

**SANYO**

No. 3942

**LC7536LHS**

CMOS LSI

**High-voltage, Two-channel  
Electronic Attenuator****OVERVIEW**

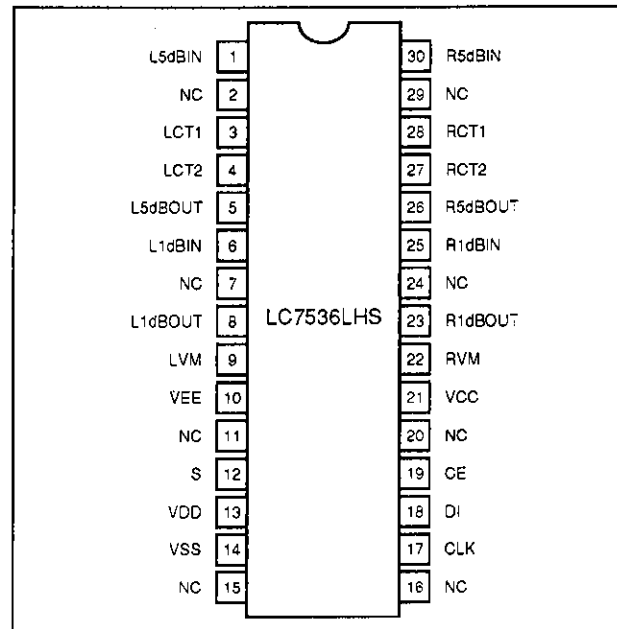
The LC7536LHS is a two-channel electronic attenuator for volume, balance and loudness controls in stereo audio applications.

The LC7536LHS reads data from a three-line serial bus to control attenuation in 1 dB steps over an 80 dB range, up to a maximum of 96 dB. It features a center tap at 20 dB attenuation for a loudness control using a minimum of external components. A device select pin allows two devices to be connected to the serial bus.

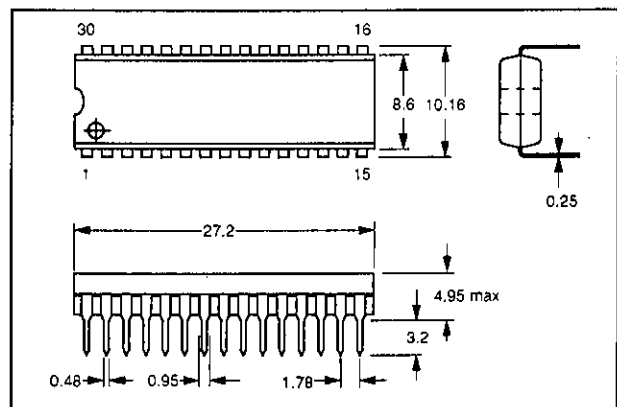
The LC7536LHS operates from 5 V and 10 V supplies and is available in 30-pin DIPs.

**FEATURES**

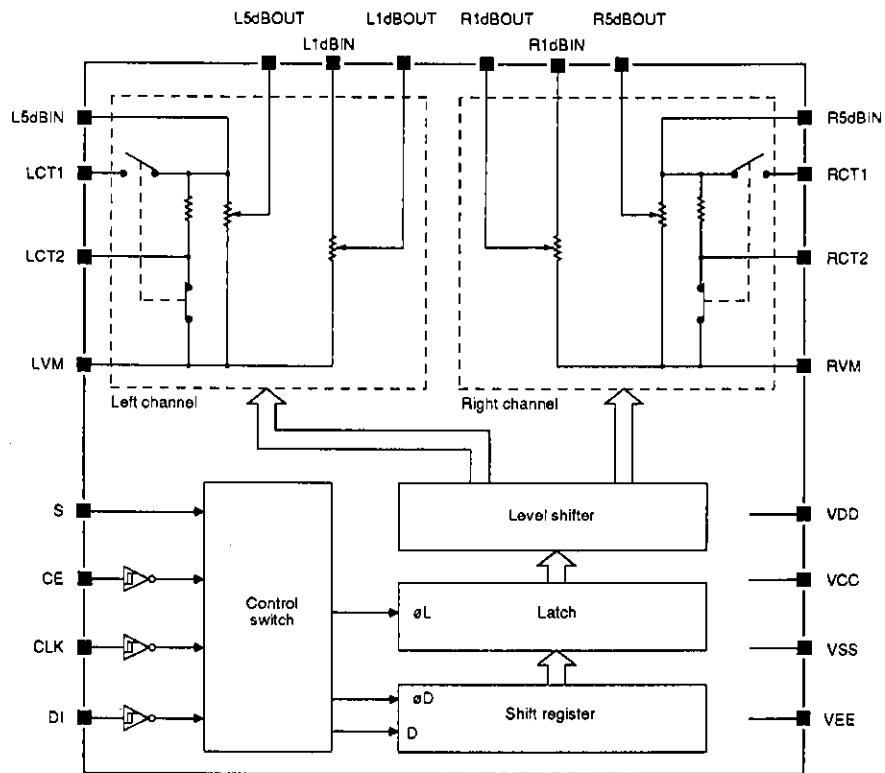
- Three-line serial control
- Two device select
- Tap at 20 dB attenuation for a loudness control
- 80 dB attenuation range adjustable in 1 dB steps
- 96 dB maximum attenuation
- 75 dB crosstalk rejection
- 0.022% total harmonic distortion
- 47 k $\Omega$  input impedance
- 5 V and 10 V supplies
- 30-pin DIP

**PINOUT****PACKAGE DIMENSIONS**

Unit: mm

**3047A-DIP30S**

**BLOCK DIAGRAM**



**PIN DESCRIPTION**

Number	Name	Description
1	L5dBIN	Left-channel 5 dB attenuation step input. Low-impedance drive. 75 k $\Omega$ total resistance
2	NC	No connection
3	LCT1	Left-channel loudness compensation inputs
4	LCT2	
5	L5dBOUT	Left-channel 5 dB attenuation step output. Approximately 1 M $\Omega$ load resistance
6	L1dBIN	Left-channel 1 dB attenuation step input. Low-impedance drive
7	NC	No connection
8	L1dBOUT	Left-channel 1 dB attenuation step output. 47 k $\Omega$ to 1 M $\Omega$ load resistance
9	LVM	Left-channel volume control common. Normally connected to ground
10	VEE	Ground
11	NC	No connection
12	S	Address select input
13	VDD	10 V supply
14	VSS	Ground
15	NC	No connection
16	NC	
17	CLK	Clock input
18	DI	Serial data input
19	CE	Chip enable input

## LC7536LHS

Number	Name	Description
20	NC	No connection
21	VCC	5 V supply
22	RVM	Right-channel volume control common. Normally connected to ground
23	R1dBOUT	Right-channel 1 dB attenuation step output. 47 k $\Omega$ to 1 M $\Omega$ load resistance
24	NC	No connection
25	R1dBIN	Right-channel 1 dB attenuation step input. Low-impedance drive
26	R5dBOUT	Right-channel 5 dB attenuation step output. Approximately 1 M $\Omega$ load resistance
27	RCT2	Right-channel loudness compensation inputs
28	RCT1	
29	NC	No connection
30	R5dBIN	Right-channel 5 dB attenuation step input. Low-impedance drive. 75 k $\Omega$ total resistance

## SPECIFICATIONS

### Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage ranges	$V_{DD}$	0 to 12	V
	$V_{CC}$	0 to 7	
CLK, DI and CE input voltage range	$V_{I1}$	0 to $V_{CC} + 0.3$	V
Analog input voltage range	$V_{I2}$	$V_{EE} - 0.3$ to $V_{DD} + 0.3$	V
Select pin input voltage range	$V_{I3}$	$V_{CC} - 0.3$ to $V_{DD} + 0.3$	V
Power dissipation	$P_D$	250 ( $T_a \leq 85$ °C)	mW
Operating temperature range	$T_{opr}$	-40 to 85	°C
Storage temperature range	$T_{stg}$	-50 to 125	°C

### Recommended Operating Conditions

$T_a = 25$  °C,  $V_{SS} = 0$  V,  $V_{EE} = 0$  V

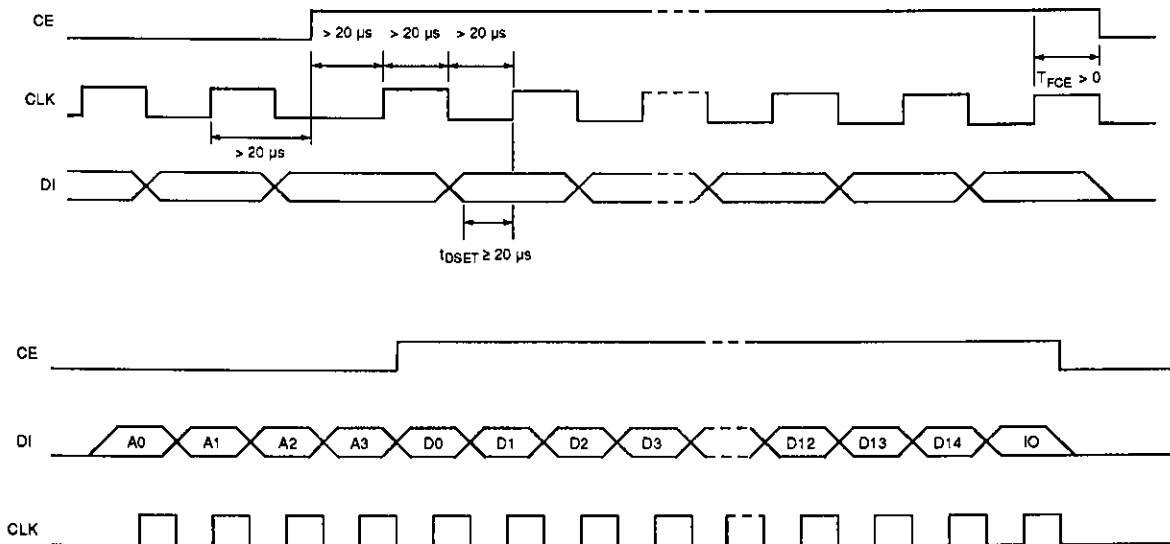
Parameter	Symbol	Rating	Unit
Analog supply voltage range	$V_{DD}$	$V_{CC} + 3.2$ to 10.0	V
Logic supply voltage	$V_{CC}$	5	V
Logic supply voltage range	$V_{CC}$	3.6 to 5.5	V

**Electrical Characteristics**

$V_{CC} = 5\text{ V}$ ,  $V_{DD} = 10\text{ V}$ ,  $V_{EE} = 0\text{ V}$ ,  $V_{SS} = 0\text{ V}$ ,  $T_a = 25\text{ }^\circ\text{C}$

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Supply currents	$I_{DD}$		-	-	1	mA
	$I_{CC}$		-	-	1	
Serial bus HIGH-level input voltage	$V_{IH1}$		$0.8V_{CC}$	-	$V_{CC}$	V
Select pin HIGH-level input voltage	$V_{IH2}$		$0.8 \times (V_{DD} - V_{CC}) + V_{CC}$	-	$V_{DD}$	V
Serial bus LOW-level input voltage	$V_{IL1}$		$V_{SS}$	-	$0.2V_{CC}$	V
Select pin LOW-level input voltage	$V_{IL2}$		$V_{CC}$	-	$0.2 \times (V_{DD} - V_{CC}) + V_{CC}$	V
Input voltage	$V_{IN}$		$V_{EE}$	-	$V_{DD}$	$V_{p-p}$
Input pulsewidth	$t_{\text{pW}}$		20	-	-	$\mu\text{s}$
Setup time	$t_{\text{setup}}$		20	-	-	$\mu\text{s}$
Hold time	$t_{\text{hold}}$		20	-	-	$\mu\text{s}$
Operating frequency	$f_{\text{opg}}$		-	-	25	kHz
Output leakage current	$I_{\text{OFF}}$	Analog switches OFF	-10	-	10	$\mu\text{A}$
Total harmonic distortion	THD	$V_{IN} = 0.3\text{ V}$ , $f = 1\text{ kHz}$ , $V_{DD} - V_{EE} = 10\text{ V}$ , $V_R = V_R(\text{max})$	-	0.022	-	%
Crosstalk rejection	$C_T$	$f = 20\text{ kHz}$ , $V_{IN} = 1\text{ V}$	60	75	-	dB
Maximum attenuation	$V_D$	$f = 20\text{ kHz}$ , $V_{IN} = 1\text{ V}$	-	96	-	dB

**Timing**



## FUNCTIONAL DESCRIPTION

### Data Control

Data is clocked into a 20-bit shift register. When 20 bits have been received, the data is latched and then passed to a level shifter.

### Data Format

The 20-bit data word comprises a 4-bit address code, two 4-bit 5 dB attenuation step selectors, two 3-bit 1 dB attenuation step selectors and a loudness control ON/OFF bit as shown in figure 1.

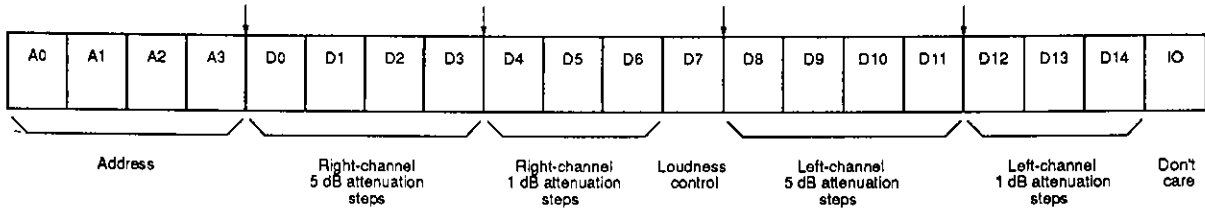


Figure 1. Data format

The voltage on the select input determines the address of the device as shown in table 1.

Table 1. Address codes

Select pin	A0	A1	A2	A3
VDD	1	0	0	1
VCC	0	0	0	1

Data bits D0 to D3 select the right-channel attenuation in 5 dB steps as shown in table 2. Similarly, bits D8 to D11 select the left-channel attenuation in 5 dB steps.

Table 2. Right-channel 5 dB steps

Attenuation (dB)	D0	D1	D2	D3
0	1	1	1	1
5	0	1	1	1
10	1	0	1	1
15	0	0	1	1
20	1	1	0	1
25	0	1	0	1
30	1	0	0	1
35	0	0	0	1
40	1	1	1	0
45	0	1	1	0
50	1	0	1	0
55	0	0	1	0
60	1	1	0	0
65	0	1	0	0
70	1	0	0	0
75	0	0	0	0

Data bits D4 to D6 select the right-channel attenuation in 1 dB steps as shown in table 3. Similarly, bits D12 to D14 select the left-channel attenuation in 1 dB steps.

Table 3. Right-channel 1 dB steps

Attenuation (dB)	D4	D5	D6
0	0	1	1
1	1	0	1
2	0	0	1
3	1	1	0
4	0	1	0
∞	0	0	0

Data bit D7 selects loudness control. When D7 is 1, loudness control is ON, and when 0, loudness control is OFF.

### Audio Signal

The right-channel audio input signal is input on R5dBIN (5 dB attenuation steps). The output, R5dBOUT, is fed back to R1dBIN (1 dB attenuation steps). The right-channel audio output is on R1dBOUT. The left-channel audio signal flow is identical.

TYPICAL APPLICATION

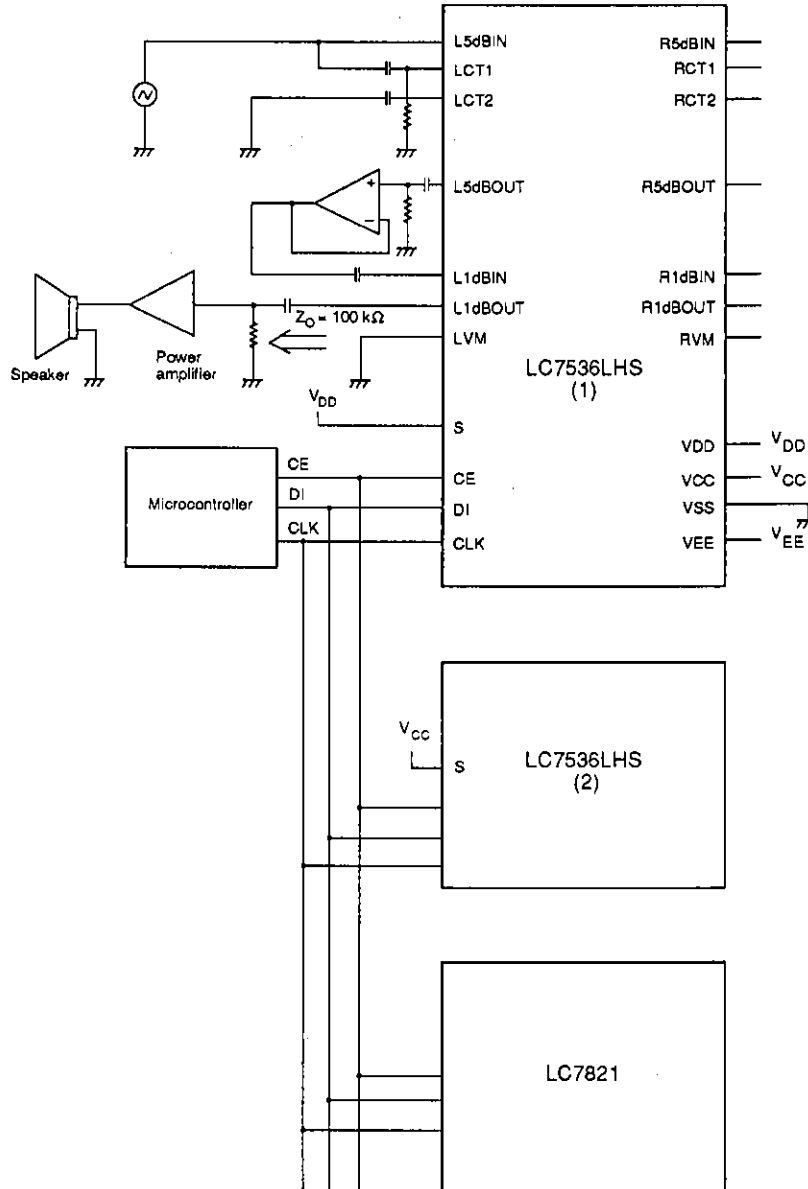


Figure 2. Typical application

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