

SANYO

LC75391, 75391M

Single-Chip Electronic Volume Control System



Overview

The LC75391 and LC75391M are single-chip electronic volume and tone control systems that support volume control, tone control, and input and output signal switching functions controlled by serial input data.

Functions

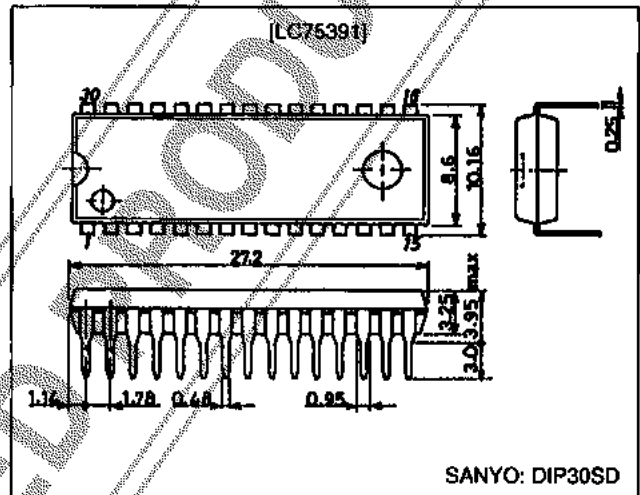
- Input and output signal switching: The four I/O switches can be set to on or off independently.
- Volume control: Independent control of the left and right channels can be used to implement a balance function.
0 to -20 dB in 2 dB steps, -20 to -32 dB in 3 dB steps, -32 to -53 dB in 4 dB steps, -52 to -70 dB in 4.5 dB steps, and -∞.
- Tone controls: Four frequency characteristic types selectable by setting internal switches.
Also supports a buffer function that requires no external components.
- Two general-purpose output ports: These ports allow this LSI to control motorized volume controls and general-purpose logic.

- 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.

Package Dimensions

unit: mm

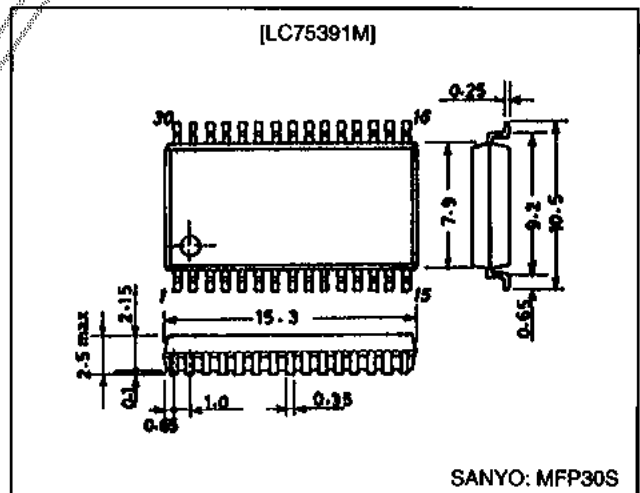
3196-DIP30SD



SANYO: DIP30SD

unit: mm

3216-MFP30S



SANYO: MFP30S

Specifications

Absolute Maximum Ratings at Ta = 25°C, VSS = 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 to L4, R1 to R4	V _{SS} - 0.3 to V _{DD} + 0.3	V
Allowable power dissipation	P _{d max}	Ta ≤ 85°C	160	mW
Operating temperature	T _{opr}		-40 to +85	°C
Storage temperature	T _{stg}		-50 to +125	°C

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Allowable Operating Ranges at $T_a = 25^\circ\text{C}$, $V_{SS} = 0\text{ V}$

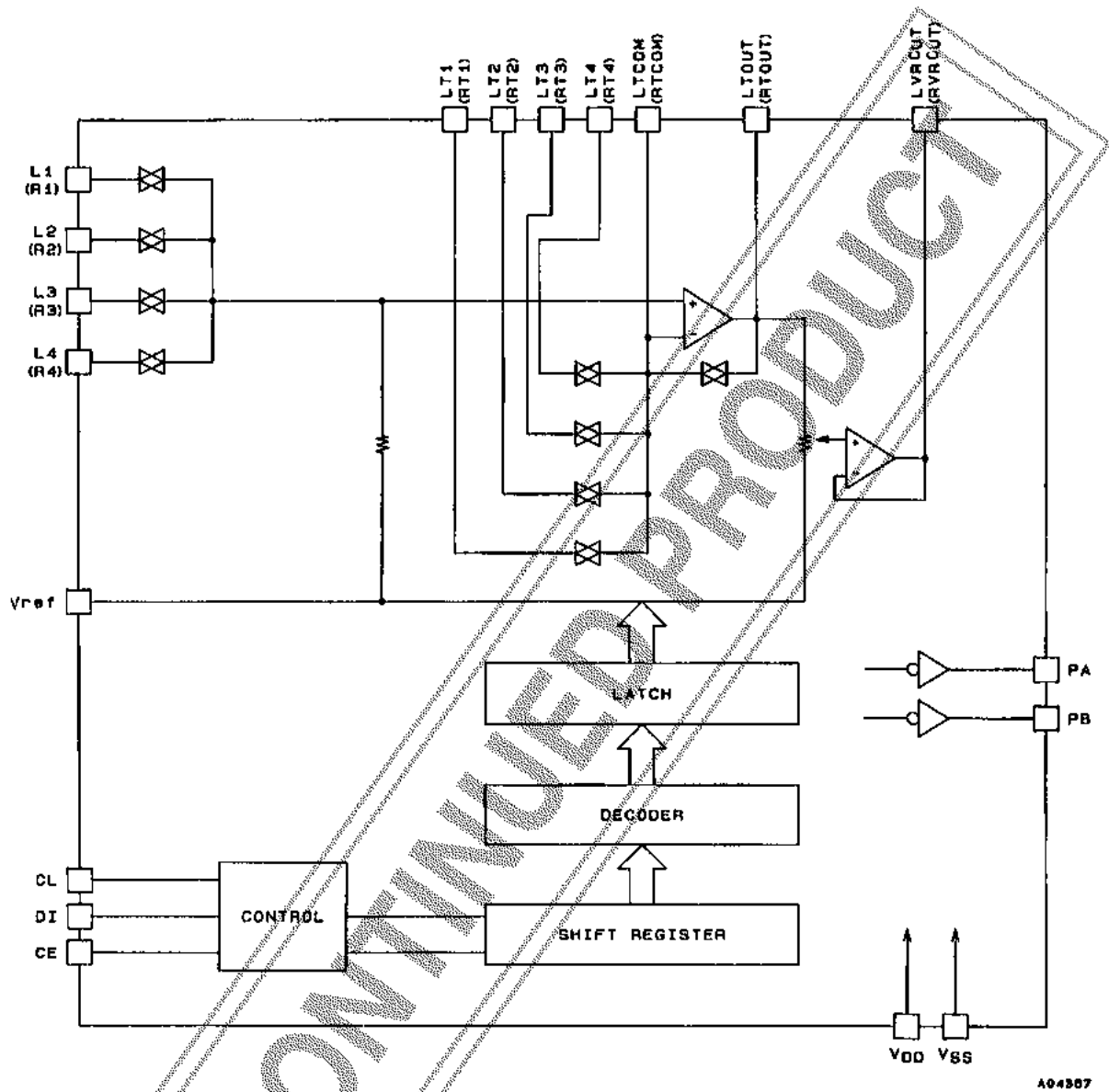
Parameter	Symbol	Conditions	min	typ	max	Unit
Supply voltage	V_{DD}	V_{DD}	5.5		11.0	V
Input high-level voltage	V_{IH}	CL, DI, CE	4.0		V_{DD}	V
Input low-level voltage	V_{IL}	CL, DI, CE	V_{SS}		1.0	V
Output high-level voltage	V_{OH}	PA, PB: $I_O = 5\text{ mA}$	$V_{DD} - 2$		V_{DD}	V
Output low-level voltage	V_{OL}	PA, PB: $I_O = 5\text{ mA}$	V_{SS}		2.0	V
Input voltage amplitude	V_{IN}	L1 to L4, R1 to R4	V_{SS}		V_{DD}	V _{P-P}
Input pulse width	t_{pw}	CL	1.0			μs
Setup time	$t_{set\ up}$	CL, DI, CE	1.0			μs
Hold time	t_{hold}	CL, DI, CE	1.0			μs
Operating frequency	f_{opg}	CL			500	kHz

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

Parameter	Symbol	Conditions	min	typ	max	Unit
[Input Block]						
Input resistance	R_{in}	L1 to L4, R1 to R4		500		k Ω
[Overall Characteristics]						
Total harmonic distortion	THD (1)	$V_{IN} = 100\text{ mVrms}$, $f = 1\text{ kHz}$, overall, buffer mode off, flat state		0.013		%
	THD (2)	$V_{IN} = 100\text{ mVrms}$, $f = 20\text{ kHz}$, overall, buffer mode off, flat state		0.013		%
Crosstalk	CT	$V_{IN} = 1\text{ Vrms}$, $f = 1\text{ kHz}$, overall, $R_g = 1\text{ k}\Omega$, buffer mode off, flat state		81		dB
Maximum attenuation	$V_O\ min$	$V_{IN} = 1\text{ Vrms}$, $f = 1\text{ kHz}$, main volume at $-\infty$, buffer mode on		-80		dB
Output noise voltage	V_N (1)	Flat overall (HF-A), $R_g = 1\text{ k}\Omega$, buffer mode off, flat state		15		μV
	V_N (2)	Flat overall (DIN-AUDIO), $R_g = 1\text{ k}\Omega$, buffer mode off, flat state		22		μV
Current drain	I_{DD}	$V_{DD} - V_{SS} = 11\text{ V}$		7	10	mA
Input high-level current	I_{IH}	CL, DI, CE, $V_{IN} = 10\text{ V}$			10	μA
Input low-level current	I_{IL}	CL, DI, CE, $V_{IN} = 0\text{ V}$	-10			μA

DISCONTINUED PRODUCT

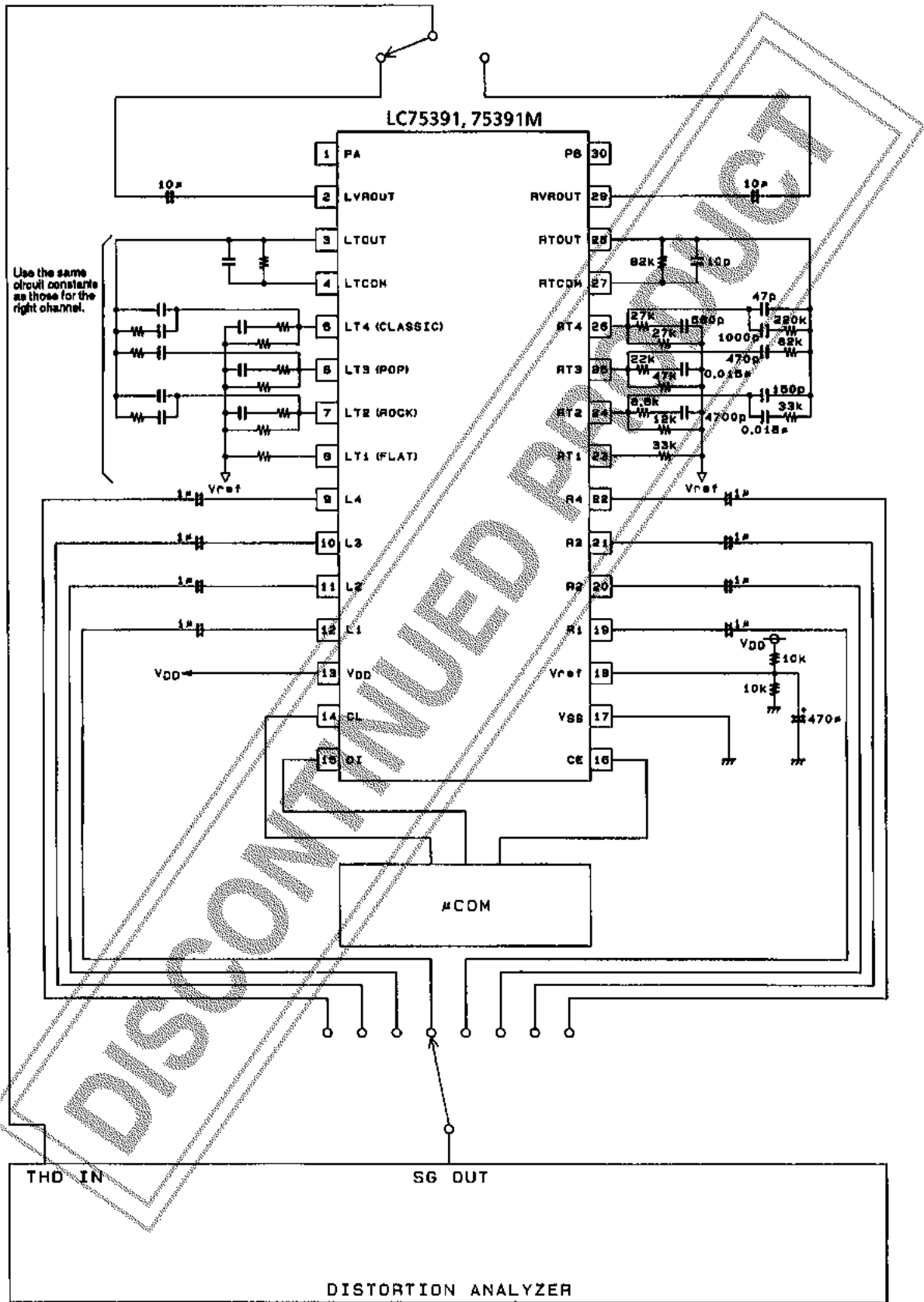
Equivalent Circuit Block Diagram



A04387

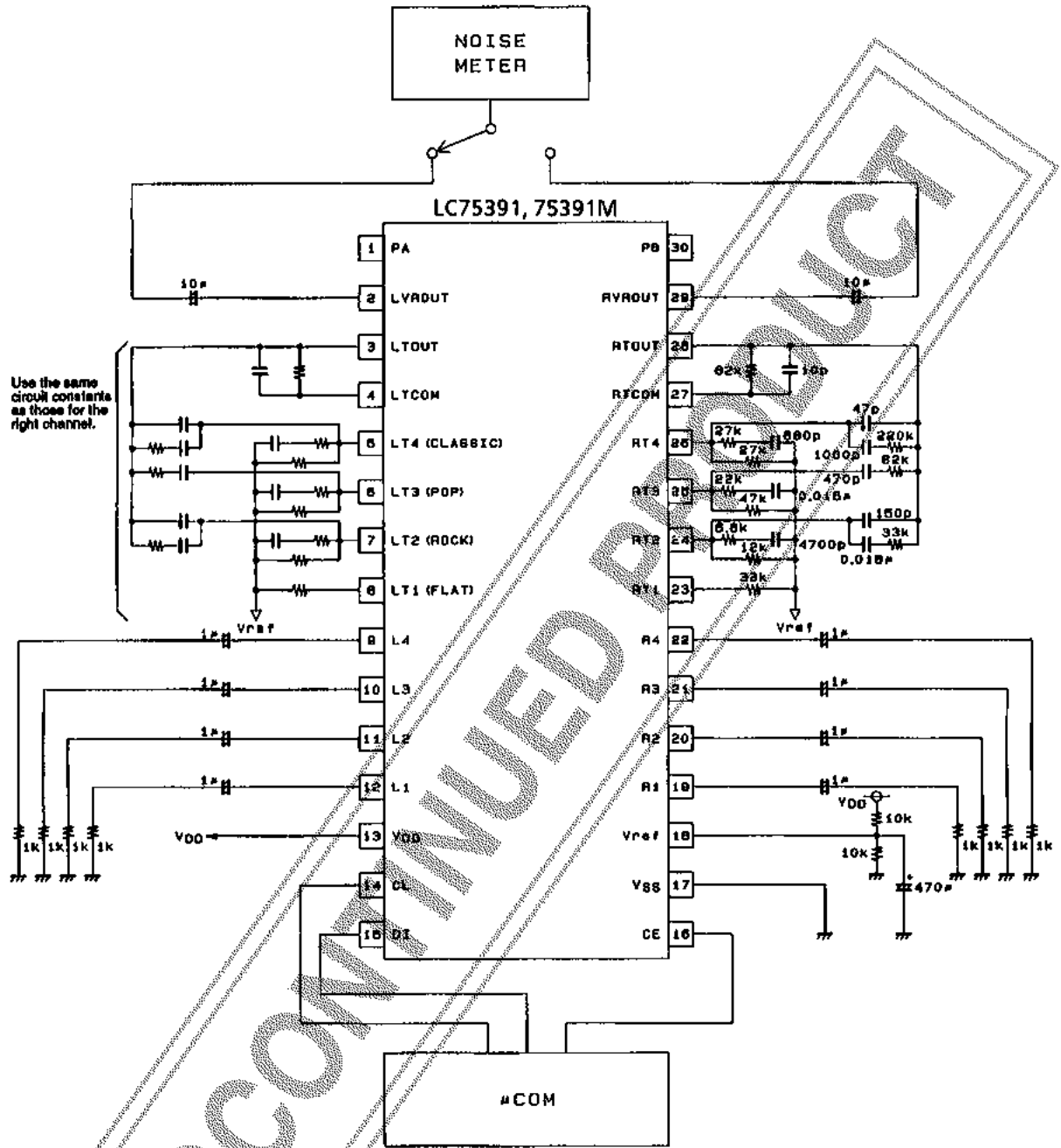
Test Circuits

1. Total harmonic distortion



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2. Output noise voltage

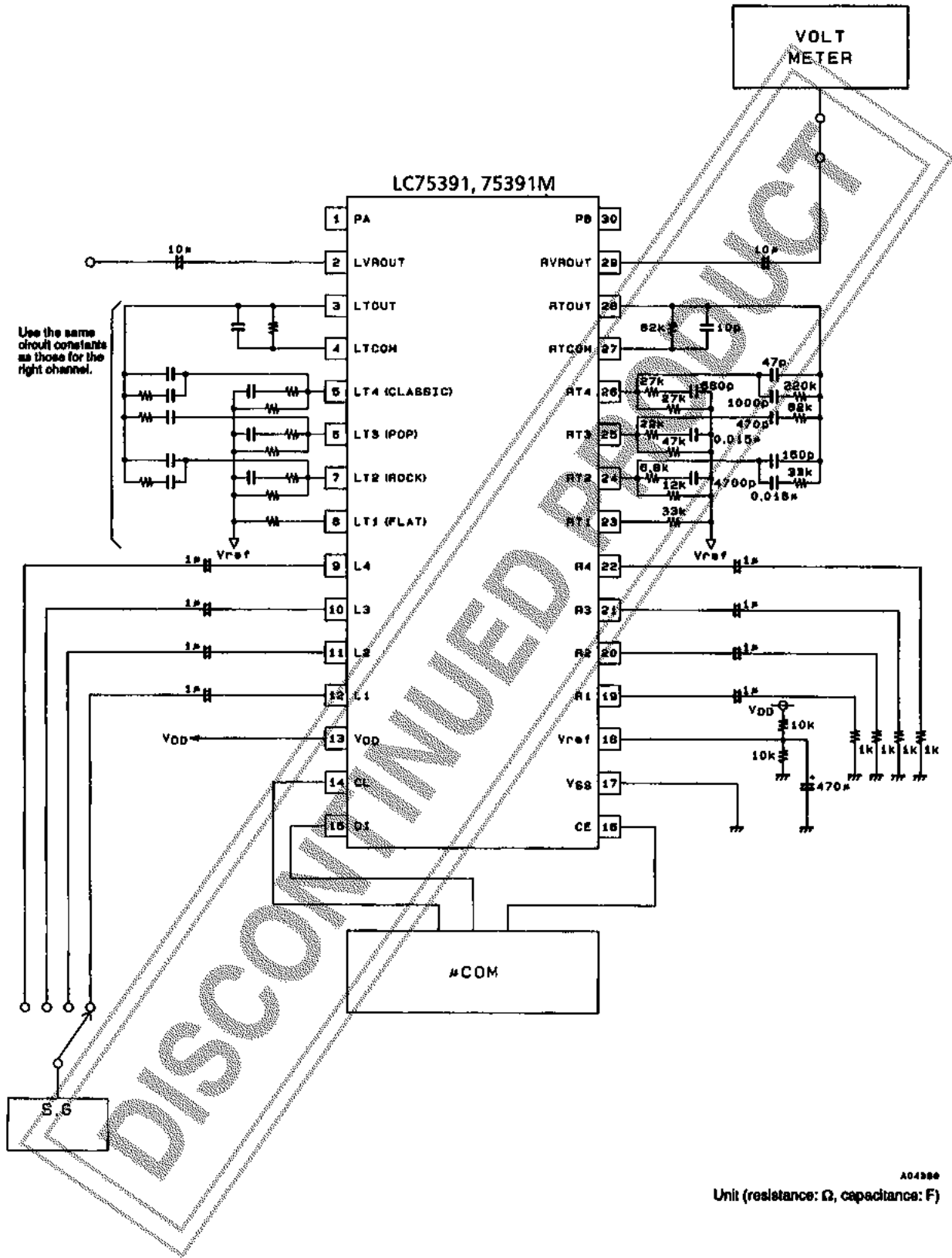


AG4289

Unit (resistance: Ω, capacitance: F)

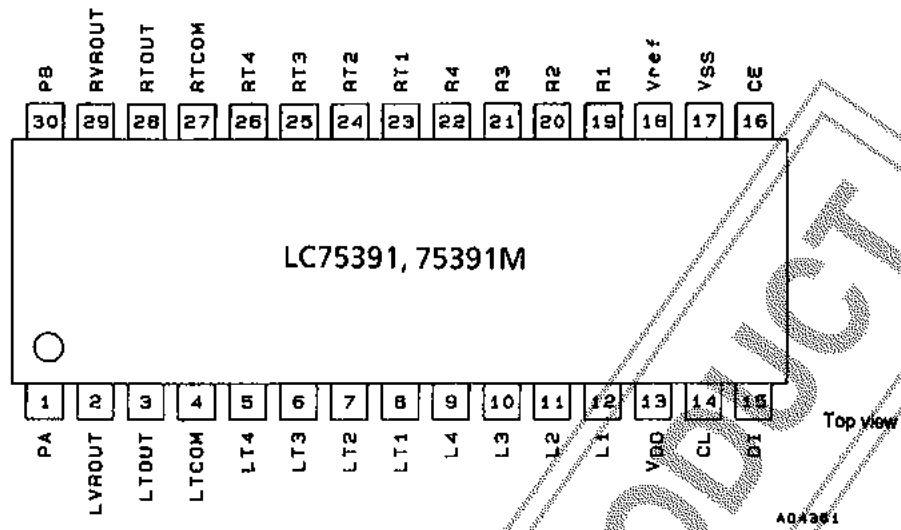
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3. Crosstalk



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Pin Assignment



Pin Functions

Pin No.	Symbol	Function	Circuit configuration
1 30	PA PB	Digital CMOS output port	<p style="text-align: right;">A04382</p>
2 29	LVROUT RVROUT	Volume control circuit outputs	<p style="text-align: right;">A04383</p>
3 28	LTOUT RTOUT	Tone control circuit outputs	<p style="text-align: right;">A04384</p>
4 27	LTCOM RTCOM	Tone control circuit operational amplifier inverting inputs	

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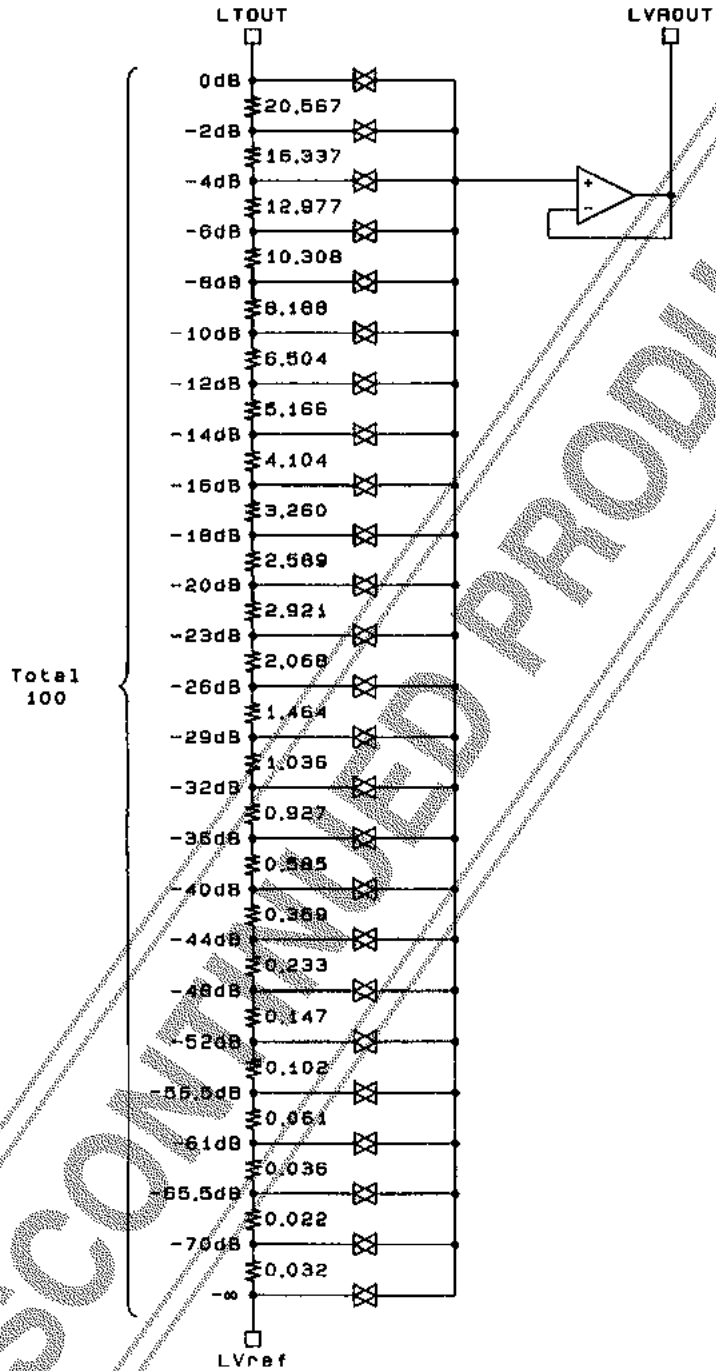
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Pin No.	Symbol	Function	Circuit configuration
8 7 6 5 23 24 25 26	LT1 LT2 LT3 LT4 RT1 RT2 RT3 RT4	Connections for the external components that determine the tone control pattern	<p>A04385</p>
12 11 10 9 19 20 21 22	L1 L2 L3 L4 R1 R2 R3 R4	Audio signal inputs and outputs	<p>A04385</p>
13	V _{DD}	Power supply	
18	V _{ref}	Analog system ground	
17	V _{SS}	Ground	
14 15	CL DI	Serial data and clock inputs for device control	<p>A04387</p>
16	CE	Chip enable Data is read into internal latches and all analog switches change state when this input changes from high to low. Data transfer is enabled when this input is high.	<p>A04387</p>

DISCONTINUED PRODUCT

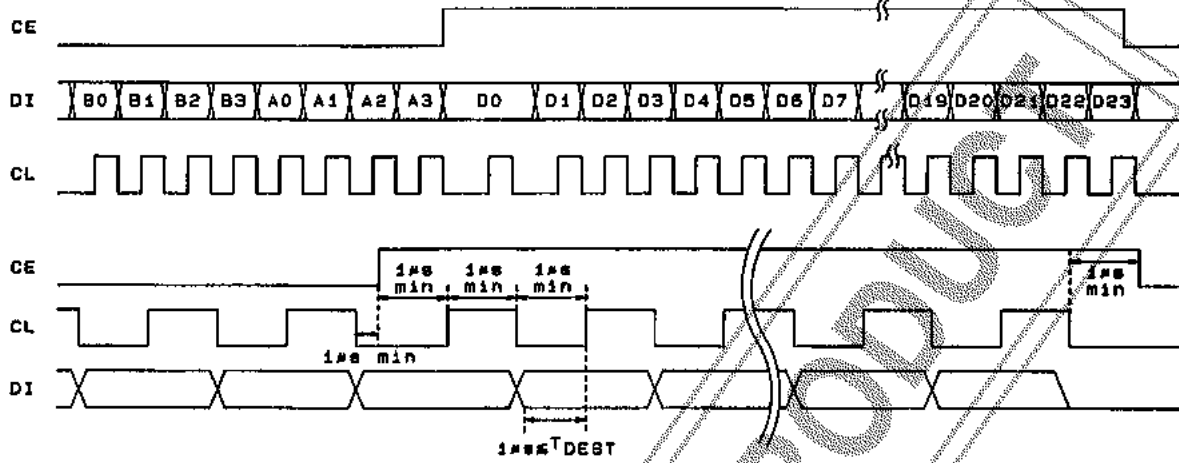
Volume Control Equivalent Circuit



The right channel is identical.
Unit (resistance: kΩ)

Control System Timing and Data Formats

The LC75391 is controlled by applying the stipulated data to the CE, CL, and DI pins. The data structure consists of a total of 32 bits, of which 8 bits are address and 24 bits are data.



Address code

Address code							
B	B	B	B	A	A	A	A
0	1	2	3	0	1	2	3
0	1	0	0	0	0	0	1

(92HEX)

Volume control data

D	D	~	B	
2	8			
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

D	D	
8	9	
0	0	T1 ON
1	0	T2 ON
0	1	T3 ON
1	1	T4 ON

Buffer mode

D	
10	
0	TS OFF
1	TS ON

Function switch control data

D	
12	
0	L1 (R1) OFF
1	L1 (R1) ON
13	
0	L2 (R2) OFF
1	L2 (R2) ON
14	
0	L3 (R3) OFF
1	L3 (R3) ON
15	
0	L4 (R4) OFF
1	L4 (R4) ON

General-purpose port (PA) control data

D	
0	Output low
1	Output high

Channel selection

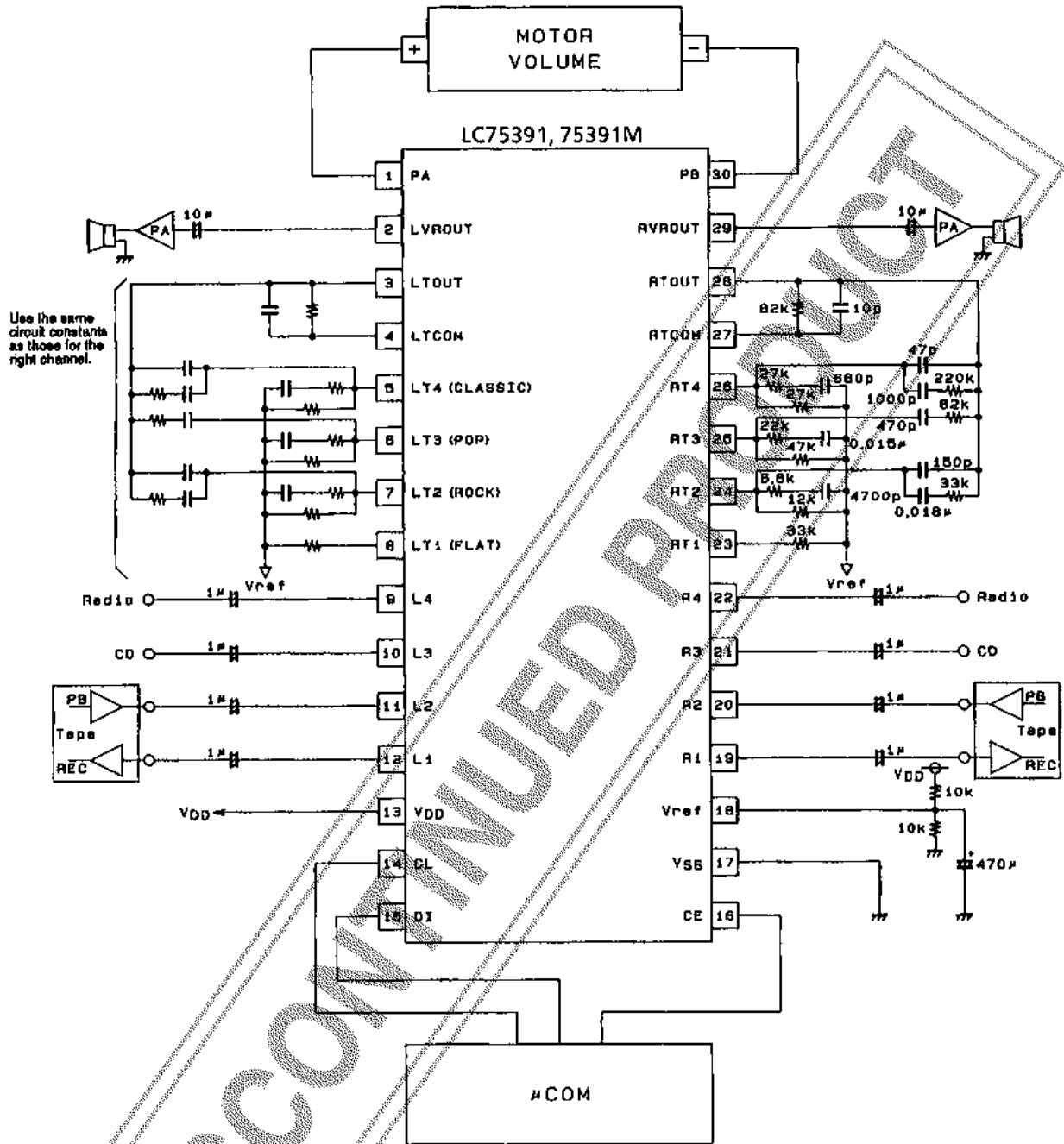
D	D	
16	17	
0	0	
0	1	Lch
1	0	Rch
1	1	Left and right together

General-purpose port (PB) control data

D	
0	Output low
1	Output high

Note: The bits D20, D21, and D22 are test mode selection bits. These bits must be set to 0 by user applications.

Application Circuit Example 1 (3-input type)



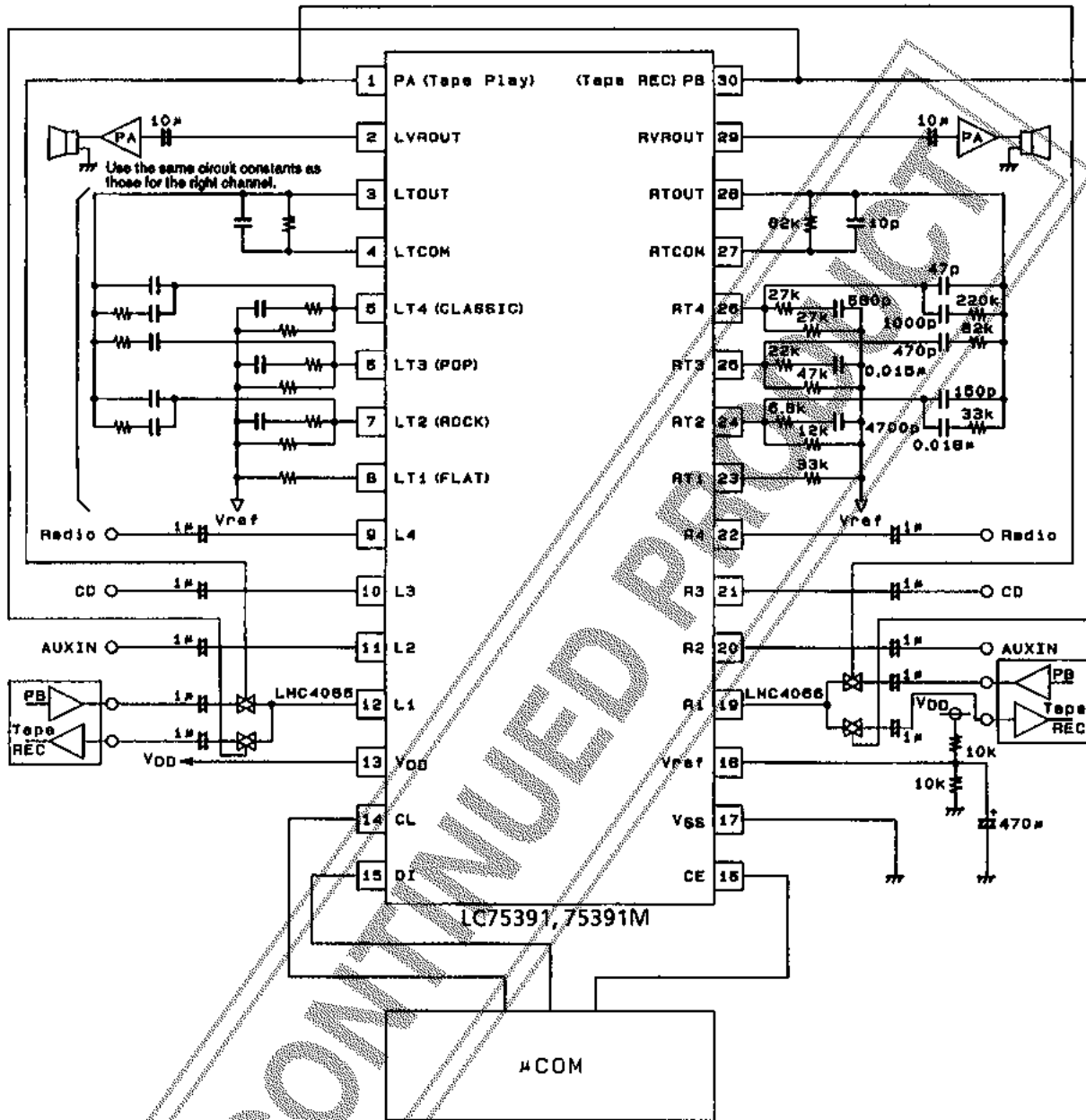
A04870
Unit (resistance: Ω, capacitance: F)

Usage Notes

1. The internal analog switch states are undefined when power is first applied. Signals should be muted externally until the control data has been set up.
2. Cover the CL, DI, and CE pin signal lines with the ground pattern or use shielded cable for those lines to prevent the high-frequency digital signals transmitted to the CL, DI, and CE pins from entering the analog system as noise.
3. Use bipolar capacitors if at all possible for capacitors for which no polarity is indicated.
4. We recommend making large changes in the electronic volume control setting, such as from 0 dB to $-\infty$ dB, by using several intermediate steps as shown in the example below. This can reduce the switching noise associated with large changes.

Example: 0 dB \rightarrow -10 dB \rightarrow -20 dB \rightarrow -40 dB \rightarrow -70 dB \rightarrow $-\infty$

Application Circuit Example 2 (4-input type)

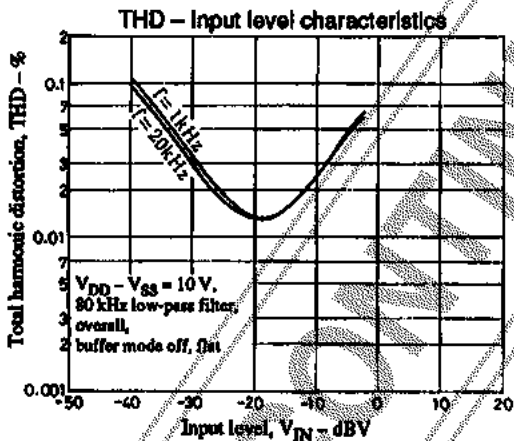
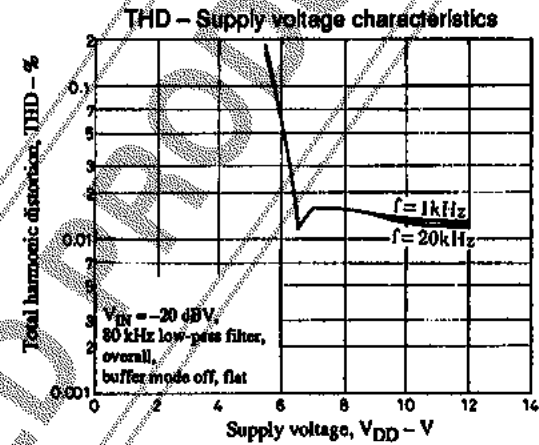
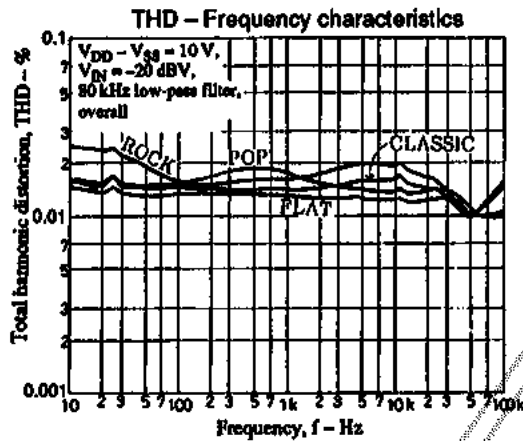
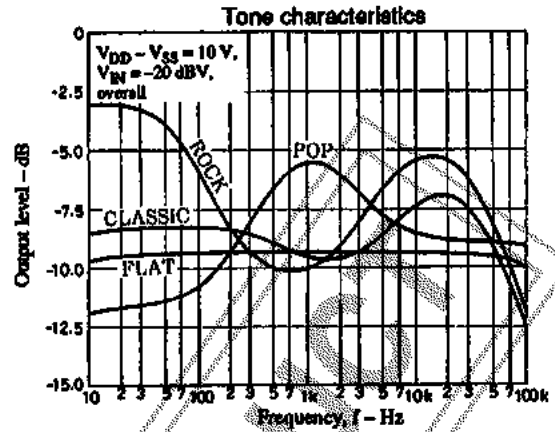
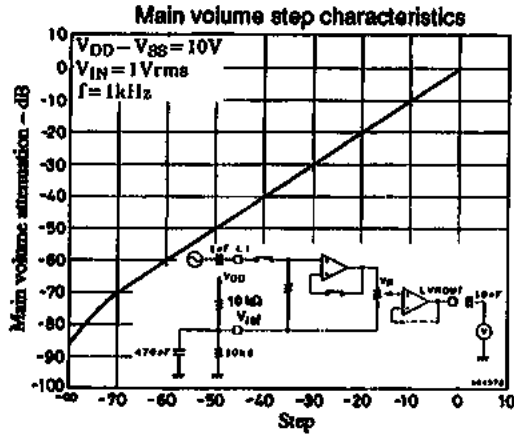


A04971

Unit (resistance: Ω, capacitance: F)

Usage Notes

1. The internal analog switch states are undefined when power is first applied. Signals should be muted externally until the control data has been set up.
2. Cover the CL, DI, and CE pin signal lines with the ground pattern or use shielded cable for those lines to prevent the high-frequency digital signals transmitted to the CL, DI, and CE pins from entering the analog system as noise.
3. If at all possible, use bipolar capacitors for capacitors which have no polarity indicated.
4. We recommend using several intermediate steps as shown in the example below to make large changes in the electronic volume control setting, such as from 0 dB to -∞ dB. This can reduce the switching noise associated with these large changes.
Example: 0 dB → -10 dB → -20 dB → -40 dB → -70 dB → -∞



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