To our customers,

Old Company Name in Catalogs and Other Documents

On April 1st, 2010, NEC Electronics Corporation merged with Renesas Technology Corporation, and Renesas Electronics Corporation took over all the business of both companies. Therefore, although the old company name remains in this document, it is a valid Renesas Electronics document. We appreciate your understanding.

Renesas Electronics website: http://www.renesas.com

April 1st, 2010
Renesas Electronics Corporation

Issued by: Renesas Electronics Corporation (http://www.renesas.com)

Send any inquiries to http://www.renesas.com/inquiry.

Notice

1. All information included in this document is current as of the date this document is issued. Such information, however, is subject to change without any prior notice. Before purchasing or using any Renesas Electronics products listed herein, please confirm the latest product information with a Renesas Electronics sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas Electronics such as that disclosed through our website.
2. Renesas Electronics does not assume any liability for infringement of patents, copyrights, or other intellectual property rights of third parties by or arising from the use of Renesas Electronics products or technical information described in this document. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
3. You should not alter, modify, copy, or otherwise misappropriate any Renesas Electronics product, whether in whole or in part.
4. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation of these circuits, software, and information in the design of your equipment. Renesas Electronics assumes no responsibility for any losses incurred by you or third parties arising from the use of these circuits, software, or information.
5. When exporting the products or technology described in this document, you should comply with the applicable export control laws and regulations and follow the procedures required by such laws and regulations. You should not use Renesas Electronics products or the technology described in this document for any purpose relating to military applications or use by the military, including but not limited to the development of weapons of mass destruction. Renesas Electronics products and technology may not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations.
6. Renesas Electronics has used reasonable care in preparing the information included in this document, but Renesas Electronics does not warrant that such information is error free. Renesas Electronics assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
7. Renesas Electronics products are classified according to the following three quality grades: "Standard", "High Quality", and "Specific". The recommended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below. You must check the quality grade of each Renesas Electronics product before using it in a particular application. You may not use any Renesas Electronics product for any application categorized as "Specific" without the prior written consent of Renesas Electronics. Further, you may not use any Renesas Electronics product for any application for which it is not intended without the prior written consent of Renesas Electronics. Renesas Electronics shall not be in any way liable for any damages or losses incurred by you or third parties arising from the use of any Renesas Electronics product for an application categorized as "Specific" or for which the product is not intended where you have failed to obtain the prior written consent of Renesas Electronics. The quality grade of each Renesas Electronics product is "Standard" unless otherwise expressly specified in a Renesas Electronics data sheets or data books, etc.

   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; and industrial robots.

   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control systems; anti-disaster systems; anti-crime systems; safety equipment; and medical equipment not specifically designed for life support.

   "Specific": Aircraft; aerospace equipment; submersible repeaters; nuclear reactor control systems; medical equipment or systems for life support (e.g. artificial life support devices or systems), surgical implantations, or healthcare intervention (e.g. excision, etc.), and any other applications or purposes that pose a direct threat to human life.
8. You should use the Renesas Electronics products described in this document within the range specified by Renesas Electronics, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas Electronics shall have no liability for malfunctions or damages arising out of the use of Renesas Electronics products beyond such specified ranges.
9. Although Renesas Electronics endeavors to improve the quality and reliability of its products, semiconductor products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Further, Renesas Electronics products are not subject to radiation resistance design. Please be sure to implement safety measures to guard them against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas Electronics product, such as safety design for hardware and software including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
10. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. Please use Renesas Electronics products in compliance with all applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive. Renesas Electronics assumes no liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
11. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products, or if you have any other inquiries.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its majority-owned subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

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

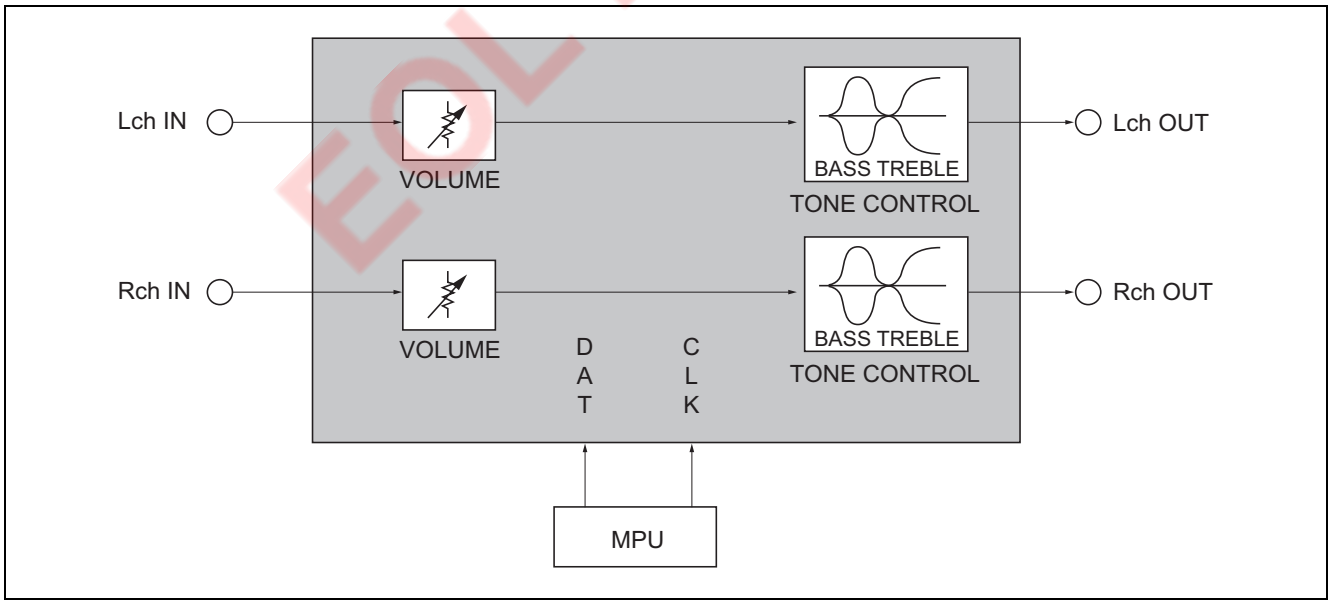
- Mini-Stereo, etc

Recommended Operating Condition

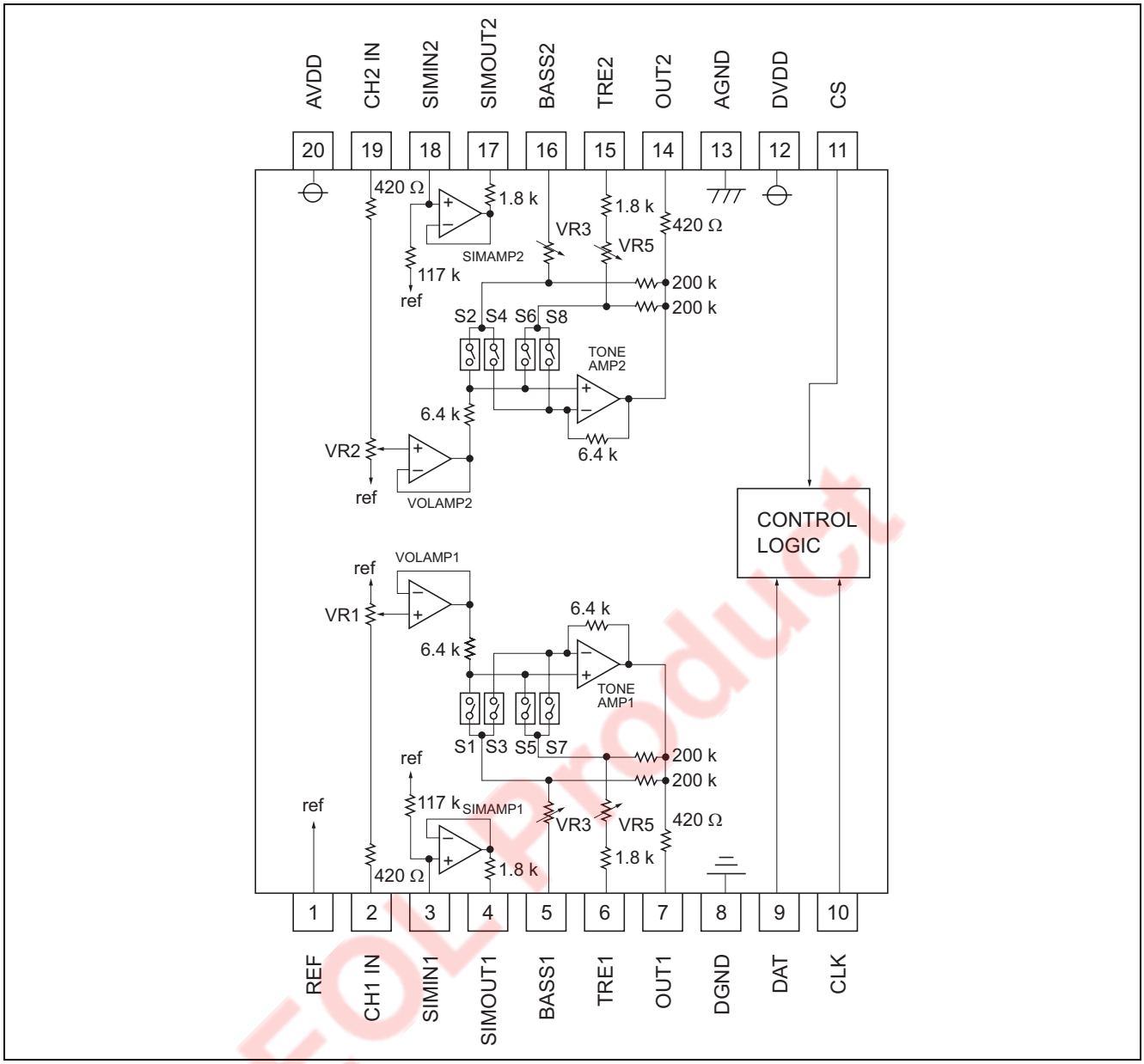
Supply voltage range: 5.5 ~ 9.5 V (analog), 4.5 ~ 5.5 V (digital)

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

System Block Diagram



Block Diagram

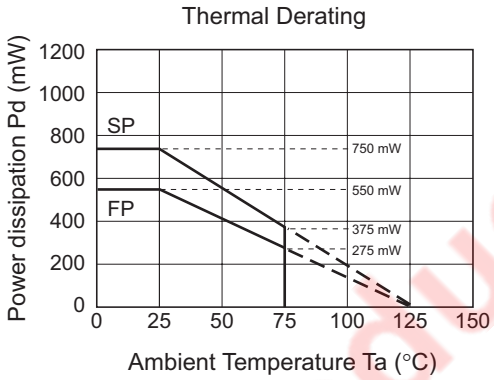


Pin Description

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 2 pin ~ 7 pin 19 pin ~ 14 pin gain IHF-A-filter
Minimum attenuation	ATTmin	–1.5	0	1.5	dB	

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)

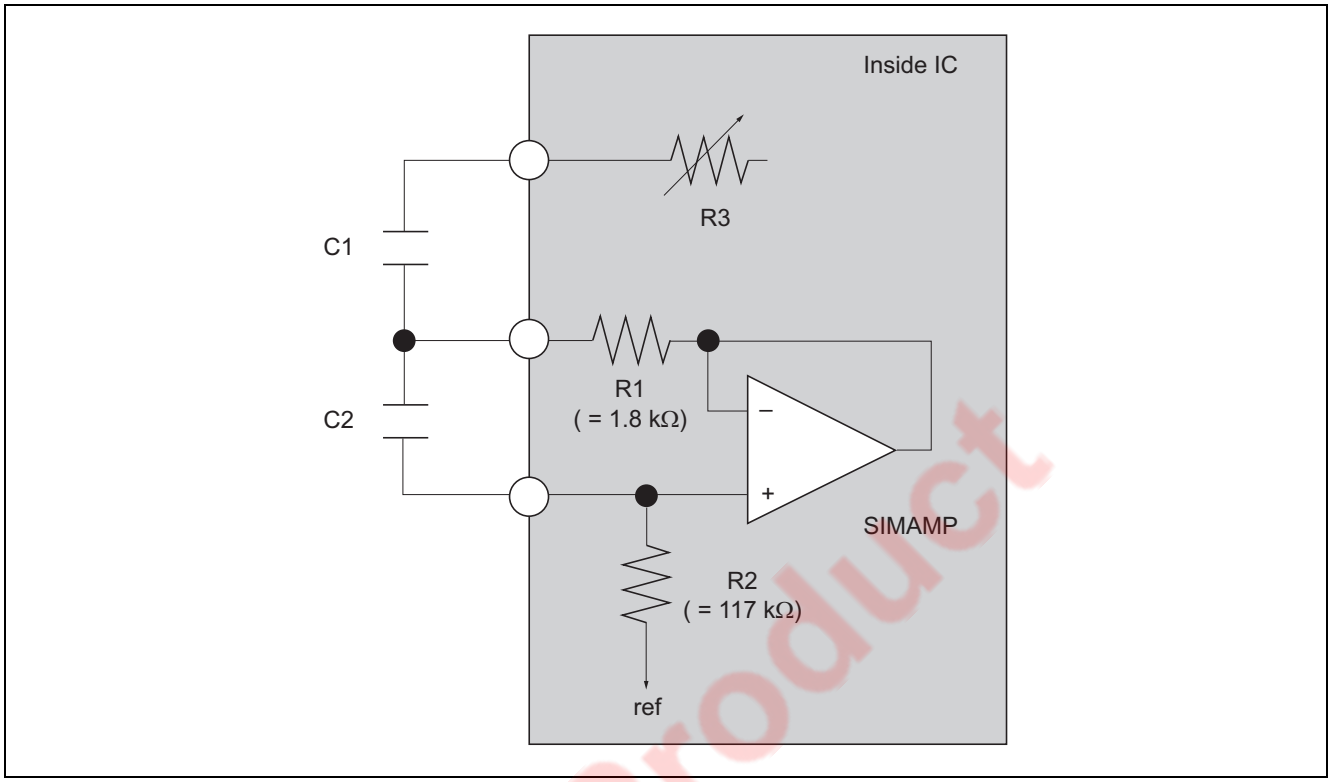


Figure 1 The circuit used simulated inductor

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

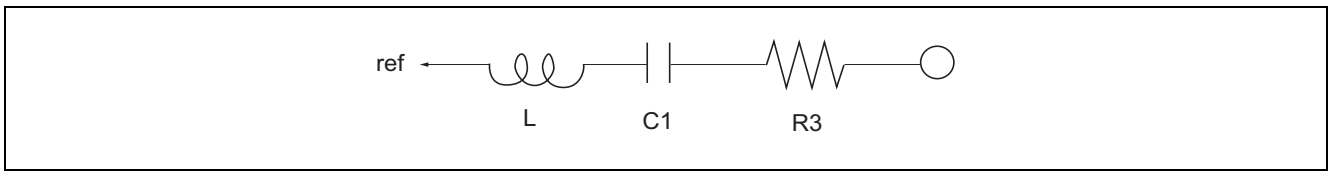


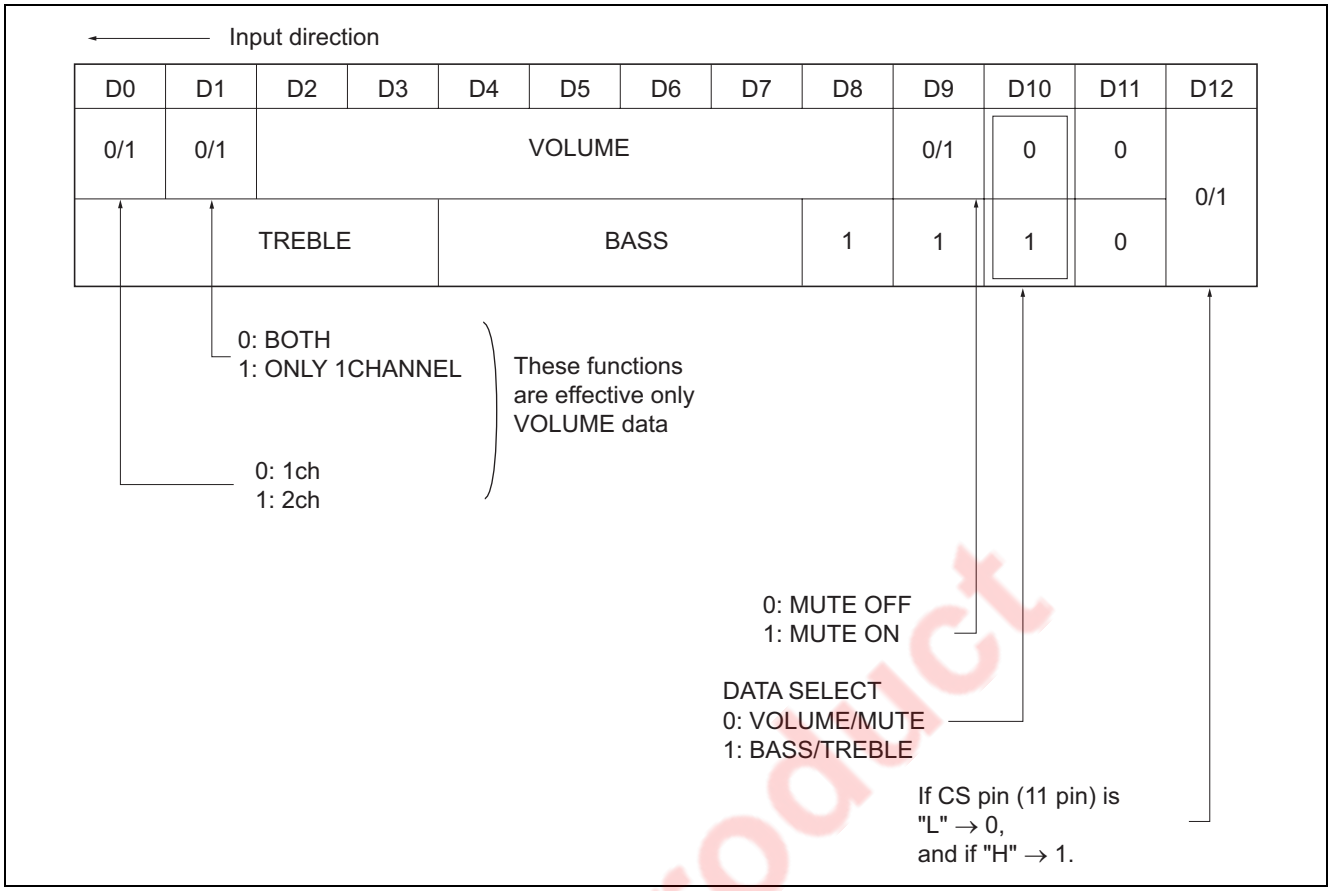
Figure 2 The equivalent circuit used L

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

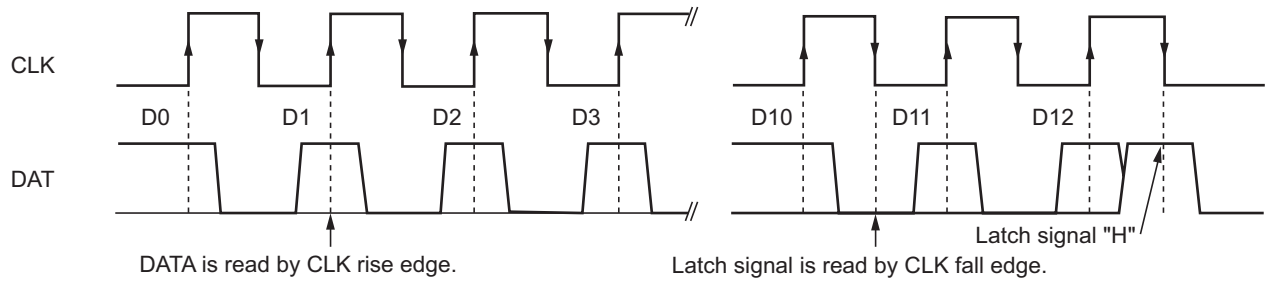
Note: Not used "HHHH", "LHHH", "HLLL"

Mute Control

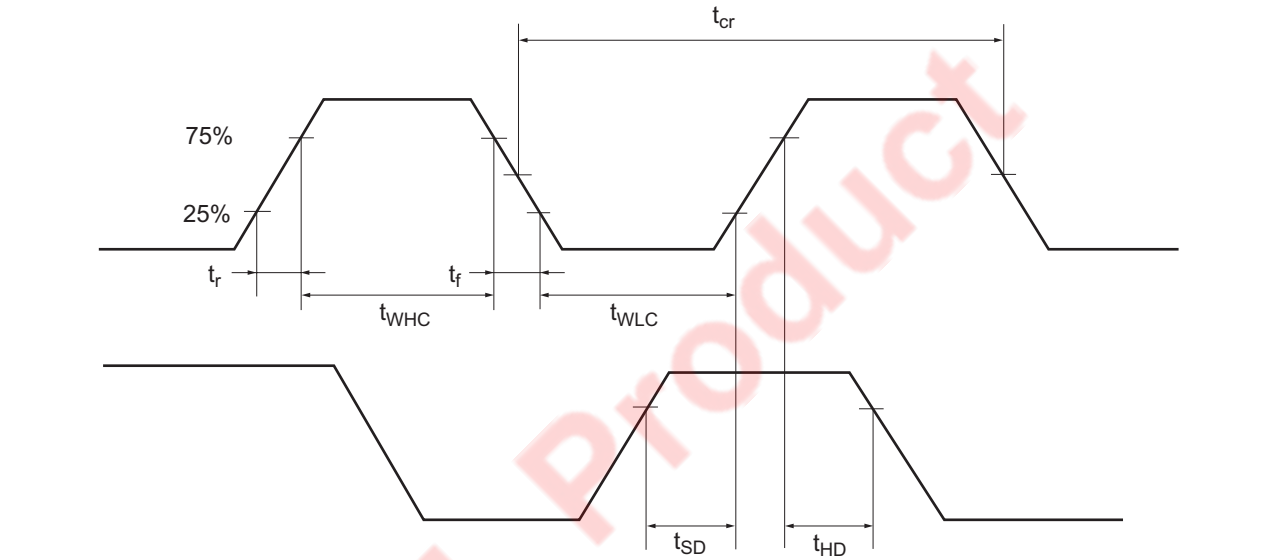
On condition D9 = 1, MUTE can be set up.

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

Data and Clock

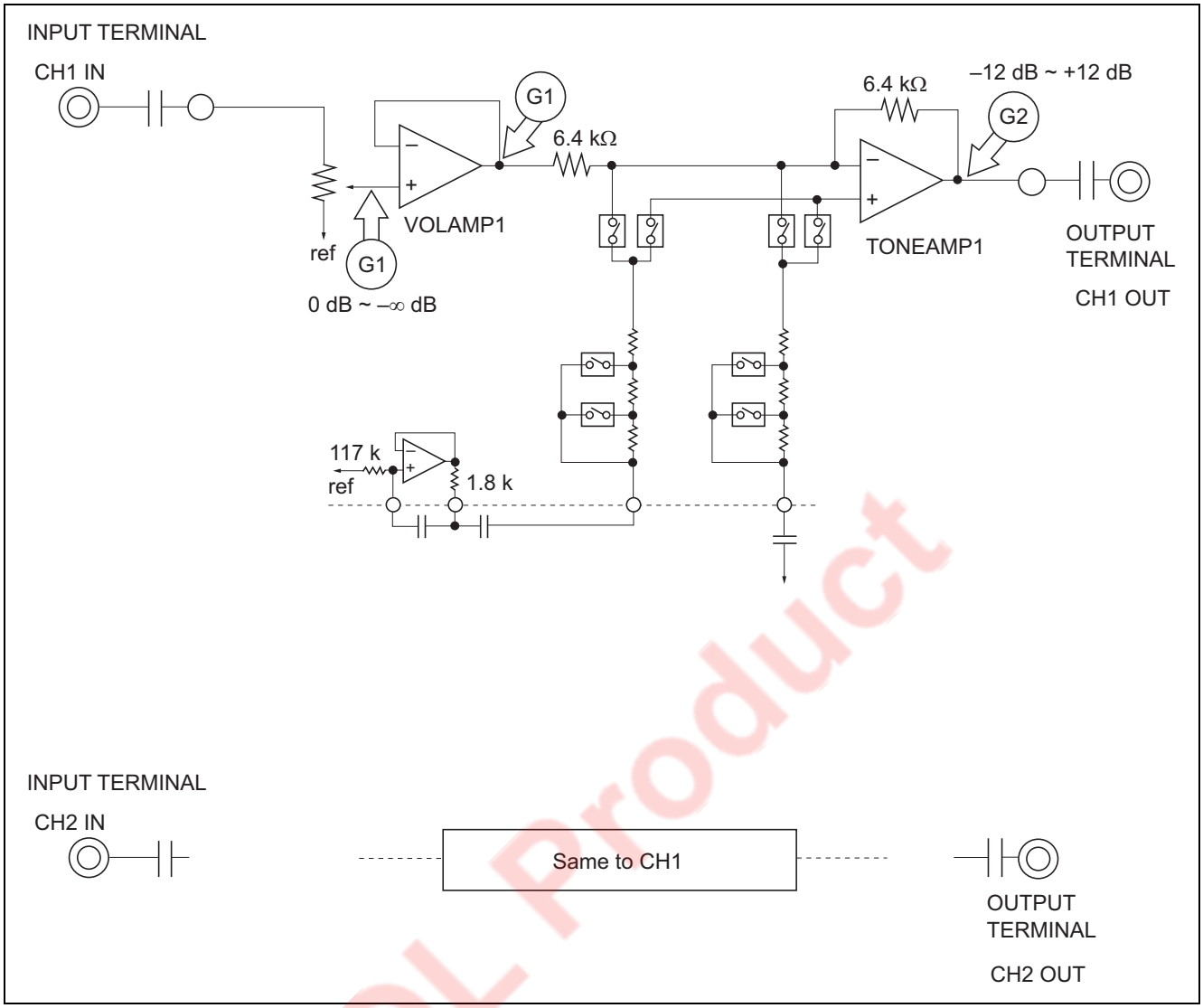


Bus Line Timing Specification

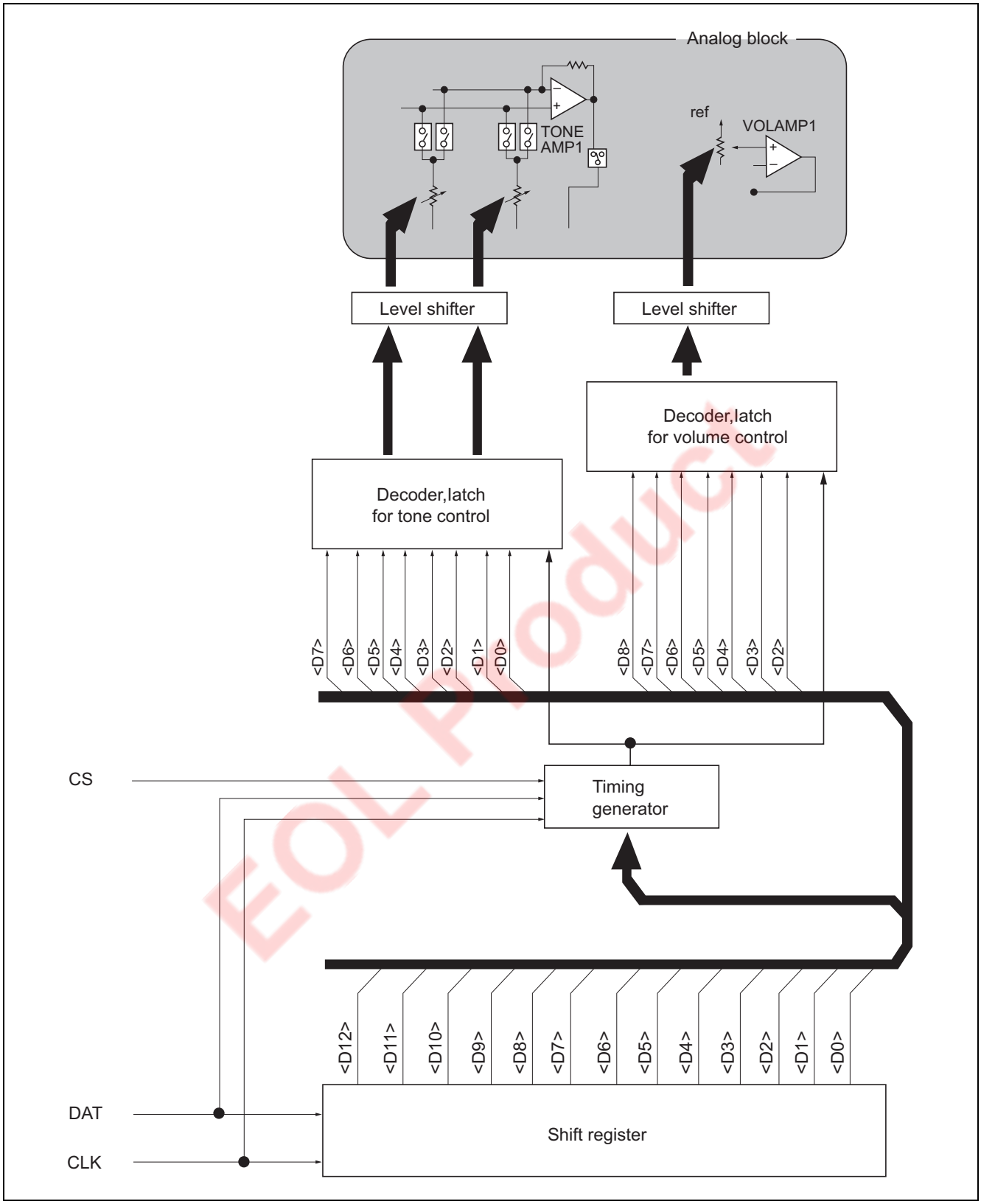


Item	Symbol	Min	Max	Units
CLK clock frequency	t_{cr}	4	—	µs
The HIGH period of the clock	t_{WHC}	1.6	—	µs
The LOW period of the clock	t_{WLC}	1.6	—	µs
Rise time of CLK line	t_r	—	0.4	µs
Fall time of CLK line	t_f	—	0.4	µs
Set-up time DATA	t_{SD}	0.8	—	µs
Hold time DATA	t_{HD}	0.8	—	µs

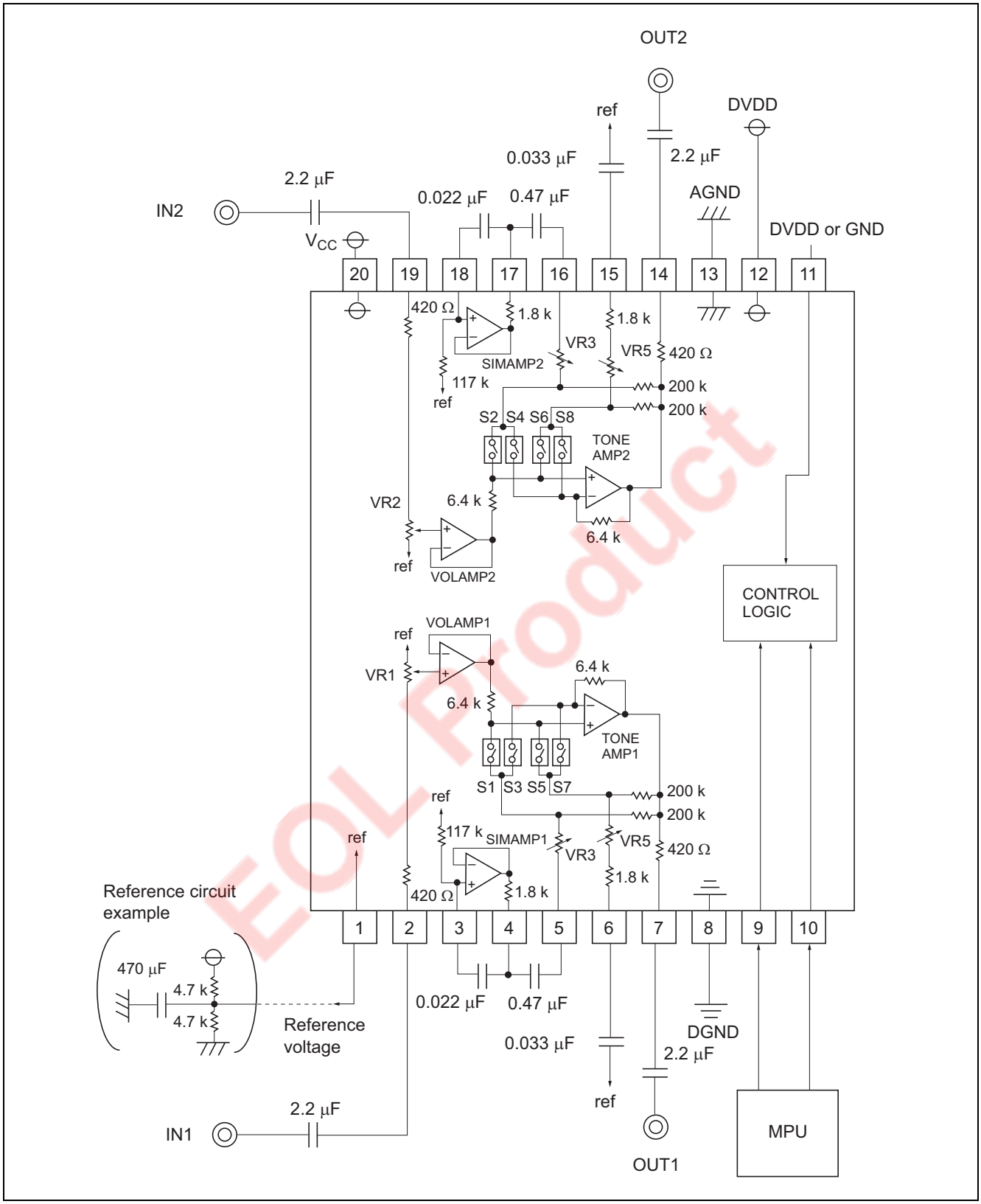
Level Diagram



Logic Circuit

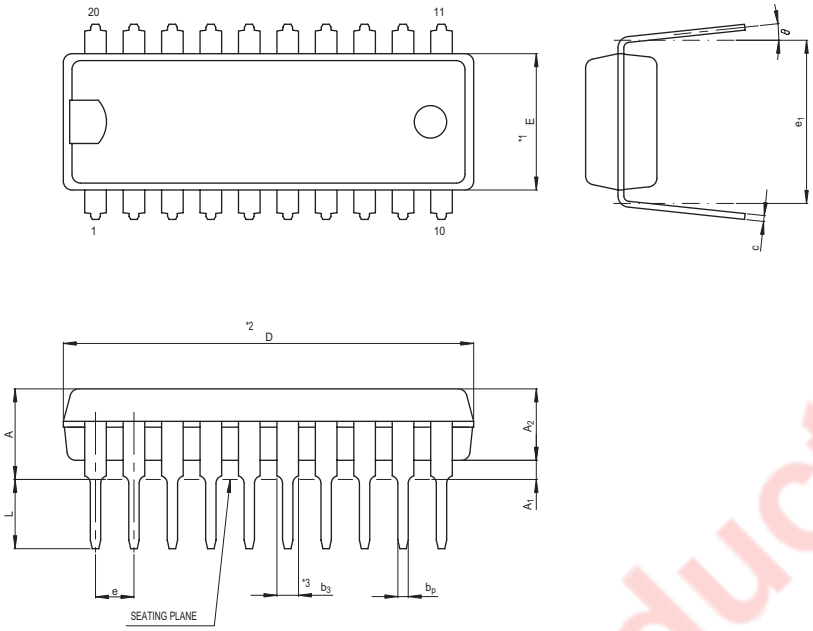


Application Example



Package Dimensions

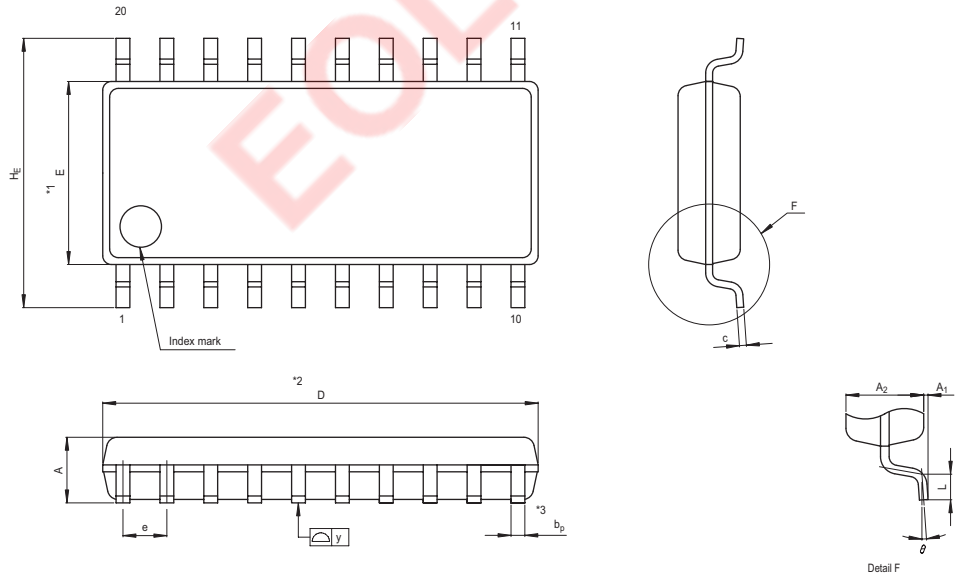
JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SDIP20-6.3x19-1.78	PRDP0020BA-A	20P4B	1.0g



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

Renesas Technology Corp. Sales Strategic Planning Div. Nippon Bldg., 2-6-2, Ohte-machi, Chiyoda-ku, Tokyo 100-0004, Japan

RENESAS SALES OFFICES

http://www.renesas.com

Refer to "**http://www.renesas.com/en/network**" for the latest and detailed information.

Renesas Technology America, Inc.
450 Holger Way, San Jose, CA 95134-1368, U.S.A
Tel: <1> (408) 382-7500, Fax: <1> (408) 382-7501

Renesas Technology Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K.
Tel: <44> (1628) 585-100, Fax: <44> (1628) 585-900

Renesas Technology (Shanghai) Co., Ltd.
Unit 204, 205, AZIACenter, No.1233 Lujiazui Ring Rd, Pudong District, Shanghai, China 200120
Tel: <86> (21) 5877-1818, Fax: <86> (21) 6887-7858/7898

Renesas Technology Hong Kong Ltd.
7th Floor, North Tower, World Finance Centre, Harbour City, Canton Road, Tsimshatsui, Kowloon, Hong Kong
Tel: <852> 2265-6688, Fax: <852> 2377-3473

Renesas Technology Taiwan Co., Ltd.
10th Floor, No.99, Fushing North Road, Taipei, Taiwan
Tel: <886> (2) 2715-2888, Fax: <886> (2) 3518-3399

Renesas Technology Singapore Pte. Ltd.
1 Harbour Front Avenue, #06-10, Keppel Bay Tower, Singapore 098632
Tel: <65> 6213-0200, Fax: <65> 6278-8001

Renesas Technology Korea Co., Ltd.
Kukje Center Bldg. 18th Fl., 191, 2-ka, Hangang-ro, Yongsan-ku, Seoul 140-702, Korea
Tel: <82> (2) 796-3115, Fax: <82> (2) 796-2145

Renesas Technology Malaysia Sdn. Bhd
Unit 906, Block B, Menara Amcorp, Amcorp Trade Centre, No.18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: <603> 7955-9390, Fax: <603> 7955-9510

Colophon .7.2