Ordering number: EN3887

CMOS LSI

No. 3887

LC7535P

High-voltage, Two-channel Electronic Attenuator

OVERVIEW

The LC7535P is a two-channel electronic attenuator for volume, balance and loudness control in stereo audio applications.

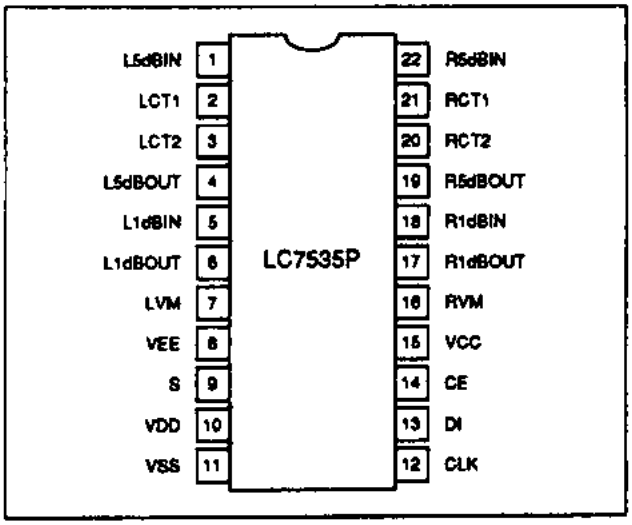
The LC7535P reads data from a three-line serial bus to control attenuation in 1 dB steps over an 80 dB range, up to a maximum of 98 dB. It features a center tap at 20 dB attenuation for loudness control using a minimum of external components. A device select pin allows two devices to be connected to the serial bus.

The LC7535P operates from 5 V and ±10 V supplies and is available in 22-pin DIPs.

FEATURES

- Three-line serial control
- Two device select
- Tap at 20 dB attenuation for loudness control
- 80 dB attenuation range adjustable in 1 dB steps
- 98 dB maximum attenuation
- 75 dB crosstalk rejection
- 0.008% total harmonic distortion
- 47 kΩ input impedance
- 5 V and ±10 V supplies
- 22-pin DIP

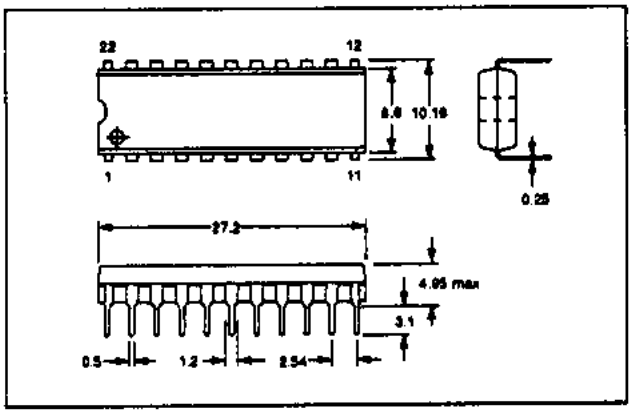
PINOUT



PACKAGE DIMENSIONS

Unit: mm

3010A-DIP22



Specifications and information herein are subject to change without notice.

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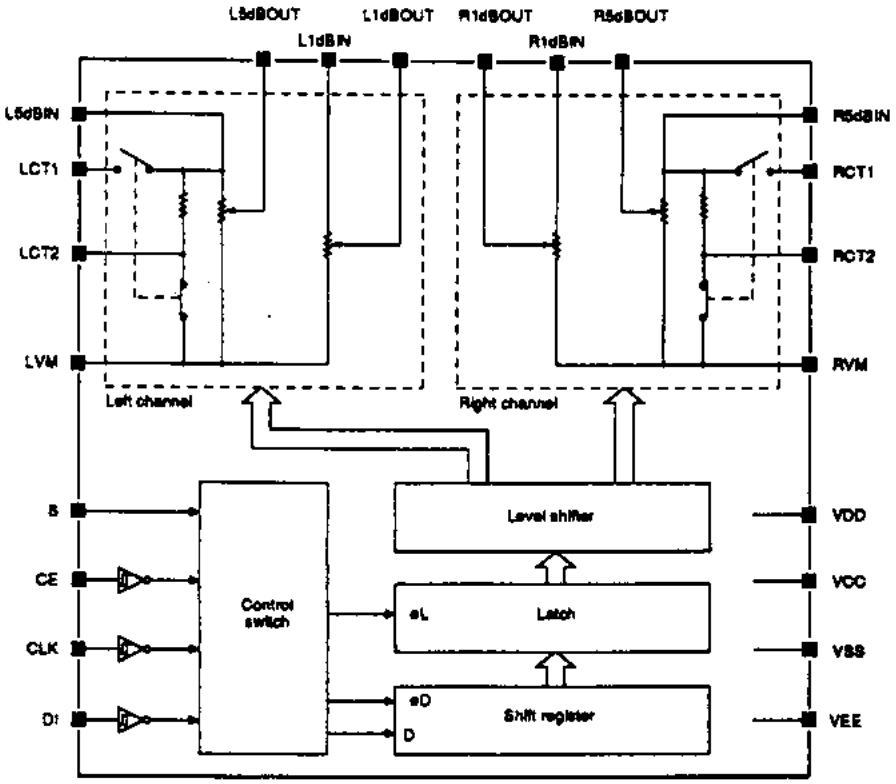
BLOCK DIAGRAM



PIN DESCRIPTION

Number	Name	Description
1	L5dBIN	Left-channel 5 dB attenuation step input. Low-impedance drive. 75 kΩ total resistance
2	LCT1	Left-channel loudness compensation inputs
3	LCT2	
4	L5dBOUT	Left-channel 5 dB attenuation step output. Approximately 1 MΩ load resistance
5	L1dBIN	Left-channel 1 dB attenuation step input. Low-impedance drive
6	L1dBOUT	Left-channel 1 dB attenuation step output. 47 kΩ to 1 MΩ load resistance
7	LVM	Left-channel volume control common. Normally connected to ground
8	VEE	−10 V supply
9	S	Address select input
10	VDD	10 V supply
11	VSS	Ground
12	CLK	Clock input
13	DI	Serial data input
14	CE	Chip enable input
15	VCC	5 V supply
16	RVM	Right-channel volume control common. Normally connected to ground
17	R1dBOUT	Right-channel 1 dB attenuation step output. 47 kΩ to 1 MΩ load resistance
18	R1dBIN	Right-channel 1 dB attenuation step input. Low-impedance drive
19	R5dBOUT	Right-channel 5 dB attenuation step output. Approximately 1 MΩ load resistance

Number	Name	Description
20	RCT2	Right-channel loudness compensation inputs
21	RCT1	
22	R5dBIN	Right-channel 5 dB attenuation step input. Low-impedance drive. 75 kΩ total resistance

SPECIFICATIONS

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage ranges	V_{DD}	0 to 12	V
	V_{EE}	−12 to 0	
	V_{CC}	0 to 7	
Analog input voltage range	V_{IN}	V_{EE} − 0.3 to V_{DD} + 0.3	V
CLK, DI, CE input voltage range	V_{I1}	0 to V_{CC} + 0.3	V
Select pin input voltage range	V_{I2}	V_{CC} − 0.3 to V_{DD} + 0.3	V
Power dissipation	P_D	250	mW
Operating temperature range	T_{opg}	−30 to 75	deg. C
Storage temperature range	T_{stg}	−40 to 125	deg. C

Recommended Operating Conditions

T_a = 25 deg. C, V_{SS} = 0 V

Parameter	Symbol	Rating			Unit
		min	typ	max	
Supply voltages	V_{DD}	V_{CC} + 3.2	–	10.0	V
	V_{EE}	−10	–	0	
	V_{CC}	3.6	5.0	5.5	

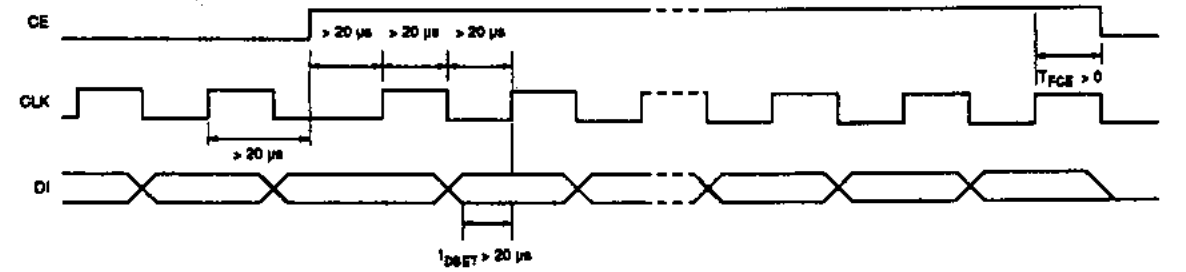
Electrical Characteristics

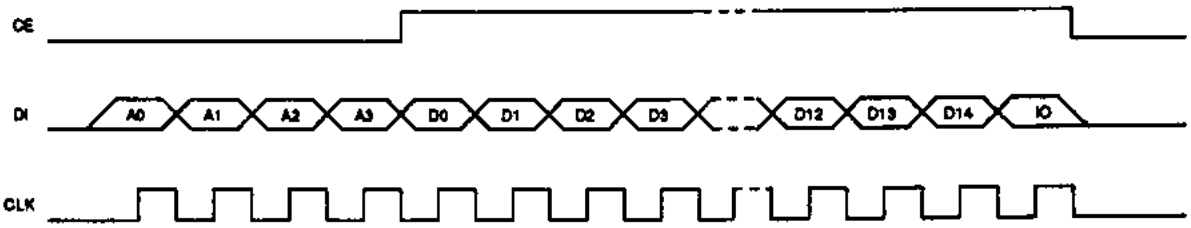
V_{CC} = 5 V, V_{DD} = 10 V, V_{EE} = −10 V, T_a = 25 deg. C unless otherwise noted

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Supply currents	I_{DD}		–	–	1	mA
	I_{CC}		–	–	1	
CLK, DI, CE HIGH-level input voltage	V_{IH1}		0.8V_{CC}	–	5.5	V
Select pin HIGH-level input voltage	V_{IH2}		0.8 × (V_{DD} − V_{CC}) + V_{CC}	–	V_{DD}	V
CLK, DI, CE LOW-level input voltage	V_{IL1}		V_{SS}	–	0.2V_{CC}	V
Select pin LOW-level input voltage	V_{IL2}		V_{CC}	–	0.2 × (V_{DD} − V_{CC}) + V_{CC}	V
Input voltage	V_{IN}		V_{EE}	–	V_{DD}	V_{p-p}

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Output leakage current	I_{OFF}	Analog switches OFF	–10	–	10	μA
Total harmonic distortion	THD	V_{IN} = 1 V, f = 1 kHz, $V_{DD} - V_{EE}$ = 20 V, V_R = max	–	0.008	–	%
Crosstalk rejection	C_T	f = 20 kHz, V_{IN} = 1 V	60	75	–	dB
Maximum attenuation	V_O	f = 20 kHz, V_{IN} = 1 V	–	98	–	dB

Timing Characteristics





Parameter	Symbol	Rating			Unit
		min	typ	max	
Input pulsewidth	t_{pw}	20	–	–	μs
Setup time	t_{setup}	20	–	–	μs
Hold time	t_{hold}	20	–	–	μs
Operating frequency	f_{opg}	–	–	25	kHz

FUNCTIONAL DESCRIPTION

Data Control

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

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.

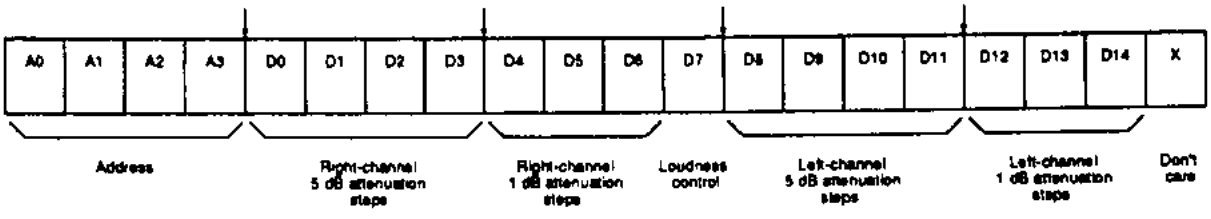


Figure 1. Data format

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

Table 2. Right-channel 5 dB steps—continued

Attenuation (dB)	D0	D1	D2	D3
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
Dummy. See note.	1	0	0
1	1	0	1
2	0	0	1
3	1	1	0
4	0	1	0
∞	0	0	0

Note

Dummy data are inserted to give 79 dB to infinity attenuation during switchover.

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

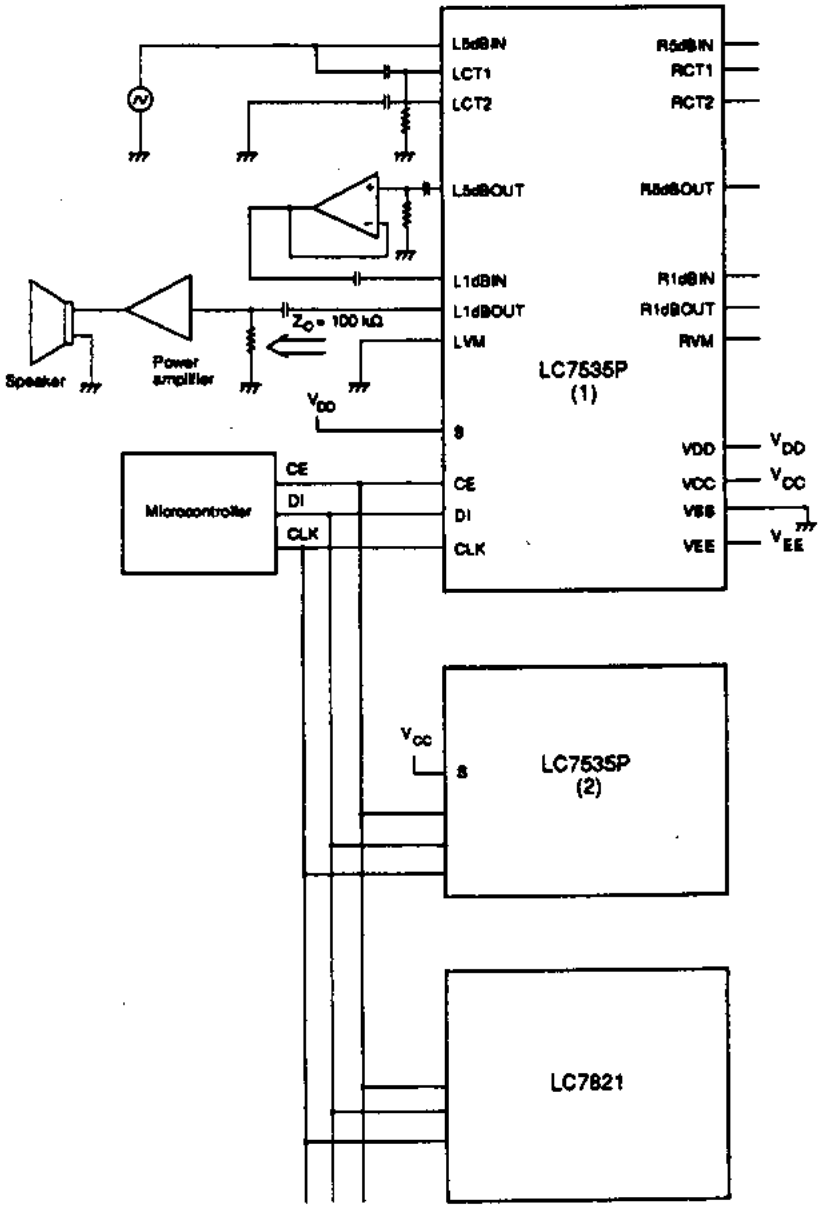


Figure 2. Typical application