Ordering number : EN4929A

CMOS LSI

LC75366, 75366M

Two-Channel Electronic Volume Control

Overview

The LC75366 (DIP20) and the LC75366M (MFP20) are electronic volume controls that can be controlled by serial input data and provide volume, balance and loudness functions.

Features

- Silicon gate CMOS process for low switching noise

Functions

- Volume: 0 dB to –68 dB (in 2 dB steps) and –∞; 36 positions.
  A balance function can be implemented by controlling the left and right channel volume settings independently.
- Loudness: Taps are provided at the –20 dB positions in the 10 dB step resistor ladder used by the volume control function. A loudness function can be implemented by attaching external RC circuits at these tap points.
- An address selection pin (the S pin) allows two LC75366 chips to be used on the same bus.
- Serial data input: Supports CCB* format communication with the system controller.

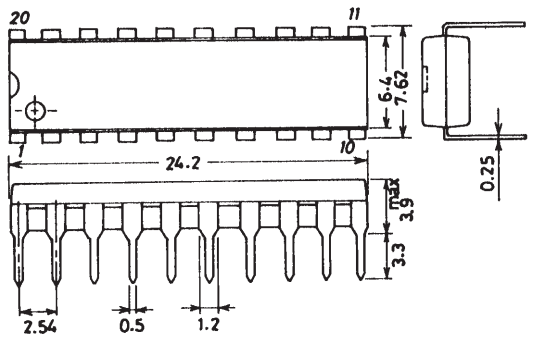
- **CCB is a trademark of SANYO ELECTRIC CO., LTD.**
- **CCB is SANYO's original bus format and all the bus addresses are controlled by SANYO.**

Package Dimensions

unit: mm

3021B-DIP20

[LC75366]

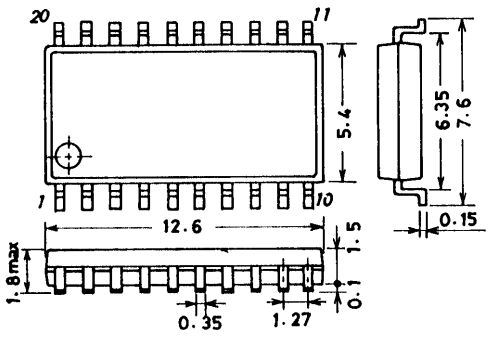


SANYO: DIP20

unit: mm

3036B-MFP20

[LC75366M]



SANYO: MFP20

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} max1	CL, DI, CE, S	V_{SS} – 0.3 to V_{DD} + 0.3	V
	V_{IN} max2	L10dBIN, L2dBIN, R10dBIN, R2dBIN	V_{SS} – 0.3 to V_{DD} + 0.3	V
Allowable power dissipation	Pd max	Ta ≤ 85°C	140	mW
Operating temperature	Topr		–40 to +85	°C
Storage temperature	Tstg		–50 to +125	°C

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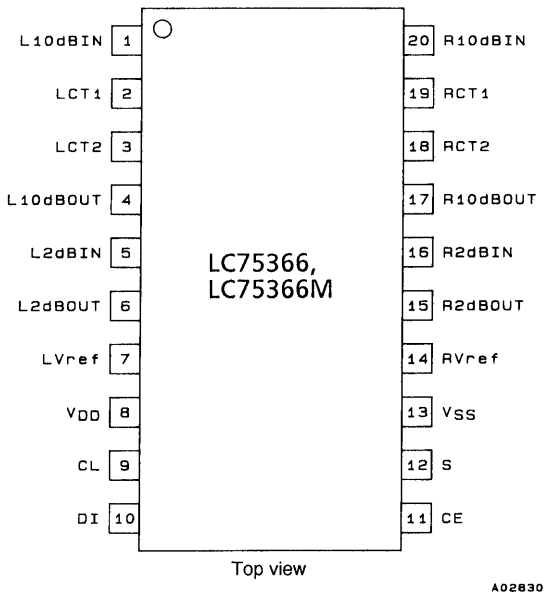
Allowable Operating Ranges at Ta = 25°C, V_{SS} = 0 V

Parameter	Symbol	Conditions	Ratings	Unit
Supply voltage	V_{DD}	V_{DD}	4.0 to 11.0	V
Input high level voltage	V_{IH} (1)	CL, DI, CE	0.3 V_{DD} + 1 to V_{DD}	V
	V_{IH} (2)	S	0.8 V_{DD} to V_{DD}	V
Input low level voltage	V_{IL} (1)	CL, DI, CE	V_{SS} to 0.2 V_{DD}	V
	V_{IL} (2)	S	V_{SS} to 0.2 V_{DD}	V
Input voltage amplitude	V_{IN}	L10dBIN, L2dBIN, R10dBIN, R2dBIN	V_{SS} to V_{DD}	Vp-p
Input pulse width	$t_{øW}$	CL	1 or longer	µs
Setup time	$t_{set\ up}$	CL, DI, CE	1 or longer	µs
Hold time	t_{hold}	CL, DI, CE	1 or longer	µs
Operating frequency	fop	CL	Up to 500	kHz

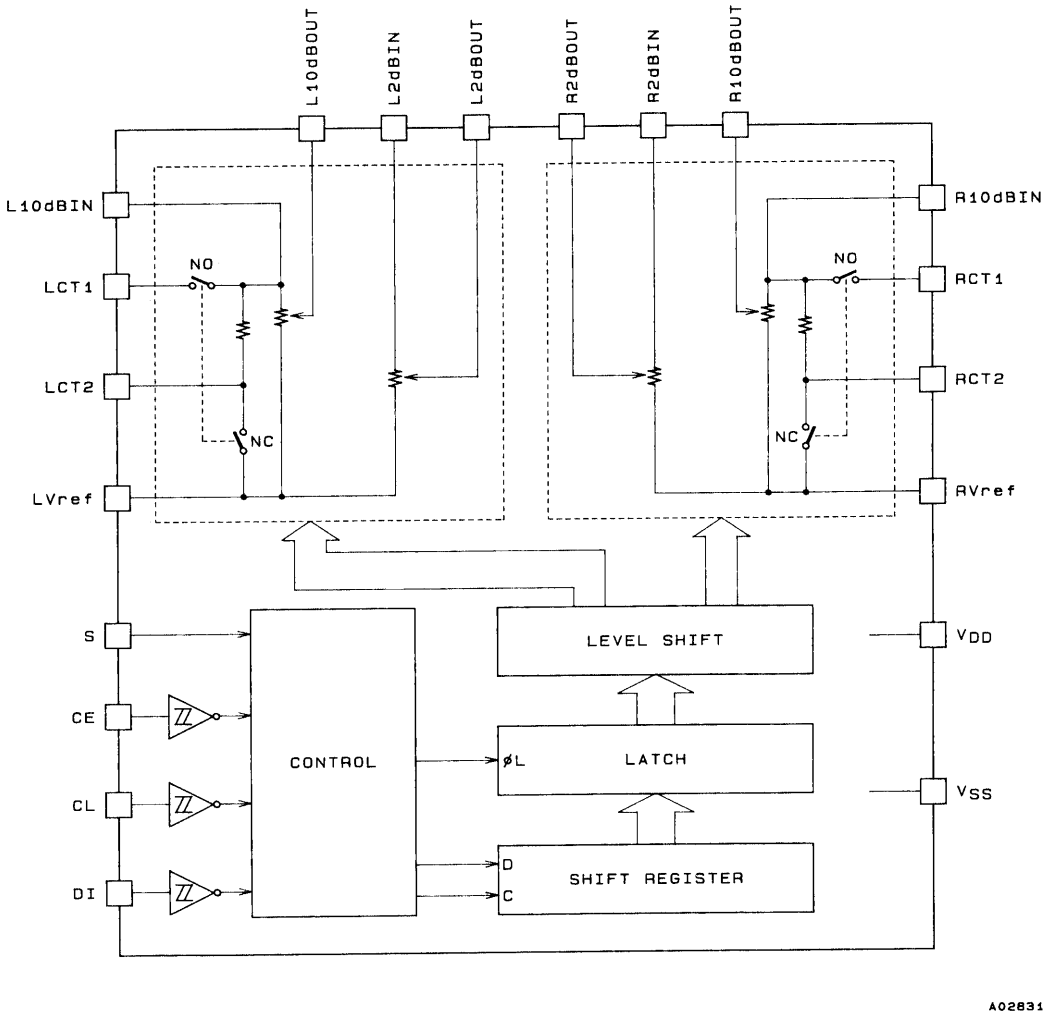
Electrical Characteristics at Ta = 25°C, V_{SS} = 0 V

Parameter	Symbol	Conditions	min	typ	max	Unit
Total harmonic distortion	THD (1)	V_{IN} = 1 Vrms, f = 1 kHz, all settings flat overall, V_{DD} = 9 V		0.006		%
	THD (2)	V_{IN} = 1 Vrms, f = 20 kHz, all settings flat overall, V_{DD} = 9 V		0.015		%
Crosstalk	CT	V_{IN} = 1 Vrms, f = 20 kHz, all settings flat overall, Rg = 1 kΩ		85		dB
Output at maximum attenuation	V_O min	V_{IN} = 1 Vrms, f = 20 kHz, volume setting: –∞, with a 470 µF capacitor between L/R Vref and V_{SS}		–80		dB
Total resistance	R_{VOL} (1)	10 dB steps	28.2	47	65.8	kΩ
	R_{VOL} (2)	2 dB steps	12	20	28	kΩ
Output off leakage current	Ioff	L10dBIN, R10dBIN, LCT1, L2dBIN, R2dBIN, RCT1, L10dBOUT, R10dBOUT, LCT2, L2dBOUT, R2dBOUT, RCT2, LVref, RVref	–10		+10	µA
Input high level current	I_{IH}	VI = V_{DD} (CL, CE and DI pins)			10	µA
Input low level current	I_{IL}	VI = V_{SS} (CL, CE and DI pins)	–10			µA
Output noise voltage	V_N	All settings flat overall (IHF-A), V_{DD} = 9 V, Rg = 1 kΩ		2	10	µV
Current drain	I_{DD}	V_{DD} – V_{SS} = 11 V			1	mA
Analog switch on resistance (Design target value)	R_{ON}	CT1	180	300	420	Ω
		For use between CT2 and Vref	90	150	210	Ω
		0 dB, –∞	0.6	1.0	1.4	kΩ
		Other than the above	6.0	10.0	14.0	kΩ

Pin Assignment

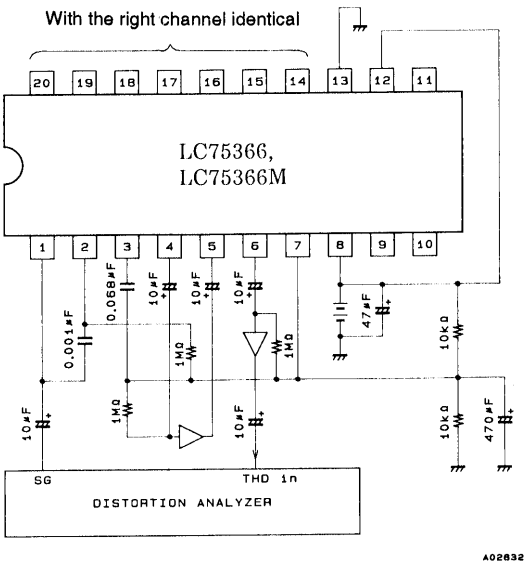


Equivalent Circuit Block Diagram

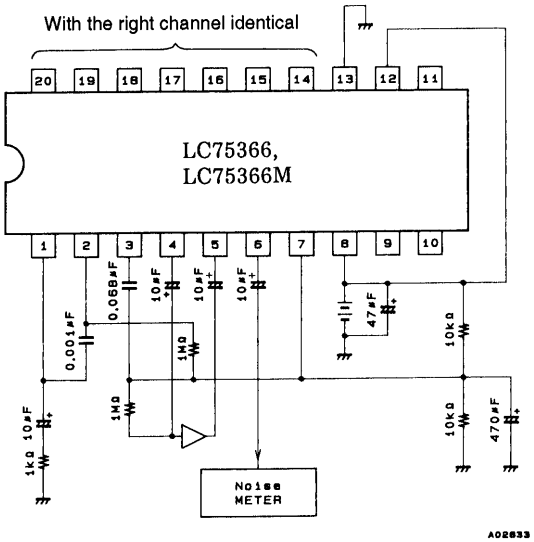


Test Circuits

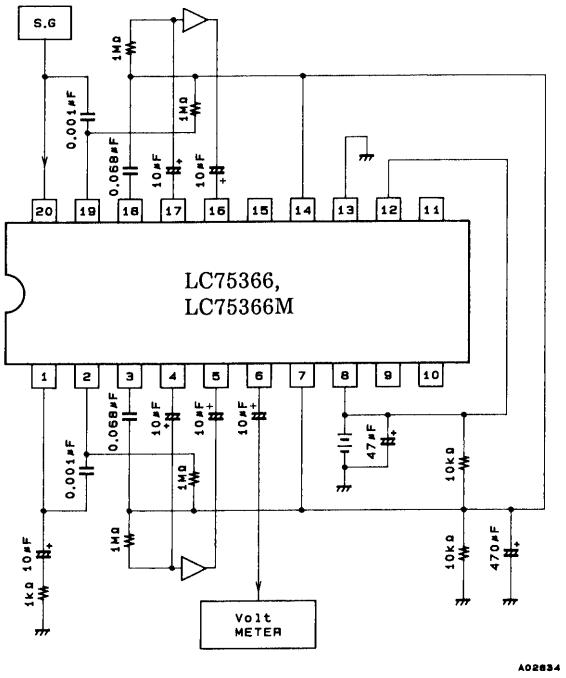
1. Total harmonic distortion



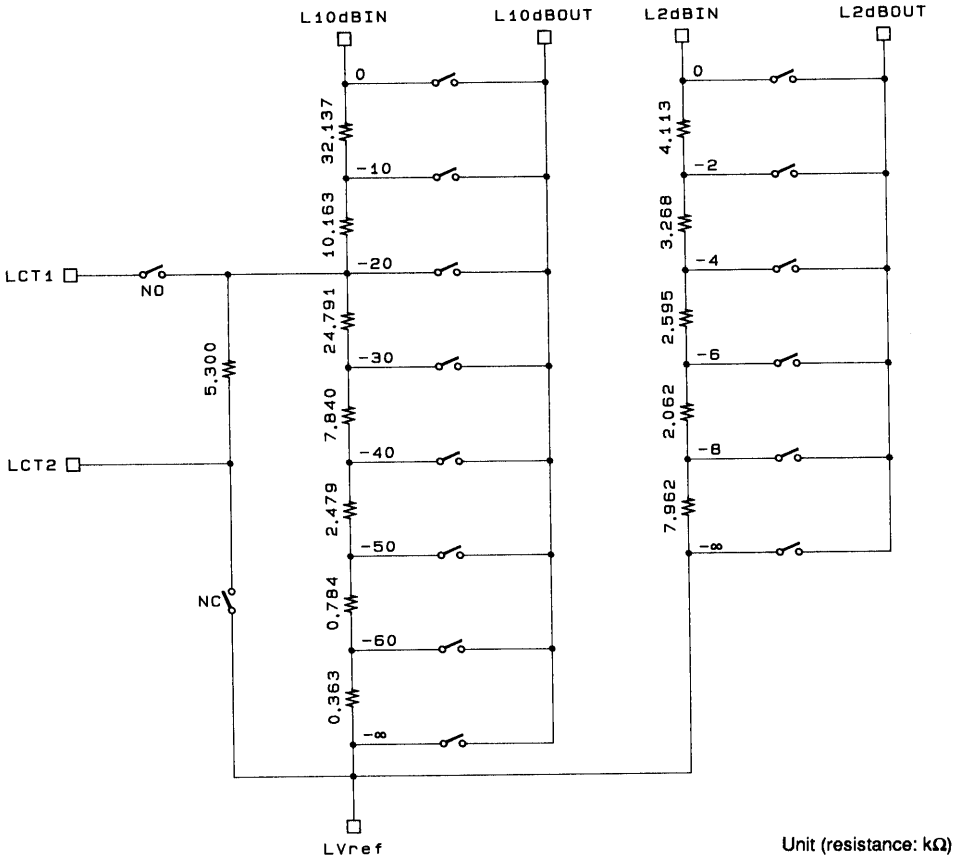
2. Output noise voltage



3. Crosstalk

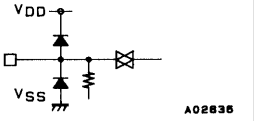
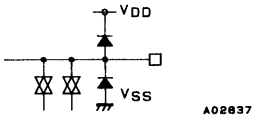
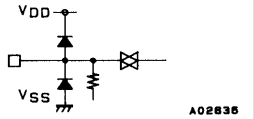
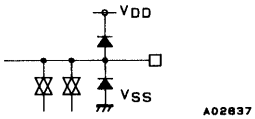
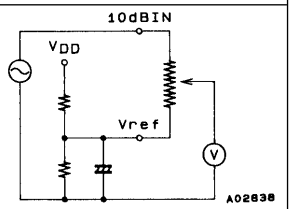
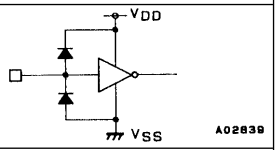
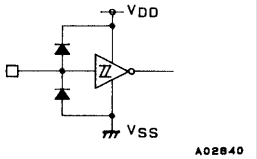


Volume Block Equivalent Circuit



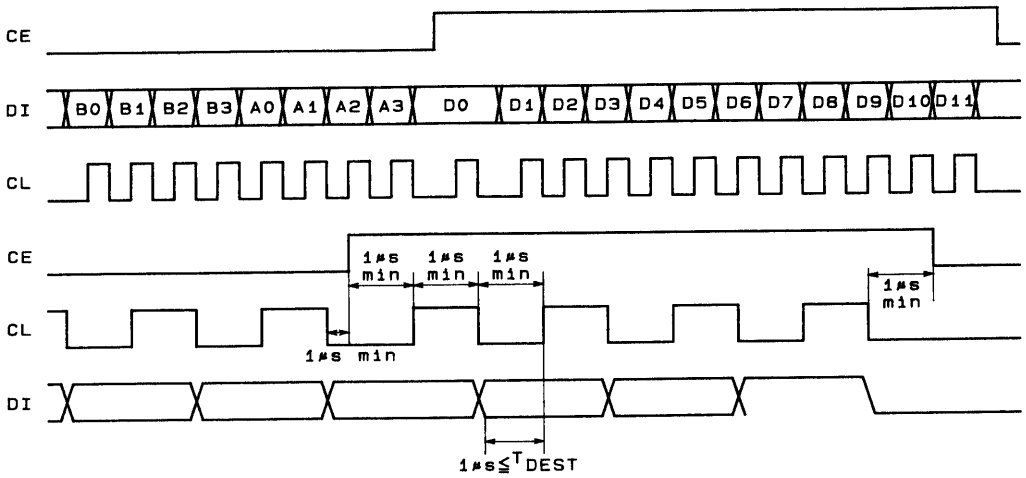
The right channel is identical.

Pin Functions

Pin No.	Symbol	Function	Note
1	L10dBIN	Input pins for the 10 dB step attenuator. Must be driven from a low impedance.	
20	R10dBIN		
2	LCT1	Loudness connections. Connect a high band compensation capacitor between CT1 and 10dBIN and connect a low band compensation capacitor between CT2 and Vref.	
3	LCT2		
19	RCT1		
18	RCT2		
4	L10dBOUT	Output pins for the 10 dB step attenuator. These outputs must be received by a load of about 1 MΩ.	
17	R10dBOUT		
5	L2dBIN	Input pins for the 2 dB step attenuator. Must be driven from a low impedance.	
16	R2dBIN		
6	L2dBOUT	Output pins for the 2 dB step attenuator. These outputs must be received by a load of about 1 MΩ.	
15	R2dBOUT		
7	LVref	Volume circuit common pins. The impedance of the pattern connected to these pins should be kept as low as possible. Since the capacitors between Vref and V_{SS} form the residual resistance components when the volume is cut, adequate care must be taken in determining the value of these capacitors.	
14	RVref		
12	S	Pin that selects the address code in the data format. Data will be accepted for an address code of 88 when this pin is tied to V_{DD}, and for an address code of 89 when tied to V_{SS}.	
9	CL	Serial data and clock inputs for control	
10	DI		
11	CE	Chip enable. The internally latched data is written and the analog switches operate when this pin goes from high to low. Data transfer is enabled when this pin is at the high level.	
8	V_{DD}	These pins must be connected to the power supply.	
13	V_{SS}		

Control System Timing and Data Format

Apply the stipulated serial data to the CE, CL and DI pins to control the LC75366 and LC75366M. The data consists of 20 bits, of which 8 bits are the address and 12 bits are control data.



B0	B1	B2	B3	A0	A1	A2	A3	D0	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11

Address code

Pin S	B0	B1	B2	B3	A0	A1	A2	A3	
VDD	0	0	0	1	0	0	0	1	(88H)
VSS	1	0	0	1	0	0	0	1	(89H)

2 dB step control

0	0	0	0	: −∞
1	0	0	0	: −8dB
0	1	0	0	: −6dB
1	1	0	0	: −4dB
0	0	1	0	: −2dB
1	0	1	0	: 0dB

Loudness control

0	OFF
1	ON

10 dB step control

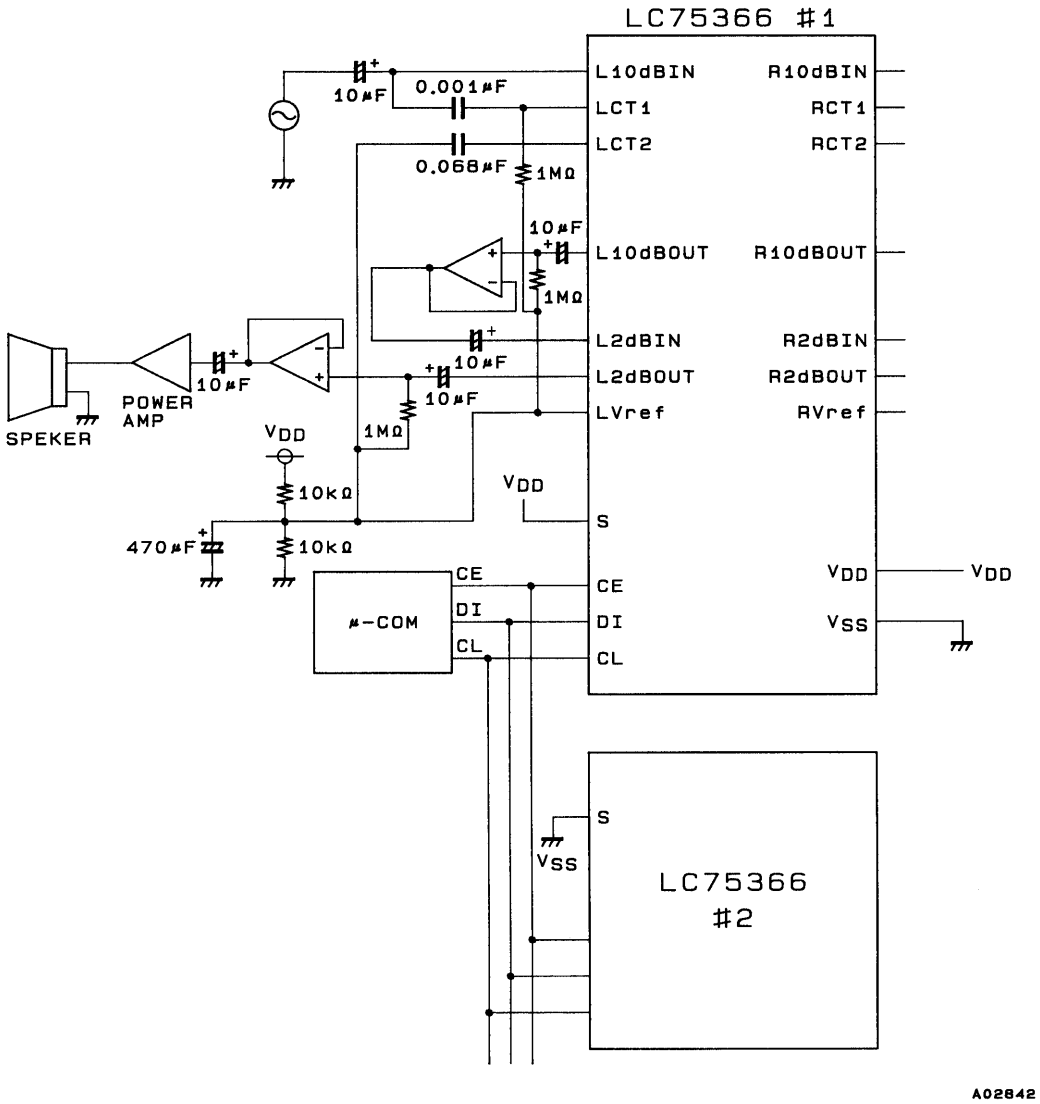
0	0	0	0	: −∞
1	0	0	0	: −60dB
0	1	0	0	: −50dB
1	1	0	0	: −40dB
0	0	1	0	: −30dB
1	0	1	0	: −20dB
0	1	1	0	: −10dB
1	1	1	0	: 0dB

Channel selection

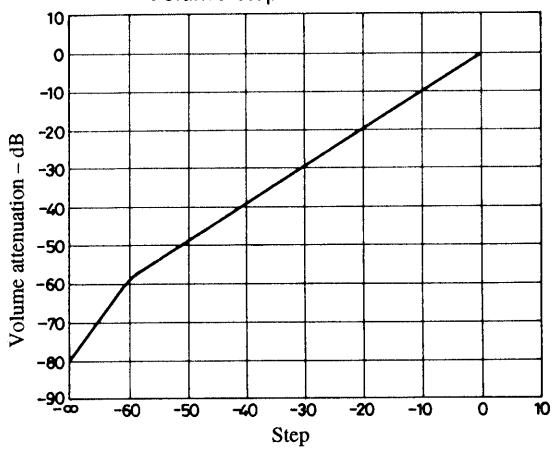
0	0	0	
1	0	0	: Rch
0	1	0	: Lch
1	1	0	: L/R together

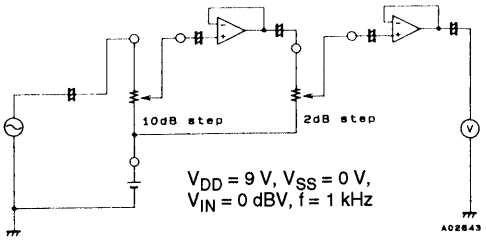
A02841

Sample Application Circuit



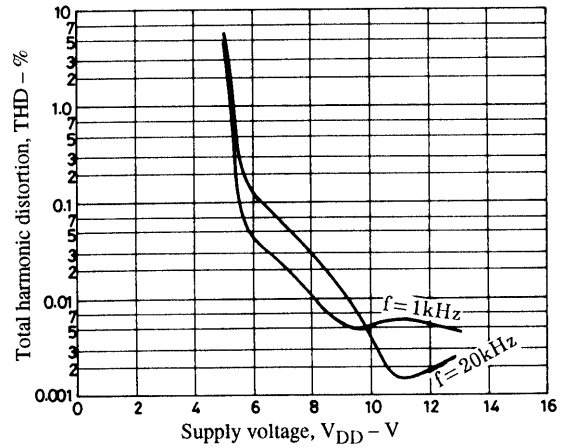
Volume step characteristics

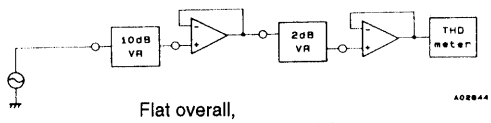




V_{DD} = 9 V, V_{SS} = 0 V,
V_{IN} = 0 dBV, f = 1 kHz

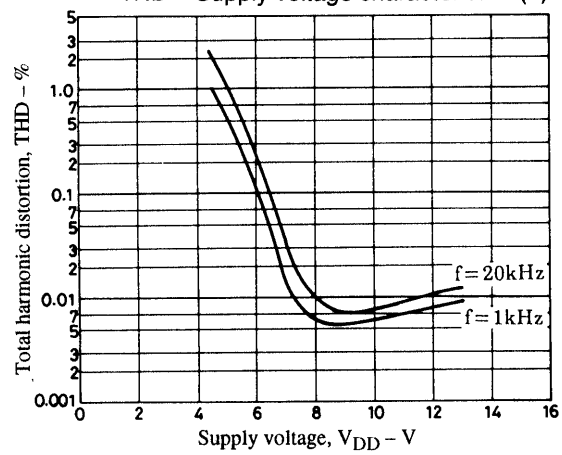
THD – Supply voltage characteristics (1)

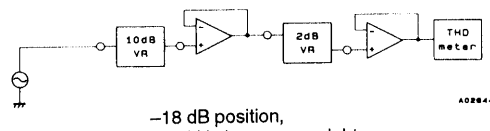




Flat overall,
100 kHz low-pass weight,
V_{IN} = 0 dBV, V_{SS} = 0 v

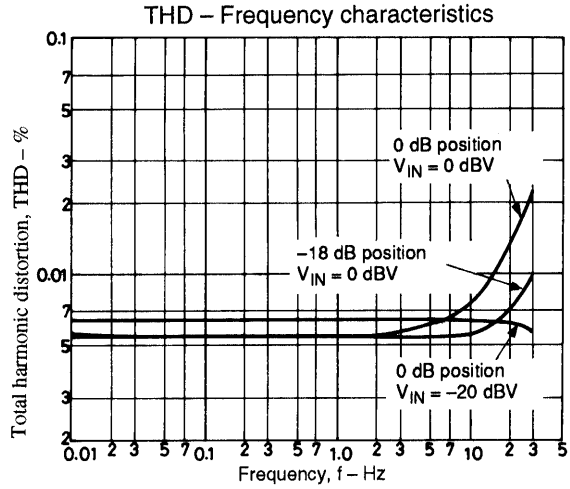
THD – Supply voltage characteristics (2)

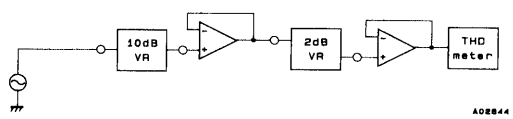




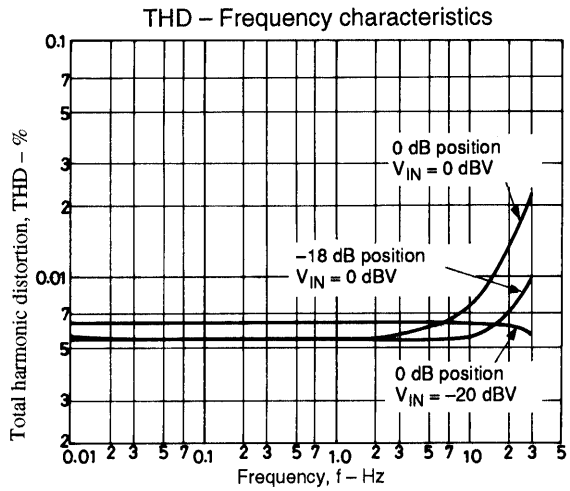
–18 dB position,
100 kHz low-pass weight,
V_{IN} = 0 dBV, V_{SS} = 0 v,

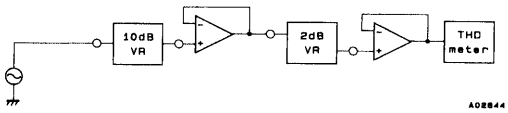
THD – Frequency characteristics



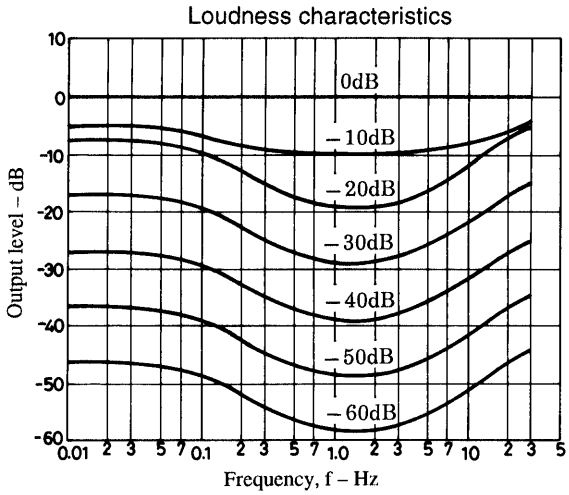


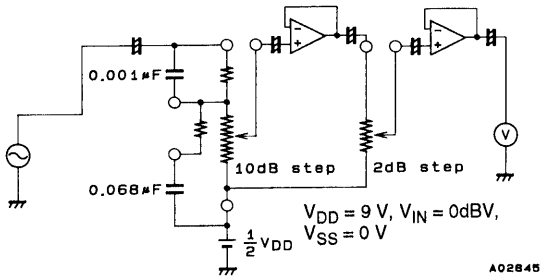
V_{DD} = 9 V, V_{SS} = 0 V,
100 kHz low-pass weight





V_{DD} = 9 V, V_{SS} = 0 V,
100 kHz low-pass weight





Loudness Function External Circuit Constant Calculation Example

First, refer to the LC75366 and LC75366M 10 dB step internal equivalent circuit shown on page 5. Figure 1 below shows this circuit simplified with the external components used for the loudness function connected for this calculation. The sample calculation below uses this diagram to acquire a 5 dB boost at f = 100 Hz.

(f = 100 Hz, 5 dB boost)
Let R and C in Figure 1 be:
R1 = R2 = 10 kΩ
R3 = 1 kΩ
C1 = Z1, C2 = Z2
Then:

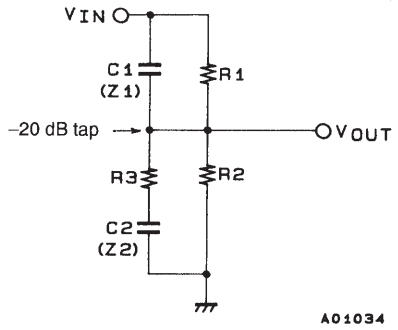
$$V_{OUT} \text{ (at = 1 kHz)} = \frac{\frac{R2\,(R3 + Z2)}{R2 + R3 + Z2}}{\frac{R1 \cdot Z1}{R1 + Z1} + \frac{R2\,(R3 + Z2)}{R2 + R3 + Z2}} = -20 \text{ dB}$$

$$V_{OUT} \text{ (at = 100 Hz)} = \frac{\frac{R2\,(R3 + 10 \cdot Z2)}{R2 + R3 + 10 \cdot Z2}}{\frac{R1 \cdot 10 \cdot Z1}{R1 + 10 \cdot Z1} + \frac{R2\,(R3 + 10 \cdot Z2)}{R2 + R3 + 10 \cdot Z2}} = -15 \text{ dB}$$

Solving the above equations gives:

Z1 ≠ 178.3 kΩ and Z2 = 176 Ω

Therefore, under such conditions where f = 1 kHz, specifications may be satisfied if C (capacitor) having these impedances is supplied externally.
The result is that C1 = 893 pF and C2 = 0.9 μF.



R1, R2, R3: LC75366/LC75366M internal resistors
C1: External high band compensation capacitor
C2: External low band compensation capacitor

Figure 1

Usage Notes

1. The states of the internal analog switches will be indeterminate when power is first applied. Muting should be applied externally until control data has been transferred and stored.

2. The signal lines for the CL, DI and CE pins should either be covered by the pattern ground or be formed from shielded cable to prevent the high-frequency digital signals transmitted over these lines from entering the analog system.