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Ordering number : EN5681

CMOS LSI

LC75392, 75392M

Single-Chip Electronic Volume Control System

Overview

The LC75392 (DIP-30SD) and the LC75392M (MFP-30S) are electronic volume control ICs that provide input and output switching, volume, and tone control functions controlled by data transferred over a serial interface.

Functions

- Input and output switching: Four inputs and outputs can be switched independently.
- Volume control: A balance function can be implemented by controlling the left and right levels independently. Each channel can be set to 0 to –20 dB in 2 dB steps, –20 to –32 dB in 3 dB steps, –32 to –52 dB in 4 dB steps, –52 dB to –70 dB in 4.5 dB steps, and –∞.
- Tone controls: Internal switches are provided to select between four sets of frequency characteristics. A buffer function can be implemented using external components.

Features

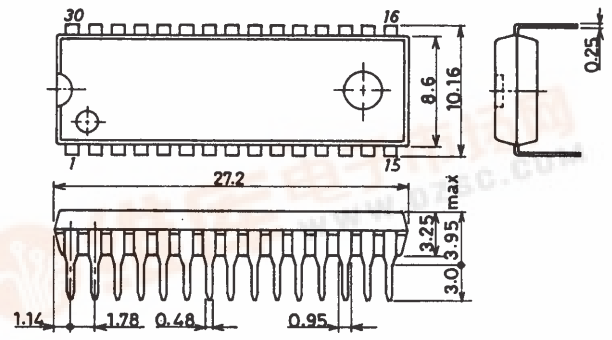
Serial data interface: Support for control and communication in the CCB format.

Package Dimensions

unit: mm

3196-DIP30SD

[LC75392]

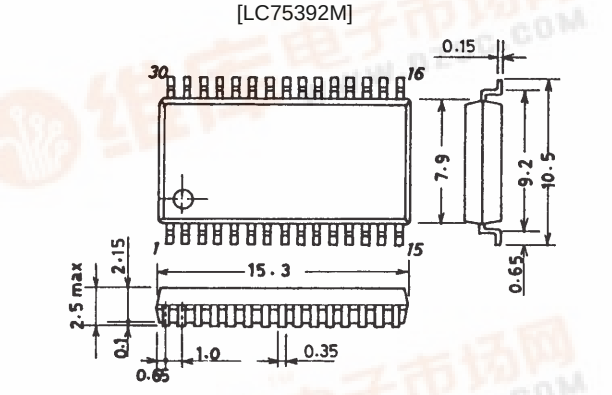


SANYO: DIP30SD

unit: mm

3216-MFP30S

[LC75392M]



SANYO: MFP30S

Specifications

Absolute Maximum Ratings at Ta = 25°C, V_{SS} = 0 V

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{DD} max	V_{DD}	12	V
Maximum input voltage	V_{IN} max	CL, DI, CE, L1, L2, L3, L4, R1, R2, R3, R4	V_{SS} – 0.3 to V_{DD} + 0.3	V
Allowable power dissipation	Pd max	Ta ≤ 85°C	160	mW
Operating temperature	Topr		–40 to +85	°C
Storage temperature	Tstg		–50 to +125	°C

- **CCB is a trademark of SANYO ELECTRIC CO., LTD.**
- **CCB is SANYO's original bus format and all the bus addresses are controlled by SANYO.**

SANYO Electric Co.,Ltd. Semiconductor Bussiness Headquarters
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110 JAPAN

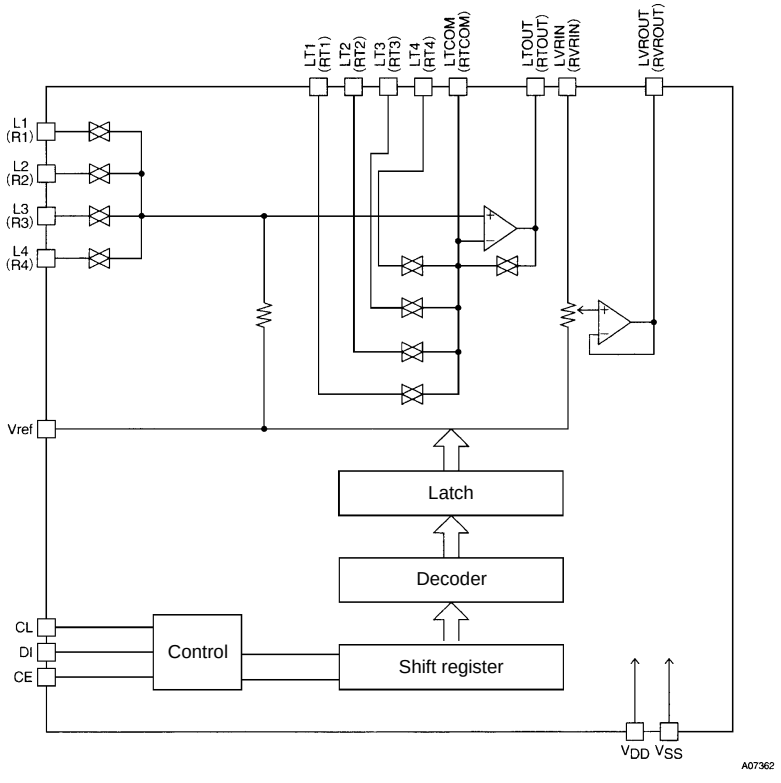
Allowable Operating Ranges at Ta = 25°C, V_{SS} = 0 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	V_{DD}	V_{DD}	5.5		11.0	V
Input high-level voltage	V_{IH}	CL, DI, CE	4.0		V_{DD}	V
Input low-level voltage	V_{IL}	CL, DI, CE	V_{SS}		1.0	V
Input voltage amplitude	V_{IN}	L1, L2, L3, L4, R1, R2, R3, R4	V_{SS}		V_{DD}	Vp-p
Input pulse width	$t_{øW}$	CL	1.0			µs
Setup time	t_{setup}	CL, DI, CE	1.0			µs
Hold time	t_{hold}	CL, DI, CE	1.0			µs
Operating frequency	fopg	CL			500	kHz

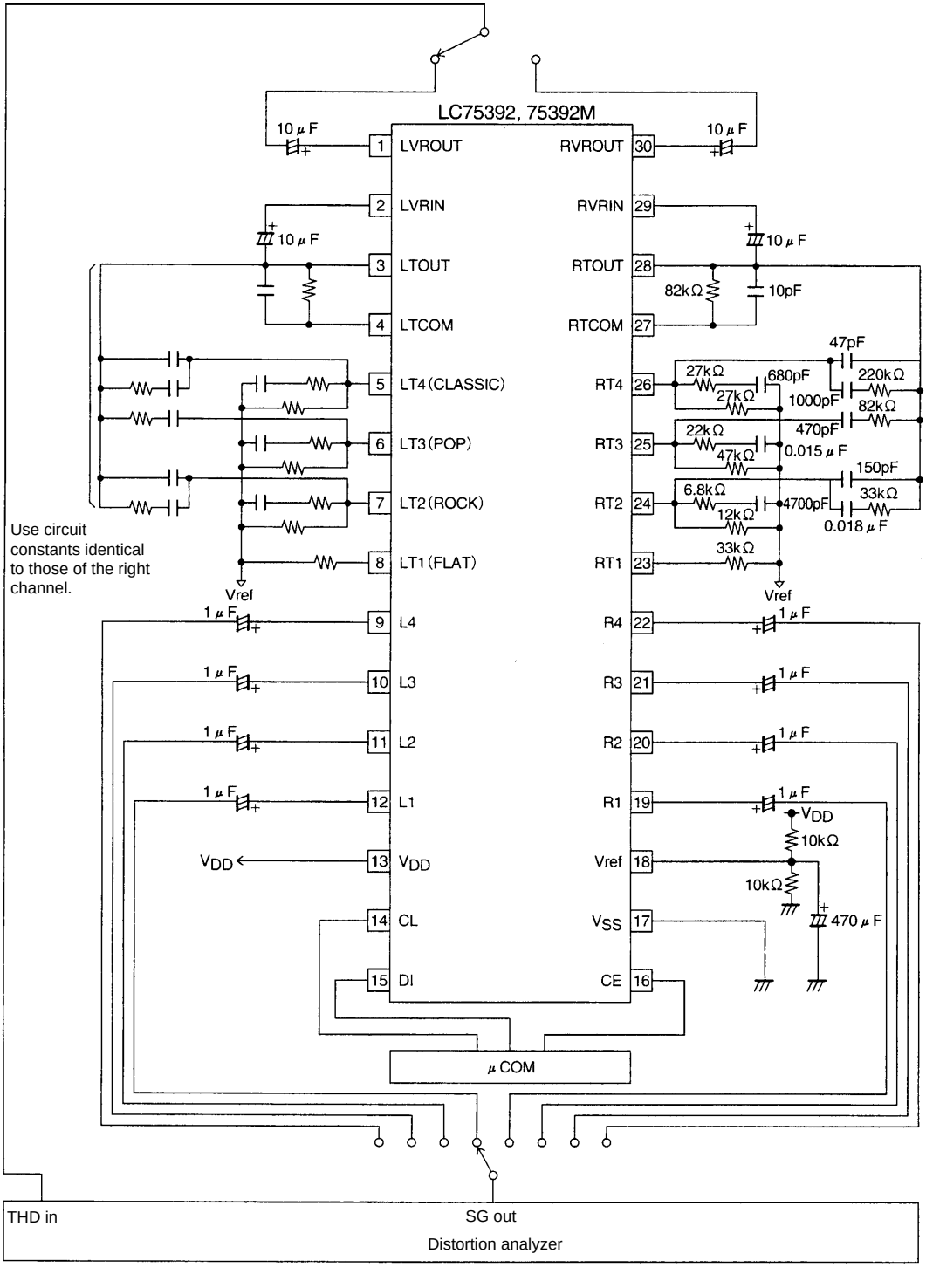
Electrical Characteristics at Ta = 25°C, V_{DD} = 10 V, V_{SS} = 0 V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
[Input Block]						
Input resistance	Rin	L1, L2, L3, L4, R1, R2, R3, R4		500		kΩ
[Overall]						
Total harmonic distortion	THD1	V_{IN} = 100 mV rms, f = 1 kHz, overall, buffer mode off, flat state		0.013		%
	THD2	V_{IN} = 100 mV rms, f = 20 kHz, overall, buffer mode off, flat state		0.013		%
Crosstalk	CT	V_{IN} = 1 V rms, f = 1 kHz, overall, Rg = 1 kΩ, buffer mode off, flat state		81		dB
Output at maximum attenuation	V_O min	V_{IN} = 1 V rms, f = 1 kHz, main volume set to –∞, buffer mode on		–80		dB
Output noise voltage	V_N1	Flat overall (IHF-A), Rg = 1 kΩ, buffer mode off, flat state		15		µV
	V_N2	Flat overall (DIN-AUDIO), Rg = 1 kΩ, buffer mode off, flat state		22		µV
Current drain	I_{DD}	V_{DD} – V_{SS} = 11 V		7	10	mA
Input high-level current	I_{IH}	CL, DI, CE, V_{IN} = 10 V			10	µA
Input low-level current	I_{IL}	CL, DI, CE, V_{IN} = 0 V	–10			µA

Equivalent Circuit Block Diagram

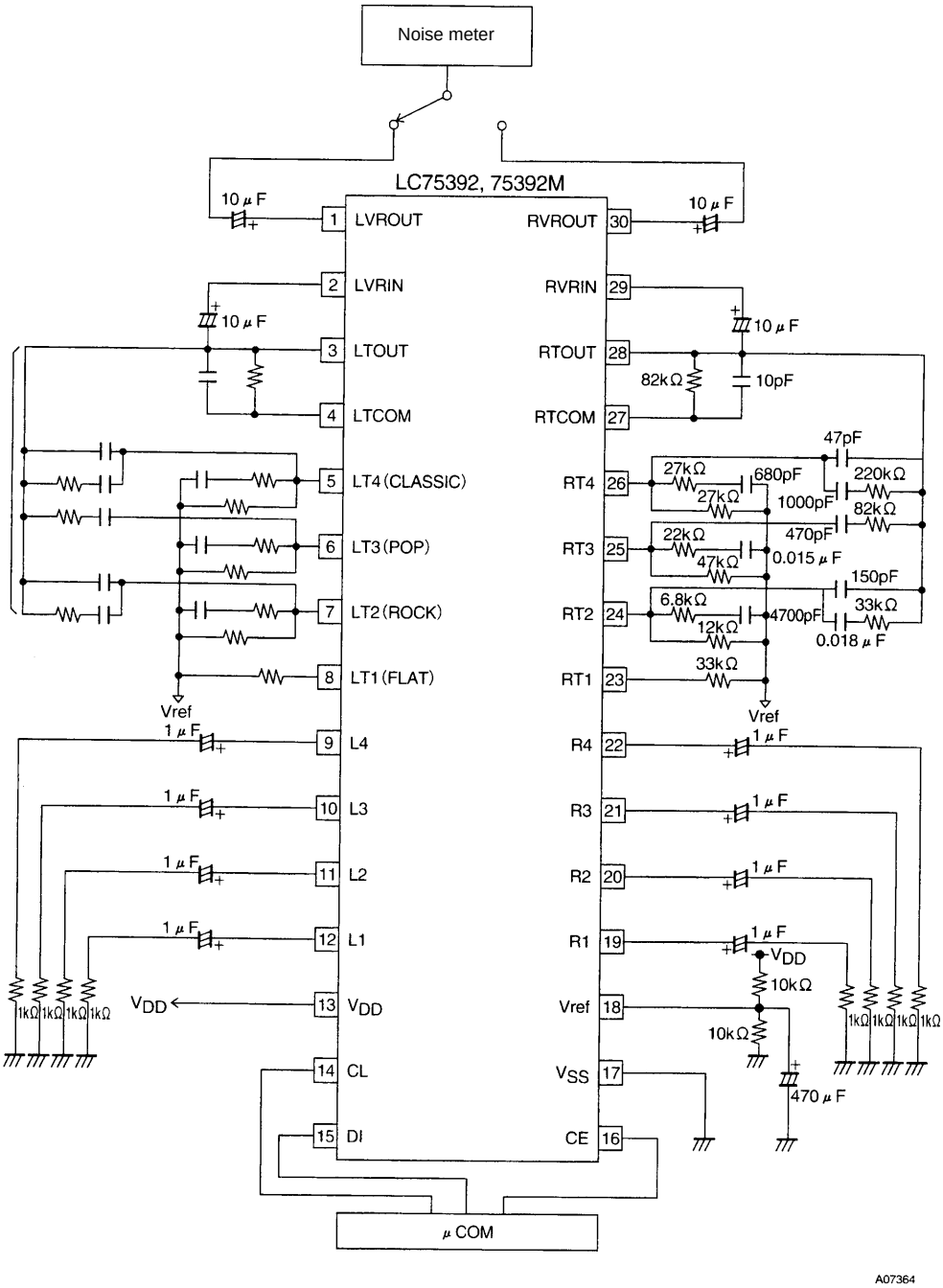


Test Circuit
Total Harmonic Distortion

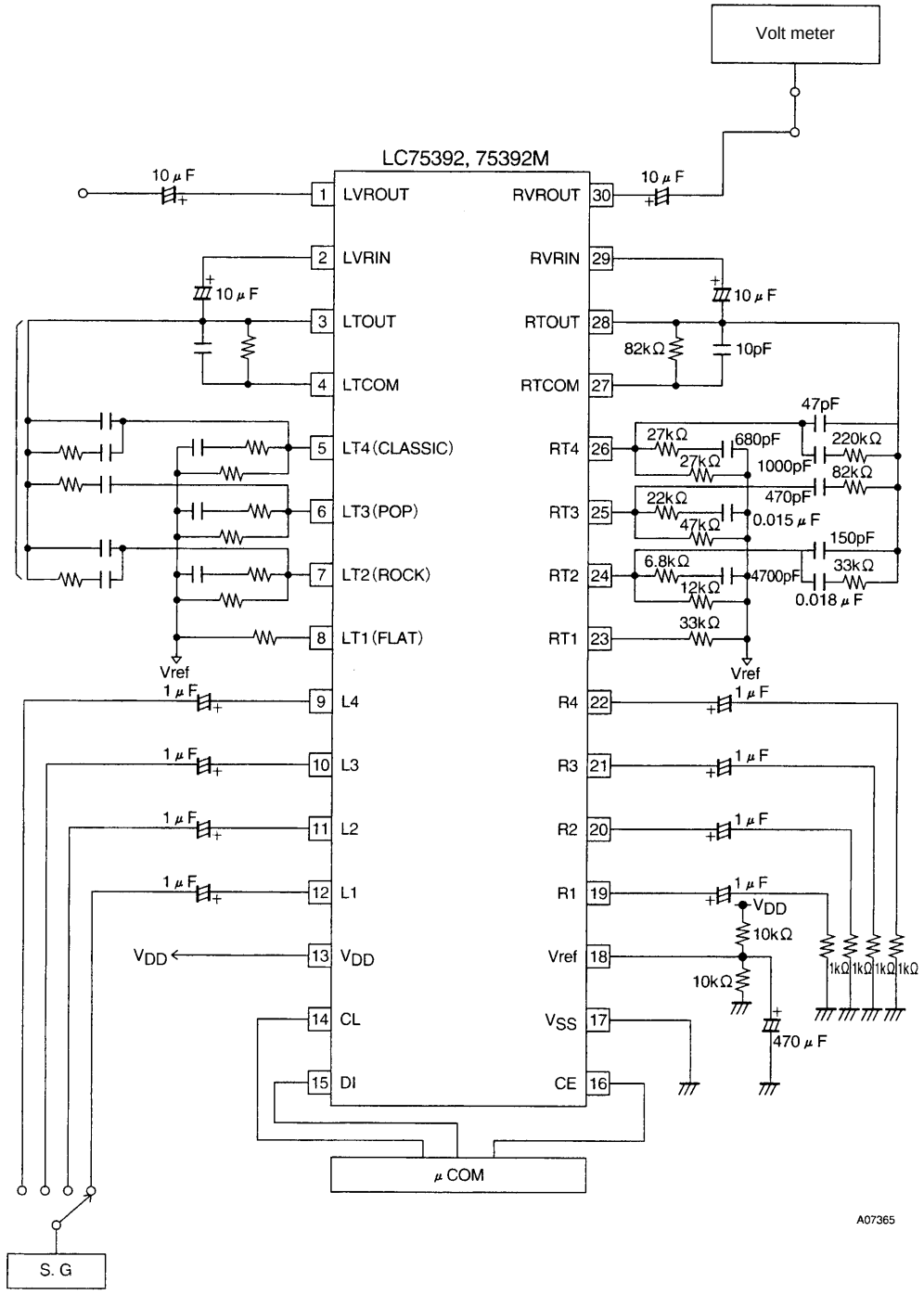


Output Noise Voltage

Use circuit constants identical to those of the right channel.

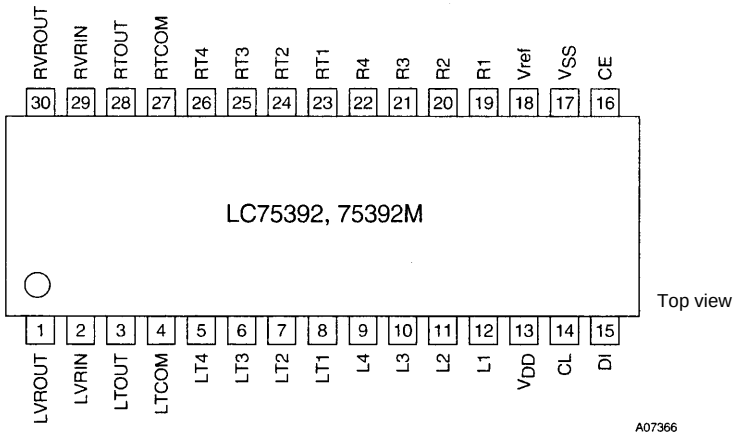


Crosstalk

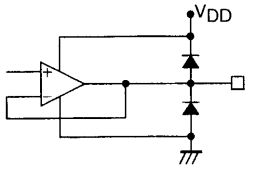
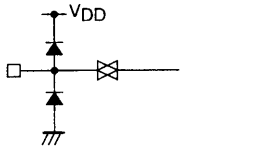
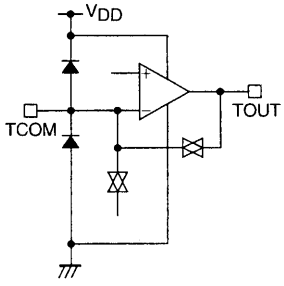
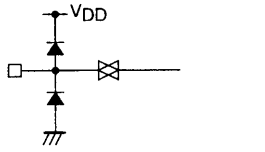


Use circuit constants identical to those of the right channel.

Pin Assignment



Pin Functions

Pin	Pin No.	Function	Circuit
LVROUT RVROUT	1 30	Volume control outputs	
LVRIN RVRIN	2 29	Volume control inputs	
LTOUT RTOUT	3 28	Tone control circuit outputs	
LTCOM RTCOM	4 27	Tone control circuit operational amplifier inverting inputs	
LT1 LT2 LT3 LT4 RT1 RT2 RT3 RT4	8 7 6 5 23 24 25 26	Connections for the tone control pattern external constants	

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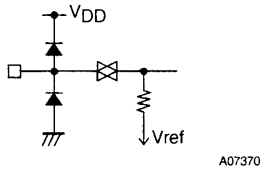
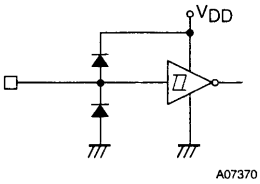
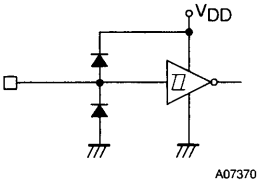
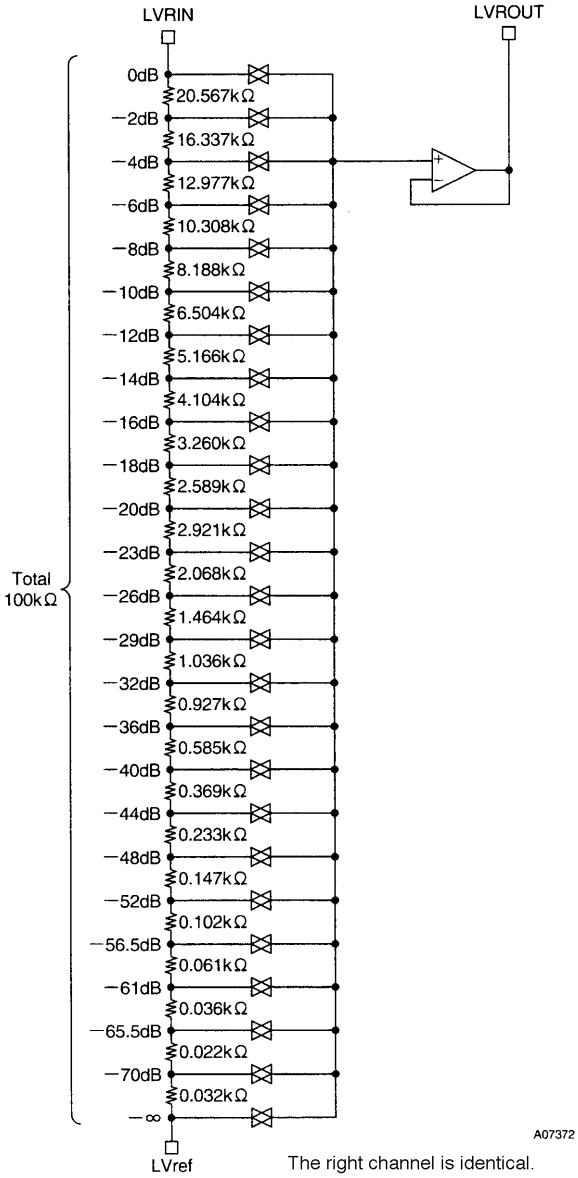
Pin	Pin No.	Function	Circuit
L1 L2 L3 L4 R1 R2 R3 R4	12 11 10 9 19 20 21 22	Audio signal inputs and outputs	
V_{DD}	13	Power supply	
Vref	18	Analog system ground	
V_{SS}	17	Ground	
CL DI	14 15	Serial data and clock inputs for device control	
CE	16	• Chip enable • Data is read into an internal latch and the analog switches operate when this pin goes from high to low. Data transfers are enabled when this pin is high.	

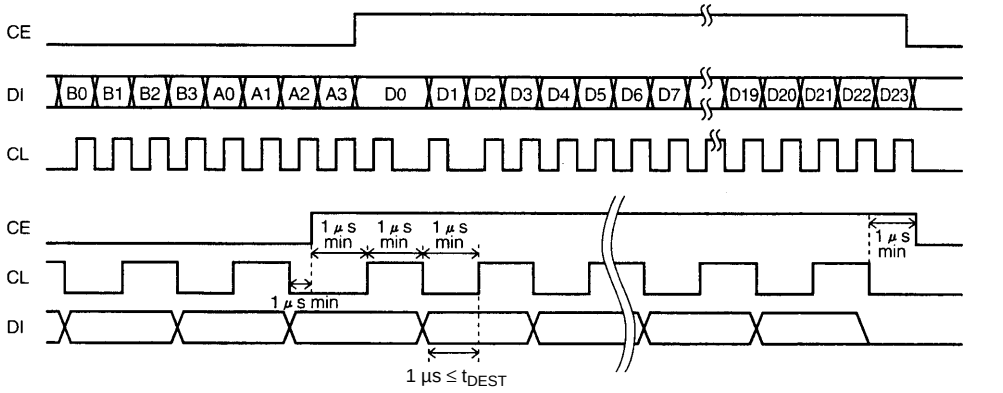
Volume Control Equivalent Circuit



The right channel is identical.

Control System Timing and Data Format

To control the LC75392, applications must apply data in the stipulated format to the CE, CL, and DI pins. This data consists of 32 bits, of which 8 bits are the address and 24 bits are the control data.



B0	B1	B2	B3	A0	A1	A2	A3	D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14	D15	D16	D17	D18	D19	D20	D21	D22	D23
								Don't care							Don't care				Don't care							Don't care		Test mode			Don't care

Address code

Address code							
B0	B1	B2	B3	A0	A1	A2	A3
0	1	0	0	0	0	0	1

(82HEX)

Volume control data

D2 to D6	
00000	−∞
10000	−70dB
01000	−65.5dB
11000	−61dB
00100	−56.5dB
10100	−52dB
01100	−48dB
11100	−44dB
00010	−40dB
10010	−36dB
01010	−32dB
11010	−29dB
00110	−26dB
10110	−23dB
01110	−20dB
11110	−18dB
00001	−16dB
10001	−14dB
01001	−12dB
11001	−10dB
00101	−8dB
10101	−6dB
01101	−4dB
11101	−2dB
00011	0dB

Tone pattern control data

D8	D9	
0	0	T1 ON
1	0	T2 ON
0	1	T3 ON
1	1	T4 ON

Buffer mode

D10	
0	T5 OFF
1	T5 ON

Function switch control data

D12	
0	L1 (R1) OFF
1	L1 (R1) ON

D13	
0	L2 (R2) OFF
1	L2 (R2) ON

D14	
0	L3 (R3) OFF
1	L3 (R3) ON

D15	
0	L4 (R4) OFF
1	L4 (R4) ON

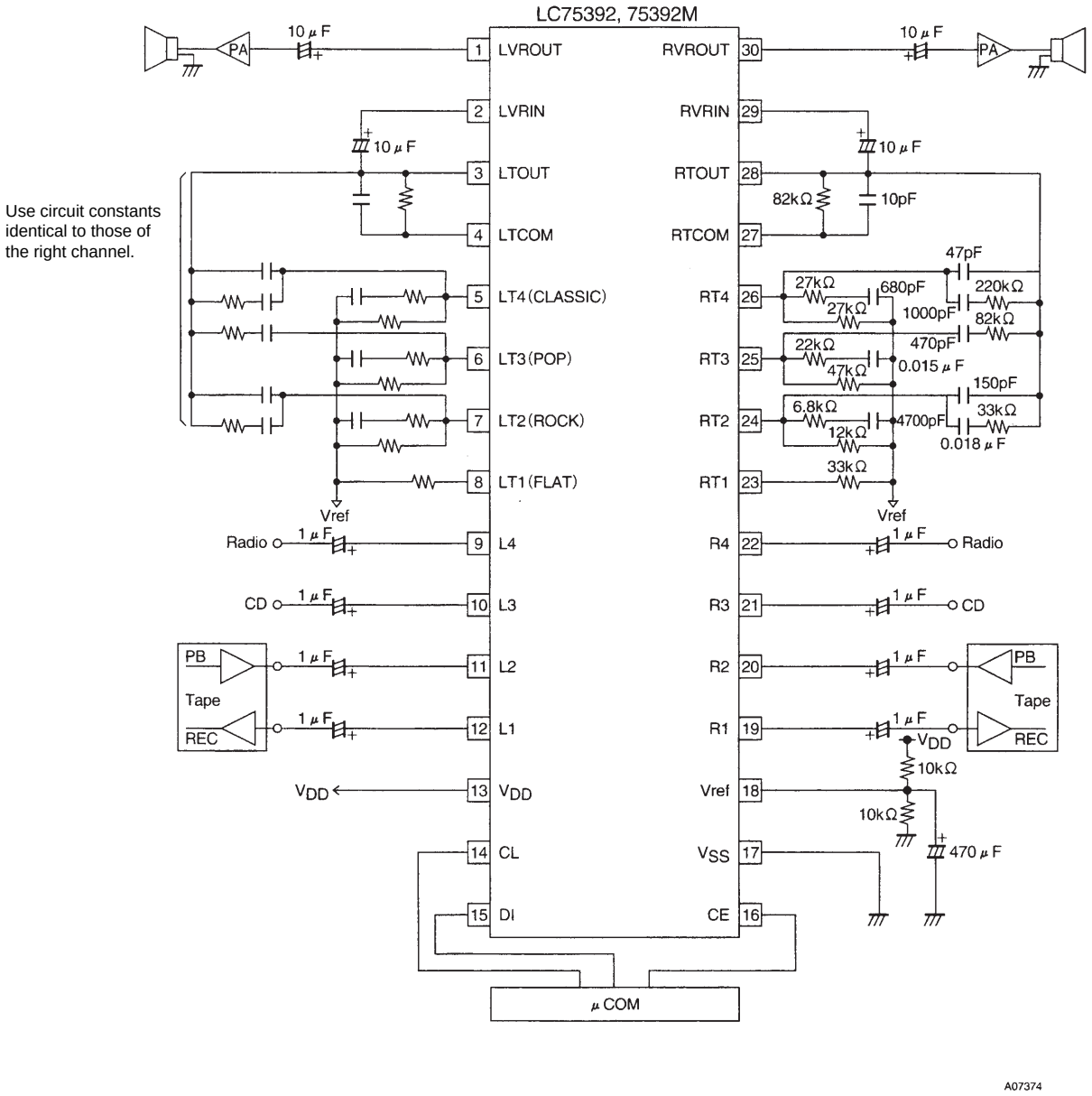
Channel selection

D16	D17	
0	0	
0	1	Lch
1	0	Rch
1	1	Left and right at the same time

A07373

Note: The bits D20, D21, and D22 are IC test mode control data. User applications must always set these bits to 0.

Sample Application Circuit (Three-input type)

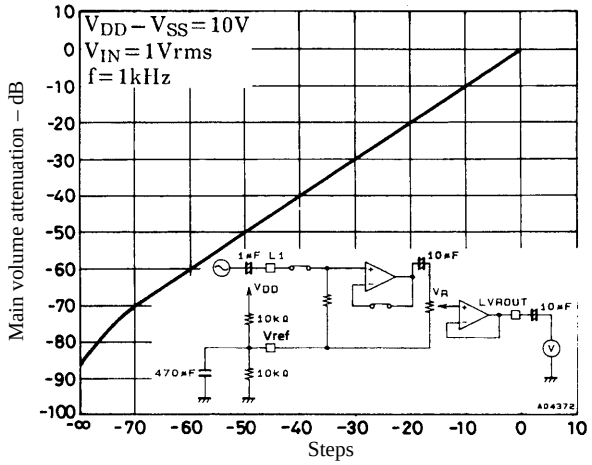


Usage Notes

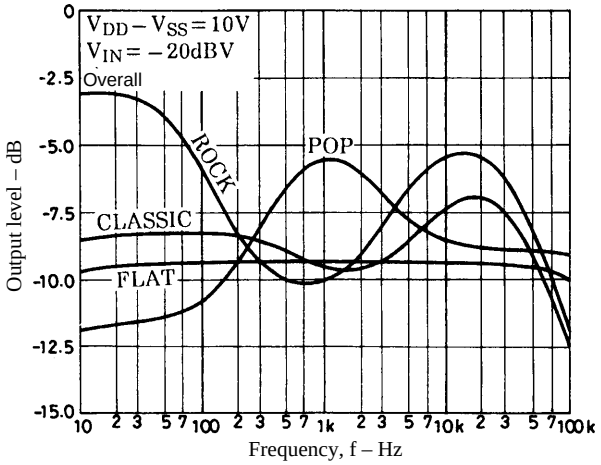
- The states of the internal analog switches are undefined immediately after power is first applied. Applications should apply muting to the outputs of this IC using external circuits until the control data has been set up.
- The CL, DI, and CE pin lines should be shielded by the ground pattern or shielded lines should be used to prevent the high-frequency digital signals that are transmitted over these lines from entering the analog system as noise.
- We recommend that applications use a sequence of several smaller steps to approach the final setting when changing the value of the volume control setting significantly. For example, the sequence shown below should be used when changing from 0 dB to –∞. This can reduce switching noise.

  Example: 0 dB → –10 dB → –20 dB → –40 dB → –70 dB →–∞

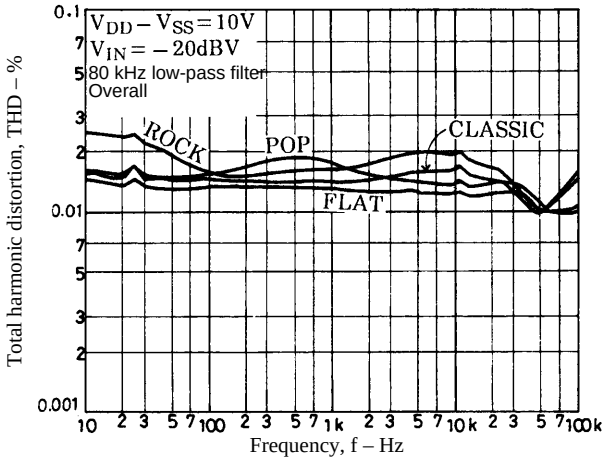
Main Volume Step Characteristics



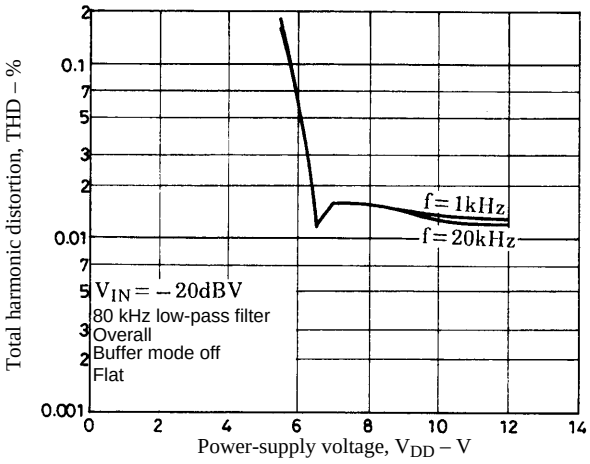
Tone Control Characteristics



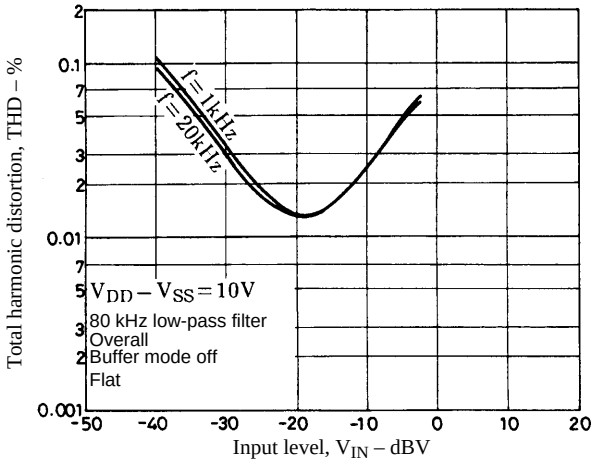
THD vs. Frequency Characteristics



THD vs. Power-Supply Voltage Characteristics



THD vs. Input Level Characteristics



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