Ordering number : ENA1657

SANYO Semiconductors
DATA SHEET

An ON Semiconductor Company

Bi-CMOS LSI

LV3328PM — For Car Audio Systems Electronic Volume IC

Overview

The LV3328PM is an electronic volume and tone IC implements a rich set of audio control functions with a minimal number of external components. Functions include input selection switching function, an input gain, volume, loudness, balance, fader, general-purpose ports and bass/mid/treble control.

Features

- It is possible to eliminate from the external components of equalizer control block by SCF technology.
- Zero-cross switching circuits (Volume control block , Fader control block and General purpose volume block), soft step (3 band equalizer control) and soft mute circuits used for low noise even when input signals are present.
- Low power consumption due to the use of BiCMOS process.

Functions

- Input switching :
  Single-end inputs (3 input systems).
  Single-end inputs (2 input systems) or differential input (1 input system).
  Differential input (1 input system).
- Input gain control :
  The input single can be amplified by 0 to +18dB (1dB 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.
- Volume control : +10dB to -79dB/-∞ (1dB steps)
  L/R independent control.
- Bass control :
  The bass control gain can be maximum boost +20dB position and maximum cut -20dB position.
  (+20dB to -20dB in 1dB steps.)
  The bass control center frequency 60Hz/70Hz/100Hz/120Hz can be selected.
  The bass control quality factor 1.0/2.0 can be selected.

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- Middle control :
  The middle control gain can be maximum boost +20dB position and maximum cut -20dB position.
  (+20dB to -20dB in 1dB steps.)
  The middle control center frequency 700Hz/1KHz/1.2KHz can be selected.
  The middle control quality factor 1.0/2.0 can be selected.
- Treble control :
  The treble control gain can be maximum boost +20dB position and maximum cut -20dB position.
  (+20dB to -20dB in 1dB steps.)
  The treble control center frequency 7KHz/10KHz/11KHz/12KHz can be selected.
  The treble control quality factor 1.0/2.0 can be selected.
- Fader control :
  A total of 81 positions from 0 to -79dB in 1dB steps and -∞dB.
  Independent control each four channels output
- General-purpose ports control :
  Mono / stereo selection.
  A total of 81 positions from 0 to -79dB in 1dB steps and -∞dB.
  Fader-front output mix / general purpose output selection.
  Input switching control block / general purpose input selection .
- Mute

Specifications

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

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{DD} max	V_{DD}	10	V
Maximum input voltage	V_{IN} max	All input pins	V_{SS}-0.3 to V_{DD}	V
Allowable power dissipation	Pd max	Ta ≤ 85°C, when mounted on a printed circuit board *	600	mW
Operating temperature	Topr		-40 to +85	°C
Storage temperature	Tstg		-50 to +125	°C

* Specified circuit board : 114.3×76.1×1.6mm^3 : glass epoxy board

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

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Supply voltage	V_{DD}	V_{DD}	7.0	9.0	9.5	V
High-level input voltage	V_{IH}	DATA, CLK, LEVDET	3.0		5.5	V
Low-level input voltage	V_{IL}	DATA, CLK, LEVDET	V_{SS}		1.0	V
Input pulse width	TϕW	CLK	0.6			μs
Setup time	Tsetup	DATA, CLK	0.1			μs
Hold time	Thold	DATA, CLK			0.9	μs
Operating frequency	fopg	CLK			400	kHz

Electrical Characteristics at Ta = 25°C, V_{DD} = 9V, V_{SS} = 0V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Input block						
Input resistance	Rin	L1-L3, R1-R3		50		kΩ
		L4-L7, R4-R7		250		kΩ
Minimum input gain	Gin min		-1.0	0	+1.0	dB
Maximum input gain	Gin max		+17	+18	+19	dB
Inter-step setting error	ATerr		-1.0		+1.0	dB
Left/Right balance	BAL		-0.5		+0.5	dB
Volume block						
Input resistance	Rvr	LVRIN, RVRIN		200		kΩ
Inter-step setting error	ATerr	+10dB to -40dB	-0.5		+0.5	dB
Left/Right balance	BAL	+10dB to -40dB	-0.5		+0.5	dB
Bass block						
The maximum gain setting	Gb max	max. boost/cut	±18	±20	±22	dB
Inter-step setting error	ATerr	-10dB to +10dB	-1.0		+1.0	dB
Left/Right balance	BAL		-1.0		+1.0	dB
Center frequency	f01			60		Hz
	f02			70		Hz
	f03			100		Hz
	f04			120		Hz
Quality Factor	Q01			1.0		
	Q02			2.0		
Mid block						
The maximum gain setting	Gb max	max. boost/cut	±18	±20	±22	dB
Inter-step setting error	ATerr	-10dB to +10dB	-1.0		+1.0	dB
Left/Right balance	BAL		-1.0		+1.0	dB
Center frequency	f01			700		Hz
	f02			1		kHz
	f03			1.2		kHz
Quality Factor	Q01			1.0		
	Q02			2.0		
Treble block						
The maximum gain setting	Gb max	max. boost/cut	±18	±20	±22	dB
Inter-step setting error	ATerr	-10dB to +10dB	-1.0		+1.0	dB
Left/Right balance	BAL		-1.0		+1.0	dB
Center frequency	f01			7		kHz
	f02			10		kHz
	f03			11		kHz
	f04			12		kHz
Quality Factor	Q01			1.0		
	Q02			2.0		
General port block						
Input resistance	Rgp	EXLIN, EXRIN		50		kΩ
Inter-step setting error	ATerr	0dB to -40dB	-0.5		+0.5	dB
Left/Right balance	BAL	0dB to -40dB	-0.5		+0.5	dB
Fader block						
Input resistance	Rfed	LFIN, RFIN		50		kΩ
Inter-step setting error	ATerr	0dB to -40dB	-0.5		+0.5	dB
Left/Right balance	BAL	0dB to -40dB	-0.5		+0.5	dB

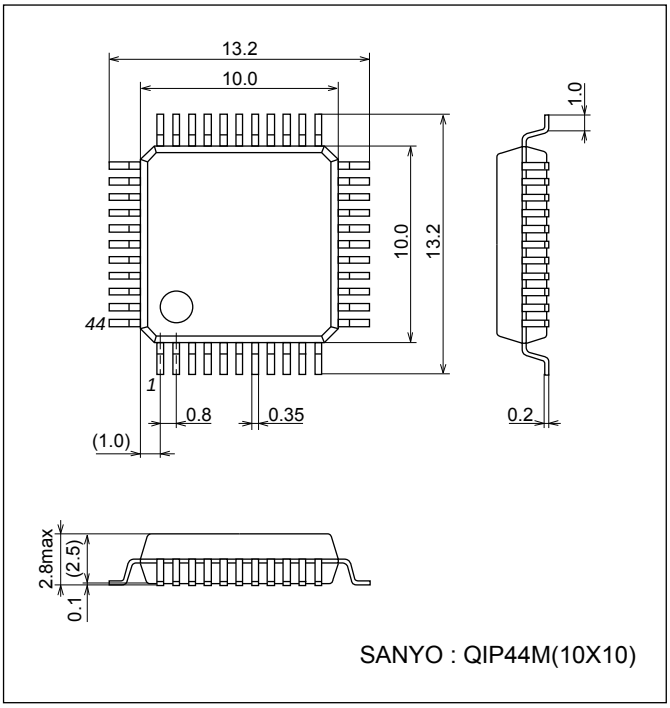
Overall Characteristics at Ta = 25°C, V_{DD} = 9V, V_{SS} = 0V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
A loss of insertion	ATT		-1.0		+1.0	dB
Total harmonic distortion	THD	V_{IN} = 1Vrms, f = 1kHz		0.01		%
Inter-input crosstalk	CT	V_{IN} = 1Vrms, f = 1kHz		80		dB
Left/Right channel crosstalk	CT	V_{IN} = 1Vrms, f = 1kHz		80		dB
Maximum attenuation	V_O min	V_{IN} = 1Vrms, f = 1kHz		80		dB
Output noise voltage	VN	IHF-A, Rin=1kΩ		11		μVrms
Current drain	I_{DD}			32		mA
Input high-level current	I_{IH}	DATA, CLK, V_{IN} = 5.5V			10	μA
Input low-level current	I_{IL}	DATA, CLK, V_{IN} = 0V	-10			μA
Maximum input voltage	VCL	THD = 1% RL = 10kΩ all controls flat, f_{IN} = 1kHz		2.5		Vrms
Common-mode rejection ratio	CMRR	V_{IN} = 1Vrms, f = 1kHz		50		dB

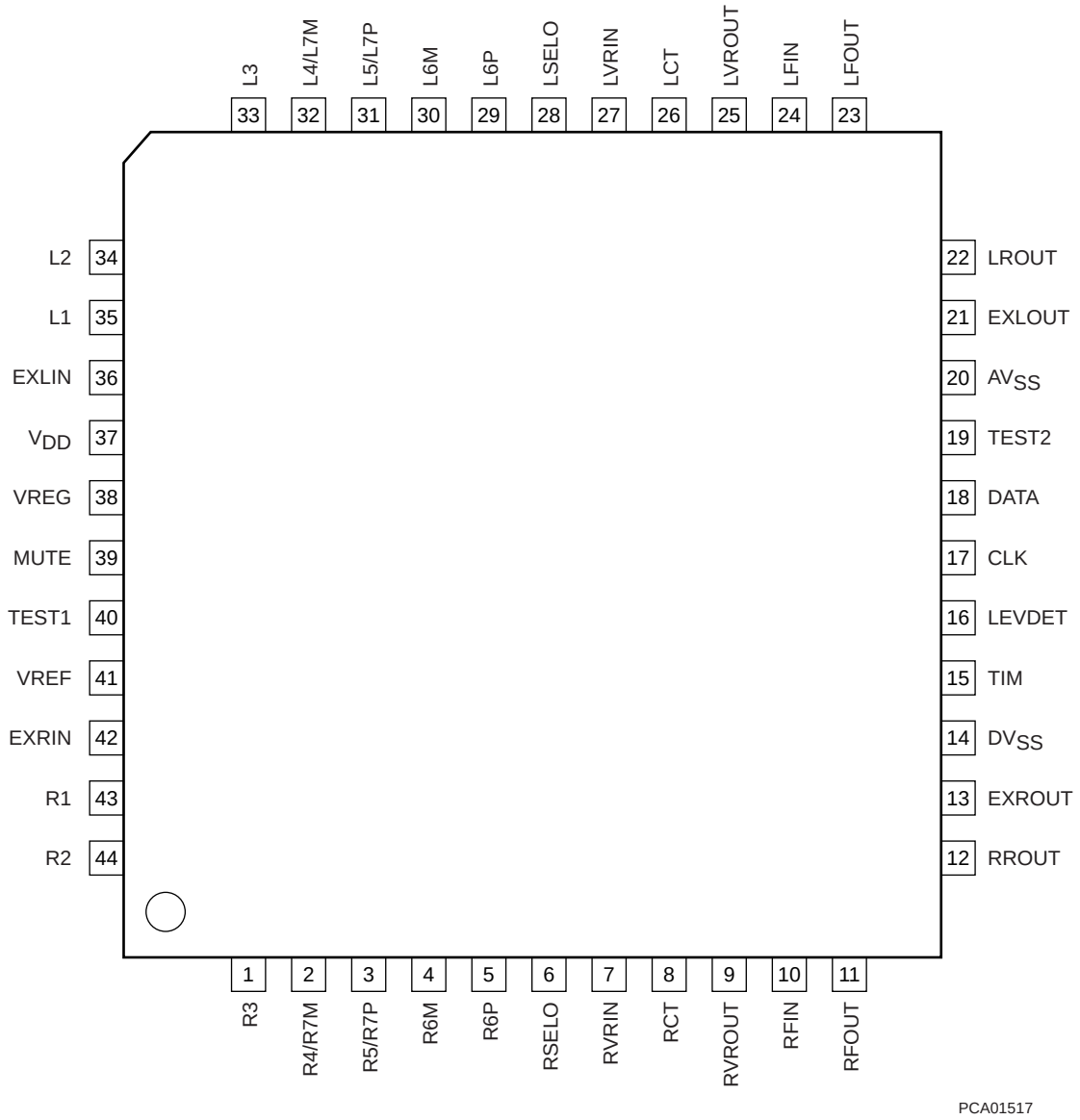
Package Dimensions

unit : mm (typ)

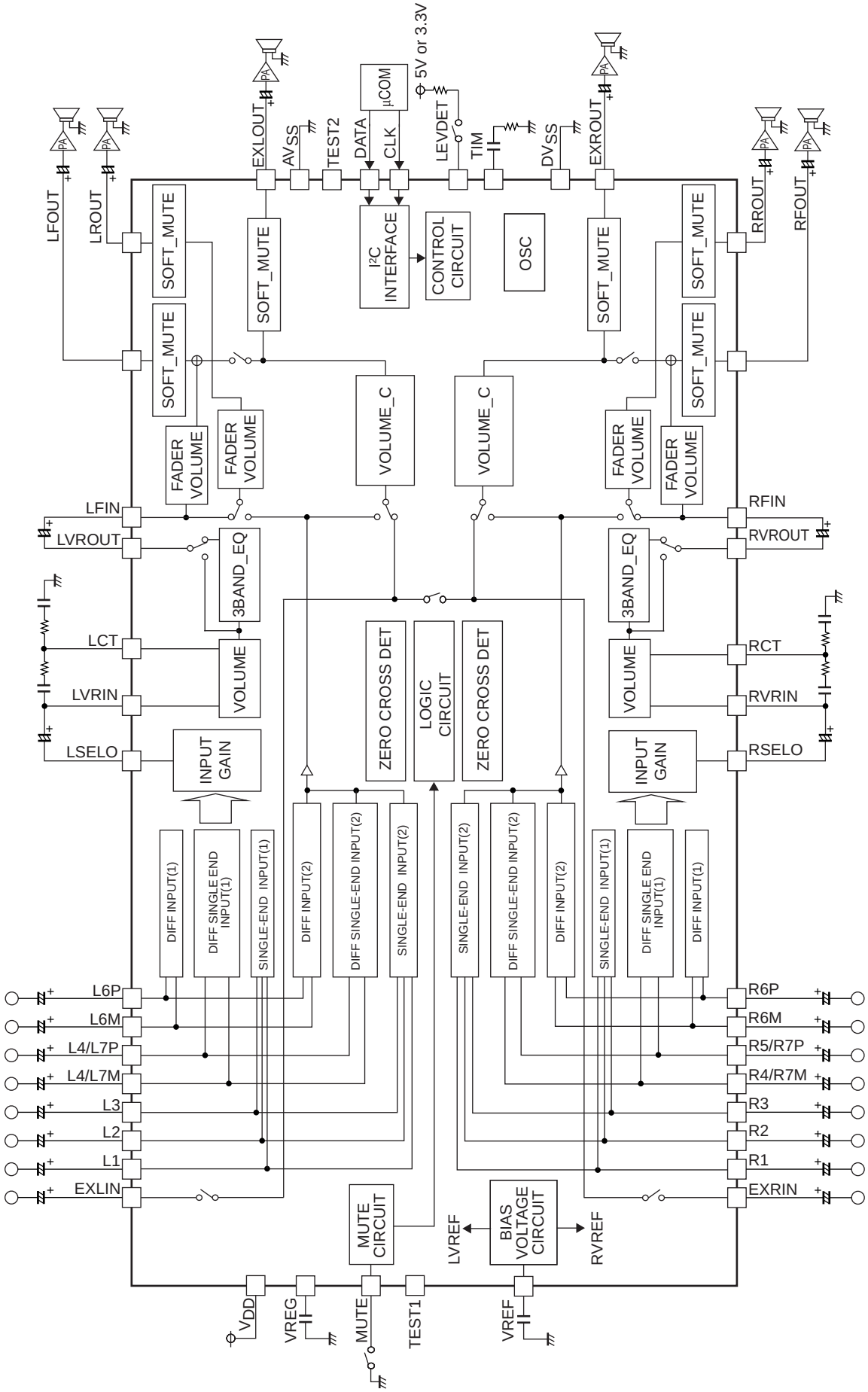
3148A



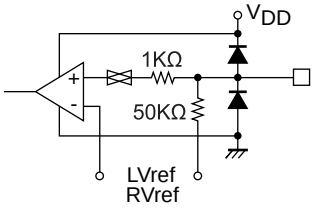
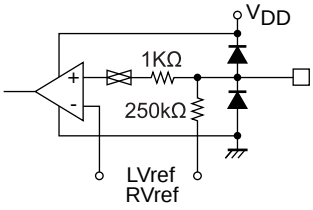
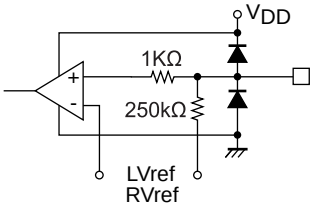
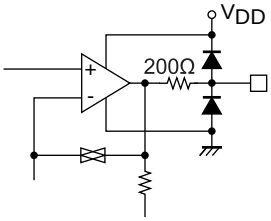
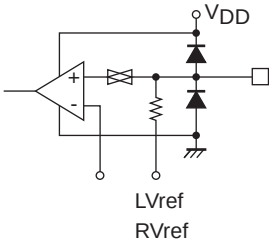
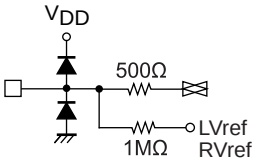
Pin Assignment



Block Diagram



Pin Functions

Pin No.	Pin	Function	Equivalent Circuit
35 34 33 43 44 1	L1 L2 L3 R1 R2 R3	Single end input pins.	
32 31 2 3	L4/L7M L5/L7P R4/R7M R5/R7P	Single end input pins/ Differential input pins When differential input is selected L4→L7M, L5→L7P, R4→R7M, R5→R7P	
30 29 4 5	L6M L6P R6M R6P	Differential input pins.	
28 6	LSELO RSELO	Input selector output pins.	
27 7	LVRIN RVRIN	Main volume input pins.	
26 8	LCT RCT	Loudness function pins.	

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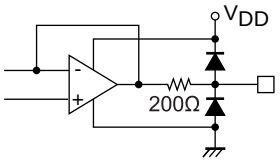
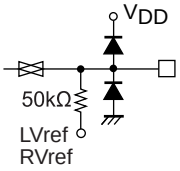
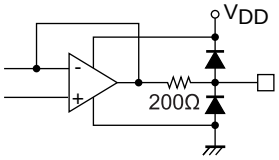
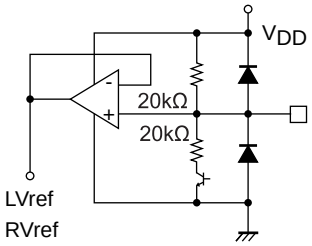
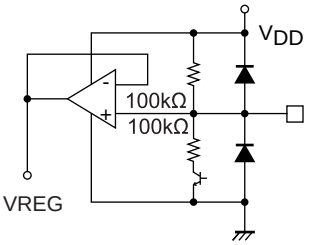
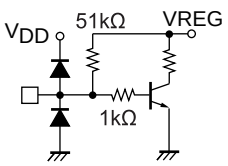
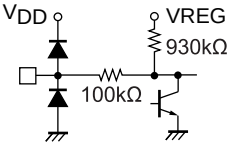
Pin No.	Pin	Function	Equivalent Circuit
25 9	LVROUT RVROUT	Tone output pins.	
24 10	LFIN RFIN	Fader block input pins. Drive at low impedance.	
23 22 11 12	LFOUT LROUT RFOUT RROUT	Fader output pins.Attenuation is possible separately for the front end and rear end.	
41	VREF	Connect a capacitor of a few tens of uF between VREF and AV_{SS} (V_{SS}) as a 0.5 × V_{DD} voltage generator, current ripple countermeasure.	
38	VREG	Internal logic voltage pin.	
37	V_{DD}	Power supply pin.	
20	AV_{SS}	Analog ground pin.	
14	DV_{SS}	Digital ground pin	
39	MUTE	External muting control pin. Setting this pin to V_{SS} level sets forcibly fader volume block to -∞ level.	
15	TIM	Timer pin when there is no signal in the zero cross circuit.Forcibly set data when there is no zero cross signal, from the time the data is set until the timer ends.	

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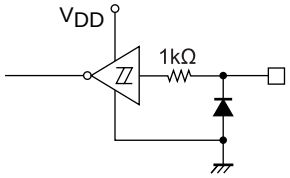
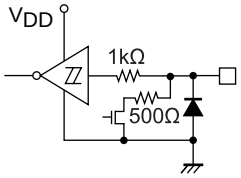
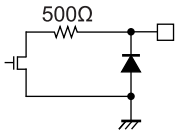
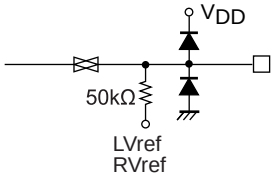
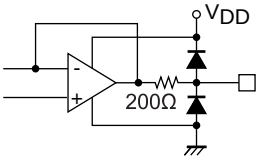
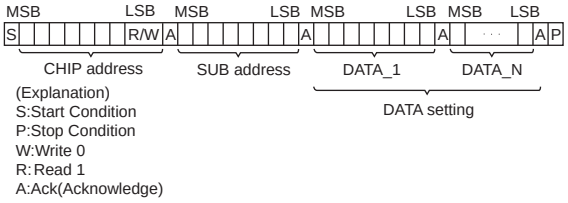
Pin No.	Pin	Function	Equivalent Circuit
17	CLK	Serial data clock input pin for control.	
18	DATA	Serial data input pin for control.	
16	LEVDET	Output level detection pin. When the level detection unused:OPEN	
40 19	TEST1 TEST2	TEST pin Normally this pin is OPEN.	
36 42	EXLIN EXRIN	General-purpose port input pin.	
21 13	EXLOUT EXROUT	General-purpose port output pin.	

DATA format : I^2C data specification



For continuous data transmission, the auto increment function causes data to be written into the sub-address DATA_(N+1). The sub-address of DATA_29 is followed by DATA_1.

CHIP address

MSB							LSB
CP7	CP6	CP5	CP4	CP3	CP2	CP1	CP0
							R/W

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

SUB address

MSB							LSB
SU7	SU6	SU5	SU4	SU3	SU2	SU1	SU0

Block	SUB address								
		SU7	SU6	SU5	SU4	SU3	SU2	SU1	SU0
Input selection (1)	DATA_1	1	0	0	0	0	0	0	0
Input selection (2)	DATA_2	0	1	0	0	0	0	0	0
Input gain control (Lch)	DATA_3	1	1	0	0	0	0	0	0
Input gain control (Rch)	DATA_4	0	0	1	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
BASS f0 Q setting(Lch)	DATA_7	1	1	1	0	0	0	0	0
BASS f0 Q setting(Rch)	DATA_8	0	0	0	1	0	0	0	0
MID f0 Q setting(Lch)	DATA_9	1	0	0	1	0	0	0	0
MID f0 Q setting(Rch)	DATA_10	0	1	0	1	0	0	0	0
TREBLE f0 Q setting(Lch)	DATA_11	1	1	0	1	0	0	0	0
TREBLE f0 Q setting(Rch)	DATA_12	0	0	1	1	0	0	0	0
BASS control (Lch)	DATA_13	1	0	1	1	0	0	0	0
BASS control (Rch)	DATA_14	0	1	1	1	0	0	0	0
MID control (Lch)	DATA_15	1	1	1	1	0	0	0	0
MID control (Rch)	DATA_16	0	0	0	0	1	0	0	0
TREBLE control (Lch)	DATA_17	1	0	0	0	1	0	0	0
TREBLE control (Rch)	DATA_18	0	1	0	0	1	0	0	0
General-purpose volume control (Lch)	DATA_19	1	1	0	0	1	0	0	0
General-purpose volume control (Rch)	DATA_20	0	0	1	0	1	0	0	0
Fader control (LFOUT)	DATA_21	1	0	1	0	1	0	0	0
Fader control (LROUT)	DATA_22	0	1	1	0	1	0	0	0
Fader control (RFOUT)	DATA_23	1	1	1	0	1	0	0	0
Fader control (RROUT)	DATA_24	0	0	0	1	1	0	0	0
General-purpose input, mixing, output level detection, FAD_rear	DATA_25	1	0	0	1	1	0	0	0
Loudness, Tone-pass select, EXTOUT output signal setting	DATA_26	0	1	0	1	1	0	0	0
Zero crossing control	DATA_27	1	1	0	1	1	0	0	0
Soft step/soft mute	DATA_28	0	0	1	1	1	0	0	0
TEST control	DATA_29	1	0	1	1	1	0	0	0

DATA

MSB							LSB
D7	D6	D5	D4	D3	D2	D1	D0

DATA_1(input selection(1))

D7	D6	D5	D4	D3	D2	D1	D0	
0	0	0	0	0	0	0	0	INMUTE
1	0	0	0	0	0	0	0	L1(R1):INPUT(1) setting
0	1	0	0	0	0	0	0	L2(R2):INPUT(1) setting
1	1	0	0	0	0	0	0	L3(R3):INPUT(1) setting
0	0	1	0	0	0	0	0	L4(R4):INPUT(1) setting
1	0	1	0	0	0	0	0	L5(R5):INPUT(1) setting
0	1	1	0	0	0	0	0	L6(R6):INPUT(1) setting
1	1	1	0	0	0	0	0	L7(R7):INPUT(1) setting*1

*1: The input is switched to the difference stereo input.(object chanel…L4(L7M),L5(L7P),R4(R7M),R5(R7P))

DATA_2(input selection(2))

D7	D6	D5	D4	D3	D2	D1	D0	
0	0	0	0	0	0	0	0	INMUTE
1	0	0	0	0	0	0	0	L1(R1):INPUT(2) setting
0	1	0	0	0	0	0	0	L2(R2):INPUT(2) setting
1	1	0	0	0	0	0	0	L3(R3):INPUT(2) setting
0	0	1	0	0	0	0	0	L4(R4):INPUT(2) setting
1	0	1	0	0	0	0	0	L5(R5):INPUT(2) setting
0	1	1	0	0	0	0	0	L6(R6):INPUT(2) setting
1	1	1	0	0	0	0	0	L7(R7):INPUT(2) setting*2

*2: The input is switched to the difference stereo input. (object chanel…L4(L7M),L5(L7P),R4(R7M),R5(R7P))

DATA_3,DATA_4(input gain control)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_3:Lch side DATA_4:Rch side
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

DATA_5,DATA_6(volume control):10dB to -40dB

D7	D6	D5	D4	D3	D2	D1	D0	DATA_5:Lch side DATA_6:Rch side
0	1	1	0	1	1	1	0	10dB
1	1	1	0	1	1	1	0	9dB
0	0	0	1	1	1	1	0	8dB
1	0	0	1	1	1	1	0	7dB
0	1	0	1	1	1	1	0	6dB
1	1	0	1	1	1	1	0	5dB
0	0	1	1	1	1	1	0	4dB
1	0	1	1	1	1	1	0	3dB
0	1	1	1	1	1	1	0	2dB
1	1	1	1	1	1	1	0	1dB
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

DATA_5,DATA_6(volume control):-41dB to -∞

D7	D6	D5	D4	D3	D2	D1	D0	DATA_5:Lch side DATA_6:Rch side
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
1	1	0	0	1	1	0	0	-51dB
0	0	1	0	1	1	0	0	-52dB
1	0	1	0	1	1	0	0	-53dB
0	1	1	0	1	1	0	0	-54dB
1	1	1	0	1	1	0	0	-55dB
0	0	0	1	1	1	0	0	-56dB
1	0	0	1	1	1	0	0	-57dB
0	1	0	1	1	1	0	0	-58dB
1	1	0	1	1	1	0	0	-59dB
0	0	1	1	1	1	0	0	-60dB
1	0	1	1	1	1	0	0	-61dB
0	1	1	1	1	1	0	0	-62dB
1	1	1	1	1	1	0	0	-63dB
0	0	0	0	0	0	1	0	-64dB
1	0	0	0	0	0	1	0	-65dB
0	1	0	0	0	0	1	0	-66dB
1	1	0	0	0	0	1	0	-67dB
0	0	1	0	0	0	1	0	-68dB
1	0	1	0	0	0	1	0	-69dB
0	1	1	0	0	0	1	0	-70dB
1	1	1	0	0	0	1	0	-71dB
0	0	0	1	0	0	1	0	-72dB
1	0	0	1	0	0	1	0	-73dB
0	1	0	1	0	0	1	0	-74dB
1	1	0	1	0	0	1	0	-75dB
0	0	1	1	0	0	1	0	-76dB
1	0	1	1	0	0	1	0	-77dB
0	1	1	1	0	0	1	0	-78dB
1	1	1	1	0	0	1	0	-79dB
0	0	0	0	1	0	1	0	-∞

DATA_7,DATA_8(BASS f0,Q setting)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_7:Lch side DATA_8:Rch side
0	0	*	*	0	0	0	0	f0:60Hz
1	0	*	*	0	0	0	0	f0:70Hz
0	1	*	*	0	0	0	0	f0:100Hz
1	1	*	*	0	0	0	0	f0:120Hz
*	*	0	0	0	0	0	0	Q:1.00
*	*	1	0	0	0	0	0	Q:2.00

DATA_9,DATA_10(MID f0,Q setting)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_9:Lch side DATA_10:Rch side
0	0	*	*	0	0	0	0	f0:700Hz
1	0	*	*	0	0	0	0	f0:1kHz
0	1	*	*	0	0	0	0	f0:1.2kHz
*	*	0	0	0	0	0	0	Q:1.00
*	*	1	0	0	0	0	0	Q:2.00

DATA_11,DATA_12(TREBLE f0,Q setting)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_11:Lch side DATA_12:Rch side
0	0	*	*	0	0	0	0	f0:7kHz
1	0	*	*	0	0	0	0	f0:10kHz
0	1	*	*	0	0	0	0	f0:11kHz
1	1	*	*	0	0	0	0	f0:12kHz
*	*	0	0	0	0	0	0	Q:1.00
*	*	1	0	0	0	0	0	Q:2.00

DATA_13,DATA_14(TONE block BASS control)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_13:Lch side DATA_14:Rch side
0	0	1	0	1	1	0	0	GAIN:+20dB
1	1	0	0	1	1	0	0	GAIN:+19dB
0	1	0	0	1	1	0	0	GAIN:+18dB
1	0	0	0	1	1	0	0	GAIN:+17dB
0	0	0	0	1	1	0	0	GAIN:+16dB
1	1	1	1	0	1	0	0	GAIN:+15dB
0	1	1	1	0	1	0	0	GAIN:+14dB
1	0	1	1	0	1	0	0	GAIN:+13dB
0	0	1	1	0	1	0	0	GAIN:+12dB
1	1	0	1	0	1	0	0	GAIN:+11dB
0	1	0	1	0	1	0	0	GAIN:+10dB
1	0	0	1	0	1	0	0	GAIN:+9dB
0	0	0	1	0	1	0	0	GAIN:+8dB
1	1	1	0	0	1	0	0	GAIN:+7dB
0	1	1	0	0	1	0	0	GAIN:+6dB
1	0	1	0	0	1	0	0	GAIN:+5dB
0	0	1	0	0	1	0	0	GAIN:+4dB
1	1	0	0	0	1	0	0	GAIN:+3dB
0	1	0	0	0	1	0	0	GAIN:+2dB
1	0	0	0	0	1	0	0	GAIN:+1dB
0	0	0	0	0	0	0	0	GAIN:0dB
1	0	0	0	0	0	0	0	GAIN:-1dB
0	1	0	0	0	0	0	0	GAIN:-2dB
1	1	0	0	0	0	0	0	GAIN:-3dB
0	0	1	0	0	0	0	0	GAIN:-4dB
1	0	1	0	0	0	0	0	GAIN:-5dB
0	1	1	0	0	0	0	0	GAIN:-6dB
1	1	1	0	0	0	0	0	GAIN:-7dB
0	0	0	1	0	0	0	0	GAIN:-8dB
1	0	0	1	0	0	0	0	GAIN:-9dB
0	1	0	1	0	0	0	0	GAIN:-10dB
1	1	0	1	0	0	0	0	GAIN:-11dB
0	0	1	1	0	0	0	0	GAIN:-12dB
1	0	1	1	0	0	0	0	GAIN:-13dB
0	1	1	1	0	0	0	0	GAIN:-14dB
1	1	1	1	0	0	0	0	GAIN:-15dB
0	0	0	0	1	0	0	0	GAIN:-16dB
1	0	0	0	1	0	0	0	GAIN:-17dB
0	1	0	0	1	0	0	0	GAIN:-18dB
1	1	0	0	1	0	0	0	GAIN:-19dB
0	0	1	0	1	0	0	0	GAIN:-20dB

DATA_15,DATA_16(TONE block MID control)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_15:Lch side DATA_16:Rch side
0	0	1	0	1	1	0	0	GAIN:+20dB
1	1	0	0	1	1	0	0	GAIN:+19dB
0	1	0	0	1	1	0	0	GAIN:+18dB
1	0	0	0	1	1	0	0	GAIN:+17dB
0	0	0	0	1	1	0	0	GAIN:+16dB
1	1	1	1	0	1	0	0	GAIN:+15dB
0	1	1	1	0	1	0	0	GAIN:+14dB
1	0	1	1	0	1	0	0	GAIN:+13dB
0	0	1	1	0	1	0	0	GAIN:+12dB
1	1	0	1	0	1	0	0	GAIN:+11dB
0	1	0	1	0	1	0	0	GAIN:+10dB
1	0	0	1	0	1	0	0	GAIN:+9dB
0	0	0	1	0	1	0	0	GAIN:+8dB
1	1	1	0	0	1	0	0	GAIN:+7dB
0	1	1	0	0	1	0	0	GAIN:+6dB
1	0	1	0	0	1	0	0	GAIN:+5dB
0	0	1	0	0	1	0	0	GAIN:+4dB
1	1	0	0	0	1	0	0	GAIN:+3dB
0	1	0	0	0	1	0	0	GAIN:+2dB
1	0	0	0	0	1	0	0	GAIN:+1dB
0	0	0	0	0	0	0	0	GAIN:0dB
1	0	0	0	0	0	0	0	GAIN:-1dB
0	1	0	0	0	0	0	0	GAIN:-2dB
1	1	0	0	0	0	0	0	GAIN:-3dB
0	0	1	0	0	0	0	0	GAIN:-4dB
1	0	1	0	0	0	0	0	GAIN:-5dB
0	1	1	0	0	0	0	0	GAIN:-6dB
1	1	1	0	0	0	0	0	GAIN:-7dB
0	0	0	1	0	0	0	0	GAIN:-8dB
1	0	0	1	0	0	0	0	GAIN:-9dB
0	1	0	1	0	0	0	0	GAIN:-10dB
1	1	0	1	0	0	0	0	GAIN:-11dB
0	0	1	1	0	0	0	0	GAIN:-12dB
1	0	1	1	0	0	0	0	GAIN:-13dB
0	1	1	1	0	0	0	0	GAIN:-14dB
1	1	1	1	0	0	0	0	GAIN:-15dB
0	0	0	0	1	0	0	0	GAIN:-16dB
1	0	0	0	1	0	0	0	GAIN:-17dB
0	1	0	0	1	0	0	0	GAIN:-18dB
1	1	0	0	1	0	0	0	GAIN:-19dB
0	0	1	0	1	0	0	0	GAIN:-20dB

DATA_17,DATA_18(TONE block treble control)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_17:Lch side DATA_18:Rch side
0	0	1	0	1	1	0	0	GAIN:+20dB
1	1	0	0	1	1	0	0	GAIN:+19dB
0	1	0	0	1	1	0	0	GAIN:+18dB
1	0	0	0	1	1	0	0	GAIN:+17dB
0	0	0	0	1	1	0	0	GAIN:+16dB
1	1	1	1	0	1	0	0	GAIN:+15dB
0	1	1	1	0	1	0	0	GAIN:+14dB
1	0	1	1	0	1	0	0	GAIN:+13dB
0	0	1	1	0	1	0	0	GAIN:+12dB
1	1	0	1	0	1	0	0	GAIN:+11dB
0	1	0	1	0	1	0	0	GAIN:+10dB
1	0	0	1	0	1	0	0	GAIN:+9dB
0	0	0	1	0	1	0	0	GAIN:+8dB
1	1	1	0	0	1	0	0	GAIN:+7dB
0	1	1	0	0	1	0	0	GAIN:+6dB
1	0	1	0	0	1	0	0	GAIN:+5dB
0	0	1	0	0	1	0	0	GAIN:+4dB
1	1	0	0	0	1	0	0	GAIN:+3dB
0	1	0	0	0	1	0	0	GAIN:+2dB
1	0	0	0	0	1	0	0	GAIN:+1dB
0	0	0	0	0	0	0	0	GAIN:0dB
1	0	0	0	0	0	0	0	GAIN:-1dB
0	1	0	0	0	0	0	0	GAIN:-2dB
1	1	0	0	0	0	0	0	GAIN:-3dB
0	0	1	0	0	0	0	0	GAIN:-4dB
1	0	1	0	0	0	0	0	GAIN:-5dB
0	1	1	0	0	0	0	0	GAIN:-6dB
1	1	1	0	0	0	0	0	GAIN:-7dB
0	0	0	1	0	0	0	0	GAIN:-8dB
1	0	0	1	0	0	0	0	GAIN:-9dB
0	1	0	1	0	0	0	0	GAIN:-10dB
1	1	0	1	0	0	0	0	GAIN:-11dB
0	0	1	1	0	0	0	0	GAIN:-12dB
1	0	1	1	0	0	0	0	GAIN:-13dB
0	1	1	1	0	0	0	0	GAIN:-14dB
1	1	1	1	0	0	0	0	GAIN:-15dB
0	0	0	0	1	0	0	0	GAIN:-16dB
1	0	0	0	1	0	0	0	GAIN:-17dB
0	1	0	0	1	0	0	0	GAIN:-18dB
1	1	0	0	1	0	0	0	GAIN:-19dB
0	0	1	0	1	0	0	0	GAIN:-20dB

DATA_19,DATA_20(General-purpose volume control):0dB to -54dB

D7	D6	D5	D4	D3	D2	D1	D0	DATA_19:Lch side DATA_20:Rch side
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
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
1	1	0	0	1	1	0	0	-51dB
0	0	1	0	1	1	0	0	-52dB
1	0	1	0	1	1	0	0	-53dB
0	1	1	0	1	1	0	0	-54dB

DATA_19,DATA_20(General-purpose volume control):-55dB to -∞

D7	D6	D5	D4	D3	D2	D1	D0	DATA_19:Lch side DATA_20:Rch side
1	1	1	0	1	1	0	0	-55dB
0	0	0	1	1	1	0	0	-56dB
1	0	0	1	1	1	0	0	-57dB
0	1	0	1	1	1	0	0	-58dB
1	1	0	1	1	1	0	0	-59dB
0	0	1	1	1	1	0	0	-60dB
1	0	1	1	1	1	0	0	-61dB
0	1	1	1	1	1	0	0	-62dB
1	1	1	1	1	1	0	0	-63dB
0	0	0	0	0	0	1	0	-64dB
1	0	0	0	0	0	1	0	-65dB
0	1	0	0	0	0	1	0	-66dB
1	1	0	0	0	0	1	0	-67dB
0	0	1	0	0	0	1	0	-68dB
1	0	1	0	0	0	1	0	-69dB
0	1	1	0	0	0	1	0	-70dB
1	1	1	0	0	0	1	0	-71dB
0	0	0	1	0	0	1	0	-72dB
1	0	0	1	0	0	1	0	-73dB
0	1	0	1	0	0	1	0	-74dB
1	1	0	1	0	0	1	0	-75dB
0	0	1	1	0	0	1	0	-76dB
1	0	1	1	0	0	1	0	-77dB
0	1	1	1	0	0	1	0	-78dB
1	1	1	1	0	0	1	0	-79dB
0	0	0	0	1	0	1	0	-∞

DATA_21,DATA_22,DATA_23,DATA_24(Fader control):0dB to -25dB

D7	D6	D5	D4	D3	D2	D1	D0	DATA_21:LFOUT, DATA_22:LROUT DATA_23:RFOUT, DATA_24:RROUT
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

DATA_21,DATA_22,DATA_23,DATA_24(Fader control):-26dB to -∞

D7	D6	D5	D4	D3	D2	D1	D0	DATA_21:LFOUT, DATA_22:LROUT DATA_23:RFOUT, DATA_24:RROUT
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
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
1	1	0	0	1	1	0	0	-51dB
0	0	1	0	1	1	0	0	-52dB
1	0	1	0	1	1	0	0	-53dB
0	1	1	0	1	1	0	0	-54dB
1	1	1	0	1	1	0	0	-55dB
0	0	0	1	1	1	0	0	-56dB
1	0	0	1	1	1	0	0	-57dB
0	1	0	1	1	1	0	0	-58dB
1	1	0	1	1	1	0	0	-59dB
0	0	1	1	1	1	0	0	-60dB
1	0	1	1	1	1	0	0	-61dB
0	1	1	1	1	1	0	0	-62dB
1	1	1	1	1	1	0	0	-63dB
0	0	0	0	0	0	1	0	-64dB
1	0	0	0	0	0	1	0	-65dB
0	1	0	0	0	0	1	0	-66dB
1	1	0	0	0	0	1	0	-67dB
0	0	1	0	0	0	1	0	-68dB
1	0	1	0	0	0	1	0	-69dB
0	1	1	0	0	0	1	0	-70dB
1	1	1	0	0	0	1	0	-71dB
0	0	0	1	0	0	1	0	-72dB
1	0	0	1	0	0	1	0	-73dB
0	1	0	1	0	0	1	0	-74dB
1	1	0	1	0	0	1	0	-75dB
0	0	1	1	0	0	1	0	-76dB
1	0	1	1	0	0	1	0	-77dB
0	1	1	1	0	0	1	0	-78dB
1	1	1	1	0	0	1	0	-79dB
0	0	0	0	1	0	1	0	-∞

DATA_25 (General-purpose input switch, Mixing, Output level detection, FADER_Rear input switch)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_25
0	*	*	*	*	*	*	*	General-purpose input mode switch:stereo mode
1	*	*	*	*	*	*	*	General-purpose input mode switch:MONO
*	0	0	*	*	*	*	*	Lch/Rch mixing : OFF
*	1	0	*	*	*	*	*	Lch mixing : ON, Rch mixing : OFF
*	0	1	*	*	*	*	*	Lch mixing : OFF, Rch mixing : ON
*	1	1	*	*	*	*	*	Lch/Rch mixing : ON
*	*	*	0	0	*	*	*	General-purpose input select:EXLIN/EXRIN
*	*	*	1	0	*	*	*	General-purpose input select:EXRIN only select
*	*	*	0	1	*	*	*	General-purpose input select:EXLIN only select
*	*	*	*	*	0	*	*	Output level detection : OFF
*	*	*	*	*	1	*	*	Output level detection : ON
*	*	*	*	*	*	0	0	FADER_REAR_L/Rch input1 select
*	*	*	*	*	*	1	0	FADER_REAR_Lch:input2, Rch:input1 select
*	*	*	*	*	*	0	1	FADER_REAR_Lch:input1, Rch:input2 select
*	*	*	*	*	*	1	1	FADER_REAR_L/Rch input2 select

DATA_26 (Loudness control, TONE pass switch, EXTOUT output signal select)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_26
0	0	*	*	*	*	0	0	Loudness:OFF
1	0	*	*	*	*	0	0	Loudness:ON
*	*	0	0	*	*	0	0	The tone block pass operation is not done.
*	*	1	0	*	*	0	0	Tone block pass operation execution only of Lch side.
*	*	0	1	*	*	0	0	Tone block pass operation execution only of Rch side.
*	*	1	1	*	*	0	0	Tone block pass operation execution of Lch and Rch side.
*	*	*	*	0	*	0	0	EXTOUT outputs signal Lch: EXTIN
*	*	*	*	1	*	0	0	EXTOUT outputs signal Lch: input 2
*	*	*	*	*	0	0	0	EXTOUT outputs signal Rch: EXTIN
*	*	*	*	*	1	0	0	EXTOUT outputs signal Rch: input 2

DATA_27 (Zero cross control)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_27
0	*	*	*	*	0	0	0	Zerocross control:OFF
1	*	*	*	*	0	0	0	Zerocross control:ON
*	0	0	*	*	0	0	0	Zerocross detection:Input GAIN(LSELO)
*	1	0	*	*	0	0	0	Zerocross detection:Main volume(LVROUT)
*	0	1	*	*	0	0	0	Zerocross detection:Fader(LFOUT)
*	1	1	*	*	0	0	0	Zerocross detection:Fader(LROUT)
*	*	*	0	0	0	0	0	Zerocross detection:Input GAIN(RSELO)
*	*	*	1	0	0	0	0	Zerocross detection:Main volume(RVROUT)
*	*	*	0	1	0	0	0	Zerocross detection:Fader(RFOUT)
*	*	*	1	1	0	0	0	Zerocross detection:Fader(RROUT)

DATA_28 (Soft_step/Soft_mute control)

D7	D6	D5	D4	D3	D2	D1	D0	DATA_28
0	*	*	*	*	*	*	*	Soft_mute mode:OFF
1	*	*	*	*	*	*	*	Soft_mute mode:ON
*	0	*	*	*	*	*	*	Mute select:OFF
*	1	*	*	*	*	*	*	Mute select:ON
*	*	0	*	*	*	*	*	Soft_step:OFF
*	*	1	*	*	*	*	*	Soft_step:ON
*	*	*	0	*	*	*	*	Usually mode
*	*	*	1	*	*	*	*	TEST mode
*	*	*	*	0	0	*	*	Mute time:0.64ms
*	*	*	*	1	0	*	*	Mute time:5.12ms
*	*	*	*	0	1	*	*	Mute time:40ms
*	*	*	*	1	1	*	*	Mute time:80ms
*	*	*	*	*	*	0	0	Soft_step time:10ms
*	*	*	*	*	*	1	0	Soft_step time:20ms
*	*	*	*	*	*	0	1	Soft_step time:40ms
*	*	*	*	*	*	1	1	Soft_step time:80ms

DATA_29 (TEST control)

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

Usage Cautions

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

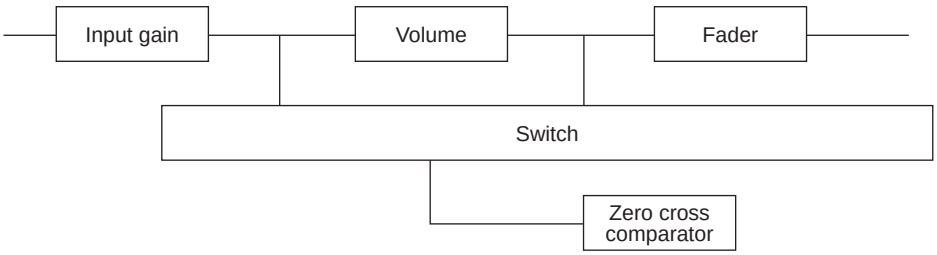
- Though the circuit initializing the IC inside at power ON is incorporated, be sure to send data to all sub-address as the initial data at power ON.
- At power ON, muting or other measures must be taken externally till the data is set.

Reference data

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
VDD power rise time	Trise	0V → 5V power rise time	30	-	-	μs
VDD voltage when power ON reset is canceled	Vpor		-	5	-	V

(2) Description of zero cross switching circuit operation

The LV3328PM have a function to switch zero cross comparator signal detection locations, enabling the selection of the optimum detection location for blocks whose data is to be updated.Basically, the switching noise can be minimized by inputting the signal immediately following the block whose data is to be updated to the zero cross comparator, so it is necessary to switch the detection location every time.



LV3328PM zero cross detection circuit

(3) Zero Cross Switching Control method

The zero cross switching control method consists of setting the zero cross control bits to the zero cross detection mode, and specifying the detection blocks before transmitting the data.

The I^2C data is held at rise of the ACK clock. For zero-cross operation, this operation begins at rise of ACK clock of the first data.

On detecting zero cross, all of holding data are switched. (Without zero cross, data is switched at rise of ACK clock.)

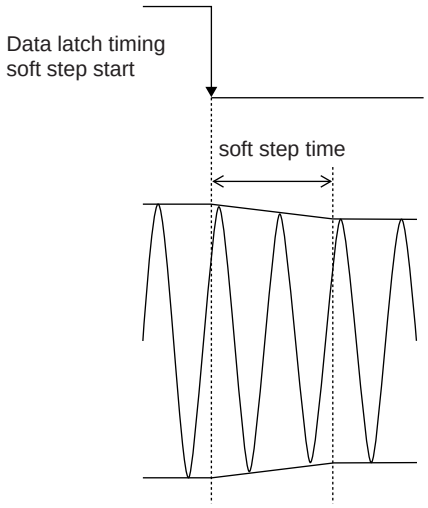
(4) Zero cross timer setting

If the input signal becomes lower than the zero cross comparator detection sensitivity, or if only low-frequency signals are input, zero cross detection continues to be impossible, and data is not latched during this time. The zero cross timer can set a time for forcible latch during such a status when zero cross detection is not possible.

(5) Soft step operation

The LV3328PM have a soft step function at 3 band equalizer control block for low switching noise.

The Soft step time can be selected by send to I^2C control. (l0ms, 20ms, 40ms, 80ms)

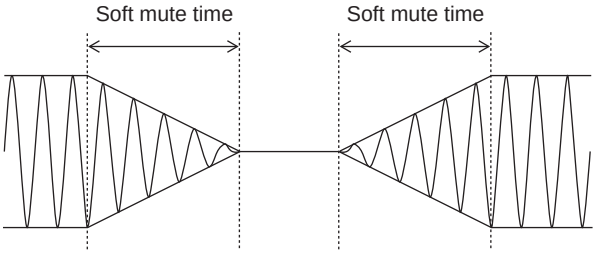


(6) Soft mute operation

The LV3328PM have a soft mute function for low switching noise, when this mute function set operation. (mute/unmute function select)

The Soft mute time can be selected by send to I^2C control. (0.6ms, 5ms, 40ms, 80ms)

A soft mute function can be implemented by set to soft mute on. (Set to mute on/off)



(7) Cautions for input switching (method to reduce the switching noise at a time of channel setting)

When switching the input channel, carry out soft muting beforehand. After completion of muting, carry out channel switching. Then, cancel muting (canceling through soft muting), and complete input switching (recommendation by SANYO).

Note also that, regardless of whether each input channel is set to ON or OFF, the external input voltage is less than the maximum input voltage (VCL) in all input channels.

Application Circuit Example