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# LV3327PV

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Bi-CMOS LSI

## Electronic Volume IC

### Overview

The LV3327PV is electronic volume LSI for the volume adjustment of the portable sound equipment usage.

### Features

- The mixing function is installed, and it is suitable for PND (personal navigation device) as the usage. It is possible to output it by allocating one system in the audio guidance among four input systems, and mixing other signals from the speaker output with the audio guidance by the microcomputer control.
- Because the volume step resolution is 0.5dB step, the volume can be made to fine-tune.
- The loudness function is installed.

### Functions

- Input switching : 4 input systems (Independent control is possible.)
- Volume control : +10dB to -79.5dB(0.5dB steps)/-∞
- Loudness control :  
Taps are output starting at the -32dB position of the ladder resistor and a loudness function implemented with external capacitor and resistor components.
- Output gain control : 0dB or +6dB select
- Mixing function
- Output switching :  
2 outputs (Each Lch output, Rch output, and Lch/Rch mixing output can be selected).
- Each control is done by the serial data input. I<sup>2</sup>C

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## Specifications

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

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	$V_{DD}$ max	$V_{DD}$	6	V
Maximum input voltage	$V_{IN}$ max	All input pins	$V_{SS}-0.3$ to $V_{DD}$	V
Operating temperature	$T_{opr}$		-40 to +85	$^\circ\text{C}$
Storage temperature	$T_{stg}$		-50 to +125	$^\circ\text{C}$

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

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

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	$V_{DD}$	$V_{DD}$	3.0	5.0	5.5	V
High-level input voltage	$V_{IH}$	DATA, CLK	$0.7 V_{DD}$		$V_{DD}$	V
Low-level input voltage	$V_{IL}$	DATA, CLK	$V_{SS}$		$0.2 V_{DD}$	V
Input pulse width	$T_{\phi W}$	CLK	0.6			$\mu\text{sec}$
Setup time	$T_{setup}$	DATA, CLK	0.1			$\mu\text{sec}$
Hold time	$T_{hold}$	DATA, CLK			0.9	$\mu\text{sec}$
Operating frequency	fopg	CLK			400	kHz

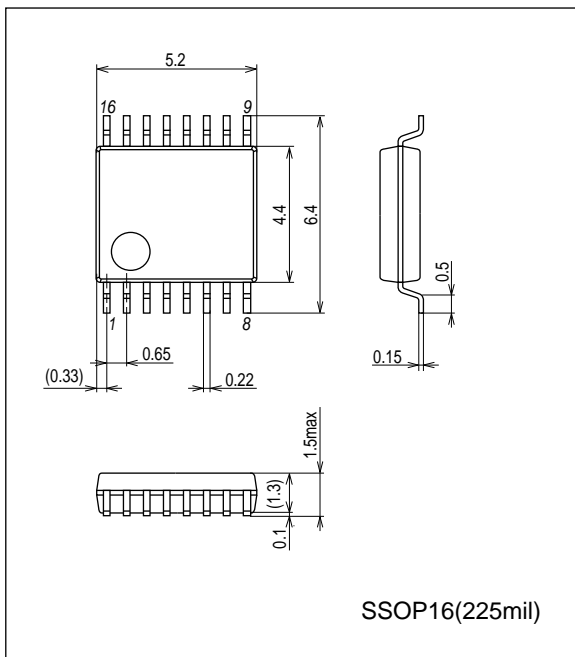
**Electrical Characteristics** at  $T_a = 25^\circ\text{C}$ ,  $V_{DD} = 5\text{V}$ ,  $V_{SS} = 0\text{V}$

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
A loss of insertion	ATT		-1.0		+1.0	dB
Input resistance	$R_{in}$	IN1/IN2/IN3/IN4		50		$\text{k}\Omega$
Volumn step setting error margin	ATerr	+10dB to -40dB	-1.0		+1.0	dB
Total harmonic distortion	THD	$V_{IN} = 1\text{V}_{rms}$ , $f = 1\text{kHz}$		0.01		%
Maximum attenuation	$V_{O}$ min	$V_{IN} = 1\text{V}_{rms}$ , $f = 1\text{kHz}$		80		dB
Output noise voltage	$V_N$	$R_{in} = 1\text{k}\Omega$		5		$\mu\text{V}_{rms}$
Current drain	$I_{DD}$			5		mA
Input high-level current	$I_{IH}$	DATA, CLK, $V_{IN} = 5.0\text{V}$			10	$\mu\text{A}$
Input low-level current	$I_{IL}$	DATA, CLK, $V_{IN} = 0\text{V}$	-10			$\mu\text{A}$
Maximum input voltage	VCL	THD = 1% $R_L = 10\text{k}\Omega$ volumn setting : flat, $f_{IN} = 1\text{kHz}$	1.0			$\text{V}_{rms}$

## Package Dimensions

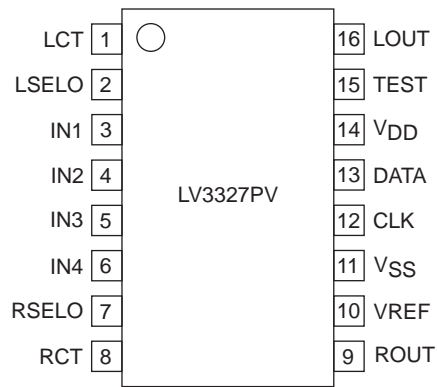
unit : mm (typ)

3178B



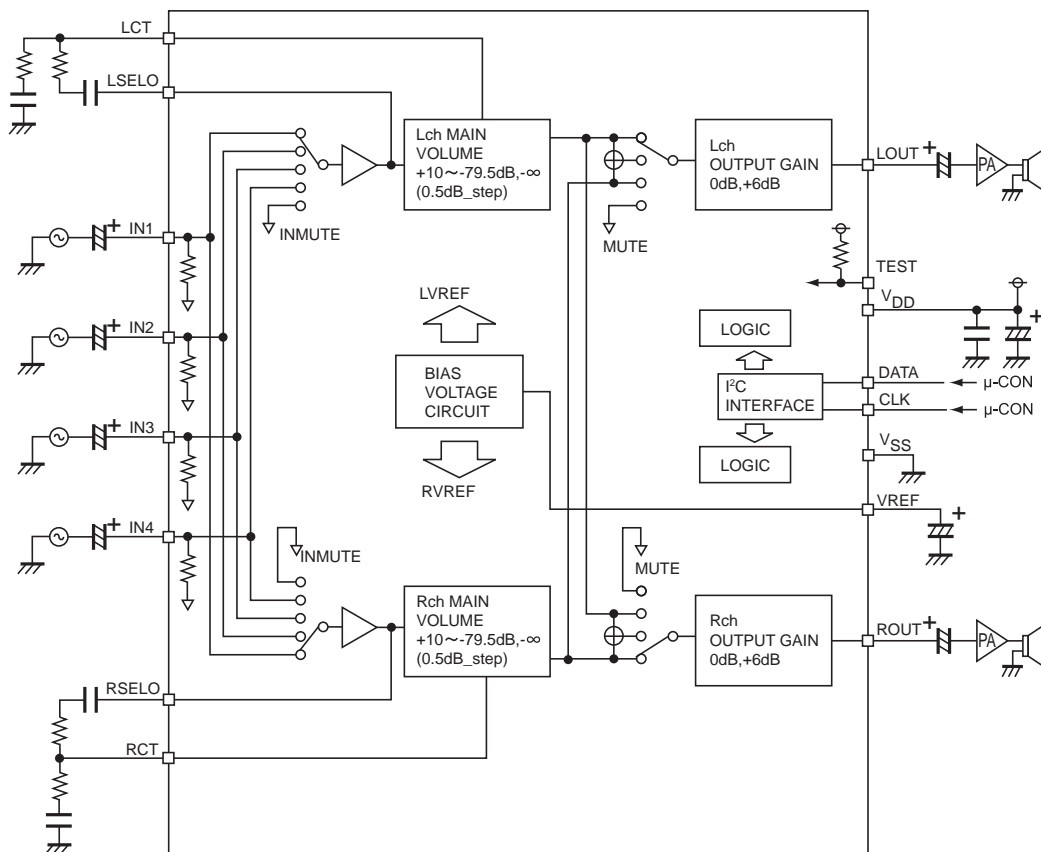
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## Pin Assignment



TOP VIEW

## Block Diagram



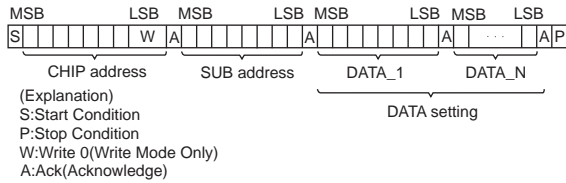
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## Pin Functions

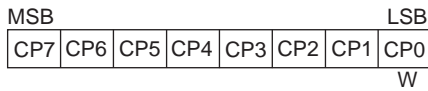
Pin	Pin No.	Function	Equivalent Circuit
IN1 IN2 IN3 IN4	3 4 5 6	Input pins.	
LSELO RSELO	2 7	Input selector output pins	
LCT RCT	1 8	Tap pins for external loudness	
LOUT ROUT	16 9	Output pins.	
VREF	10	Connect a capacitor of a few tens of uF between VREF and AVSS (VSS) as a 0.5 × VDD voltage generator, current ripple countermeasure.	
CLK	12	Serial data clock input pin for control.	
DATA	13	Serial data input pin for control.	
TEST	15	TEST pin Normally this pin is OPEN.	
VDD	14	Power supply pin.	
VSS	11	Ground pin.	

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## DATA format : I<sup>2</sup>C data specification

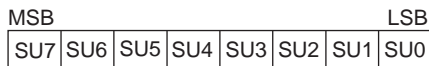


### CHIP address



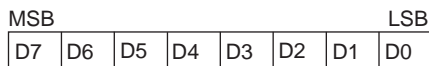
CP7	CP6	CP5	CP4	CP3	CP2	CP1	CP0
1	0	0	0	0	0	1	0

### SUB address



Block	SUB address								
	DATA	SU7	SU6	SU5	SU4	SU3	SU2	SU1	SU0
Input switching control (Lch)	DATA_1	1	0	0	0	0	0	0	0
Input switching control (Rch)	DATA_2	0	1	0	0	0	0	0	0
Volume control (Lch)	DATA_5	1	0	1	0	0	0	0	0
Volume control(Rch)	DATA_6	0	1	1	0	0	0	0	0
Loudness	DATA_26	0	1	0	1	1	0	0	0
TEST control	DATA_29	1	0	1	1	1	0	0	0
Output switching control / Output gain control (Lch)	DATA_30	0	1	1	1	1	0	0	0
Output switching control / Output gain control (Rch)	DATA_31	1	1	1	1	1	0	0	0

### DATA



#### Input switching control (DATA\_1, DATA\_2)

D7	D6	D5	D4	D3	D2	D1	D0	
								DATA_1: Lch side DATA_2: Rch side
0	0	0	0	0	0	0	0	INMUTE
1	0	0	0	0	0	0	0	IN1 select
0	1	0	0	0	0	0	0	IN2 select
1	1	0	0	0	0	0	0	IN3 select
0	0	1	0	0	0	0	0	IN4 select

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Volume control :10.0dB to -18.0dB (DATA\_5, DATA\_6)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_5:Lch side DATA_6:Rch side
0	0	1	1	0	1	1	1	10.0dB
1	0	1	1	0	1	1	1	9.5dB
0	1	1	1	0	1	1	1	9.0dB
1	1	1	1	0	1	1	1	8.5dB
0	0	0	0	1	1	1	1	8.0dB
1	0	0	0	1	1	1	1	7.5dB
0	1	0	0	1	1	1	1	7.0dB
1	1	0	0	1	1	1	1	6.5dB
0	0	1	0	1	1	1	1	6.0dB
1	0	1	0	1	1	1	1	5.5dB
0	1	1	0	1	1	1	1	5.0dB
1	1	1	0	1	1	1	1	4.5dB
0	0	0	1	1	1	1	1	4.0dB
1	0	0	1	1	1	1	1	3.5dB
0	1	0	1	1	1	1	1	3.0dB
1	1	0	1	1	1	1	1	2.5dB
0	0	1	1	1	1	1	1	2.0dB
1	0	1	1	1	1	1	1	1.5dB
0	1	1	1	1	1	1	1	1.0dB
1	1	1	1	1	1	1	1	0.5dB
0	0	0	0	0	0	0	0	0dB
1	0	0	0	0	0	0	0	-0.5dB
0	1	0	0	0	0	0	0	-1.0dB
1	1	0	0	0	0	0	0	-1.5dB
0	0	1	0	0	0	0	0	-2.0dB
1	0	1	0	0	0	0	0	-2.5dB
0	1	1	0	0	0	0	0	-3.0dB
1	1	1	0	0	0	0	0	-3.5dB
0	0	0	1	0	0	0	0	-4.0dB
1	0	0	1	0	0	0	0	-4.5dB
0	1	0	1	0	0	0	0	-5.0dB
1	1	0	1	0	0	0	0	-5.5dB
0	0	1	1	0	0	0	0	-6.0dB
1	0	1	1	0	0	0	0	-6.5dB
0	1	1	1	0	0	0	0	-7.0dB
1	1	1	1	0	0	0	0	-7.5dB
0	0	0	0	1	0	0	0	-8.0dB
1	0	0	0	1	0	0	0	-8.5dB
0	1	0	0	1	0	0	0	-9.0dB
1	1	0	0	1	0	0	0	-9.5dB
0	0	1	0	1	0	0	0	-10.0dB
1	0	1	0	1	0	0	0	-10.5dB
0	1	1	0	1	0	0	0	-11.0dB
1	1	1	0	1	0	0	0	-11.5dB
0	0	0	1	1	0	0	0	-12.0dB
1	0	0	1	1	0	0	0	-12.5dB
0	1	0	1	1	0	0	0	-13.0dB
1	1	0	1	1	0	0	0	-13.5dB
0	0	1	1	1	0	0	0	-14.0dB
1	0	1	1	1	0	0	0	-14.5dB
0	1	1	1	1	0	0	0	-15.0dB
1	1	1	1	1	0	0	0	-15.5dB
0	0	0	0	0	1	0	0	-16.0dB
1	0	0	0	0	1	0	0	-16.5dB
0	1	0	0	0	1	0	0	-17.0dB
1	1	0	0	0	1	0	0	-17.5dB
0	0	1	0	0	1	0	0	-18.0dB

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Volume control :-18.5dB to -43.5dB (DATA\_5, DATA\_6)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_5:Lch side DATA_6:Rch side
1	0	1	0	0	1	0	0	-18.5dB
0	1	1	0	0	1	0	0	-19.0dB
1	1	1	0	0	1	0	0	-19.5dB
0	0	0	1	0	1	0	0	-20.0dB
1	0	0	1	0	1	0	0	-20.5dB
0	1	0	1	0	1	0	0	-21.0dB
1	1	0	1	0	1	0	0	-21.5dB
0	0	1	1	0	1	0	0	-22.0dB
1	0	1	1	0	1	0	0	-22.5dB
0	1	1	1	0	1	0	0	-23.0dB
1	1	1	1	0	1	0	0	-23.5dB
0	0	0	0	1	1	0	0	-24.0dB
1	0	0	0	1	1	0	0	-24.5dB
0	1	0	0	1	1	0	0	-25.0dB
1	1	0	0	1	1	0	0	-25.5dB
0	0	1	0	1	1	0	0	-26.0dB
1	0	1	0	1	1	0	0	-26.5dB
0	1	1	0	1	1	0	0	-27.0dB
1	1	1	0	1	1	0	0	-27.5dB
0	0	0	1	1	1	0	0	-28.0dB
1	0	0	1	1	1	0	0	-28.5dB
0	1	0	1	1	1	0	0	-29.0dB
1	1	0	1	1	1	0	0	-29.5dB
0	0	1	1	1	1	0	0	-30.0dB
1	0	1	1	1	1	0	0	-30.5dB
0	1	1	1	1	1	0	0	-31.0dB
1	1	1	1	1	1	0	0	-31.5dB
0	0	0	0	0	0	1	0	-32.0dB
1	0	0	0	0	0	1	0	-32.5dB
0	1	0	0	0	0	1	0	-33.0dB
1	1	0	0	0	0	1	0	-33.5dB
0	0	1	0	0	0	1	0	-34.0dB
1	0	1	0	0	0	1	0	-34.5dB
0	1	1	0	0	0	1	0	-35.0dB
1	1	1	0	0	0	1	0	-35.5dB
0	0	0	1	0	0	1	0	-36.0dB
1	0	0	1	0	0	1	0	-36.5dB
0	1	0	1	0	0	1	0	-37.0dB
1	1	0	1	0	0	1	0	-37.5dB
0	0	1	1	0	0	1	0	-38.0dB
1	0	1	1	0	0	1	0	-38.5dB
0	1	1	1	0	0	1	0	-39.0dB
1	1	1	1	0	0	1	0	-39.5dB
0	0	0	0	1	0	1	0	-40.0dB
1	0	0	0	1	0	1	0	-40.5dB
0	1	0	0	1	0	1	0	-41.0dB
1	1	0	0	1	0	1	0	-41.5dB
0	0	1	0	1	0	1	0	-42.0dB
1	0	1	0	1	0	1	0	-42.5dB
0	1	1	0	1	0	1	0	-43.0dB
1	1	1	0	1	0	1	0	-43.5dB

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Volume control :-44.0dB to -69.0dB (DATA\_5, DATA\_6)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_5:Lch side DATA_6:Rch side
0	0	0	1	1	0	1	0	-44.0dB
1	0	0	1	1	0	1	0	-44.5dB
0	1	0	1	1	0	1	0	-45.0dB
1	1	0	1	1	0	1	0	-45.5dB
0	0	1	1	1	0	1	0	-46.0dB
1	0	1	1	1	0	1	0	-46.5dB
0	1	1	1	1	0	1	0	-47.0dB
1	1	1	1	1	0	1	0	-47.5dB
0	0	0	0	0	1	1	0	-48.0dB
1	0	0	0	0	1	1	0	-48.5dB
0	1	0	0	0	1	1	0	-49.0dB
1	1	0	0	0	1	1	0	-49.5dB
0	0	1	0	0	1	1	0	-50.0dB
1	0	1	0	0	1	1	0	-50.5dB
0	1	1	0	0	1	1	0	-51.0dB
1	1	1	0	0	1	1	0	-51.5dB
0	0	0	1	0	1	1	0	-52.0dB
1	0	0	1	0	1	1	0	-52.5dB
0	1	0	1	0	1	1	0	-53.0dB
1	1	0	1	0	1	1	0	-53.5dB
0	0	1	1	0	1	1	0	-54.0dB
1	0	1	1	0	1	1	0	-54.5dB
0	1	1	1	0	1	1	0	-55.0dB
1	1	1	1	0	1	1	0	-55.5dB
0	0	0	0	1	1	1	0	-56.0dB
1	0	0	0	1	1	1	0	-56.5dB
0	1	0	0	1	1	1	0	-57.0dB
1	1	0	0	1	1	1	0	-57.5dB
0	0	1	0	1	1	1	0	-58.0dB
1	0	1	0	1	1	1	0	-58.5dB
0	1	1	0	1	1	1	0	-59.0dB
1	1	1	0	1	1	1	0	-59.5dB
0	0	0	1	1	1	1	0	-60.0dB
1	0	0	1	1	1	1	0	-60.5dB
0	1	0	1	1	1	1	0	-61.0dB
1	1	0	1	1	1	1	0	-61.5dB
0	0	1	1	1	1	1	0	-62.0dB
1	0	1	1	1	1	1	0	-62.5dB
0	1	1	1	1	1	1	0	-63.0dB
1	1	1	1	1	1	1	0	-63.5dB
0	0	0	0	0	0	0	1	-64.0dB
1	0	0	0	0	0	0	1	-64.5dB
0	1	0	0	0	0	0	1	-65.0dB
1	1	0	0	0	0	0	1	-65.5dB
0	0	1	0	0	0	0	1	-66.0dB
1	0	1	0	0	0	0	1	-66.5dB
0	1	1	0	0	0	0	1	-67.0dB
1	1	1	0	0	0	0	1	-67.5dB
0	0	0	1	0	0	0	1	-68.0dB
1	0	0	1	0	0	0	1	-68.5dB
0	1	0	1	0	0	0	1	-69.0dB



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### Volume control : -69.5dB to $-\infty$ (DATA\_5, DATA\_6)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_5:Lch side DATA_6:Rch side
1	1	0	1	0	0	0	1	-69.5dB
0	0	1	1	0	0	0	1	-70.0dB
1	0	1	1	0	0	0	1	-70.5dB
0	1	1	1	0	0	0	1	-71.0dB
1	1	1	1	0	0	0	1	-71.5dB
0	0	0	0	1	0	0	1	-72.0dB
1	0	0	0	1	0	0	1	-72.5dB
0	1	0	0	1	0	0	1	-73.0dB
1	1	0	0	1	0	0	1	-73.5dB
0	0	1	0	1	0	0	1	-74.0dB
1	0	1	0	1	0	0	1	-74.5dB
0	1	1	0	1	0	0	1	-75.0dB
1	1	1	0	1	0	0	1	-75.5dB
0	0	0	1	1	0	0	1	-76.0dB
1	0	0	1	1	0	0	1	-76.5dB
0	1	0	1	1	0	0	1	-77.0dB
1	1	0	1	1	0	0	1	-77.5dB
0	0	1	1	1	0	0	1	-78.0dB
1	0	1	1	1	0	0	1	-78.5dB
0	1	1	1	1	0	0	1	-79.0dB
1	1	1	1	1	0	0	1	-79.5dB
0	0	0	0	0	1	0	1	$-\infty$

### Loudness control (DATA\_26)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_26
0	0	0	0	0	0	0	0	Loudness: OFF
1	0	0	0	0	0	0	0	Loudness: ON

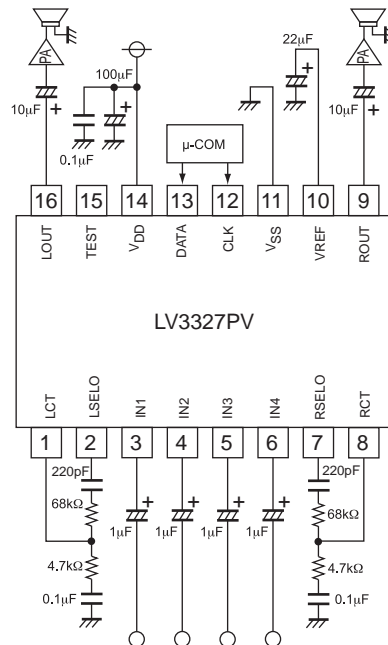
### TEST control (DATA\_29)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_29
0	0	0	0	0	0	0	0	Setting usually for operation use

### Output switching control / Output gain control (DATA\_30, DATA\_31)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_30: Lch side DATA_31: Rch side
0	0	0	*	0	0	0	0	MUTE
1	0	0	*	0	0	0	0	Output selector: Lch side select
0	1	0	*	0	0	0	0	Output selector: Rch side select
1	1	0	*	0	0	0	0	Output selector: Lch/Rch mixing select
*	*	0	0	0	0	0	0	Output gain: 0dB setting
*	*	0	1	0	0	0	0	Output gain: 6dB setting

## Application Circuit Example



### Usage Cautions

(1) Request to send the initial data at power ON

- Though the circuit initializing the IC inside at power ON is incorporated, be sure to send data to all sub-address as the initial data at power ON.
- At power ON, muting or other measures must be taken externally till the data is set.

Reference data

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
VDD power rise time	Trise	0V → 2V power rise time	30	-	-	μsec
VDD voltage when power ON reset is canceled	Vpor		-	2	-	V

(2) Data is switched by standing up about the ACK clock of the data setting bit.

(3) The auto increment function is moved in the SUB address as follows.

...=>DATA\_1=>DATA\_2=>DATA\_5=>DATA\_6=>DATA\_26=>DATA\_29=>DATA\_30=>DATA\_31=>DATA\_1=>...

(4) As for the mixing function, half the value in which the Lch volume output and the Rch volume output are added is output.  $(Lch+Rch)/2$ . Please set +6dB if necessary in the output steps.

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