

# LC7535



3010A

SANYO SEMICONDUCTOR CORP

CMOS LSI

## High-voltage, Two-channel Electronic Attenuator

©2443C

### OVERVIEW

The LC7535 is a two-channel electronic attenuator for volume, balance and loudness controls in stereo audio applications.

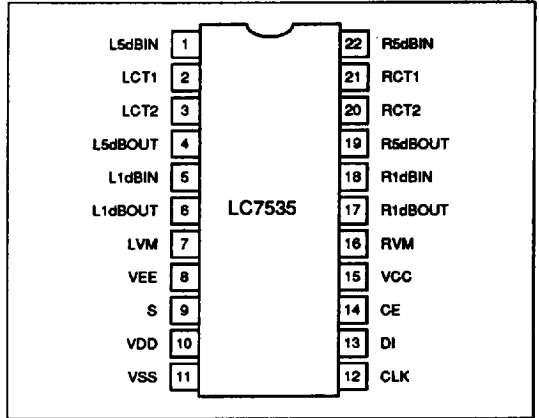
The LC7535 reads data from a three-line serial bus to control attenuation in 1 dB steps over an 80 dB range, up to a maximum of 98 dB. It features a center tap at 20 dB attenuation for a loudness control using a minimum of external components. A device select pin allows two devices to be connected to the serial bus.

The LC7535 operates from 5 V and  $\pm 16$  V supplies and is available in 22-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
- 98 dB maximum attenuation
- 75 dB crosstalk rejection
- 0.011% total harmonic distortion
- 47 k $\Omega$  input impedance
- 5 V and  $\pm 16$  V supplies
- 22-pin DIP

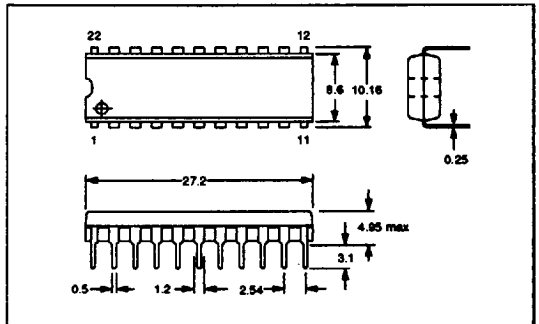
### PINOUT



### PACKAGE DIMENSIONS

Unit: mm

3010A-DIP22



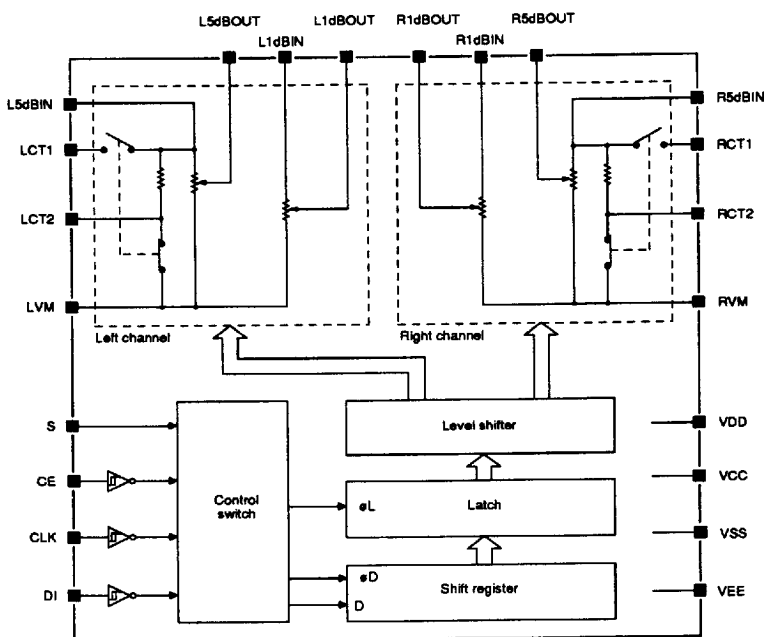
8051JN/N247AT/1307KI,TS No.2443-1/6

533

LC7535

SANYO SEMICONDUCTOR CORP

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	-16 V supply
9	S	Address select input
10	VDD	16 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

LC7535

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

SANYO SEMICONDUCTOR CORP

Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply voltage ranges	V <sub>DD</sub>	0 to 18	V
	V <sub>EE</sub>	-18 to 0	
	V <sub>CC</sub>	0 to 7	
CLK, DI and CE input voltage range	V <sub>I1</sub>	0 to V <sub>CC</sub> + 0.3	V
Analog input voltage range	V <sub>I2</sub>	V <sub>EE</sub> - 0.3 to V <sub>DD</sub> + 0.3	V
Select pin input voltage range	V <sub>I3</sub>	V <sub>CC</sub> - 0.3 to V <sub>DD</sub> + 0.3	V
Power dissipation	P <sub>D</sub>	250	mW
Operating temperature range	T <sub>opp</sub>	-30 to 75	°C
Storage temperature range	T <sub>stg</sub>	-40 to 125	°C

Recommended Operating Conditions

T<sub>a</sub> = 25 °C, V<sub>SS</sub> = 0 V

Parameter	Symbol	Rating	Unit
Analog supply voltage ranges	V <sub>DD</sub>	V <sub>CC</sub> + 4.5 to 16.0	V
	V <sub>EE</sub>	-16 to 0	V
Logic supply voltage	V <sub>CC</sub>	5	V
Logic supply voltage range	V <sub>CC</sub>	4.5 to 5.5	V

Electrical Characteristics

T<sub>a</sub> = 25 °C, V<sub>SS</sub> = 0 V

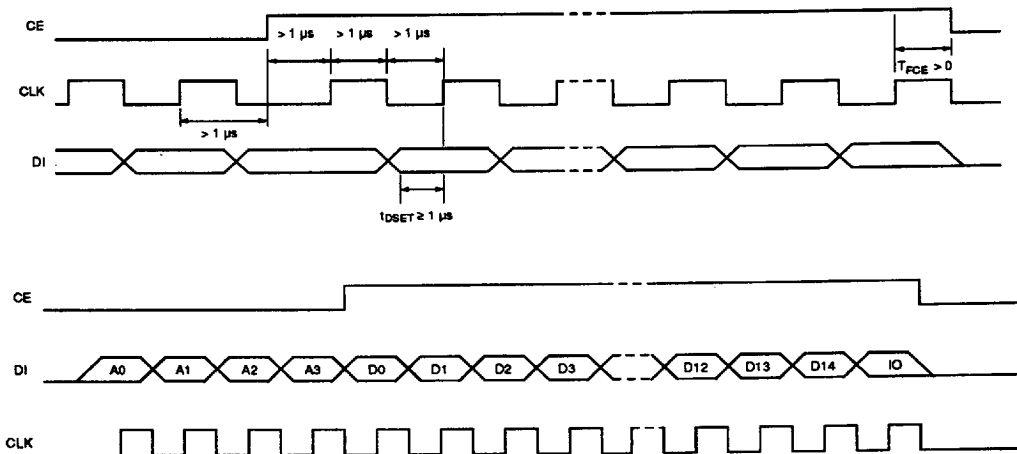
Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Supply currents	I <sub>DD</sub>		-	-	1	mA
	I <sub>CC</sub>		-	-	1	
Serial bus LOW-level input voltage	V <sub>IL1</sub>		V <sub>SS</sub>	-	0.2V <sub>CC</sub>	V
Serial bus HIGH-level input voltage	V <sub>IH1</sub>		0.8V <sub>CC</sub>	-	V <sub>CC</sub>	V
Select pin LOW-level input voltage	V <sub>IL2</sub>		V <sub>CC</sub>	-	0.2 × (V <sub>DD</sub> - V <sub>CC</sub> ) + V <sub>CC</sub>	V
Select pin HIGH-level input voltage	V <sub>IH2</sub>		0.8 × (V <sub>DD</sub> - V <sub>CC</sub> ) + V <sub>CC</sub>	-	V <sub>DD</sub>	V
Input voltage	V <sub>IN</sub>		V <sub>EE</sub>	-	V <sub>DD</sub>	V <sub>P-P</sub>
Input pulsewidth	t <sub>LOW</sub>		1	-	-	μs

LC7535

Parameter	Symbol	Condition	Rating			Unit
			min	typ	max	
Setup time	$t_{setup}$		1	-	-	$\mu s$
Hold time	$t_{hold}$		1	-	-	$\mu s$
Operating frequency	$f_{opg}$		-	-	500	kHz
Output leakage current	$I_{off}$	Analog switches OFF	-10	-	10	$\mu A$
Total harmonic distortion	THD	$V_{IN} = 1 V, f = 1 kHz,$ $V_{DD} - V_{EE} = 32 V,$ $V_R = V_R (max)$	-	0.003	-	%
		$V_{IN} = 1 V, f = 1 kHz,$ $V_{DD} - V_{EE} = 32 V,$ $V_R = V_R (max)$	-	0.011	-	
Crosstalk rejection	$C_T$	$f = 20 kHz, V_{IN} = 1 V$	60	75	-	dB
Maximum attenuation	$V_D$	$f = 20 kHz, V_{IN} = 1 V$	-	98	-	dB

Timing

SANYO SEMICONDUCTOR CORP



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.

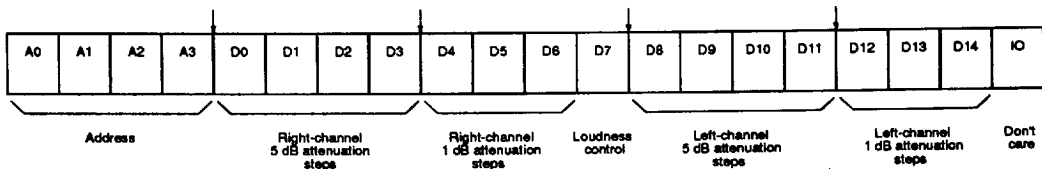


Figure 1. Data format

LC7535

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
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 is 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.

SANYO SEMICONDUCTOR CORP

LC7535

SANYO SEMICONDUCTOR CORP

TYPICAL APPLICATION

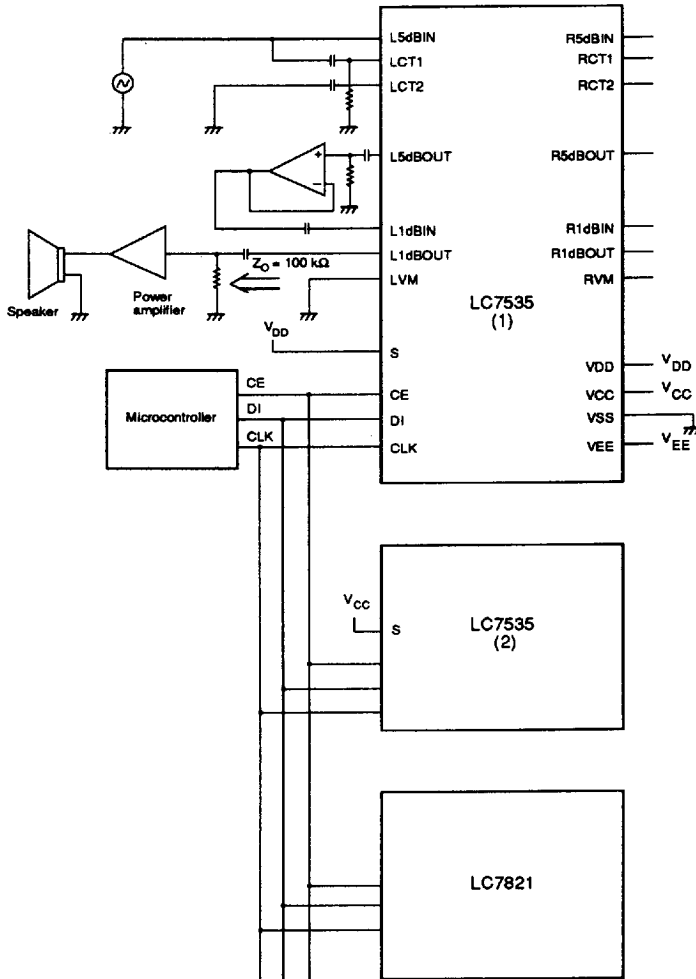


Figure 2. Typical application