



LC7536LHS

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.
- 47k Ω input impedance.
- 5 V and 10 V supplies.
- 30-pin DIP.

Specifications

Absolute Maximum Ratings at $T_a=25^\circ\text{C}$, $V_{SS}=0\text{V}$, $V_{EE}=0\text{V}$

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{DD\text{ max}}$		0 to 12	V
	$V_{CC\text{ max}}$		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
Allowable power dissipation	$P_d\text{ max}$	$T_a \leq 85^\circ\text{C}$	250	mW
Operating temperature range	T_{opr}		-40 to +85	$^\circ\text{C}$
Storage temperature range	T_{stg}		-50 to +125	$^\circ\text{C}$

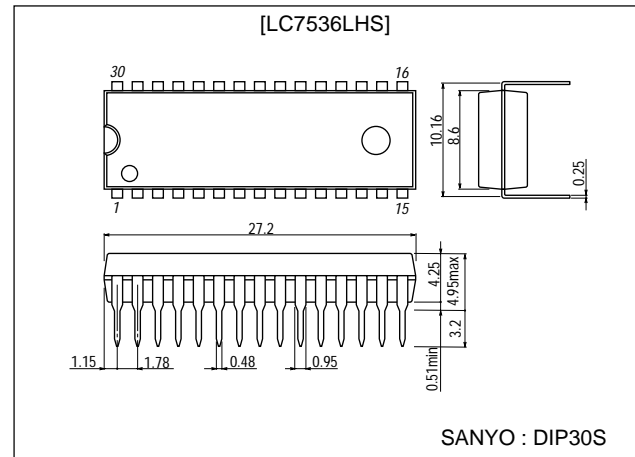
■ Any and all SANYO products described or contained herein do not have specifications that can handle applications that require extremely high levels of reliability, such as life-support systems, aircraft's control systems, or other applications whose failure can be reasonably expected to result in serious physical and/or material damage. Consult with your SANYO representative nearest you before using any SANYO products described or contained herein in such applications.

■ SANYO assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all SANYO products described or contained herein.

Package Dimensions

unit:mm

3061-DIP30S



LC7536LHS

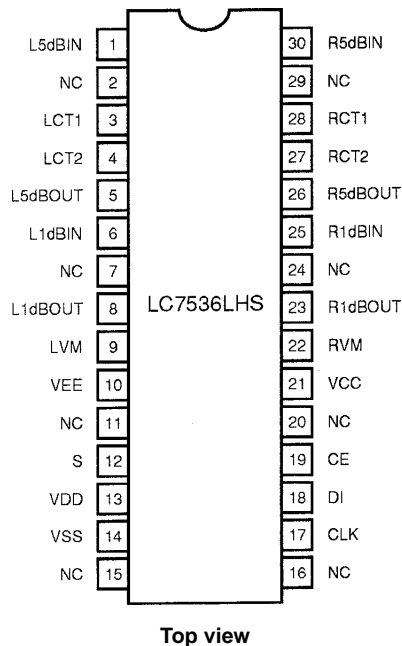
Recommended Operating Conditions at $T_a = 25^\circ\text{C}$, $V_{SS} = 0\text{ V}$, $V_{EE} = 0\text{ V}$

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

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

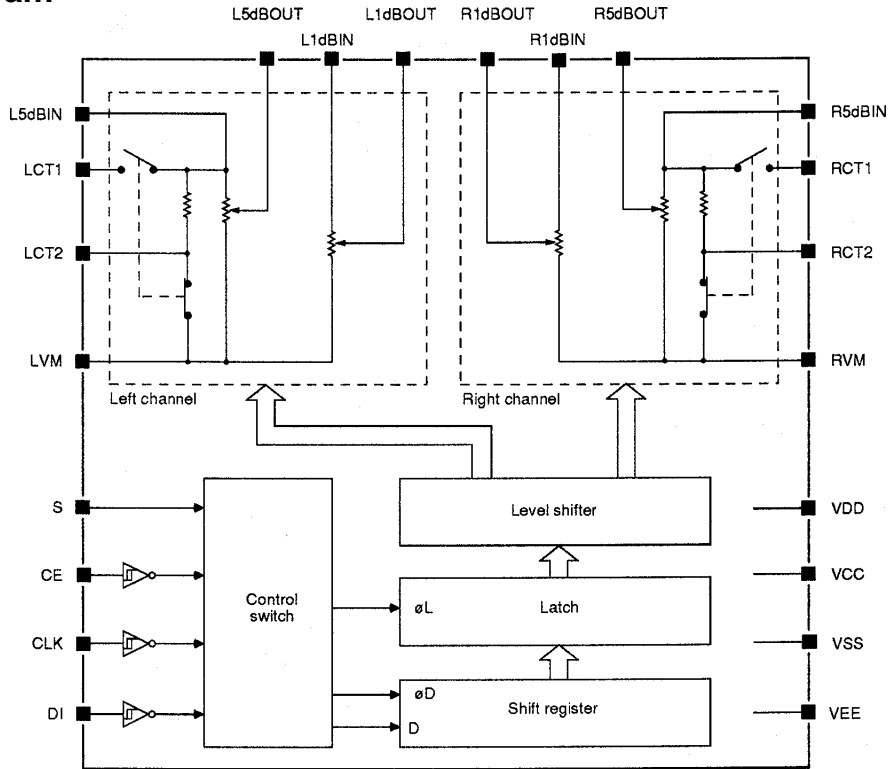
Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply current	I_{DD}				1	mA
	I_{CC}				1	
Serial bus HIGH-level input voltage	V_{IH1}		$0.8V_{CC}$		V_{CC}	V
Select pin HIGH-level input voltage	V_{IH2}		$0.8 \times (V_{DD} - V_{CC}) + V_{CC}$		V_{DD}	V
Serial bus LOW-level input voltage	V_{IL1}		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	$t_{\phi W}$		20			μs
Setup time	t_{setup}		20			μs
Hold time	t_{hold}		20			μs
Operating frequency	f_{opg}				25	kHz
Output leakage current	I_{OFF}	Analog switches OFF	-10		+10	μA
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_r	$f=20\text{kHz}$, $V_{IN}=1\text{V}$	60	75		dB
Maximum attenuation	V_0	$f=20\text{kHz}$, $V_{IN}=1\text{V}$		96		dB

Pin Assignment



LC7536LHS

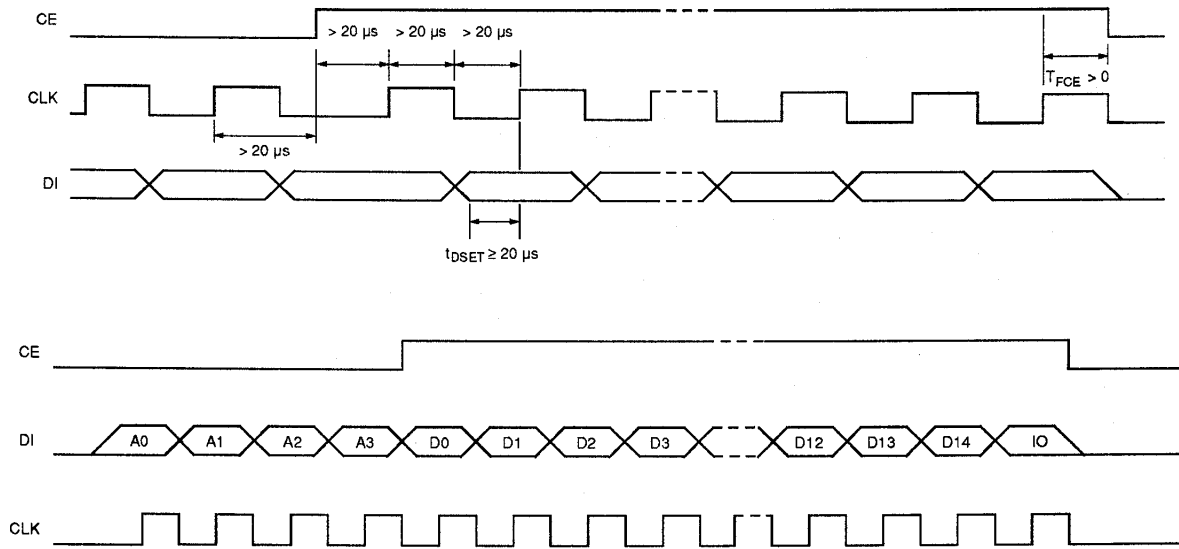
Block Diagram



Pin Description

Number	Name	Description
1	L5dBIN	Left-channel 5 dB attenuaiton step input. Low-impedance drive. 75 kΩ total resistance.
2	NC	No connection
3	LCT1	Left-channel loudness compensation inputs.
4	LCT2	
5	L5dBOUT	Left-channel 5 dB attenuaiton step output. Approximately 1 MΩ load resistance.
6	L1dBIN	Left-channel 1 dB attenuaiton step input. Low-impedance drive.
7	NC	No connection
8	L1dBOUT	Left-channel 1 dB attenuaiton step output. 47 kΩ to 1 MΩ load resistance.
9	LVM	Left-channel volume control common. Normally connected to ground.
10	V _{EE}	Ground
11	NC	No connection
12	S	Address select input.
13	V _{DD}	10 V supply
14	V _{SS}	Ground
15	NC	No connection
16	NC	No connection
17	CLK	Clock input.
18	D1	Serial data input.
19	CE	Chip enable input.
20	NC	No connection
21	V _{CC}	5 V supply
22	RVM	Right-channel volume control common. Normally connected to ground.
23	R1dBOUT	Right-channel 1 dB attenuaiton step oput. 47 kΩ to 1 MΩ load resistance.
24	NC	No connection
25	R1dBIN	Right-channel 1 dB attenuaiton step input. Low-impedance drive.
26	R5dBOUT	Right-channel 5 dB attenuaiton step output. Approximately 1 MΩ load resistance.
27	RCT2	Right-channel loudness compensation inputs.
28	RCT1	
29	NC	No connection
30	R5dBIN	Right-channel 5 dB attenuaiton step input. Low-impedance drive. 75 kΩ total resistance.

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.

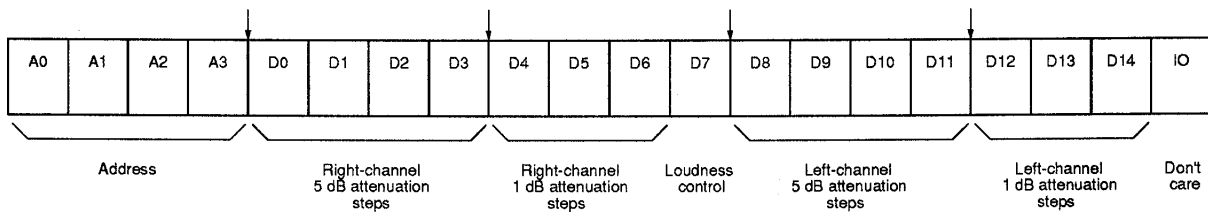


Figure 1. Data format

LC7536LHS

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
V _{DD}	1	0	0	1
V _{CC}	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 bits 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.

LC7536LHS

Typical Application

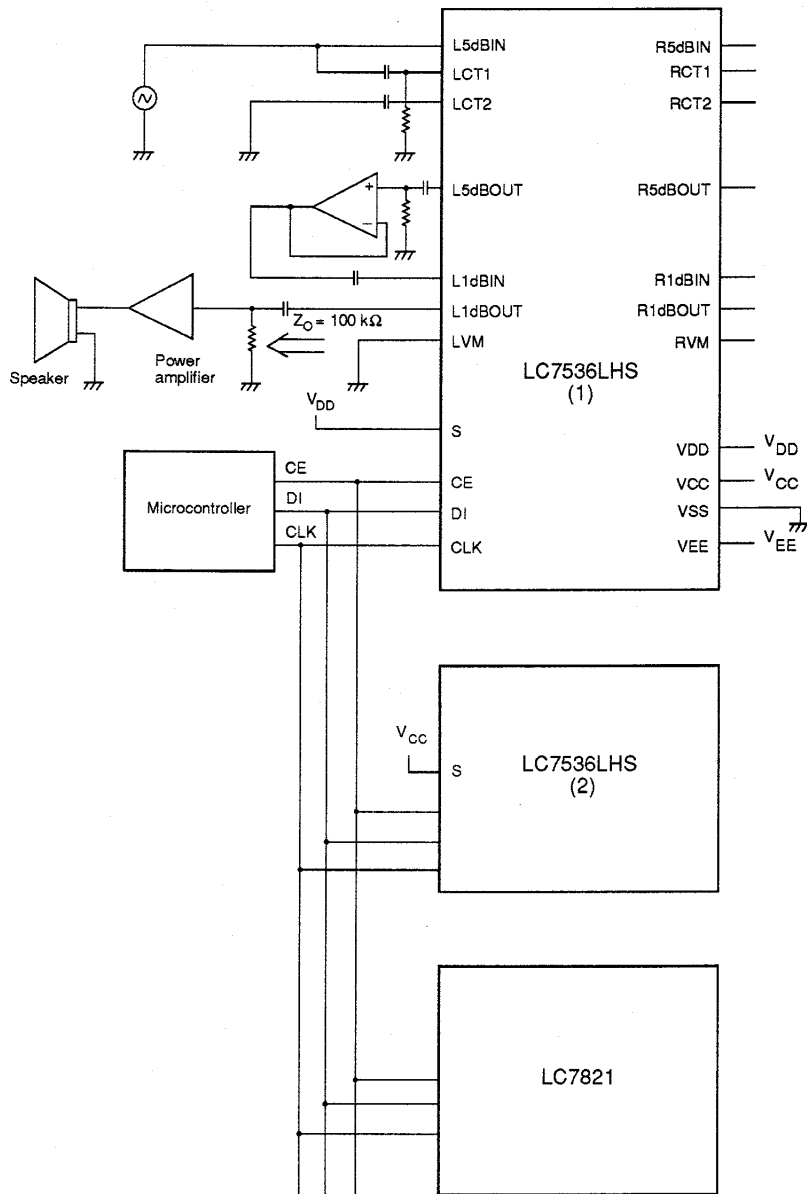


Figure 2. Typical application

- Specifications of any and all SANYO products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.
- SANYO Electric Co., Ltd. strives to supply high-quality high-reliability products. However, any and all semiconductor products fail with some probability. It is possible that these probabilistic failures could give rise to accidents or events that could endanger human lives, that could give rise to smoke or fire, or that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all SANYO products(including technical data, services) described or contained herein are controlled under any of applicable local export control laws and regulations, such products must not be exported without obtaining the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written permission of SANYO Electric Co., Ltd.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the SANYO product that you intend to use.
- Information (including circuit diagrams and circuit parameters) herein is for example only ; it is not guaranteed for volume production. SANYO believes information herein is accurate and reliable, but no guarantees are made or implied regarding its use or any infringements of intellectual property rights or other rights of third parties.

This catalog provides information as of May, 2001. Specifications and information herein are subject to change without notice.