M62421SP/FP

Tone and Volume Controller with 2 Line Control

REJ03F0208-0201
Rev.2.01
Mar 31, 2008

Outline

M62421SP/FP is the tone and volume controller with 2 line control.

This IC can apply the broad application because of low noise and distortion.

Feature

- Tone (Bass/Treble) control and 1 dB step volume control are enabled.
- Low noise and low distortion.
  V_{NO} = 4.5 µVrms, THD = 0.1% max
- Controlling by 2 Line serial data.

Application

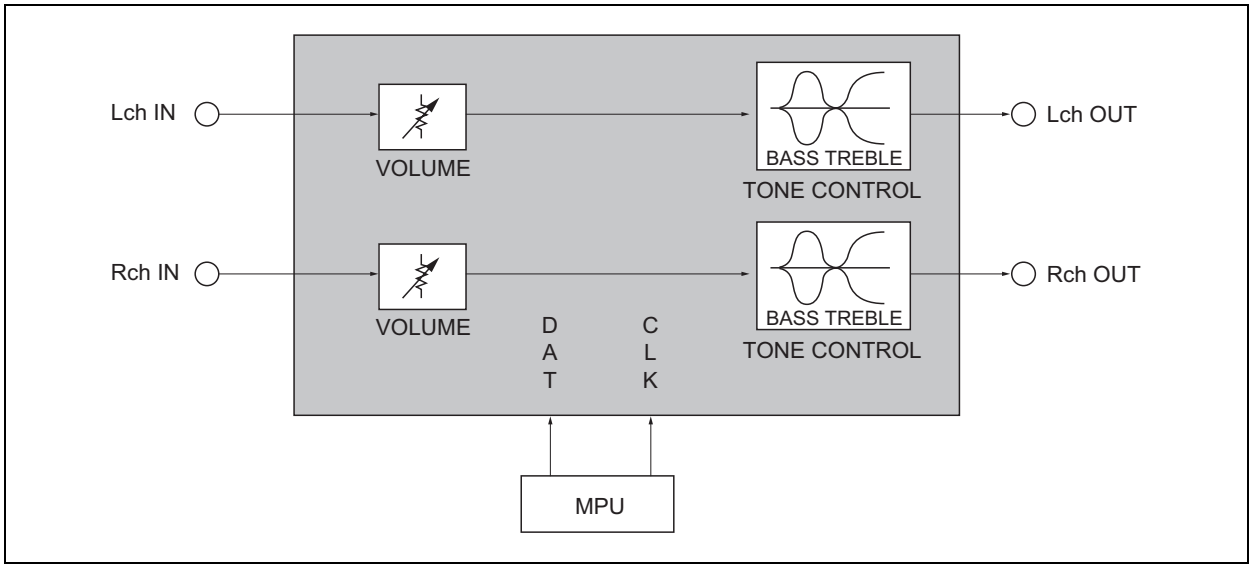
- Mini-Stereo, etc

Recommended Operating Condition

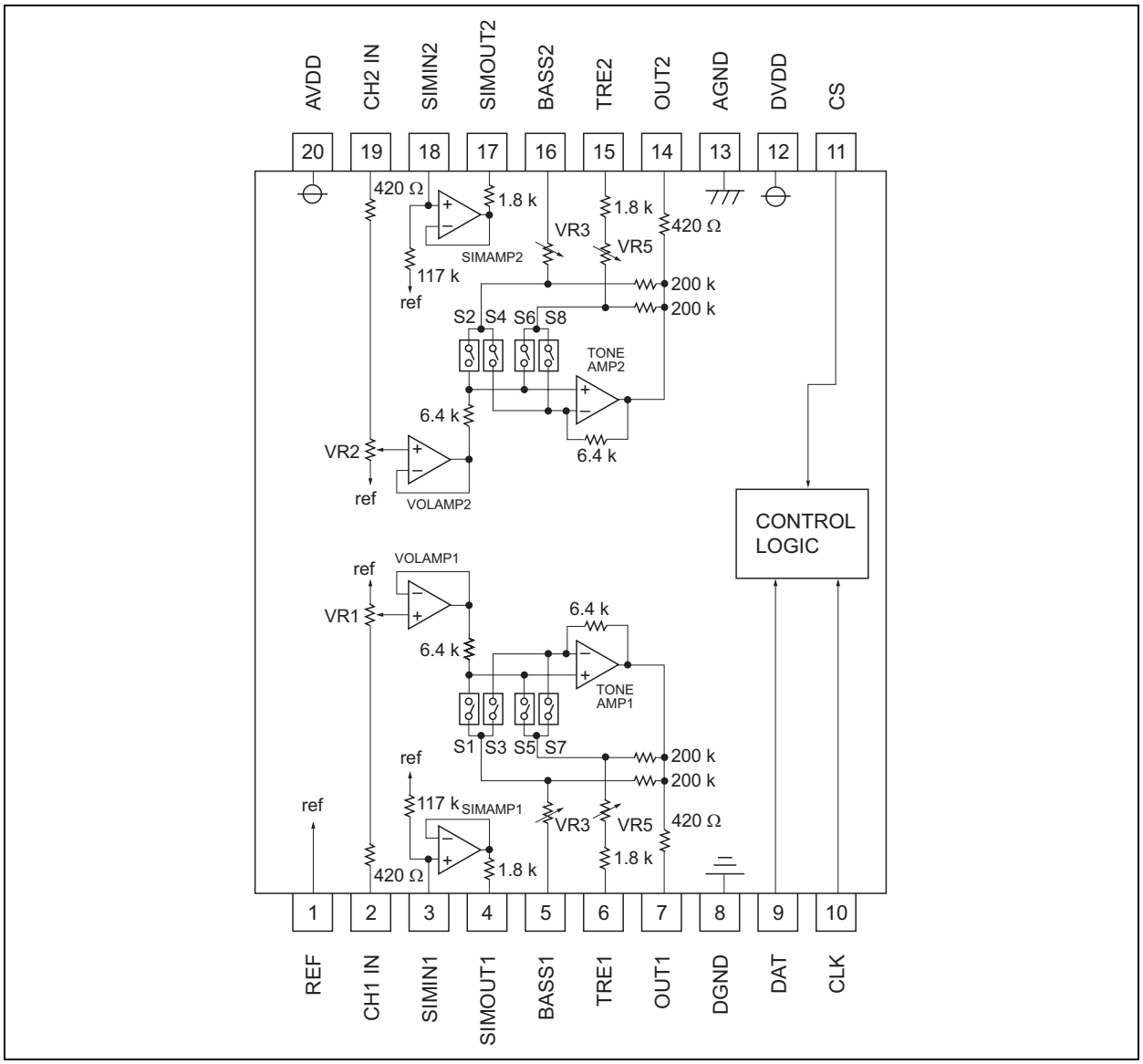
Supply voltage range: 5.5 ~ 9.5 V (analog), 4.5 ~ 5.5 V (digital)

Rated supply voltage: 9 V (analog), 5 V (digital)

System Block Diagram



Block Diagram

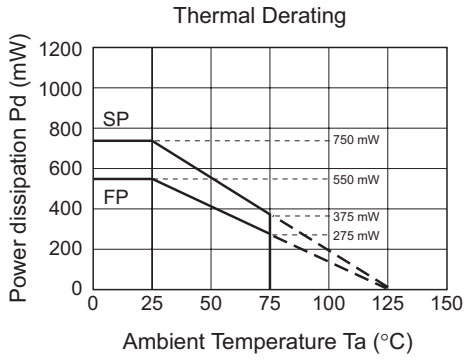


Pin Description

Pin No.	Pin Name	I/O	Description
1	REF	I	Reference voltage terminal for analog
2	CH1 IN	I	Input terminal (ch1)
3	SIMIN1	I	Pin for capacitor of simulated inductor 1
4	SIMOUT1	O	Pin for capacitor of simulated inductor 1
5	BASS1	I	Pin for capacitor of ch1-side bass setting
6	TRE1	I	Pin for capacitor of ch1-side treble setting
7	OUT1	O	Output terminal (ch1)
8	DGND	—	Digital GND
9	DAT	I	I/O terminal of DATA 2 line bus format
10	CLK	I	Input terminal of CLOCK 2 line bus format
11	CS	I	Chip select terminal
12	DVDD	—	VDD for digital circuit
13	AGND	—	GND for analog circuit
14	OUT2	O	Output terminal (ch2)
15	TRE2	I	Pin for capacitor of ch2-side treble setting
16	BASS2	I	Pin for capacitor of ch2-side bass setting
17	SIMOUT2	O	Pin for capacitor of simulated inductor 2
18	SIMIN2	I	Pin for capacitor of simulated inductor 2
19	CH2 IN	I	Input terminal (ch2)
20	AVDD	—	V_{CC} for analog circuit

Absolute Maximum Ratings

Item	Symbol	Limits	Unit	Condition
Analog supply voltage	AVdd	10.0	V	
Digital supply voltage	DVdd	7.0	V	
Power dissipation	Pd	750 (SP)	mW	Ta ≤ 25°C
		550 (FP)		
Thermal derating ratio	Kθ	7.5 (SP)	mW/°C	Ta > 25°C
		5.5 (FP)		
Operating temperature	Topr	–20 ~ +75	°C	
Storage temperature	Tstg	–40 ~ +125	°C	



Recommended Operating Condition

(Ta = 25°C unless otherwise noted)

Item	Symbol	Min	Typ	Max	Unit
Analog supply voltage	AVDD	5.5	9.0	9.5	V
Digital supply voltage	DVDD	4.5	5.0	5.5	V
H level input voltage (logic circuit)	VIH	0.7 DVDD	—	VDD	V
L level input voltage (logic circuit)	VIL	0	—	0.3 DVDD	V

Electric Characteristics

(Ta = 25°C, AVdd = 9 V, DVdd = 5 V and bass and treble = 0 dB unless otherwise noted)

(1) Supply Voltage

Item	Symbol	Limit			Unit	Condition
		Min	Typ	Max		
Analog supply current	Icc	—	10	20	mA	• AVdd = 9.0 V • measure terminal = 20 pin • no signal input
Digital supply current	Idd	—	0	2	μA	• DVdd = 5 V • measure terminal = 12 pin • no signal input

(2) I/O Characteristics

Item	Symbol	Limit			Unit	Condition
		Min	Typ	Max		
Maximum input voltage	VIM	2.0	3.2	—	Vrms	2, 19 pin input 7, 14 pin output RL = 10 kΩ, THD = 1%, f = 1 kHz ATT = –6 dB
Output voltage	Vodc	4.35	4.5	4.65	V	7 pin, 14 pin, no signal
Gain	Gv	–2	0	2	dB	Vin = 0 dBm, FLAT, f = 1 kHz 2 ~ 7 pin, 19 ~ 14 pin gain
Output noise voltage	Vono	—	4.5	10	μVrms	IHF-A filter no signal Rg = 10 kΩ 7, 14 pin
Total harmonic distortion	THD	—	0.007	0.1	%	7 pin, 14 pin f = 1 kHz Vo = 0.5 Vrms, RL = 10 kΩ LPF = 30 kHz
Channel separation	CT	—	–100	–70	dB	RL = 10 kΩ S: Vin = 1 Vrms, f = 1 kHz M: Rg = 10 kΩ, IHF-A filter

(3) Tone Characteristics

Item	Symbol	Limit			Unit	Condition
		Min	Typ	Max		
Tone control gain (bass)	Gbassb	9	12	15	dB	f = 100 Hz
	Gbassc	–15	–12	–9	dB	
Tone control gain (treble)	Gtrebb	9	12	15	dB	f = 10 kHz
	Gtrebc	–15	–12	–9	dB	

(4) Volume Characteristics

Item	Symbol	Limit			Unit	Condition
		Min	Typ	Max		
Maximum attenuation	ATTmax	–108	–100	–80	dB	f = 1 kHz, Vin = 0 dBm
Minimum attenuation	ATTmin	–1.5	0	1.5	dB	2 pin ~ 7 pin 19 pin ~ 14 pin gain IHF-A-filter

Function Explanation

Equivalent Circuit of Tone Control

The resonance circuit is able to construct by using built-in amplifier for simulated inductor. (Shows the constant as follow)

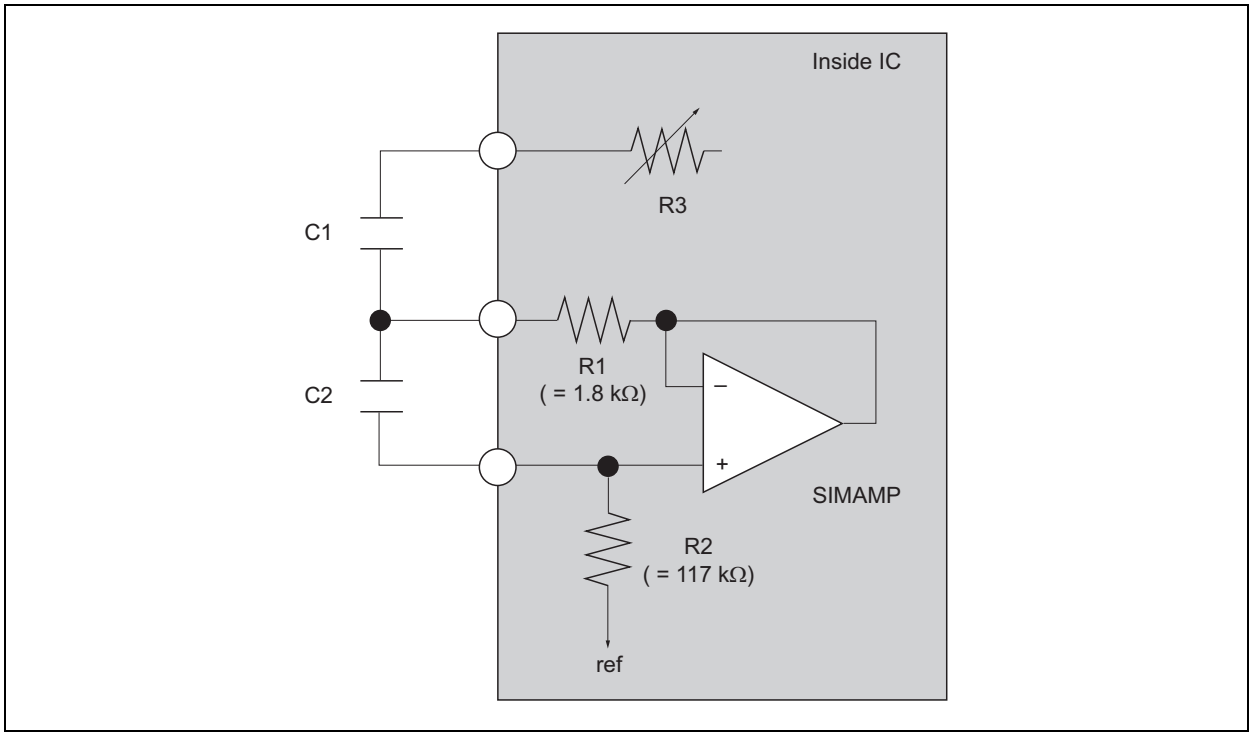


Figure 1 The circuit used simulated inductor

Center frequency:

$$f0 = 1 / 2\pi \sqrt{C1 \bullet C2 \bullet R1 \bullet R2}\ [Hz]$$

$$Q = \sqrt{(C2 \bullet R2) / (C1 \bullet R1)}$$

Example: BASS band (f ≈ 100 Hz)

R1 = 1.8 kΩ, R2 =117 kΩ

C1 = 0.47 μ, C2 = 0.022 μ

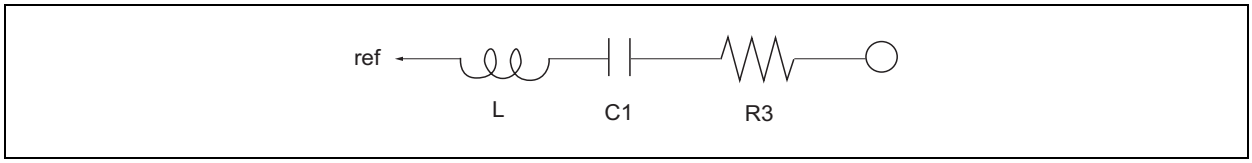


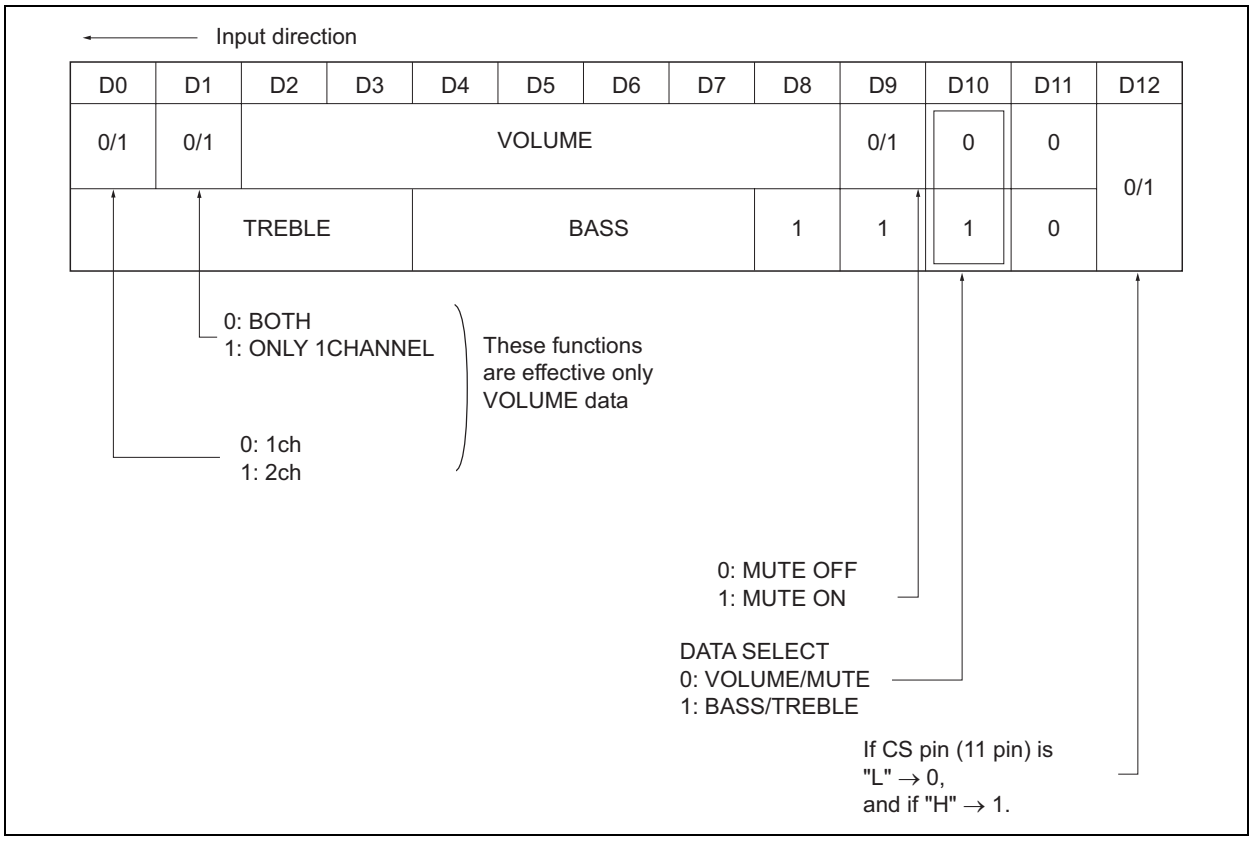
Figure 2 The equivalent circuit used L

Figure1 is equal to figure2.

The following relation is concluded.

$$L = C2 \bullet ER1 \bullet ER2$$

Input Data Format



Volume Control

Volume Code

ATT	D2	D3	D4	D5	D6
0 dB	H	L	H	L	H
–4 dB	L	L	H	L	H
–8 dB	H	H	L	L	H
–12 dB	L	H	L	L	H
–16 dB	H	L	L	L	H
–20 dB	L	L	L	L	H
–24 dB	H	H	H	H	L
–28 dB	L	H	H	H	L
–32 dB	H	L	H	H	L
–36 dB	L	L	H	H	L
–40 dB	H	H	L	H	L
–44 dB	L	H	L	H	L
–48 dB	H	L	L	H	L
–52 dB	L	L	L	H	L
–56 dB	H	H	H	L	L
–60 dB	L	H	H	L	L
–64 dB	H	L	H	L	L
–68 dB	L	L	H	L	L
–72 dB	H	H	L	L	L
–76 dB	L	H	L	L	L
–80 dB	H	L	L	L	L
–∞ dB	L	L	L	L	L

ATT	D7	D8
0 dB	H	H
–1 dB	L	H
–2 dB	H	L
–3 dB	L	L

Tone Level Control

Tone Code

	Bass				Treble			
	D7	D6	D5	D4	D3	D2	D1	D0
12 dB	L	H	H	L	L	H	H	L
10 dB	L	H	L	H	L	H	L	H
8 dB	L	H	L	L	L	H	L	L
6 dB	L	L	H	H	L	L	H	H
4 dB	L	L	H	L	L	L	H	L
2 dB	L	L	L	H	L	L	L	H
0 dB	L	L	L	L	L	L	L	L
–2 dB	H	L	L	H	H	L	L	H
–4 dB	H	L	H	L	H	L	H	L
–6 dB	H	L	H	H	H	L	H	H
–8 dB	H	H	L	L	H	H	L	L
–10 dB	H	H	L	H	H	H	L	H
–12 dB	H	H	H	L	H	H	H	L

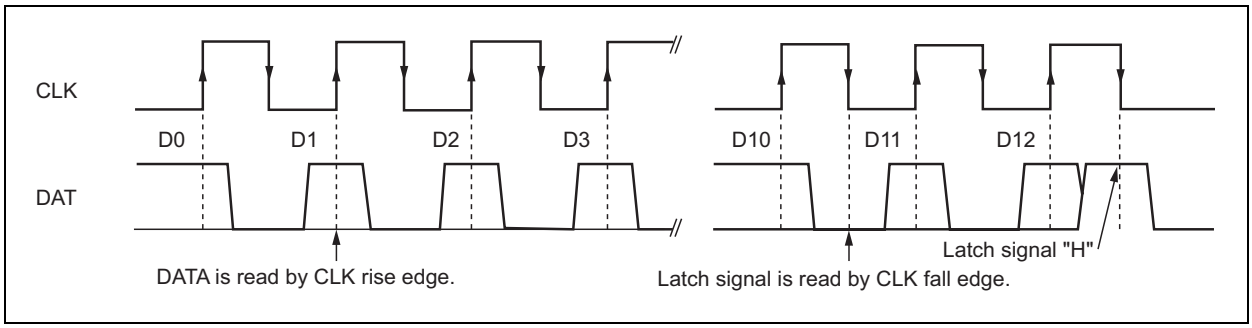
Note: Not used "HHHH", "LHHH", "HLLL"

Mute Control

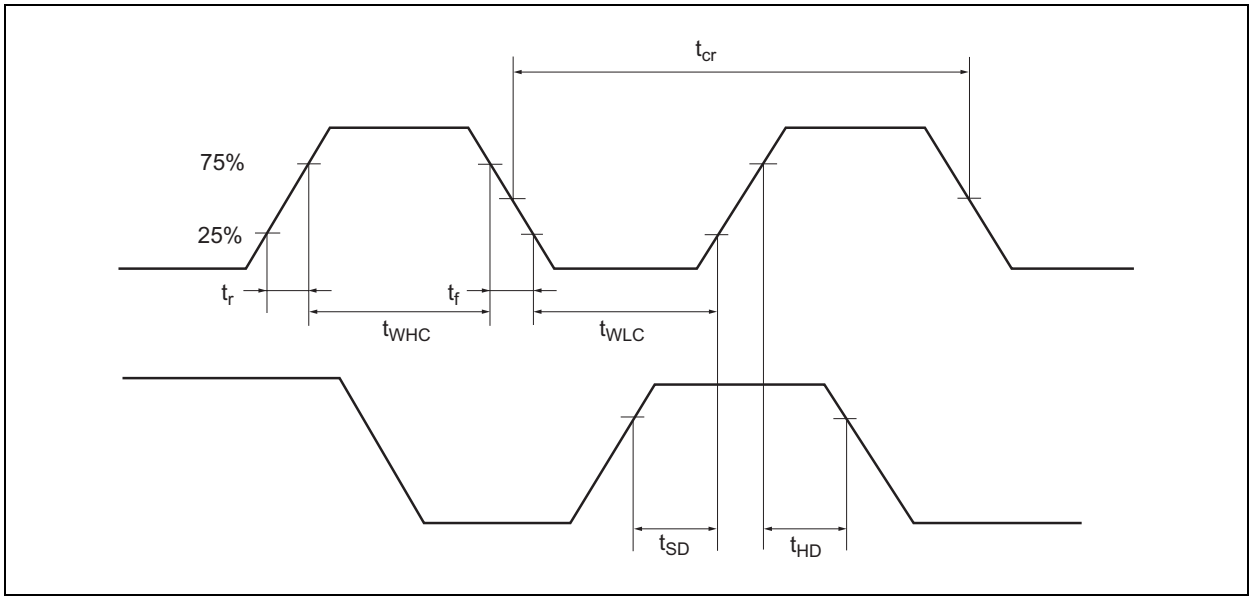
On condition D9 = 1, MUTE can be set up.

In MUTE, VOLUME LEVEL is set up VOL = –∞ automatically.

Data and Clock

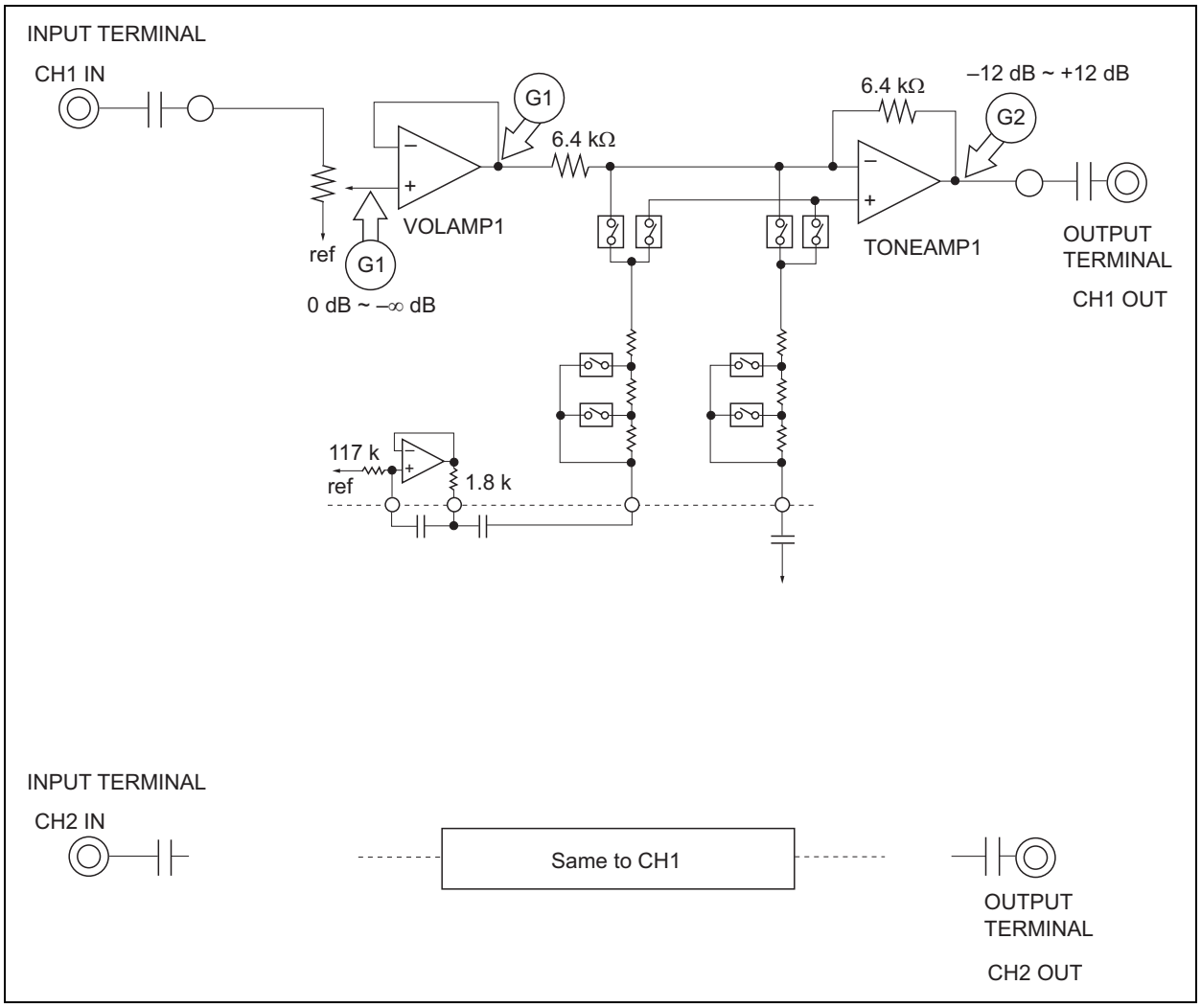


Bus Line Timing Specification

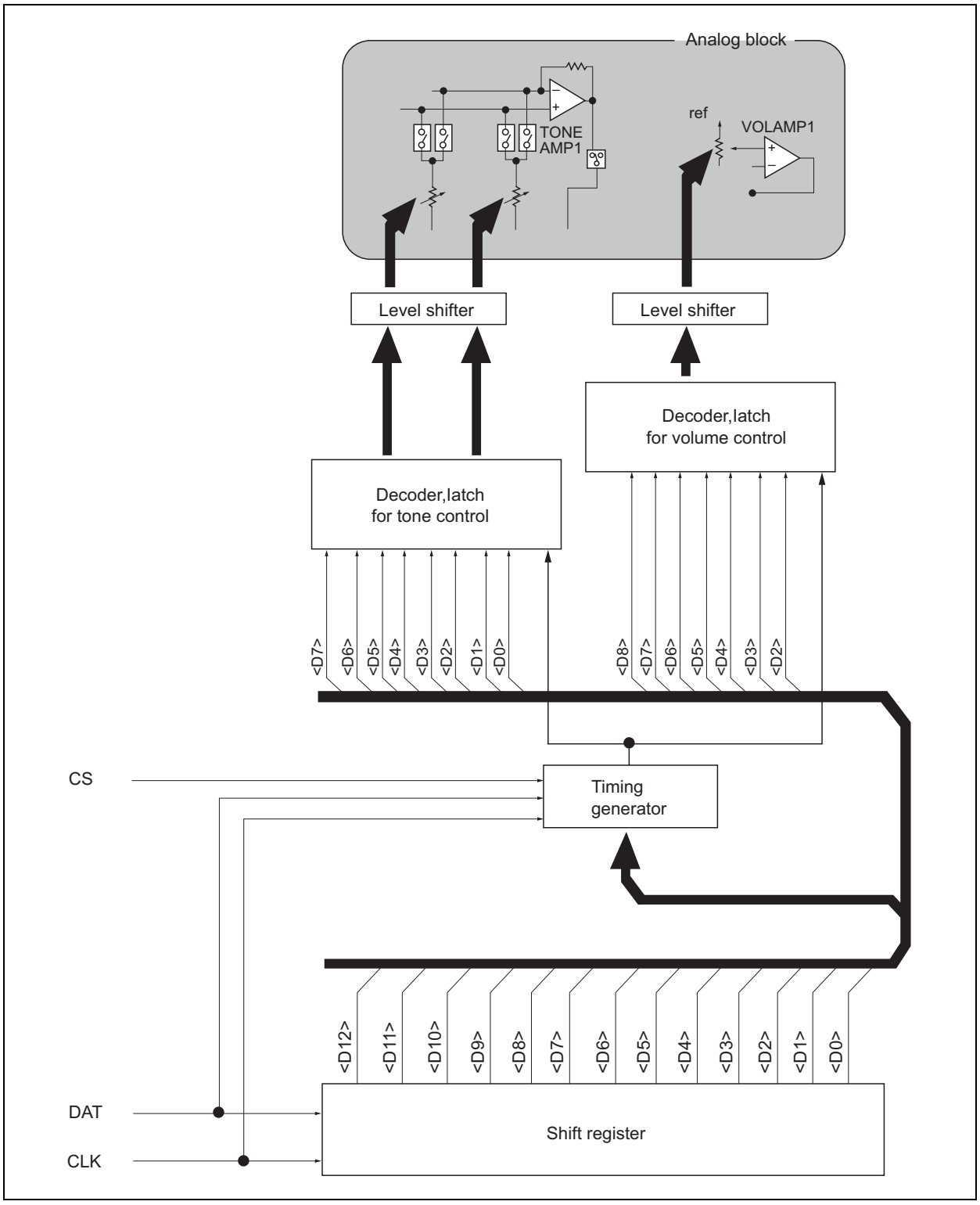


Item	Symbol	Min	Max	Units
CLK clock frequency	t_{cr}	4	—	µs
The HIGH period of the clock	t_{WHC}	1.6	—	µs
The LOW period of the clock	t_{WLC}	1.6	—	µs
Rise time of CLK line	t_r	—	0.4	µs
Fall time of CLK line	t_f	—	0.4	µs
Set-up time DATA	t_{SD}	0.8	—	µs
Hold time DATA	t_{HD}	0.8	—	µs

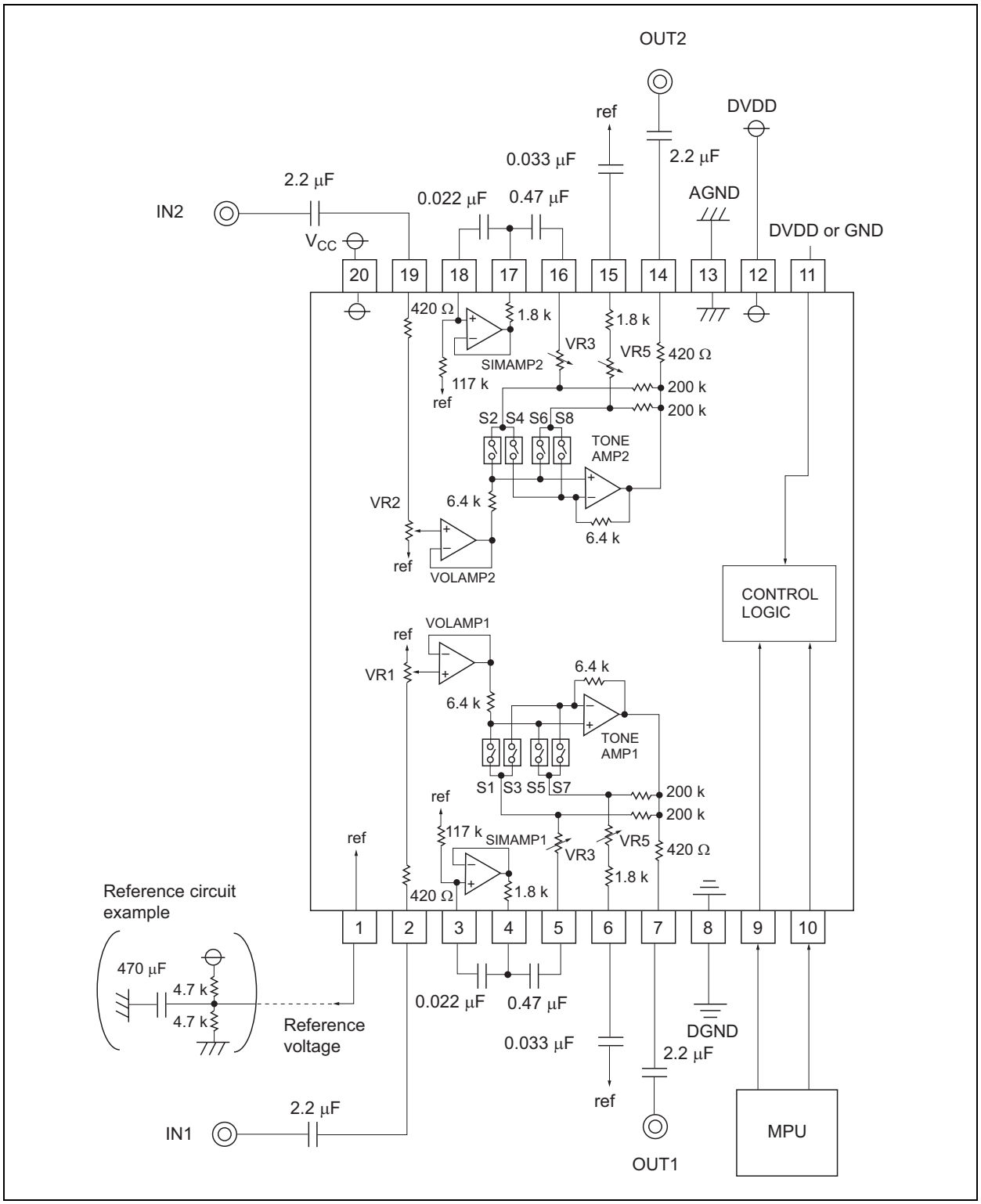
Level Diagram



Logic Circuit

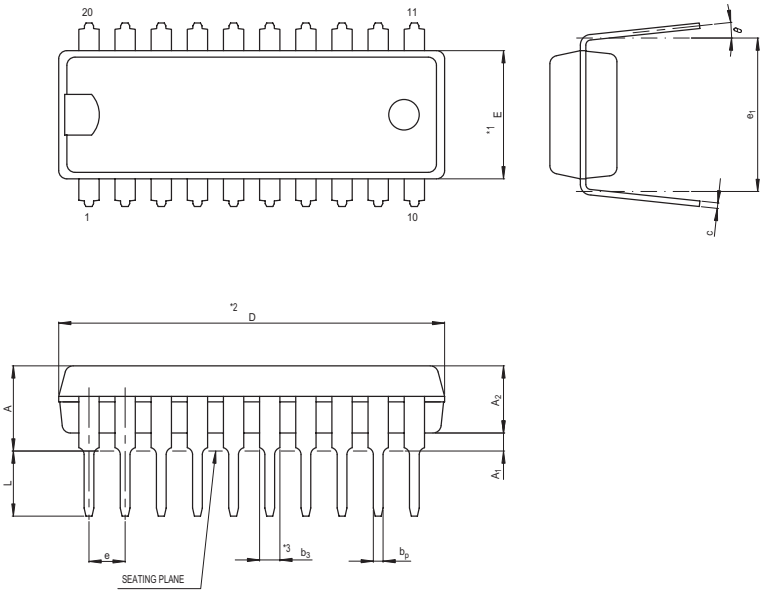


Application Example



Package Dimensions

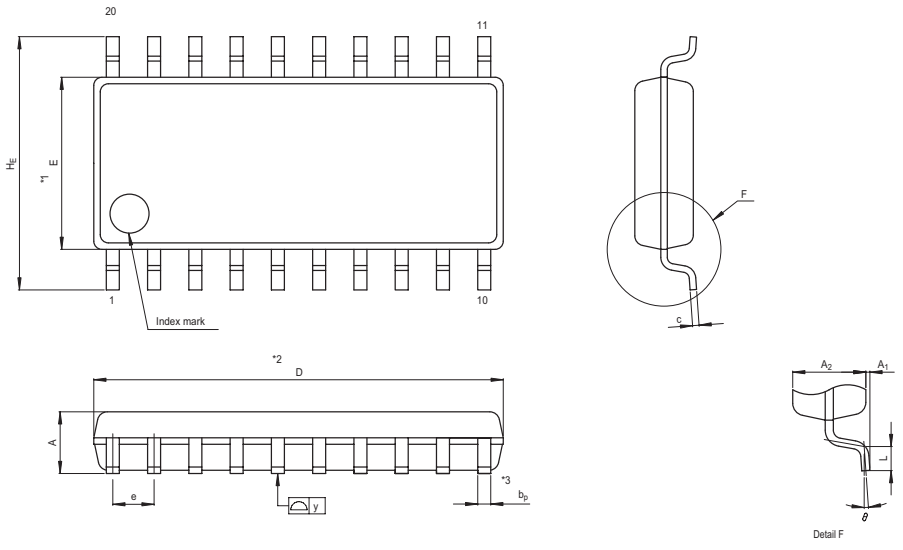
JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SDIP20-6.3x19-1.78	PRDP0020BA-A	20P4B	1.0g



NOTE)
1. DIMENSIONS "*1" AND "*2" DO NOT INCLUDE MOLD FLASH.
2. DIMENSION "*3" DOES NOT INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
e_1	7.32	7.62	7.92
D	18.8	19.0	19.2
E	6.15	6.3	6.45
A	—	—	4.5
A_1	0.51	—	—
A_2	—	3.3	—
b_p	0.38	0.48	0.58
b_3	0.9	1.0	1.3
c	0.22	0.27	0.34
θ	0°	—	15°
e	1.528	1.778	2.028
L	3.0	—	—

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SOP20-5.3x12.6-1.27	PRSP0020DA-A	20P2N-A	0.3g



NOTE)
1. DIMENSIONS "*1" AND "*2" DO NOT INCLUDE MOLD FLASH.
2. DIMENSION "*3" DOES NOT INCLUDE TRIM OFFSET.

Reference Symbol	Dimension in Millimeters		
	Min	Nom	Max
D	12.5	12.6	12.7
E	5.2	5.3	5.4
A_2	—	1.8	—
A_1	0	0.1	0.2
A	—	—	2.1
b_p	0.35	0.4	0.5
c	0.18	0.2	0.25
θ	0°	—	8°
H_E	7.5	7.8	8.1
e	1.12	1.27	1.42
y	—	—	0.1
L	0.4	0.6	0.8

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