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LC75344MD

Two-Channel Electronic Volume Control System



ON Semiconductor®

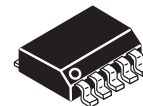
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Overview

The LC75344MD is a two-channel electronic volume control IC that is controlled by data input over a serial interface.

Functions

- Volume control: 0 dB to -50 dB in 1 dB steps, -52 dB to -78 dB in 2 dB steps, and $-\infty$, for a total of 66 positions.
A balance function can be implemented by controlling the left and right channels independently.



SOIC-10 NB

Features

- Built-in buffer amplifiers minimize the number of external components required.
- Fabricated in a silicon gate CMOS process to minimize the switching noise generated by internal switches.
- Built-in reference voltage generation circuit for the analog ground level.
- All settings are controlled by data input over a serial interface that conforms to the CCB* specifications.

Specifications

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

| Parameter | Symbol | Conditions | Ratings | unit |
|-----------------------------|---------------------|--|----------------------------------|------------------|
| Maximum supply voltage | $V_{DD\text{ max}}$ | V_{DD} | 11 | V |
| Input voltage | $V_{IN\text{ max}}$ | CE, CL, DI | -0.3 to +11.0 | V |
| | | LIN, RIN | $V_{SS} - 0.3$ to $V_{DD} + 0.3$ | |
| Output voltage | V_{OUT1} | OSC | -0.3 to $V_{DD} + 0.3$ | V |
| | V_{OUT2} | S1 to S87, COM1 to COM4, P1 to P8 | -0.3 to $V_{LCD} + 0.3$ | |
| Allowable power dissipation | $P_d\text{ max}$ | $T_a \leq 75^\circ\text{C}$ *1: When mounted on a PCB. | 300 | mW |
| Operating temperature | T_{opr} | | -30 to +75 | $^\circ\text{C}$ |
| Storage temperature | T_{stg} | | -40 to +125 | $^\circ\text{C}$ |

*1: Printed Circuit Board size : 76.1 x 114.3 x 1.6 tmm : Glass Epoxy Board

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

* Computer Control Bus (CCB) is an ON Semiconductor's original bus format and the bus addresses are controlled by ON Semiconductor.

ORDERING INFORMATION

See detailed ordering and shipping information on page 13 of this data sheet.

Allowable Operating Ranges at $T_a = -30$ to $+75^\circ\text{C}$, $V_{SS} = 0\text{V}$

| Parameter | Symbol | Pin Name | Conditions | Ratings | | | Unit |
|--------------------------|----------------|------------|----------------------------|----------|-----|----------|---------------|
| | | | | min | typ | max | |
| Supply voltage | V_{DD} | V_{DD} | | 4.5 | | 10 | V |
| High-level input voltage | V_{IH} | CL, DI, CE | | 2.0 | | 10 | V |
| Low-level input voltage | V_{IL} | CL, DI, CE | $7.5 \leq V_{DD} \leq 10$ | V_{SS} | | 0.8 | V |
| | | CL, DI, CE | $4.5 \leq V_{DD} \leq 7.5$ | V_{SS} | | 0.3 | V |
| Input voltage amplitude | V_{IN} | LIN, RIN | | V_{SS} | | V_{DD} | Vp-p |
| Input pulse width | $t_{\theta W}$ | CL | | 1 | | | μs |
| Setup time | t_{setup} | CL, DI, CE | | 1 | | | μs |
| Hold time | t_{hold} | CL, DI, CE | | 1 | | | μs |
| Operating frequency | f_{opg} | CL | | | | 500 | kHz |

Functional operation above the stresses listed in the Recommended Operating Ranges is not implied. Extended exposure to stresses beyond the Recommended Operating Ranges limits may affect device reliability.

Electrical Characteristics at $T_a = 25^\circ\text{C}$, $V_{DD} = 9\text{V}$, $V_{SS} = 0\text{V}$

| Parameter | Symbol | Pin Name | Conditions | Ratings | | | Unit |
|------------------|----------|----------|------------|---------|-----|-----|------------|
| | | | | min | typ | max | |
| Input resistance | R_{in} | LIN, RIN | | | 50 | | k Ω |

Overall Characteristics

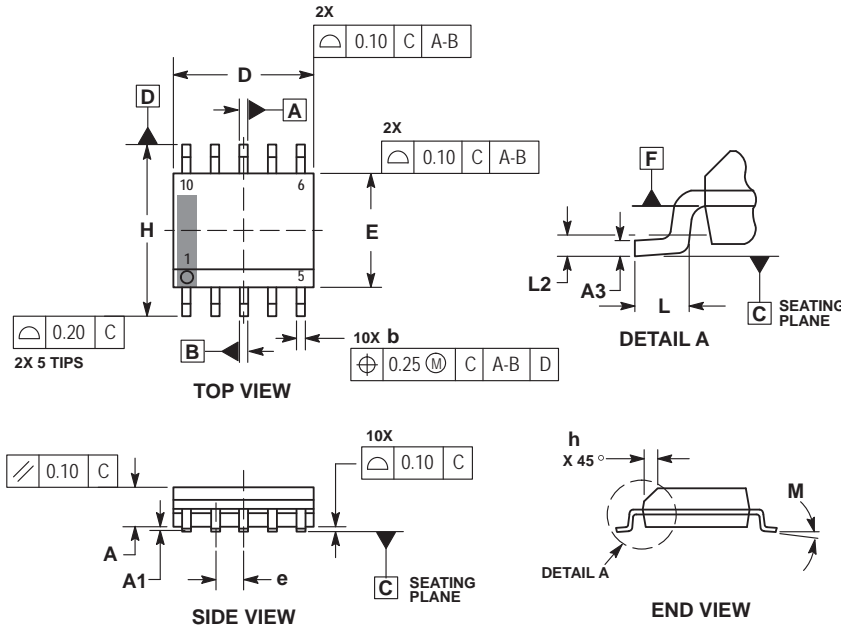
| Parameter | Symbol | Conditions | Ratings | | | Unit |
|---------------------------|------------|---|---------|-------|------|---------------|
| | | | min | typ | max | |
| Total harmonic distortion | THD | $V_{IN} = 1\text{ V}_{rms}$, $f = 1\text{ kHz}$ With all settings flat overall | | 0.002 | 0.01 | % |
| | | $V_{IN} = 1\text{ V}_{rms}$, $f = 20\text{ kHz}$ With all settings flat overall | | 0.003 | | % |
| Crosstalk | CT | $V_{IN} = 1\text{ V}_{rms}$, $f = 1\text{ kHz}$, $R_g = 1\text{ k}\Omega$ With all settings flat overall | 90 | | | dB |
| Output noise voltage | V_N | 80 kHz L.P.F., $R_g = 1\text{ k}\Omega$ With all settings flat overall | | 6.0 | | μV |
| Maximum attenuation | V_{omin} | $V_{IN} = 1\text{ V}_{rms}$, $f = 1\text{ kHz}$ With all settings flat overall | | -92 | | dB |
| Current drain | I_{DD} | $V_{DD} - V_{SS} = +9\text{ V}$ | | 12 | | mA |
| High-level input current | I_{IH} | CL, DI, CE: $V_{IN} = 10\text{ V}$, $V_{DD} = 10\text{ V}$ | | | 10 | μA |
| Low-level input current | I_{IL} | CL, DI, CE: $V_{IN} = 0\text{ V}$, $V_{DD} = 10\text{ V}$ | -10 | | | μA |

Product parametric performance is indicated in the Electrical Characteristics for the listed test conditions, unless otherwise noted. Product performance may not be indicated by the Electrical Characteristics if operated under different conditions.

Package Dimensions

unit : mm

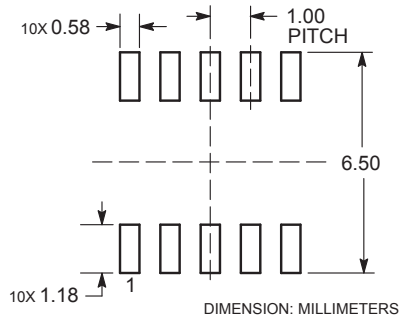
SOIC-10 NB
CASE 751BQ
ISSUE B



- NOTES:
1. DIMENSIONING AND TOLERANCING PER ASME Y14.5M, 1994.
 2. CONTROLLING DIMENSION: MILLIMETERS.
 3. DIMENSION b DOES NOT INCLUDE DAMBAR PROTRUSION. ALLOWABLE PROTRUSION SHALL BE 0.10mm TOTAL IN EXCESS OF 'b' AT MAXIMUM MATERIAL CONDITION.
 4. DIMENSIONS D AND E DO NOT INCLUDE MOLD FLASH, PROTRUSIONS, OR GATE BURRS. MOLD FLASH, PROTRUSIONS, OR GATE BURRS SHALL NOT EXCEED 0.15mm PER SIDE. DIMENSIONS D AND E ARE DETERMINED AT DATUM F.
 5. DIMENSIONS A AND B ARE TO BE DETERMINED AT DATUM F.
 6. A1 IS DEFINED AS THE VERTICAL DISTANCE FROM THE SEATING PLANE TO THE LOWEST POINT ON THE PACKAGE BODY.

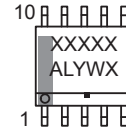
| MILLIMETERS | | |
|-------------|----------|------|
| DIM | MIN | MAX |
| A | 1.25 | 1.75 |
| A1 | 0.10 | 0.25 |
| A3 | 0.17 | 0.25 |
| b | 0.31 | 0.51 |
| D | 4.80 | 5.00 |
| E | 3.80 | 4.00 |
| e | 1.00 BSC | |
| H | 5.80 | 6.20 |
| h | 0.37 REF | |
| L | 0.40 | 0.80 |
| L2 | 0.25 BSC | |
| M | 0° | 8° |

RECOMMENDED SOLDERING FOOTPRINT*



*For additional information on our Pb-Free strategy and soldering details, please download the ON Semiconductor Soldering and Mounting Techniques Reference Manual, SOLDERRM/D.

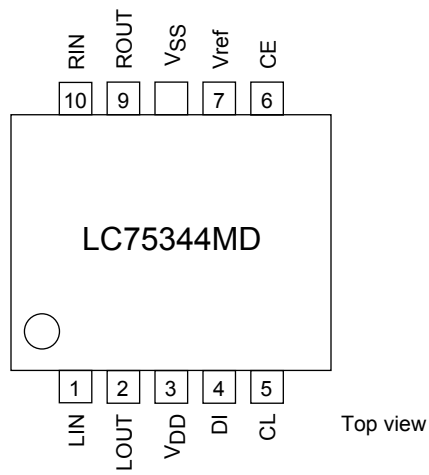
GENERIC MARKING DIAGRAM*



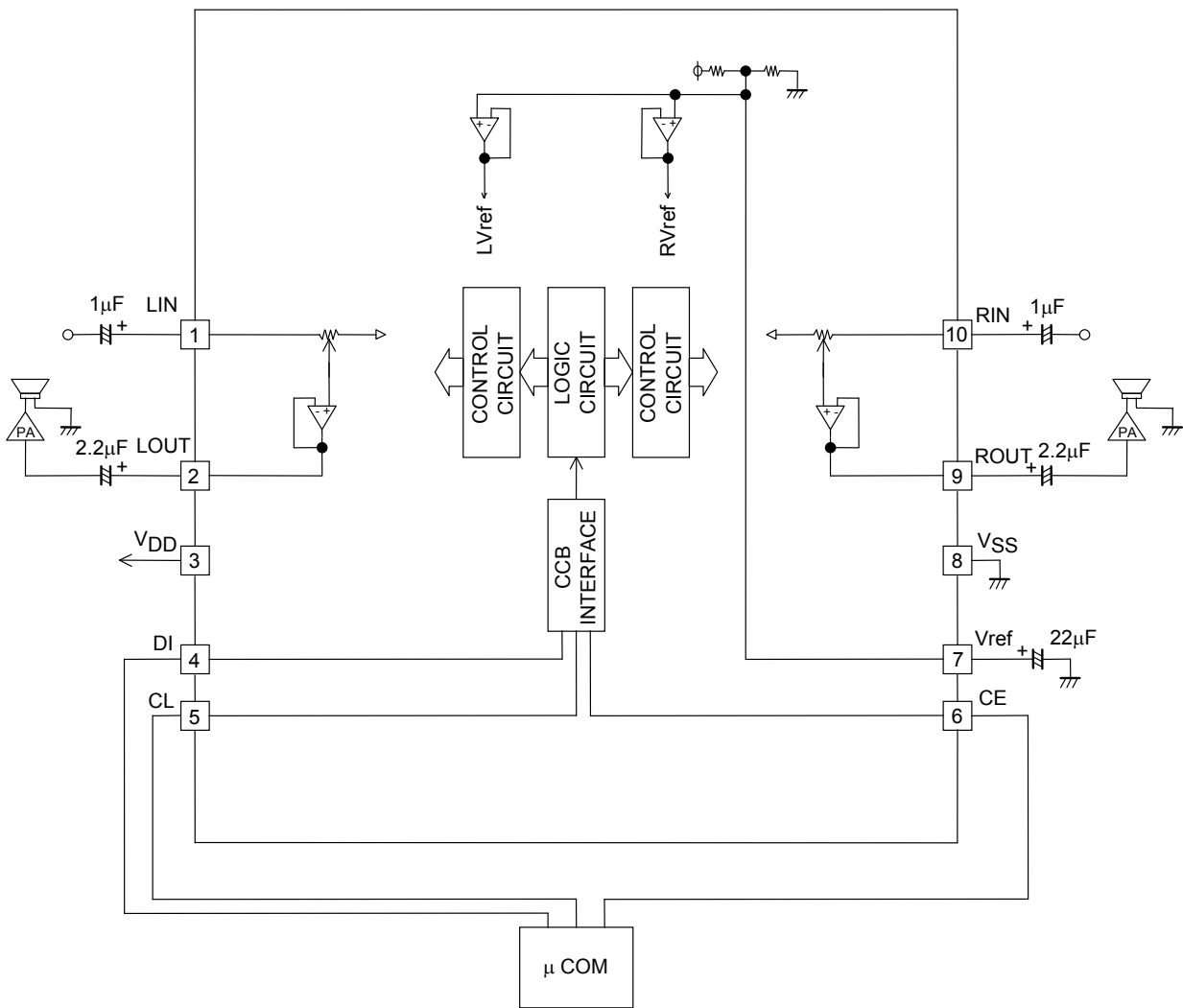
- XXXXX = Specific Device Code
- A = Assembly Location
- L = Wafer Lot
- Y = Year
- W = Work Week
- = Pb-Free Package

*This information is generic. Please refer to device data sheet for actual part marking. Pb-Free indicator, "G", may or not be present.

Pin Arrangement

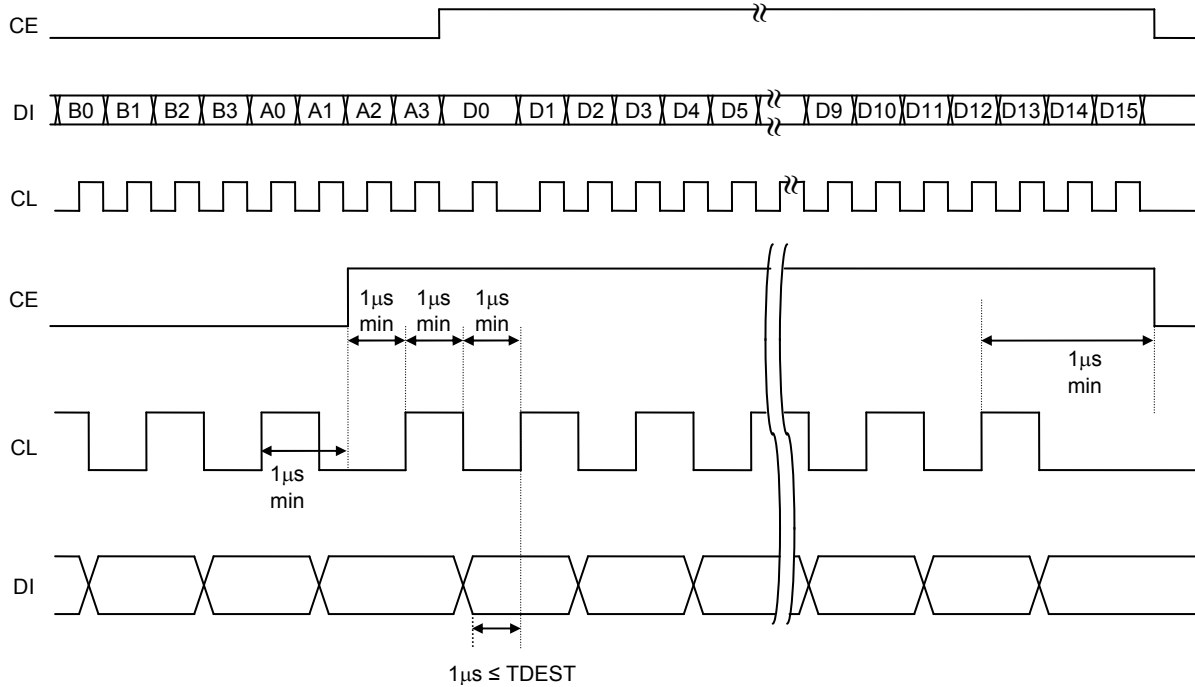


Equivalent Circuit



Control System Timing and Data Format

The LC75344MD is controlled by inputting the stipulated data serially to the CL, DI, and CE pins. The data consists of a total of 24 bits, of which 8 bits are the address and 16 bits are the data.



- Address Code (B0 to A3)

The data has an 8-bit address field, and conforms to the CCB serial bus specifications.

| Address code (LSB) | B0 | B1 | B2 | B3 | A0 | A1 | A2 | A3 | (88HEX) |
|--------------------|----|----|----|----|----|----|----|----|---------|
| | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | |

• Control Code Allocations

Volume control

| D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | Operation |
|----|----|----|----|----|----|----|----|-----------|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0dB |
| 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | -1dB |
| 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | -2dB |
| 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | -3dB |
| 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | -4dB |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | -5dB |
| 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | -6dB |
| 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | -7dB |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | -8dB |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | -9dB |
| 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | -10dB |
| 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | -11dB |
| 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | -12dB |
| 1 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | -13dB |
| 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | -14dB |
| 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | -15dB |
| 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | -16dB |
| 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | -17dB |
| 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | -18dB |
| 1 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | -19dB |
| 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | -20dB |
| 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | -21dB |
| 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | -22dB |
| 1 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | -23dB |
| 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | -24dB |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | -25dB |
| 0 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | -26dB |
| 1 | 1 | 0 | 1 | 1 | 0 | 0 | 0 | -27dB |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | -28dB |
| 1 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | -29dB |
| 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | -30dB |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | -31dB |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | -32dB |
| 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | -33dB |
| 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | -34dB |
| 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | -35dB |
| 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | -36dB |
| 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | -37dB |
| 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | -38dB |
| 1 | 1 | 1 | 0 | 0 | 1 | 0 | 0 | -39dB |
| 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | -40dB |

Continued on next page.

Volume control

| D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7 | Operation |
|----|----|----|----|----|----|----|----|-----------|
| 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | -41dB |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | -42dB |
| 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | -43dB |
| 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | -44dB |
| 1 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | -45dB |
| 0 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | -46dB |
| 1 | 1 | 1 | 1 | 0 | 1 | 0 | 0 | -47dB |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | -48dB |
| 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | -49dB |
| 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | -50dB |
| 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | -52dB |
| 0 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | -54dB |
| 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | -56dB |
| 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | -58dB |
| 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | -60dB |
| 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | -62dB |
| 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | -64dB |
| 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | -66dB |
| 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | -68dB |
| 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | -70dB |
| 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | -72dB |
| 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | -74dB |
| 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | -76dB |
| 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | -78dB |
| 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | -∞ |

Channel selection

| D8 | D9 | Operation |
|----|----|----------------------------------|
| 0 | 0 | Normally not used |
| 1 | 0 | RCH |
| 0 | 1 | LCH |
| 1 | 1 | Left and right channels together |

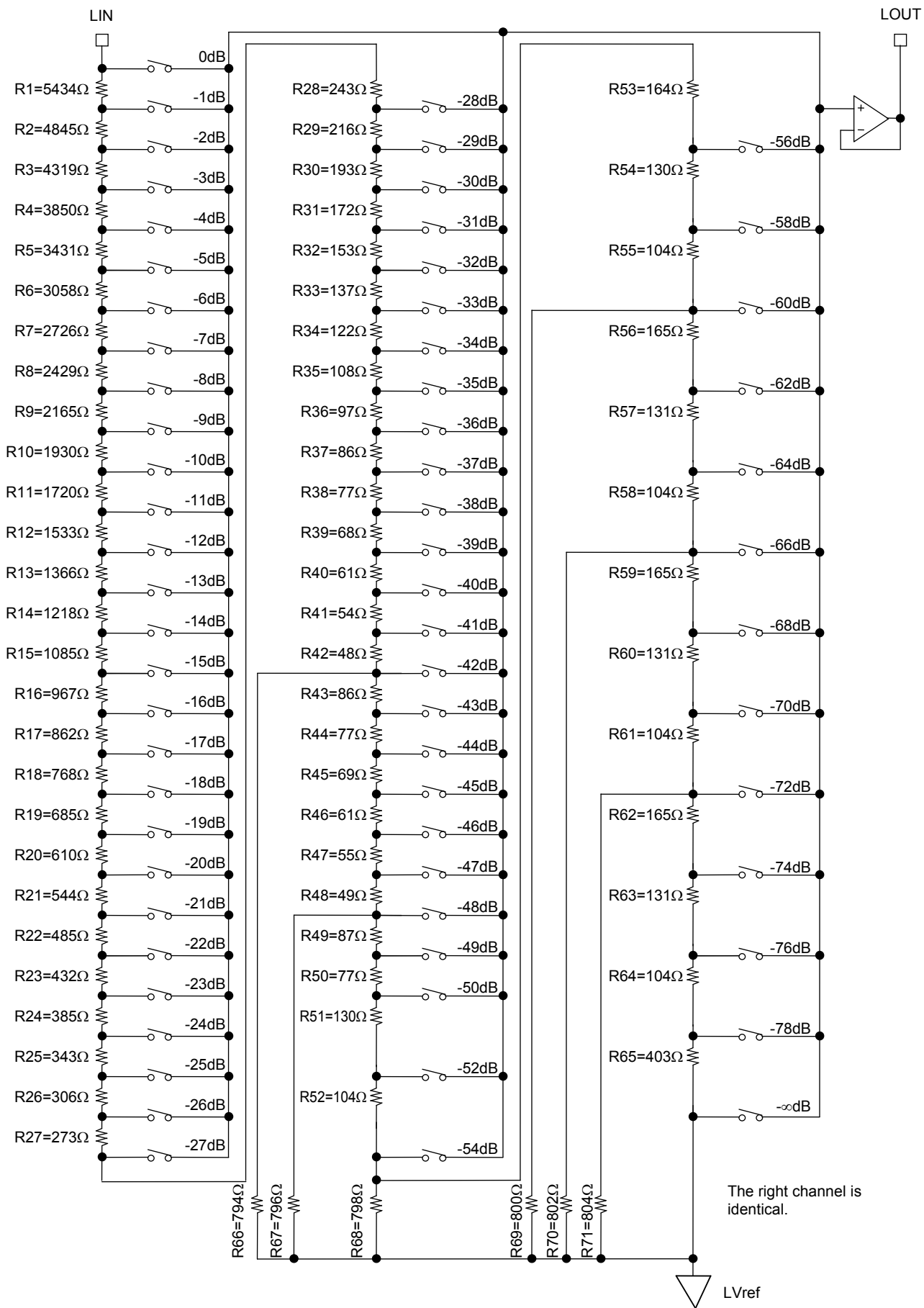
Test mode

| D10 | D11 | D12 | D13 | D14 | D15 | Operation |
|---|-----|-----|-----|-----|-----|-----------|
| 0 | 0 | 0 | 0 | 0 | 0 | |
| These bits specify the IC test mode. They must be set to zero for normal operation. | | | | | | |

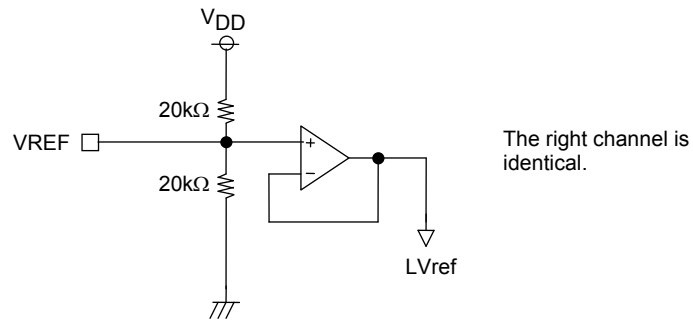
Pin Functions

| Pin name | Pin No. | Function | Notes |
|--------------|---------|---|-------|
| LIN RIN | 1 10 | Volume control inputs | |
| LOUT ROUT | 2 9 | Volume control outputs | |
| Vref | 7 | VDD × 0.5 voltage generator block for the analog ground level. A capacitor with a value a few times 10 μF must be inserted between Vref and AVSS (VSS) to minimize power supply ripple. | |
| VSS | 8 | Ground | |
| VDD | 3 | Power supply | |
| CE | 6 | Chip enable The internal latch data is written and the analog switches operate at the point this pin goes from high to low. Data transfer is enabled when this pin is at the high level. | |
| DI CL | 4 5 | Serial data and clock inputs for IC control. | |

Equivalent Circuit

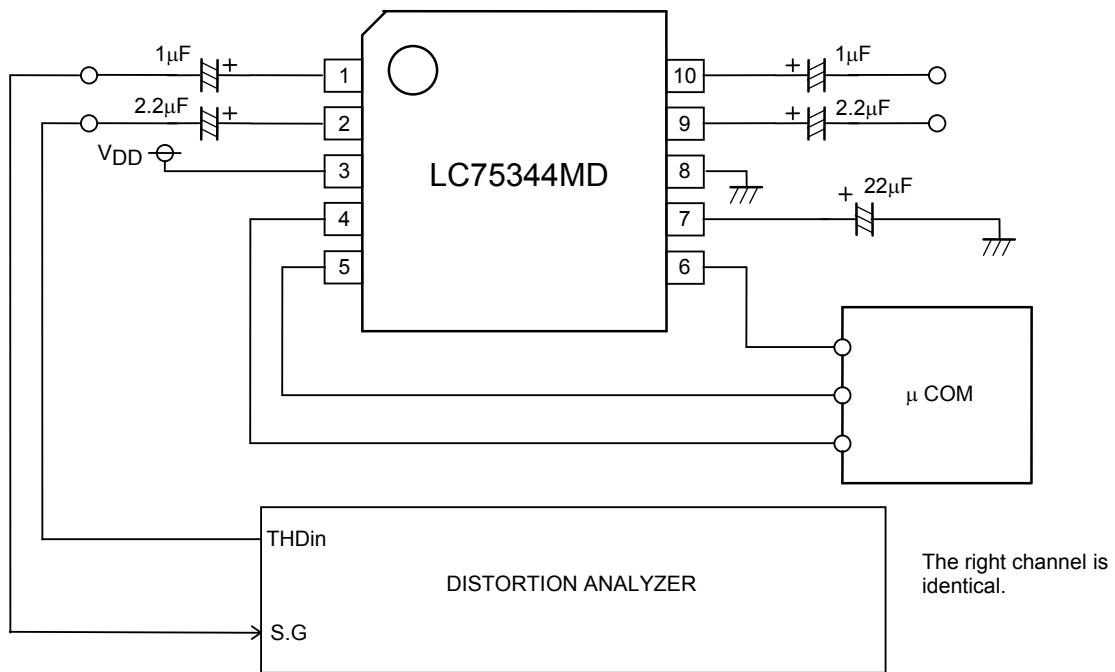


Reference Voltage Generator Equivalent Circuit

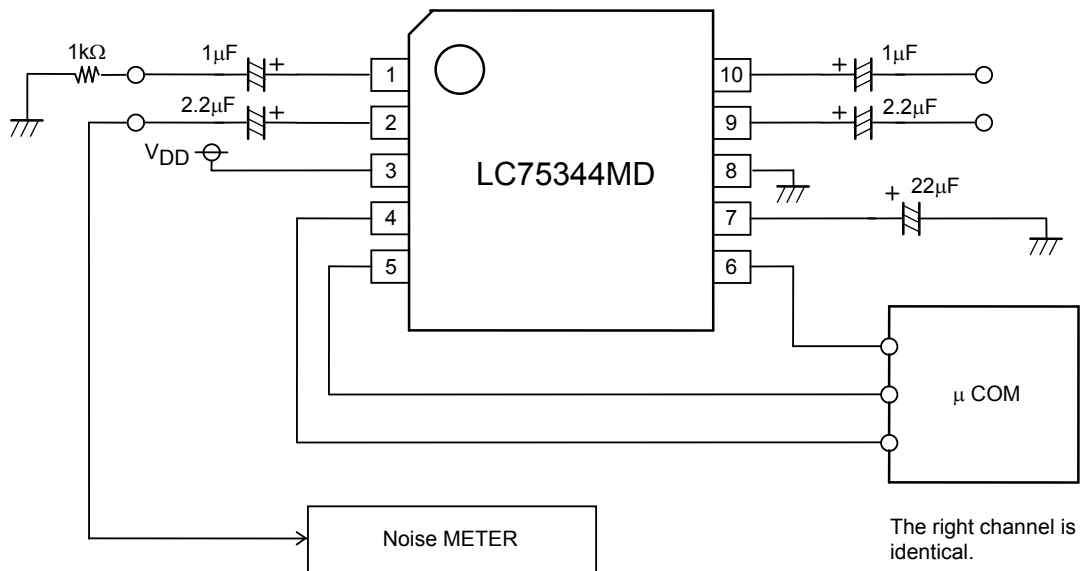


Test Circuit

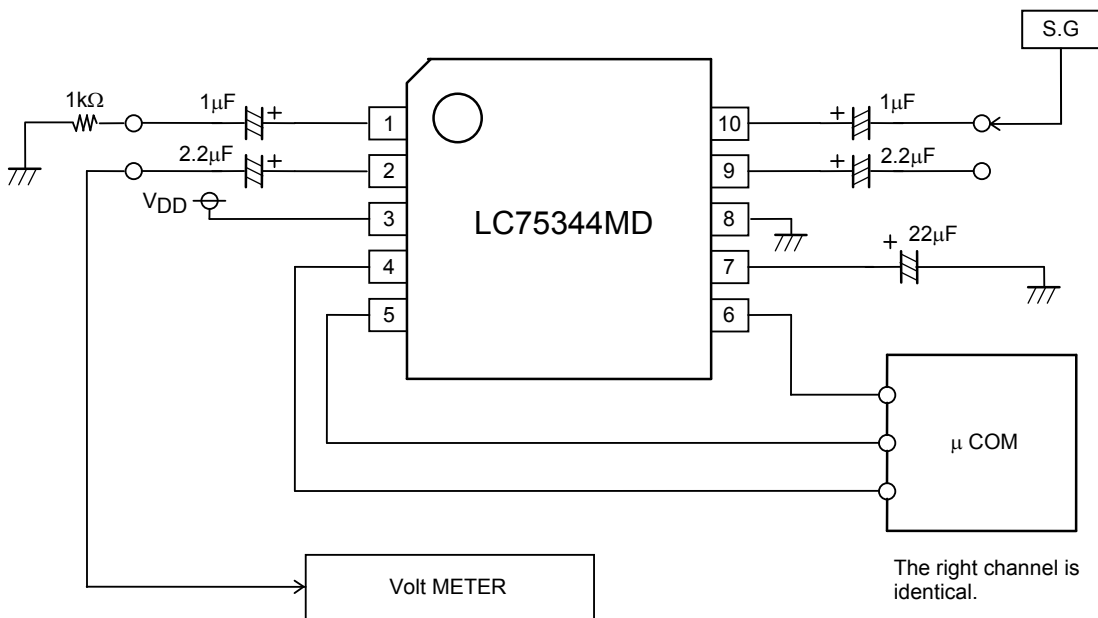
- Total harmonic distortion



• Output noise voltage

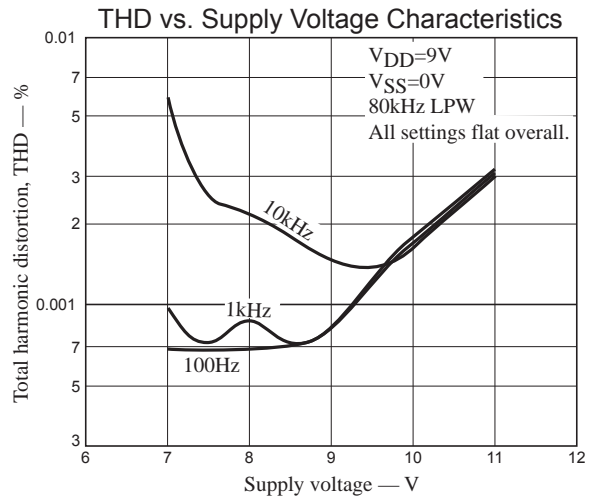
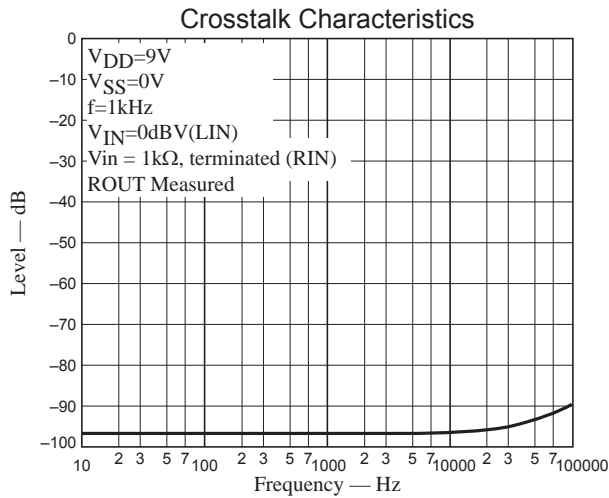
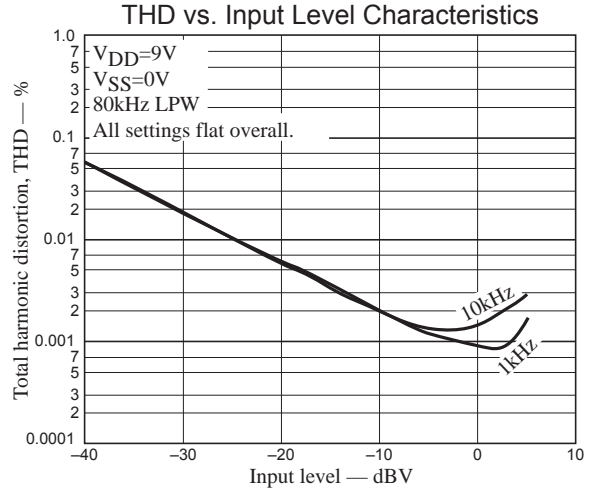
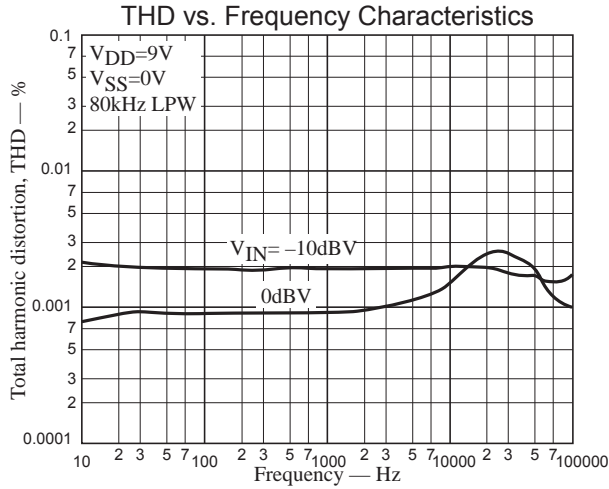
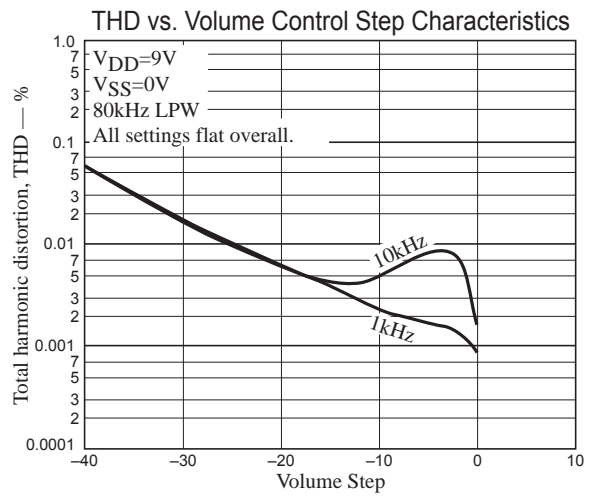
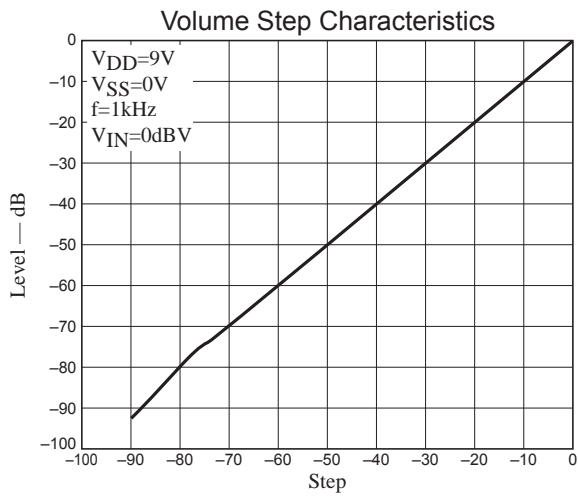


• Crosstalk



Usage Notes

- The states of the internal analog switches are undefined after power is first applied. Muting must be applied externally until the control data has been sent.
- When performing the initial settings after power is first applied, both the left and right channel initial settings data must be sent before releasing the external mute.
- Either cover the CL, DI, and CE lines with the ground pattern or use shielded lines to prevent high-frequency digital noise from entering the analog signal system from these lines.



ORDERING INFORMATION

| Device | Package | Shipping (Qty / Packing) |
|--------------|--|--------------------------|
| LC75344MD-AH | SOIC-10 NB (Pb-Free / Halogen Free) | 2500 / Tape & Reel |

† For information on tape and reel specifications, including part orientation and tape sizes, please refer to our Tape and Reel Packaging Specifications Brochure, BRD8011/D. http://www.onsemi.com/pub_link/Collateral/BRD8011-D.PDF

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