambient Temperature Range	-40 to 85	℃
T_J	Maximum Junction Temperature	150	℃
T_S	Soldering Temperature, 10 seconds	260	℃
R_{THJA}	Thermal Resistance from Junction to Ambient in Free Air SOP8 MSOP8 DFN8	 175 235 120	℃/W

OPERATING RATINGS

Symbol	Parameter	Min	Typ	Max	Unit
V_{DD}	Supply Voltage	2.5	-	6.5	V

6V ELECTRICAL CHARACTERISTICS

(Ta=25℃, V_{DD}=6V, f=1kHz, Cap=1uF; unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
DC Characteristics						
V_{CAP}	Voltage at Cap		2.95	3	3.05	V
V_{DC}	Output DC level		2.95	3	3.05	V
V_{FS}	Full scale output voltage	V_{FS}=0.5V_{DD}	2.8	3	3.2	Vpp
I_Q	Quiescent current	At code 0000H	-	3	-	mA
I_{FS}	Maximum operation current	V_{FS}=0.5V_{DD}	-	3.2	-	mA
PSRR	Power supply rejection ratio	Cap=1uF, f=100Hz	44	49	-	dB
		Cap=10uF, f=100Hz	59	63	-	dB
CS	Channel separation		89	94	-	dB
AC Characteristics						
Res	Resolution		-	-	16	bits
THD+N	Total harmonic distortion plus noise		-	-68	-63	dB
			-	0.04	0.068	%
S/N	Signal-to-noise ratio		89	95	-	dB

5V ELECTRICAL CHARACTERISTICS

(Ta=25℃, V_{DD}=5V, f=1kHz, Cap=1uF; unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
DC Characteristics						
V_{CAP}	Voltage at Cap		2.45	2.5	2.55	V
V_{DC}	Output DC level		2.45	2.5	2.55	V
V_{FS}	Full scale output voltage	V_{FS}=0.5V_{DD}	2.3	2.5	2.7	Vpp
I_Q	Quiescent current	At code 0000H	-	2.7	-	mA
I_{FS}	Maximum operation current	V_{FS}=0.5V_{DD}	-	2.8	-	mA
PSRR	Power supply rejection ratio	Cap=1uF, f=100Hz	45	50	-	dB
		Cap=10uF, f=100Hz	64	69	-	dB
CS	Channel separation		88	93	-	dB
AC Characteristics						
Res	Resolution		-	-	16	bits
THD+N	Total harmonic distortion plus noise		-	-68	-63	dB
			-	0.04	0.068	%
S/N	Signal-to-noise ratio		89	95	-	dB

3.3V ELECTRICAL CHARACTERISTICS

(Ta=25℃, V_{DD}=3.3V, f=1kHz, Cap=1uF; unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
DC Characteristics						
V_{CAP}	Voltage at CAP		1.6	1.65	1.7	V
V_{DC}	Output DC level		1.6	1.65	1.7	V
V_{FS}	Full scale output voltage	V_{FS}=0.5V_{DD}	1.5	1.65	1.8	Vpp
I_Q	Quiescent current	At code 0000H	-	2.3	-	mA
I_{FS}	Maximum operation current	V_{FS}=0.5V_{DD}	-	2.4	-	mA
PSRR	Power supply rejection ratio	Cap=1uF, f=100Hz	45	50	-	dB
		Cap=10uF, f=100Hz	63	68	-	dB
CS	Channel separation		85	90	-	dB
AC Characteristics						
THD+N	Total harmonic distortion plus noise		-	-66	-62	dB
			-	0.05	0.08	%
S/N	Signal-to-noise ratio		86	92	-	dB

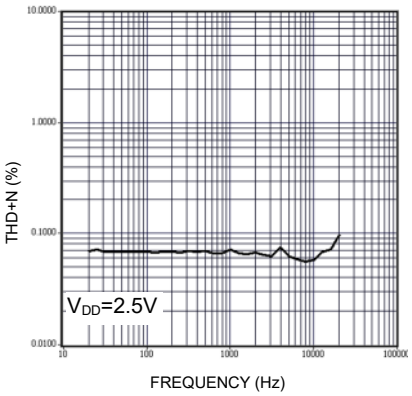
2.5V ELECTRICAL CHARACTERISTICS

(Ta=25℃, V_{DD}=2.5V, f=1kHz, Cap=1uF; unless otherwise specified)

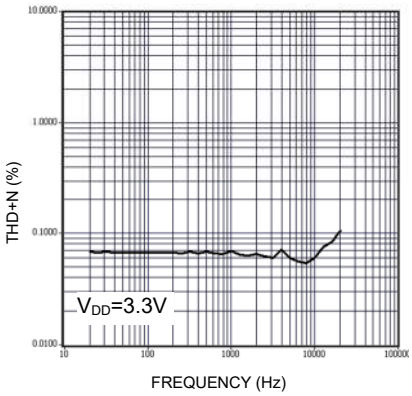
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
DC Characteristics						
V_{CAP}	Voltage at CAP		1.2	1.25	1.3	V
V_{DC}	Output DC level		1.2	1.25	1.3	V
V_{FS}	Full scale output voltage	V_{FS}=0.5V_{DD}	1.15	1.25	1.35	Vpp
I_Q	Quiescent current	At code 0000H	-	2.0	-	mA
I_{FS}	Maximum operation current	V_{FS}=0.5V_{DD}	-	2.05	-	mA
PSRR	Power supply rejection ratio	Cap=1uF, f=100Hz	45	49	-	dB
		Cap=10uF, f=100Hz	62	67	-	dB
CS	Channel separation		82	87	-	dB
AC Characteristics						
THD+N	Total harmonic distortion plus noise		-	-66	-62	dB
			-	0.05	0.08	%
S/N	Signal-to-noise ratio		83	89	-	dB

TYPICAL PERFORMANCE CHARACTERISTICS

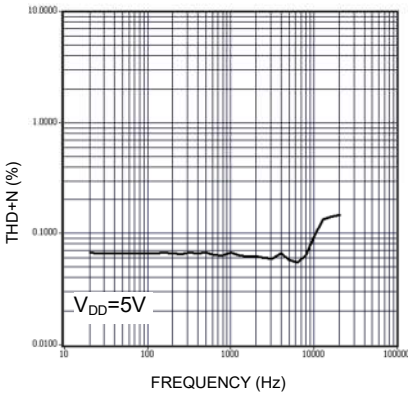
(Ta=25℃, f=1kHz, Cap=1uF, sampling rate=4fs; unless otherwise specified,)



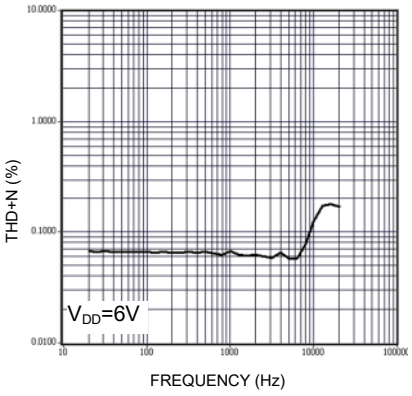
THD+N vs. frequency



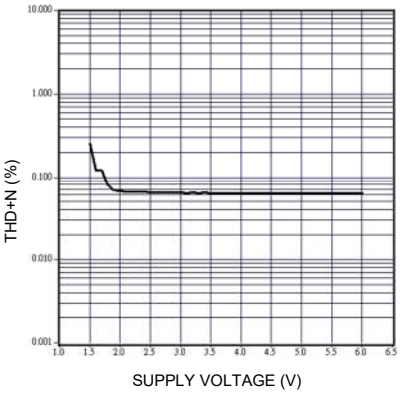
THD+N vs. frequency



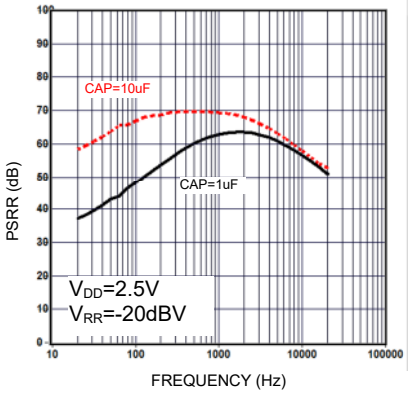
THD+N vs. frequency



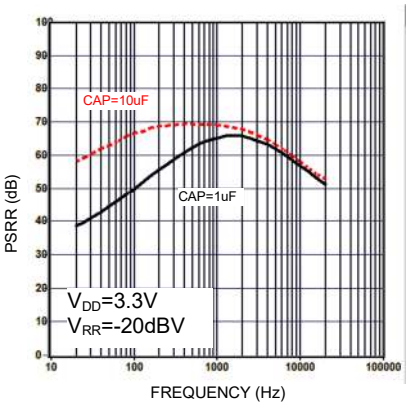
THD+N vs. frequency



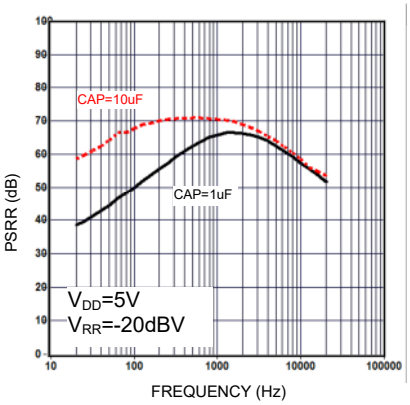
THD+N vs. supply voltage



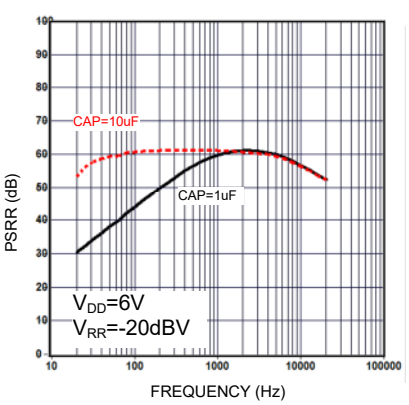
PSRR vs. frequency



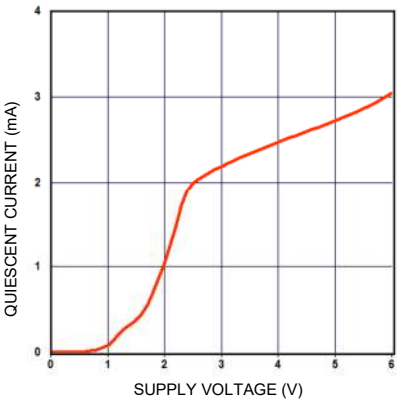
PSRR vs. frequency



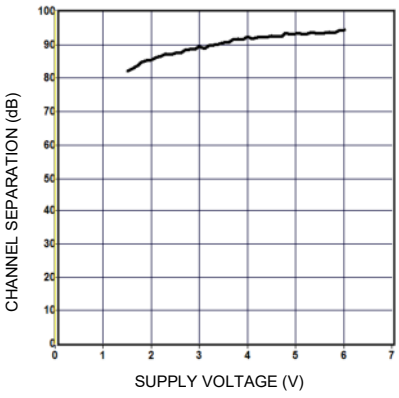
PSRR vs. frequency



PSRR vs. frequency



Quiescent current vs. supply voltage



Channel separation vs. supply voltage

TIMING AND DATA FORMAT

The MS6324/26 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.

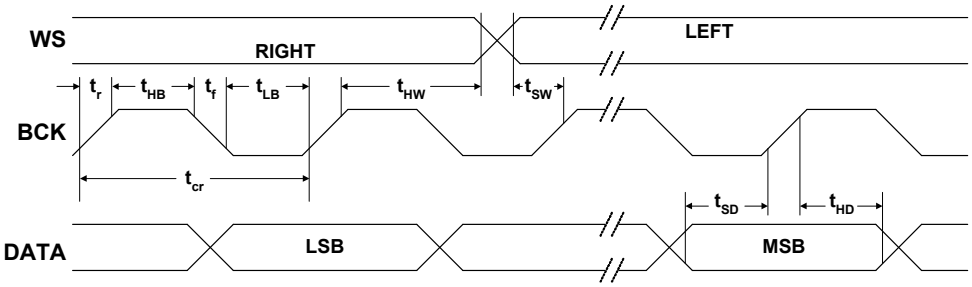


Fig.2 Timing and input signals.

Data format (BCK, WS, DATA)

Symbol	Parameter	Conditions	Min	Typ.	Max	Unit
V_{IL}	Input LOW level		-	-	0.7	V
V_{IH}	Input HIGH level		1.8	-	-	V
$\lvert I_{IL} \rvert$	Input Leakage Current LOW		-	-	10	μA
$\lvert I_{IH} \rvert$	Input Leakage Current HIGH		-	-	10	μA
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

I2S format

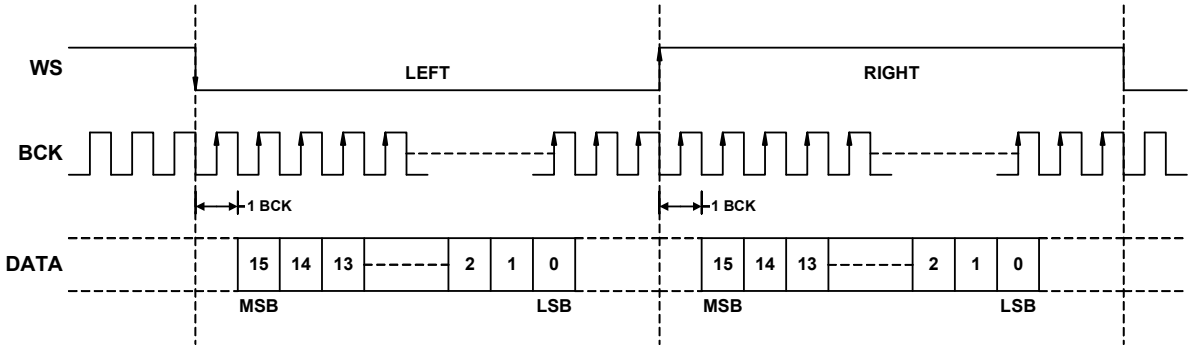


Fig.4 I2S format(MS6324)

Right justified format

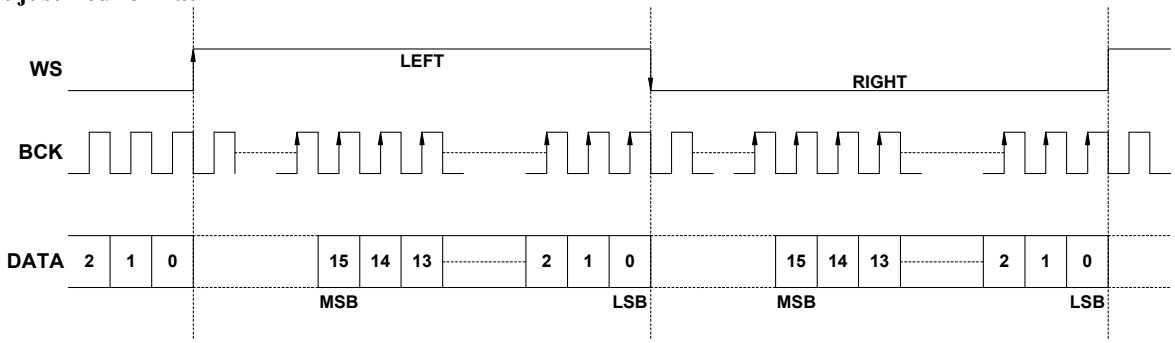


Fig.3 Right justified format(MS6326)

APPLICATION INFORMATION

MP3 digital to analog converting solution

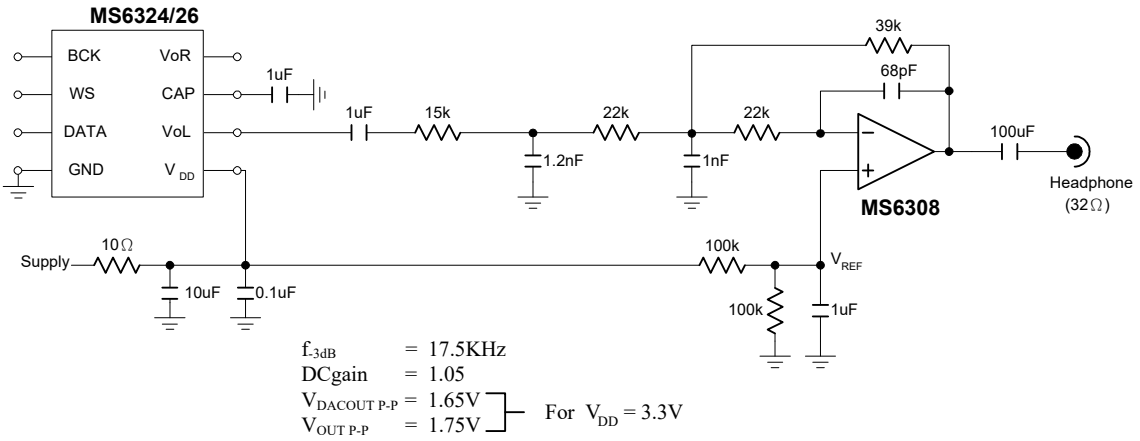


Fig.4 A third order lowpass filter (Smoothing filter) for DAC output.

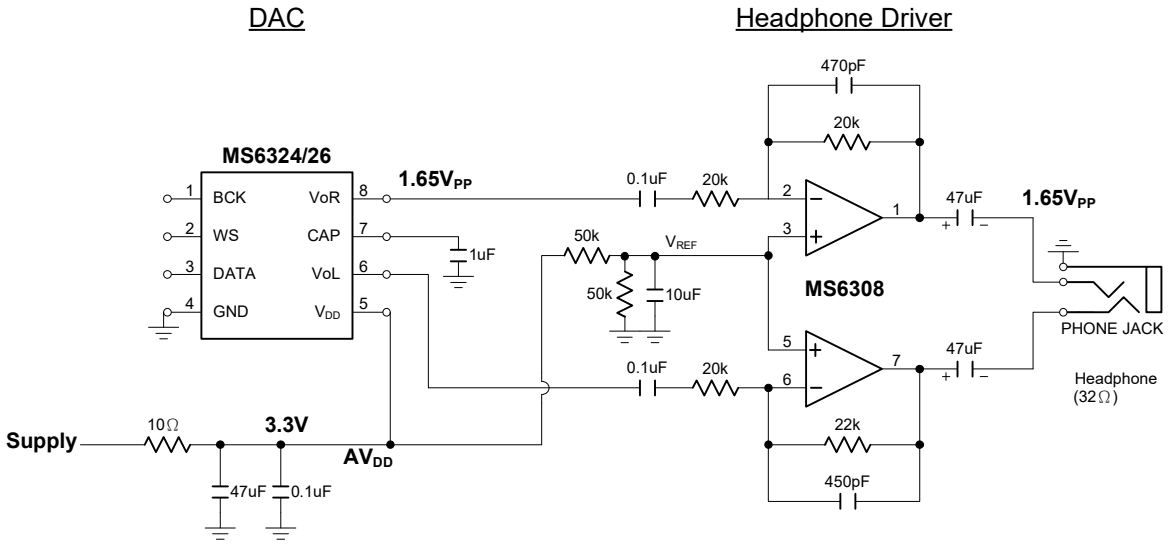
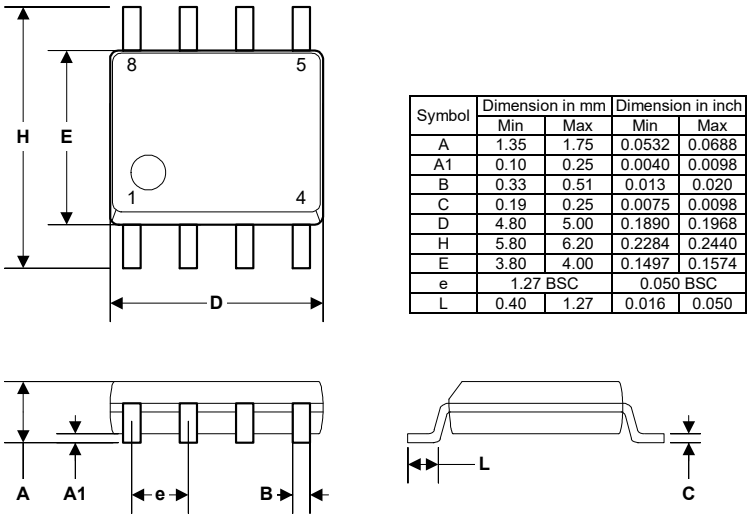


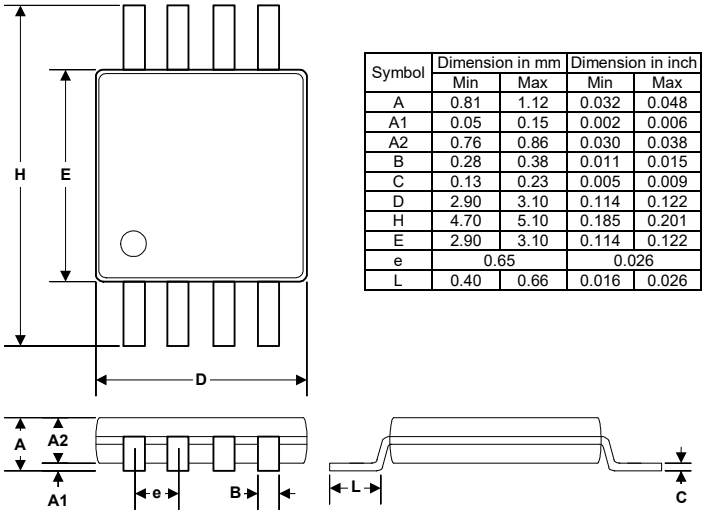
Fig.5 A first order lowpass filter for DAC output.

EXTERNAL DIMENSIONS



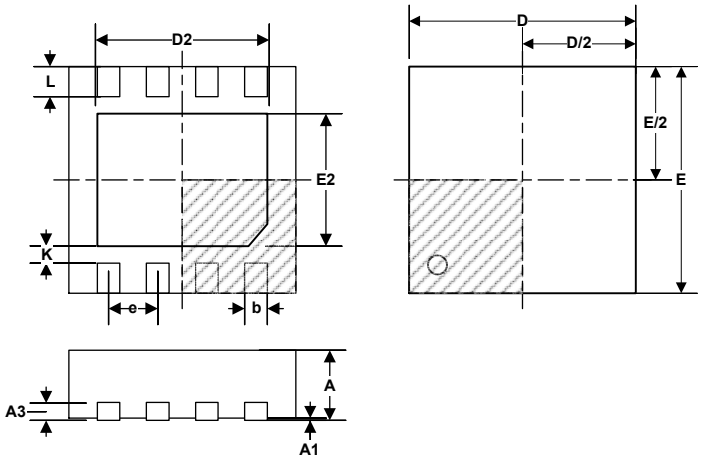
Symbol	Dimension in mm		Dimension in inch	
	Min	Max	Min	Max
A	1.35	1.75	0.0532	0.0688
A1	0.10	0.25	0.0040	0.0098
B	0.33	0.51	0.013	0.020
C	0.19	0.25	0.0075	0.0098
D	4.80	5.00	0.1890	0.1968
H	5.80	6.20	0.2284	0.2440
E	3.80	4.00	0.1497	0.1574
e	1.27 BSC		0.050 BSC	
L	0.40	1.27	0.016	0.050

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

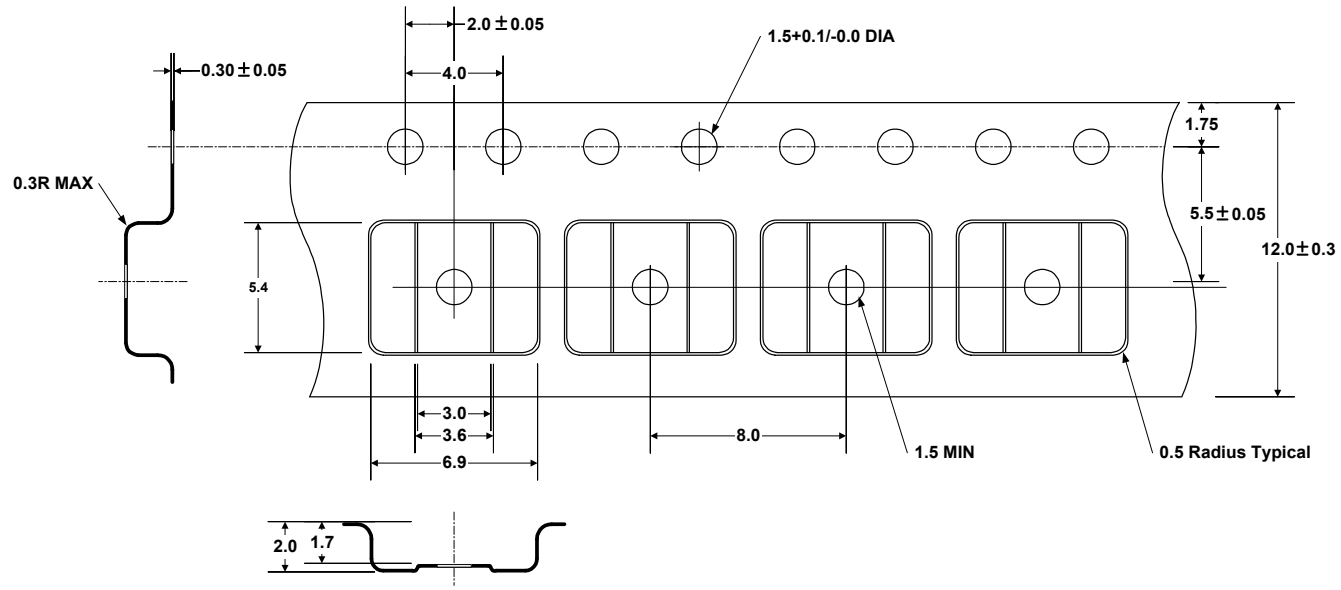
MSOP8



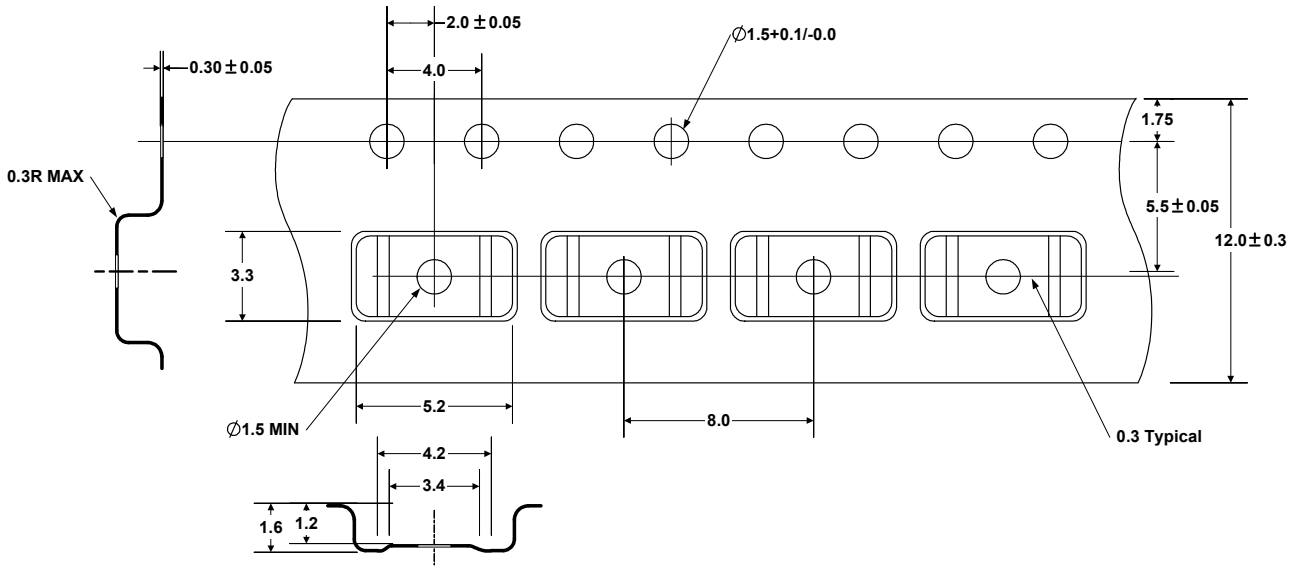
Symbol	Dimension in mm		
	Min	Nom	Max
A	0.80	0.90	1.00
A1	0	0.02	0.05
A3	0.20 REF.		
D	3.00 BASIC		
D2	1.60		2.50
E	3.00 BASIC		
E2	1.35		1.75
e	0.65 BASIC		
b	0.25	0.30	0.35
L	0.30	0.40	0.50
K	0.20		
JEDEC	MO-229(Variation V3030C-2)		

DFN8

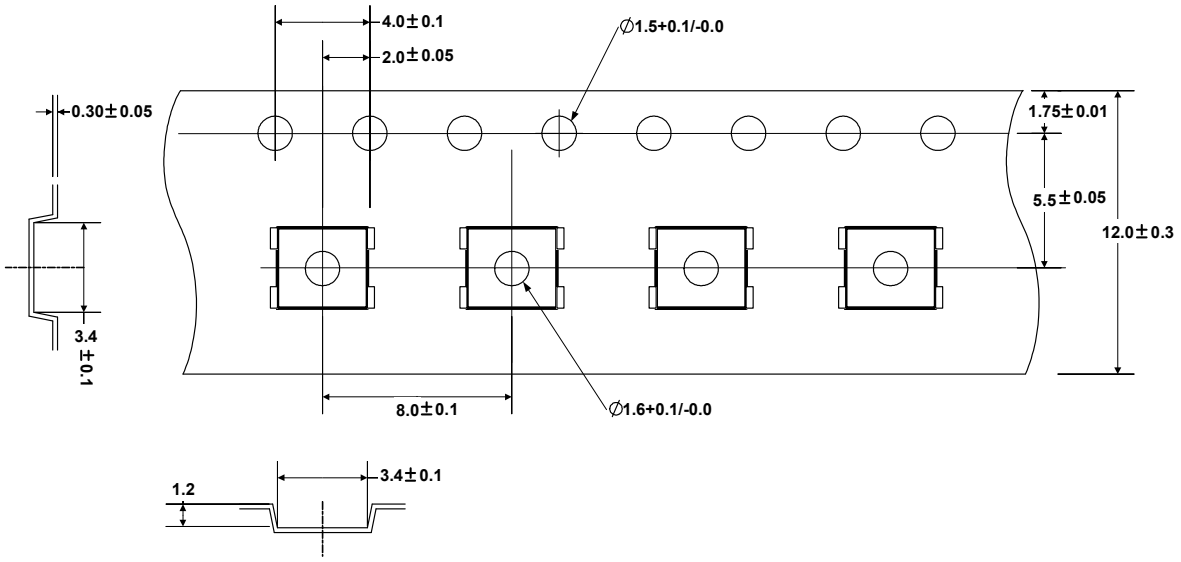
TAPE AND REEL (Unit : mm)



SOP8

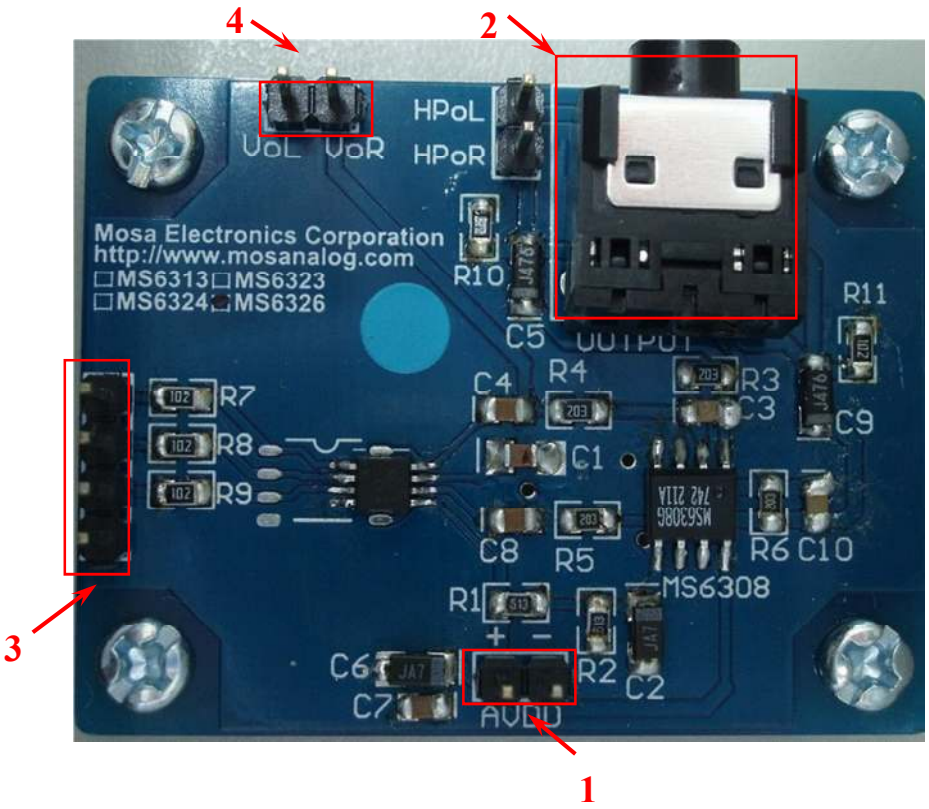


MSOP8


4.0±0.1
2.0±0.05
∅1.5+0.1/-0.0
0.30±0.05
1.75±0.01
5.5±0.05
12.0±0.3
3.4±0.1
8.0±0.1
∅1.6+0.1/-0.0
1.2
3.4±0.1

DFN8(3x3mm)

Demo board



Function description

Label 1: Supply Input
Supply voltage range is 2.5V to 6.5V.

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

Label 3: Digital Signal Input
Connected to digital audio format.

Label 4: MS6324/26 output
MS6324/26 output test ports.

Circuit

