

### FEATURES

- Voltage Output
- Space saving package (SOP8)
- Low power consumption
- Low total harmonic distortion
- Wide dynamic range(16-bit resolution)
- No zero crossing distortion
- Wide operating temperature range(-40°C to 85°C)
- Internal bias current ensures maximum dynamic range
- 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, TTL
- The full scale output voltage can be mask optioned
- Cost efficient
- Easy application :  
single 2.7 to 5.5 rail power supply  
output and bias current are proportional to supply voltage  
integrated current-to-voltage converter

### APPLICATIONS

VCD Player, DVD Player, CD-ROM, DVD-ROM, CD-RW, DVD-RW, Motherboard.

### DESCRIPTION

The MS6311 is a 16-bit voltage-output Digital-to-Analog Converter(DAC). The MS6311 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 MS6311 ideally suited for use in digital audio equipment. MS6311 is pin and function compatible with the Philips, TDA1311.

### PINNING

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
n.c.	7	not connected
V <sub>OR</sub>	8	right channel output

**Pin configuration**

### BLOCK DIAGRAM

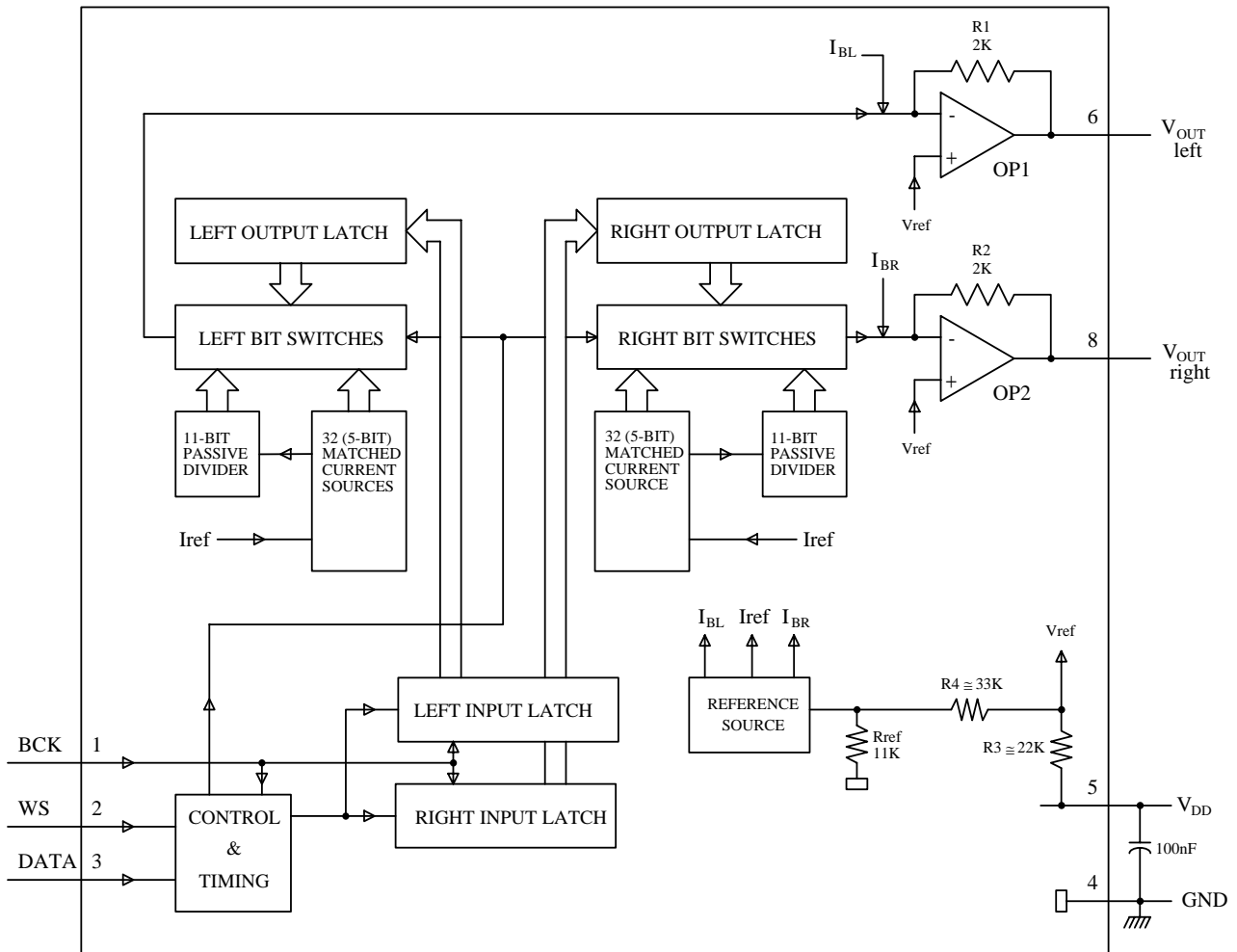


Fig.1 Block diagram.

### LIMITING VALUES

Symbol	Parameter	Min	Max	Unit
VDD	Positive Supply Voltage	-	6	V
Tsig	Storage Temperature Range	-55	+150	°C
TXTAL	Maximum Crystal Temperature	-	+150	°C
TAMB	Operating Ambient Temperature Range	-40	+85	°C
Ves	Electrostatic Handling	-2000	2000	V

### ELECTRICAL CHARACTERISTICS

(Ta=25°C, V<sub>DD</sub>=5V)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V <sub>DD</sub>	Positive Supply Voltage		2.7	5	5.5	V
I <sub>DD</sub>	Operating Current	at code 0000H	-	3.4	6.0	mA

### DIGITAL INPUTS (WS, BCK, DATA)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I <sub>IL</sub>	Input Leakage Current LOW	V <sub>I</sub> =0.8V	-	-	10	μA
I <sub>IH</sub>	Input Leakage Current HIGH	V <sub>I</sub> =2.4V	-	-	10	μA
f <sub>BCK</sub>	Input Clock Frequency		-	-	18.4	MHz
BR	Bit Rate Data Input (Pin 3)		-	-	18.4	Mbits/s
f <sub>WS</sub>	Word Select Input (Pin 2)		-	-	384	kHz
t <sub>r</sub>	Rise Time		-	-	12	ns
t <sub>f</sub>	Fall Time		-	-	12	ns
t <sub>Cr</sub>	Bit Clock Cycle Time		54	-	-	ns
t <sub>HB</sub>	Bit Clock High Time		15	-	-	ns
t <sub>LB</sub>	Bit Clock Low Time		15	-	-	ns
t <sub>SD</sub>	Data Set-up Time		12	-	-	ns
t <sub>HD</sub>	Data Hold Time to Bit Clock		2	-	-	ns
t <sub>HW</sub>	Word Select Hold Time		2	-	-	ns
t <sub>SW</sub>	Word Select Set-up Time		12	-	-	ns

### ANALOG OUTPUTS (V<sub>OL</sub>, V<sub>OR</sub>)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Res	Resolution		-	-	16	bits
V <sub>FS</sub>	Full Scale Output Voltage	V <sub>FS</sub> =0.4V <sub>DD</sub>	1.8	2.0	2.2	V
T <sub>CFS</sub>	Full Scale Temperature Coefficient at Analog Outputs ; V <sub>OL</sub> , V <sub>OR</sub>		-	±400	-	10 <sup>-16</sup>
V <sub>DC</sub>	Output Bias		-	2.5	-	V
THD	Total Harmonic Distortion	including noise	-	-68	-63	dB
		at 0 dB; note 1	-	0.04	0.07	%
THD	Total Harmonic Distortion	including noise	-	-30	-24	dB
		at -60 dB; note 1	-	3	6	%
CS	Channel Separation		75	80	-	dB
I <sub>dIo</sub>	Unbalance Between Outputs	note 1	-	0.2	0.3	dB
I <sub>td</sub>	Time Delay Between Outputs		-	±0.2	-	μs
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.

### TIMING AND DATA FORMAT

The MS6311 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.

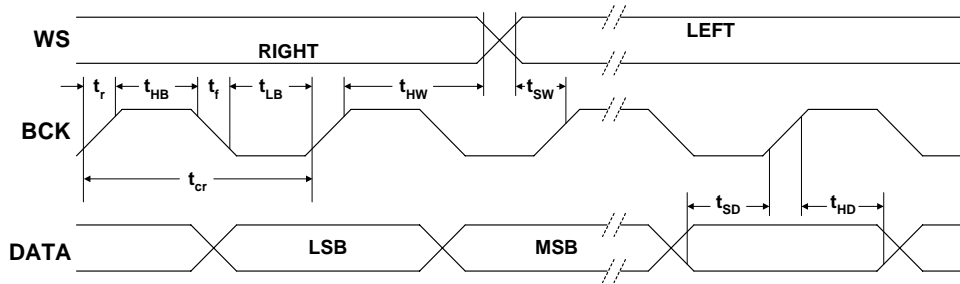


Fig.2 Timing and input signals.

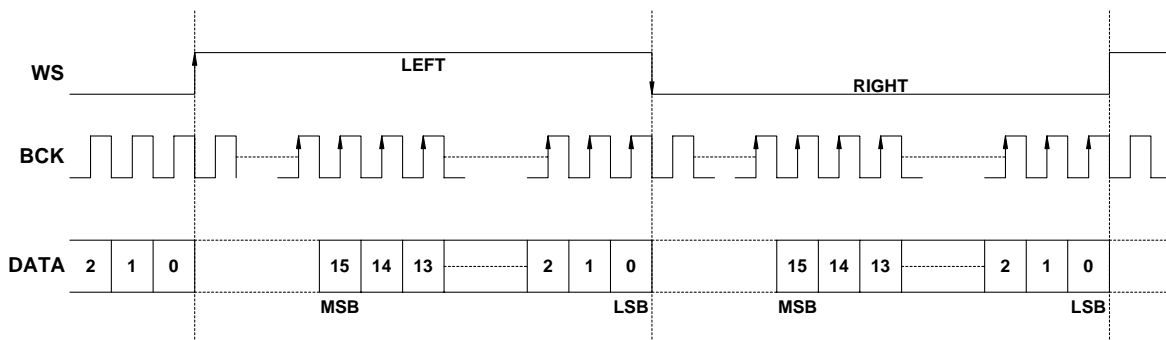
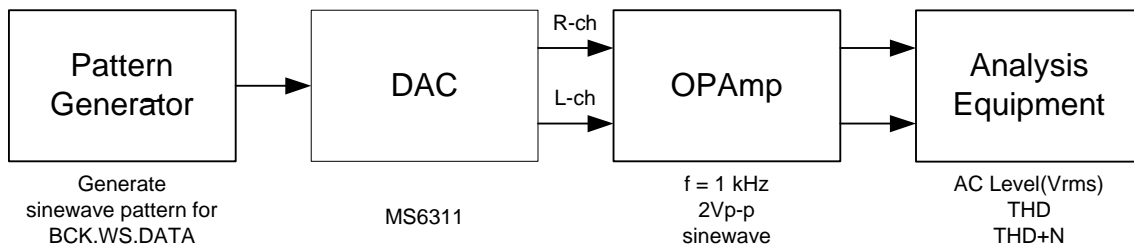


Fig.3 Format of input signals.

### MEASUREMENT BLOCK DIAGRAM

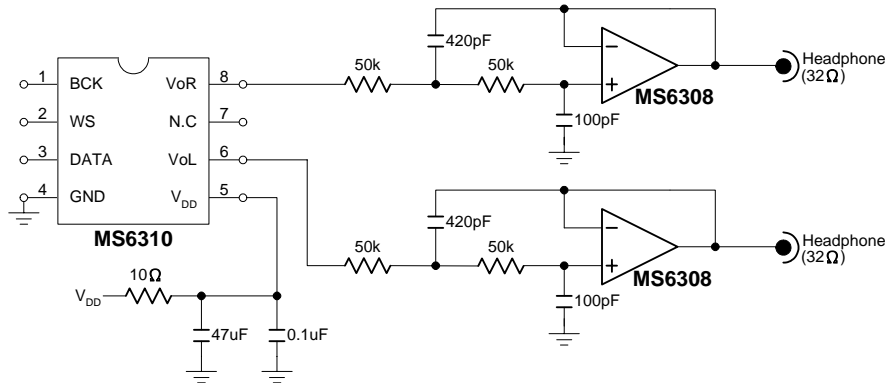


NOTE : THD and THD+N is measured by HP AUDIO ANALYZER and FFT Analysis.

### APPLICATION INFORMATION

#### Basic application example

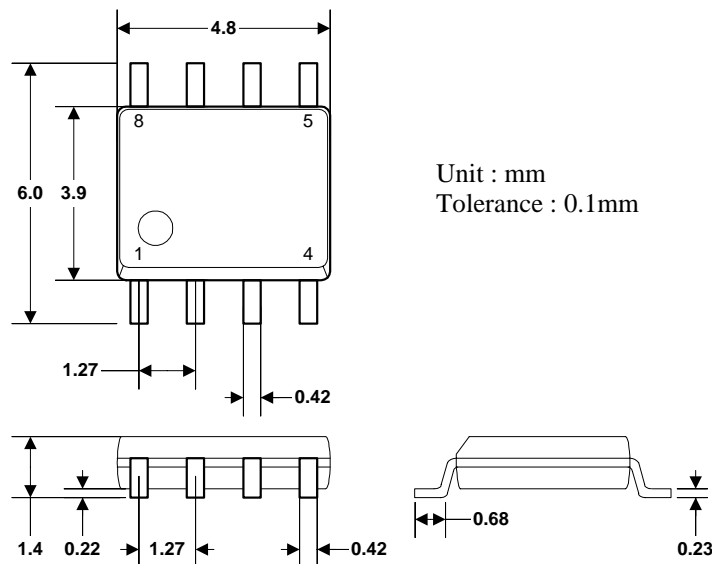
A typical example of a CD-application with the MS6311 is shown in Fig.4. It features typical decoupling components and a second-order analog post-filter (smoothing filter) stage providing a line output.



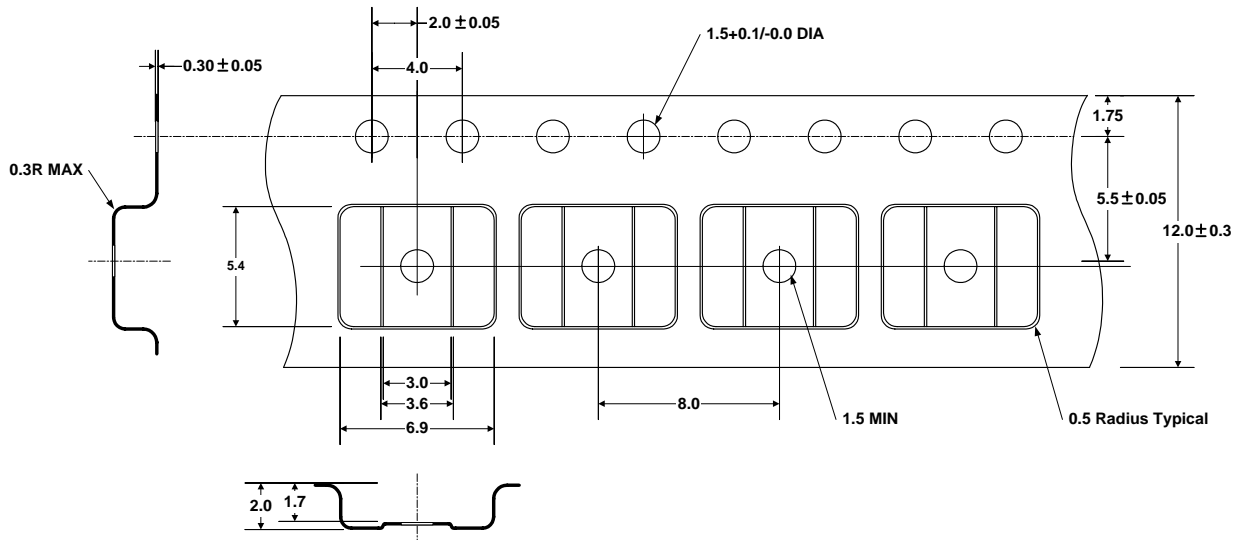
**Fig.4 Example of a 2nd order filter application.**

**Note :** No external capacitor loading is allowed at the output pins 6 and 8.

### EXTERNAL DIMENSIONS



TAPE AND REEL (Unit : mm)



### ORDERING INFORMATION

Package	Part number	Packaging Marking	Transport Media
8-Pin SOP	MS6311ASTR	MS6311AS	2.5k Units Tape and Reel
8-Pin SOP	MS6311ASU	MS6311AS	100 Units Tube
8-Pin SOP (lead free)	MS6311ASGTR	MS6311ASG	2.5k Units Tape and Reel
8-Pin SOP (lead free)	MS6311ASGU	MS6311ASG	100 Units Tube