

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.
 $V_{NO} = 4.5 \mu V_{rms}$, THD = 0.1% max
- Controlling by 2 Line serial data.

Application

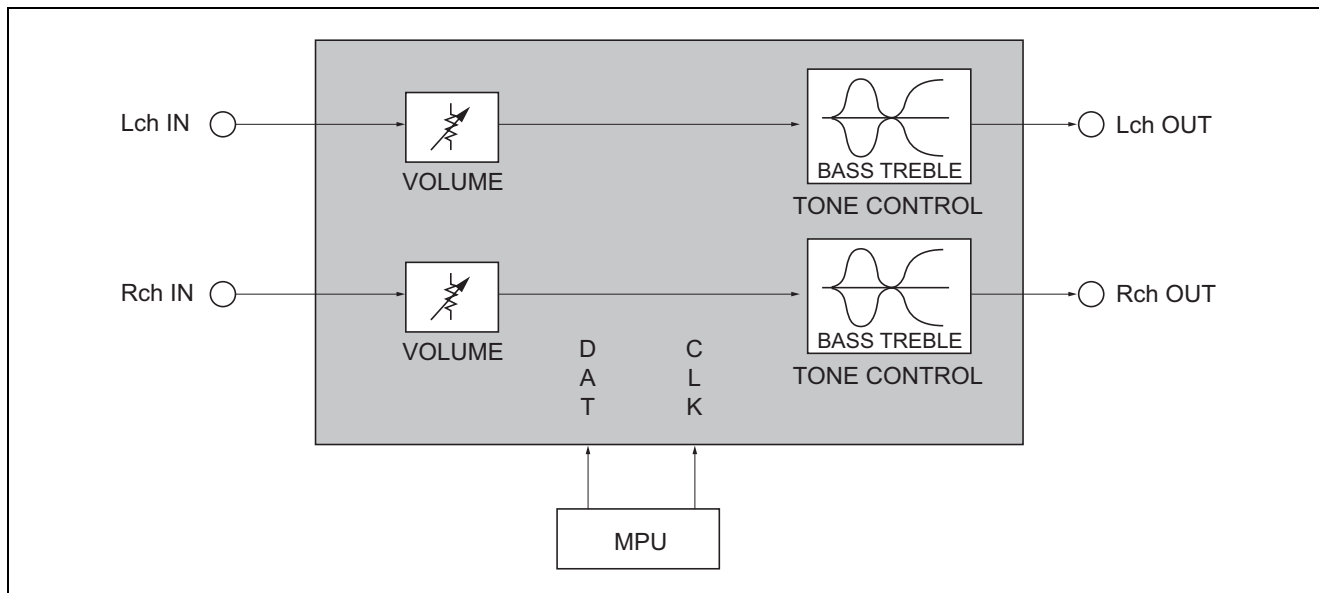
- Mini-Stereo, etc

Recommended Operating Condition

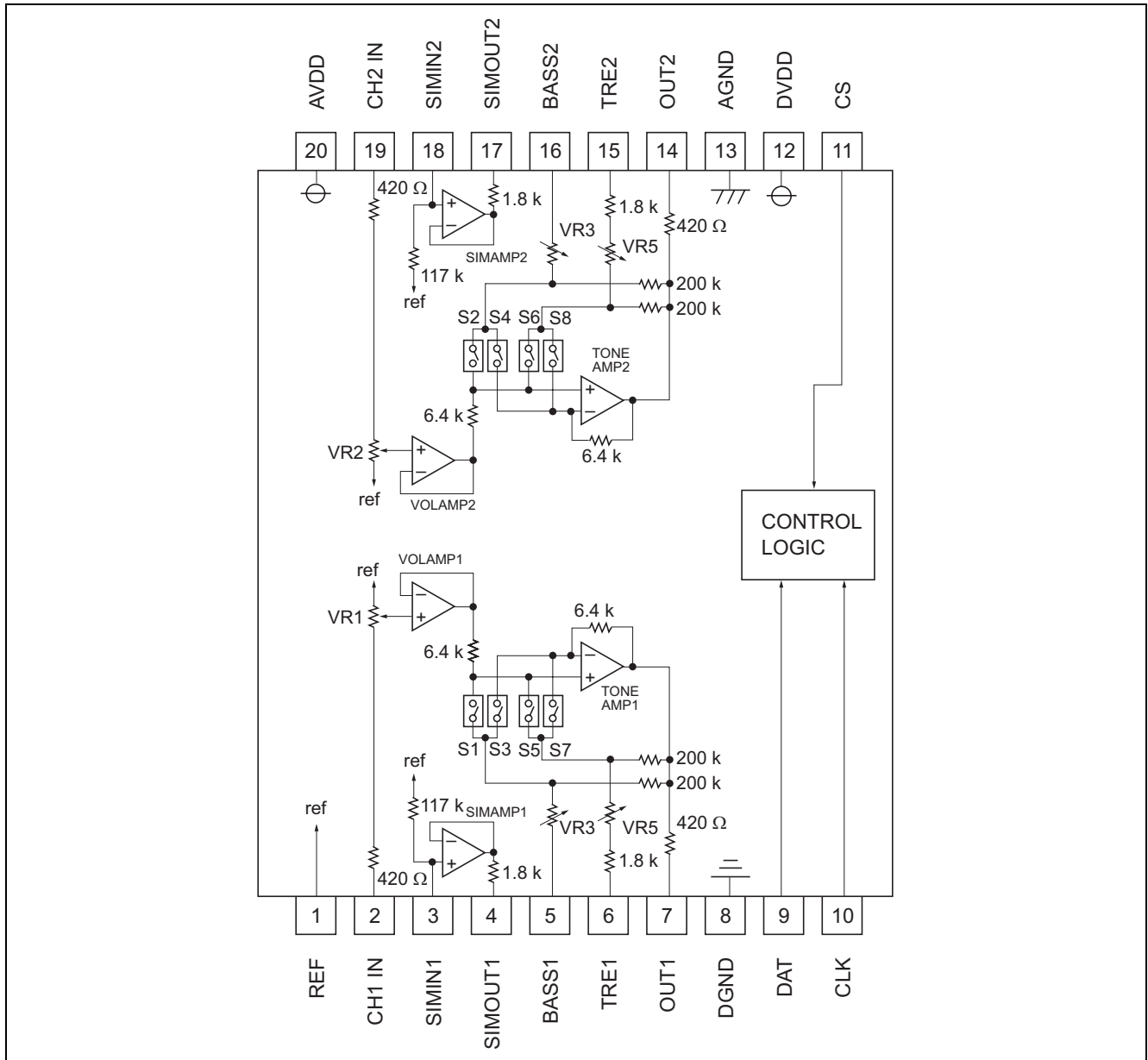
Supply voltage range: 5.5 ~ 9.5 V (analog), 4.5 ~ 5.5 V (digital)

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

System Block Diagram



Block Diagram

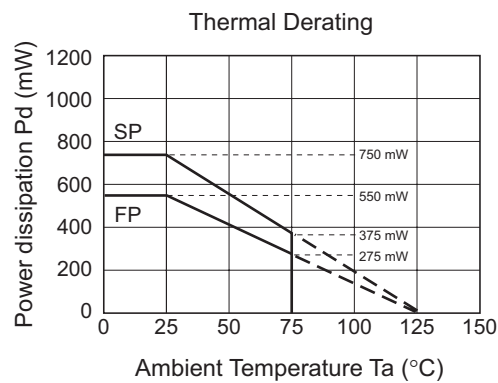


Pin Description

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)

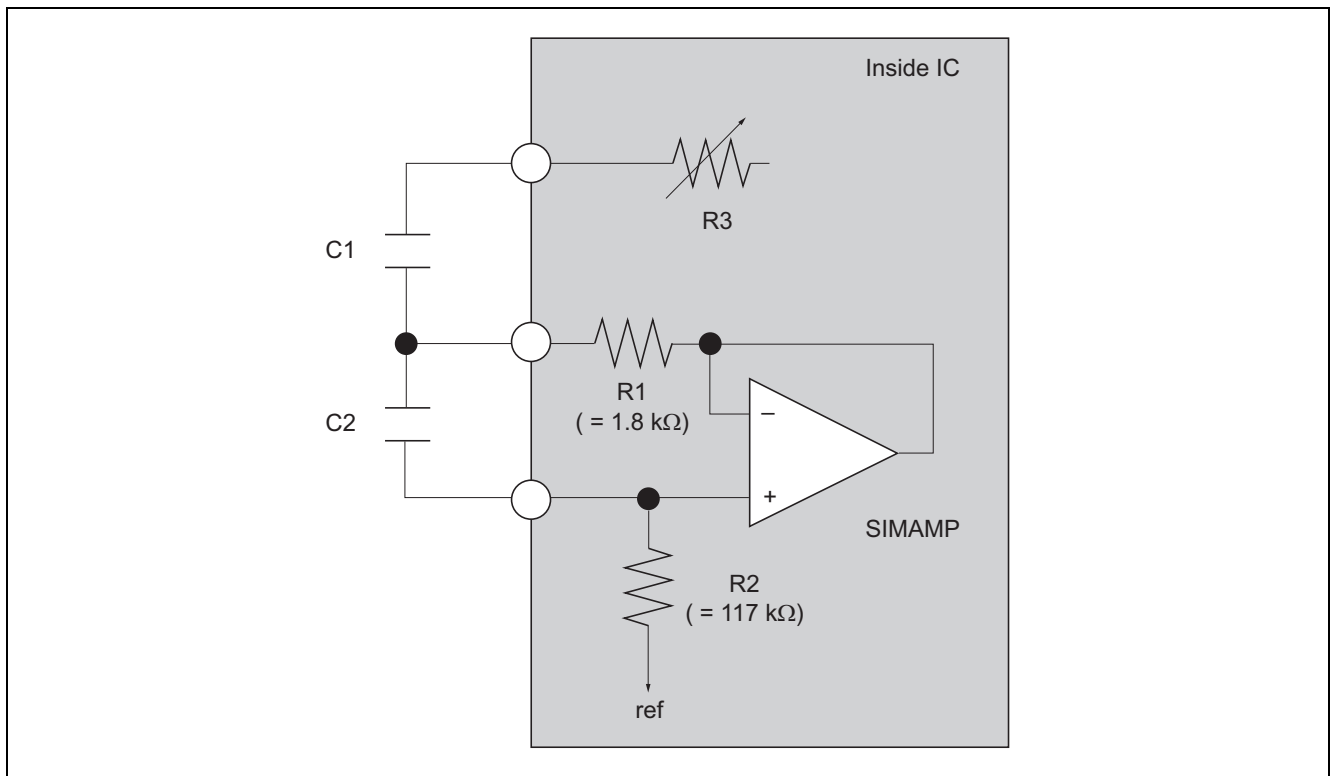


Figure 1 The circuit used simulated inductor

Center frequency:

$$f_0 = 1 / 2\pi \sqrt{C1 \cdot C2 \cdot R1 \cdot R2} \text{ [Hz]}$$

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

Example: BASS band ($f \approx 100 \text{ Hz}$)

$$R1 = 1.8 \text{ k}\Omega, R2 = 117 \text{ k}\Omega$$

$$C1 = 0.47 \text{ }\mu, C2 = 0.022 \text{ }\mu$$

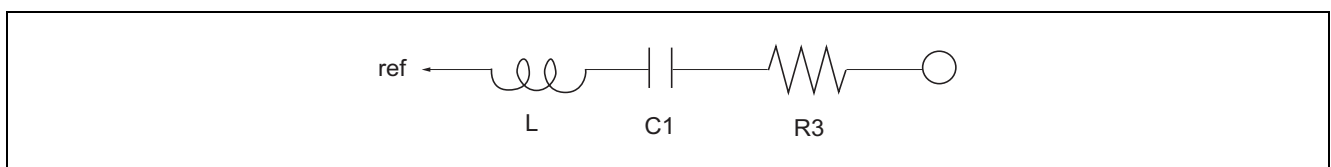


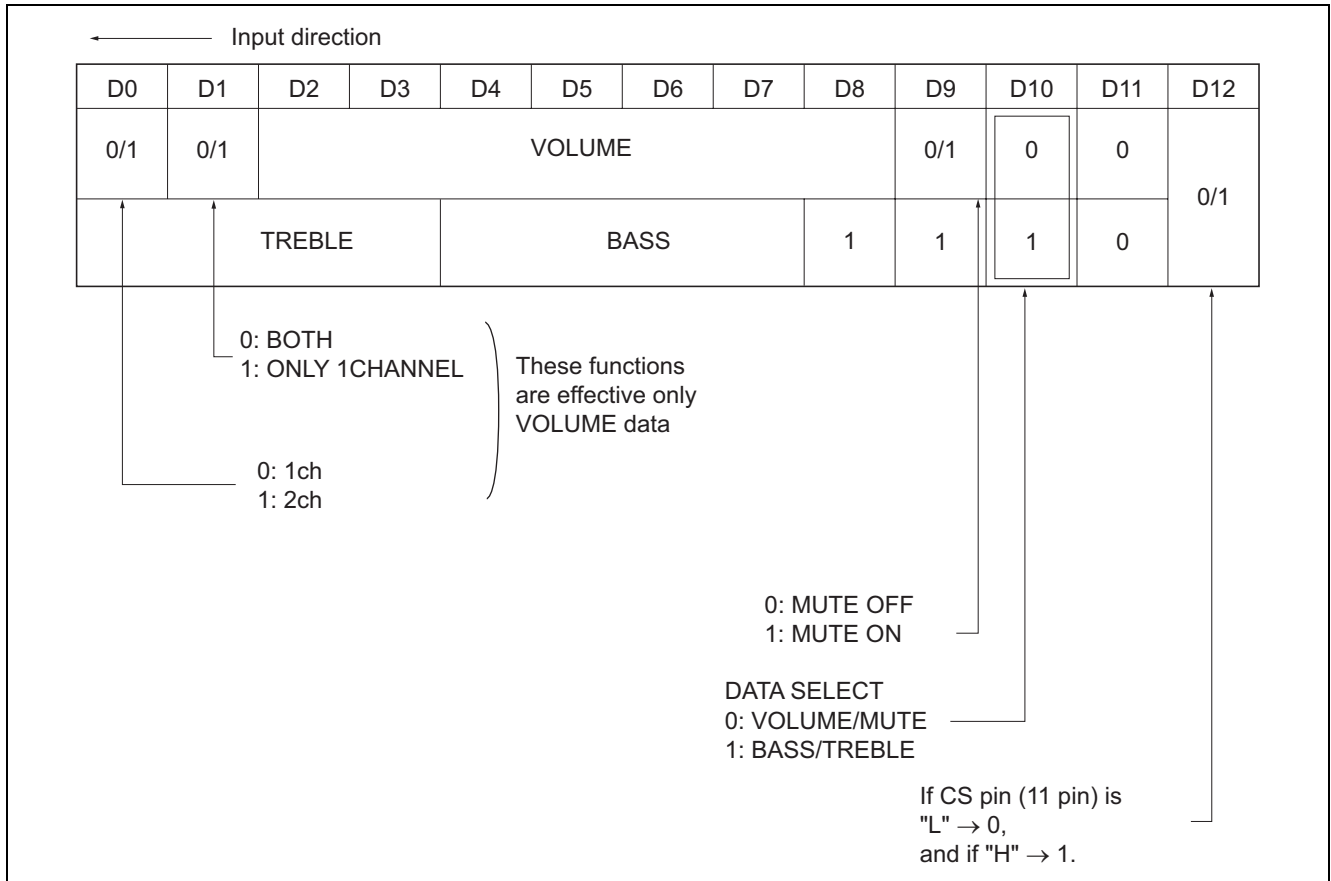
Figure 2 The equivalent circuit used L

Figure1 is equal to figure2.

The following relation is concluded.

$$L = C2 \cdot R1 \cdot R2$$

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
$-\infty$ 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

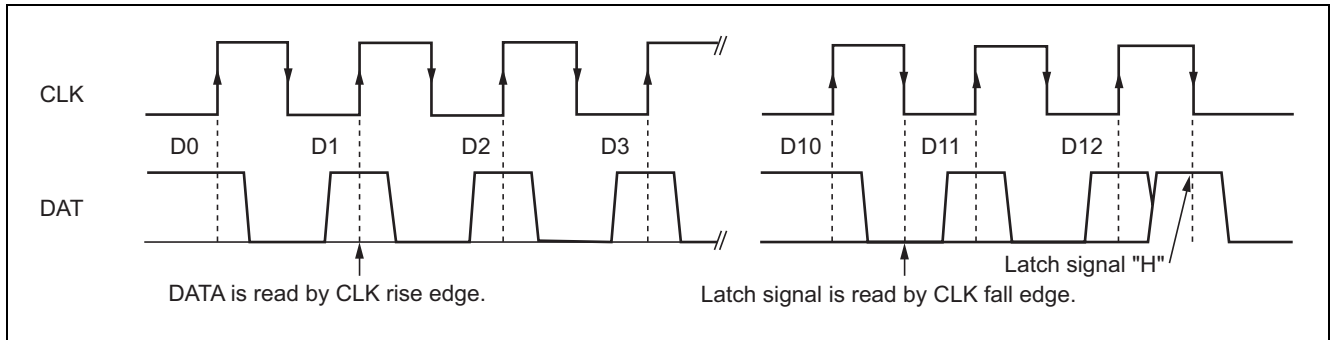
Note: Not used "HHHH", "LHHH", "HLLL"

Mute Control

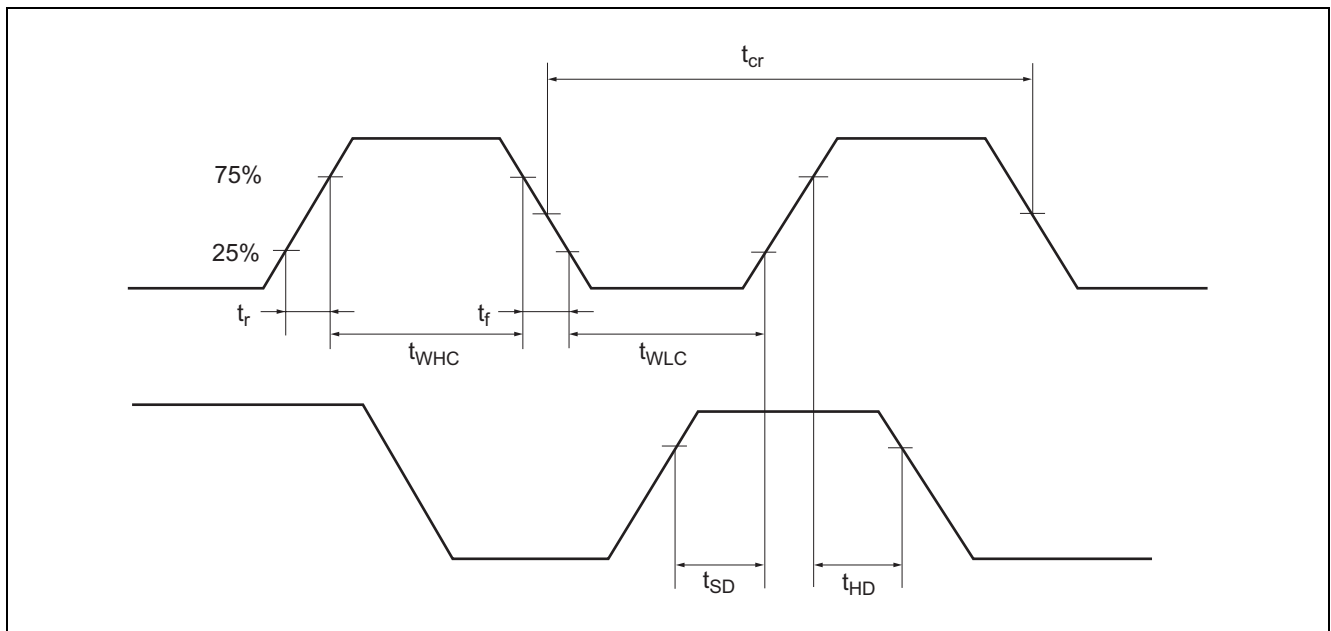
On condition D9 = 1, MUTE can be set up.

In MUTE, VOLUME LEVEL is set up VOL = $-\infty$ automatically.

Data and Clock

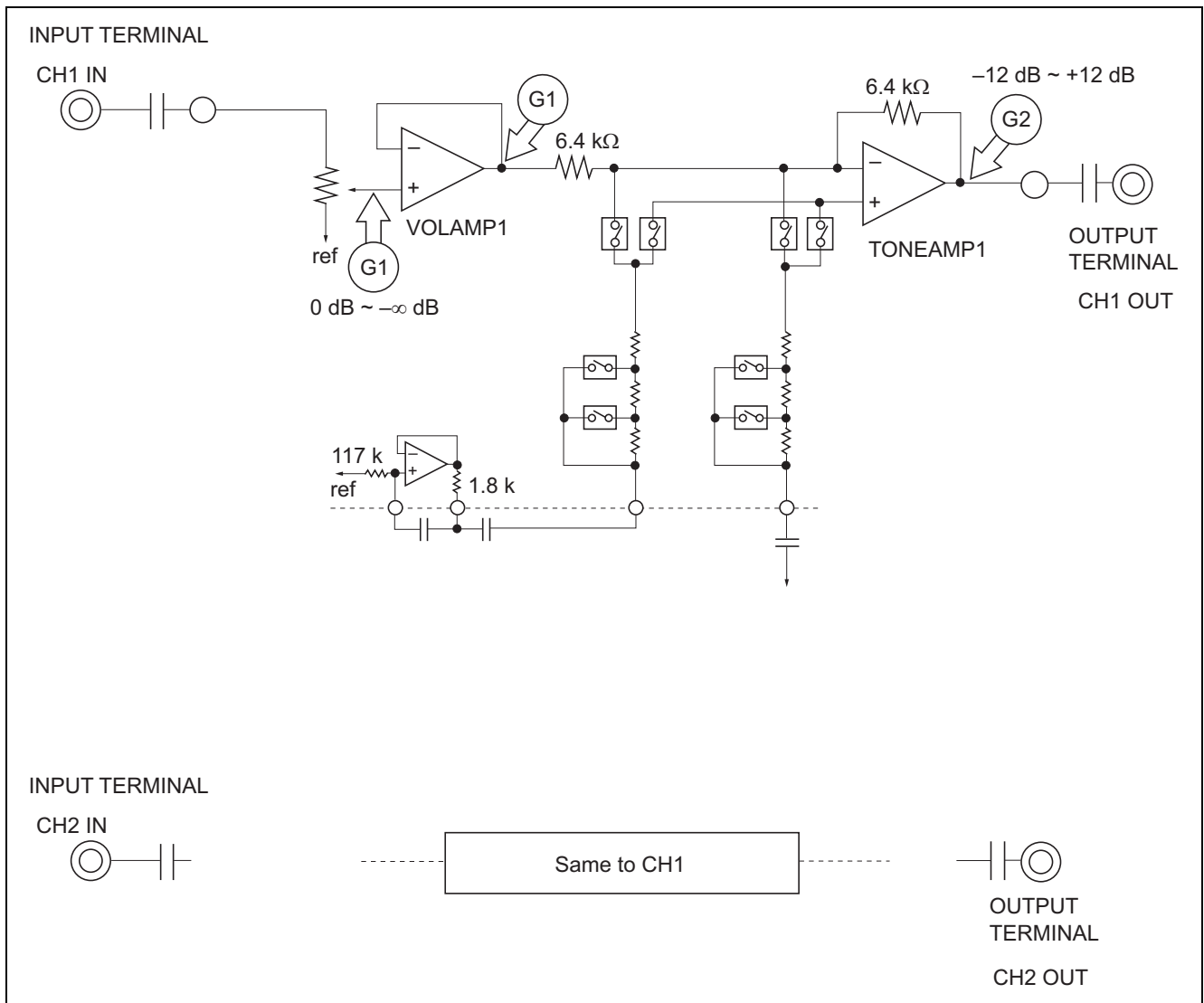


Bus Line Timing Specification

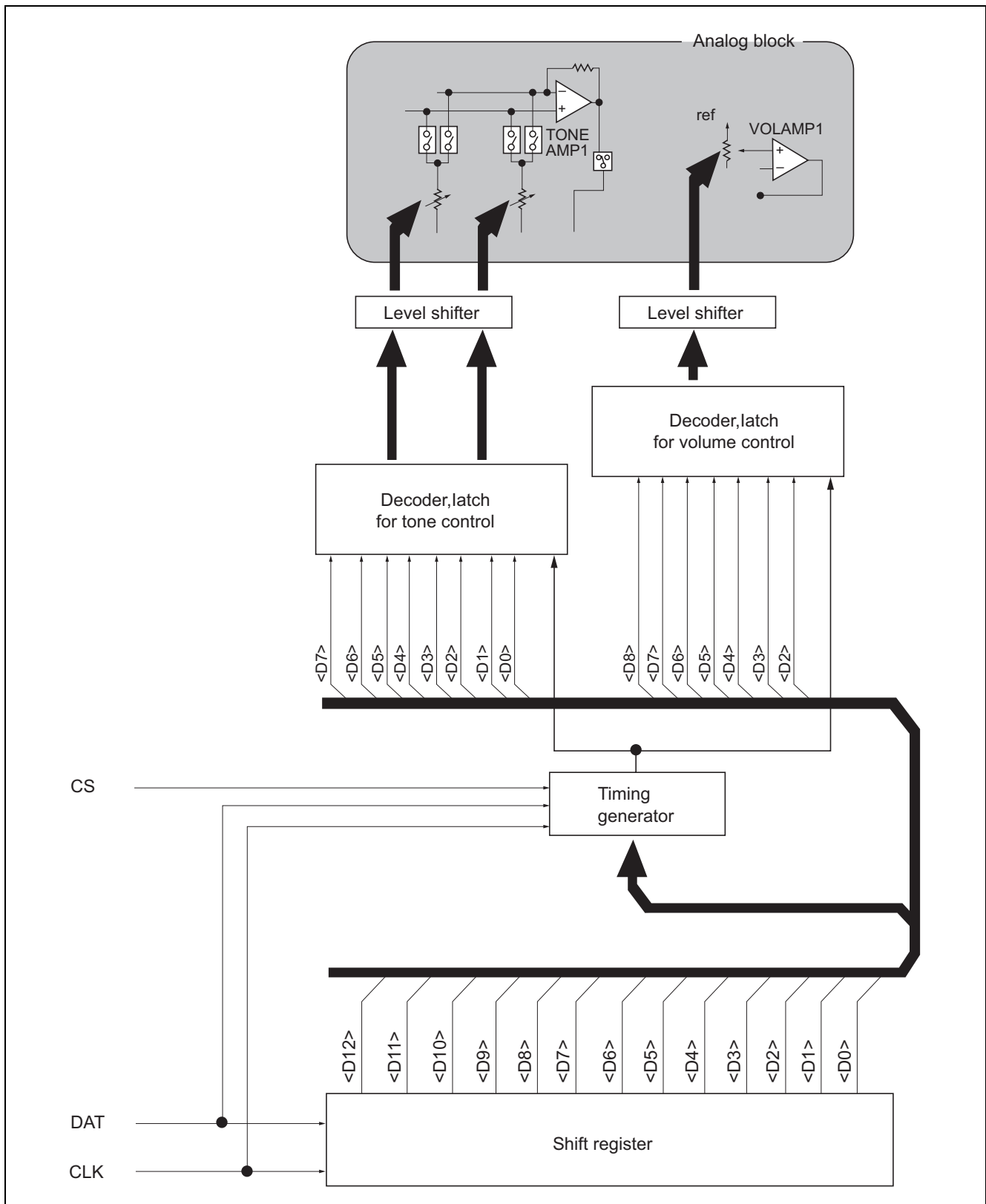


Item	Symbol	Min	Max	Units
CLK clock frequency	t_{cr}	4	—	μs
The HIGH period of the clock	t_{WHC}	1.6	—	μs
The LOW period of the clock	t_{WLC}	1.6	—	μs
Rise time of CLK line	t_r	—	0.4	μs
Fall time of CLK line	t_f	—	0.4	μs
Set-up time DATA	t_{SD}	0.8	—	μs
Hold time DATA	t_{HD}	0.8	—	μs

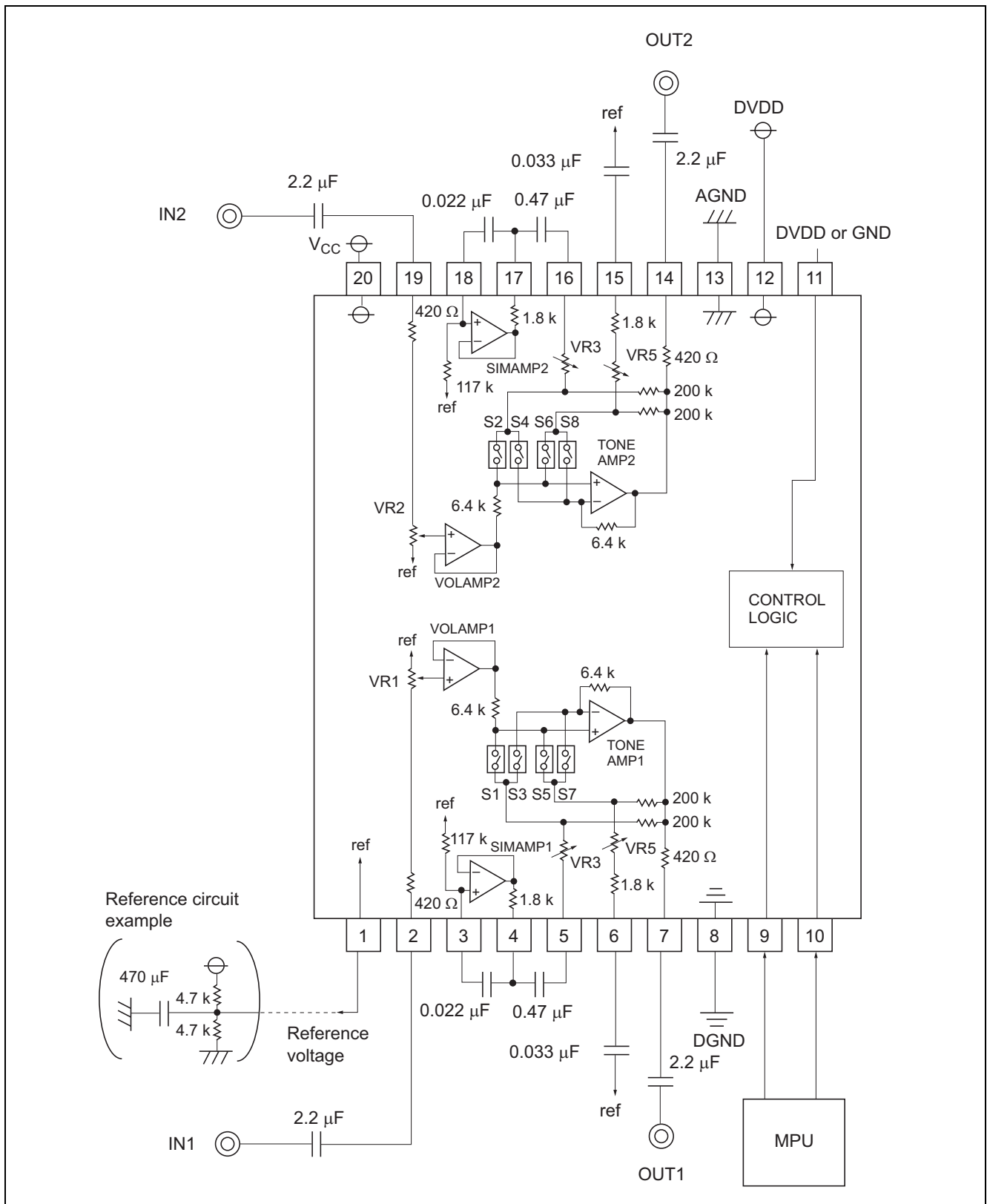
Level Diagram



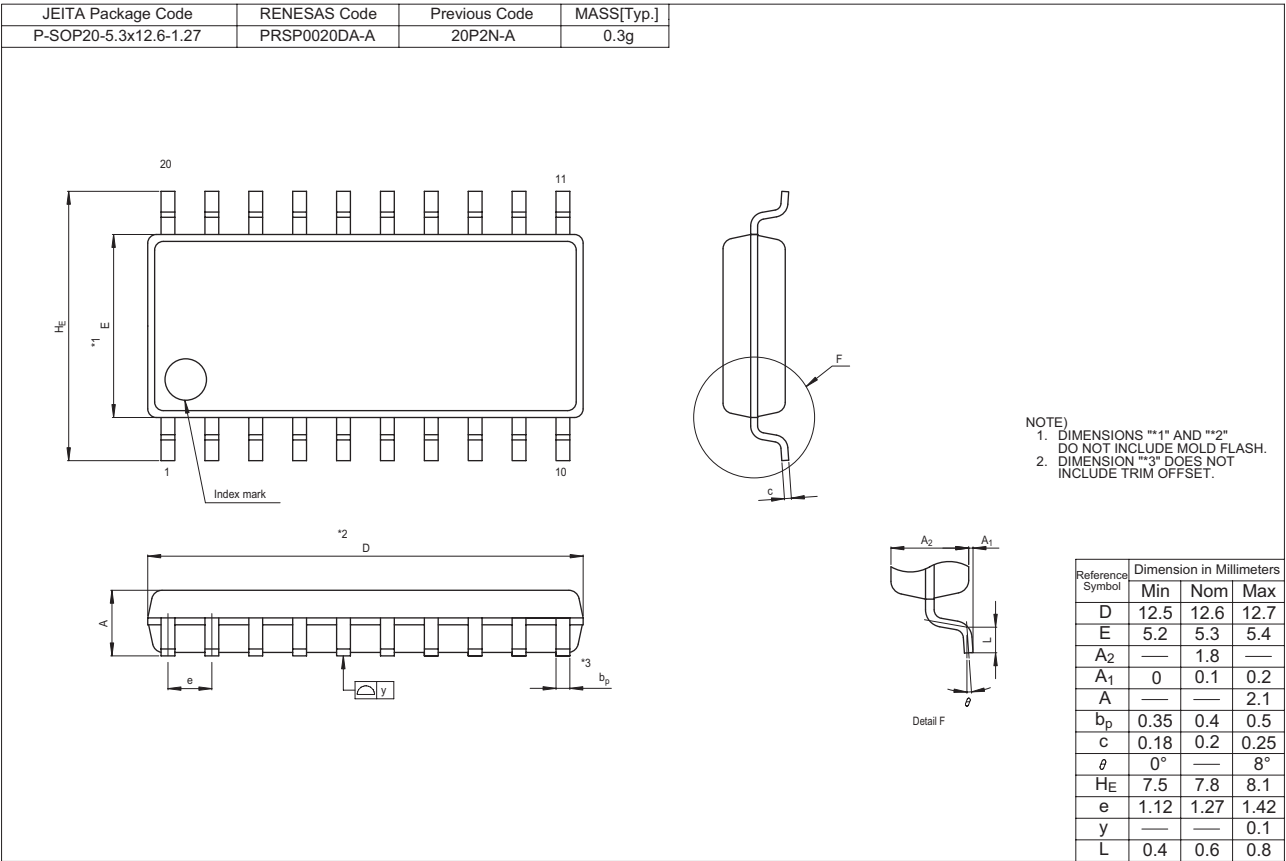
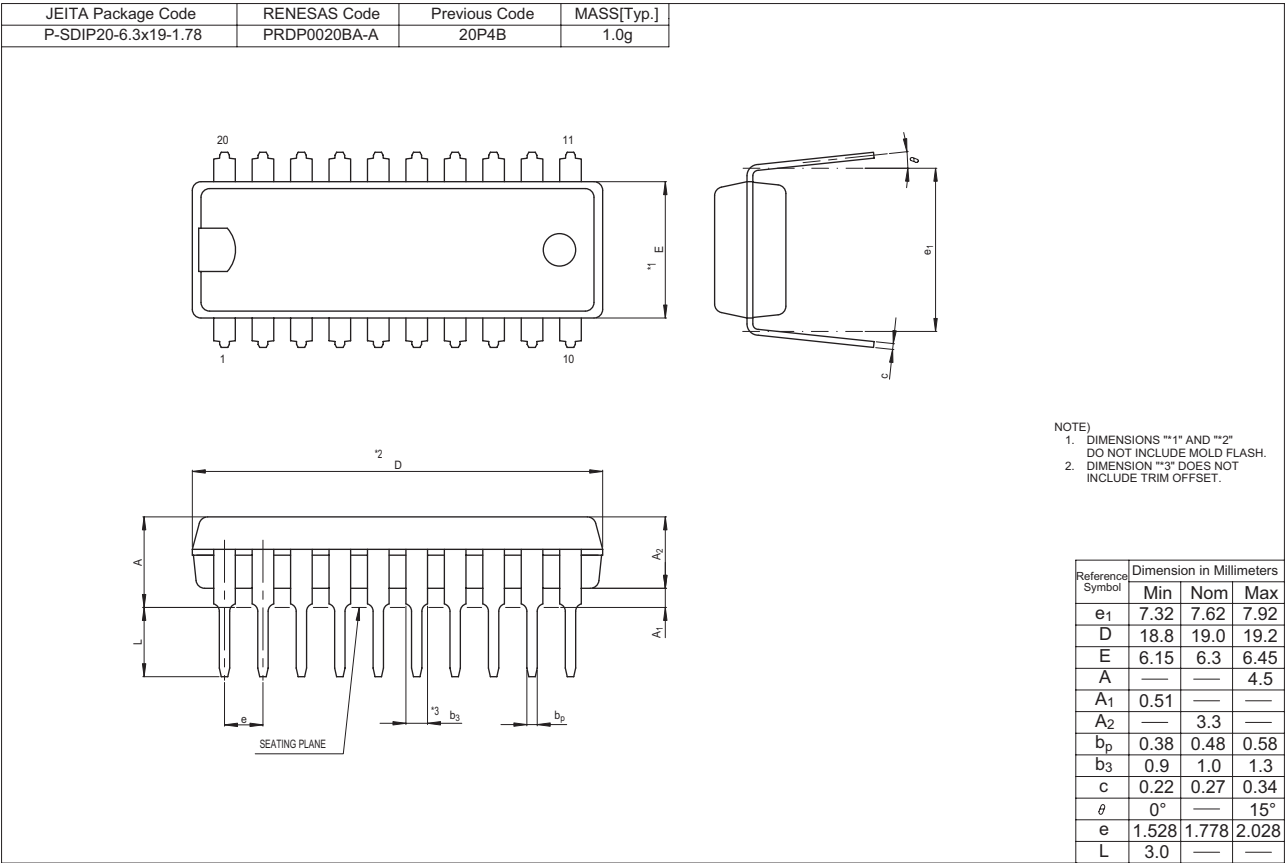
Logic Circuit



Application Example



Package Dimensions



Notes:

1. This document is provided for reference purposes only so that Renesas customers may select the appropriate Renesas products for their use. Renesas neither makes warranties or representations with respect to the accuracy or completeness of the information contained in this document nor grants any license to any intellectual property rights or any other rights of Renesas or any third party with respect to the information in this document.
2. Renesas shall have no liability for damages or infringement of any intellectual property or other rights arising out of the use of any information in this document, including, but not limited to, product data, diagrams, charts, programs, algorithms, and application circuit examples.
3. You should not use the products or the technology described in this document for the purpose of military applications such as the development of weapons of mass destruction or for the purpose of any other military use. When exporting the products or technology described herein, you should follow the applicable export control laws and regulations, and procedures required by such laws and regulations.
4. All information included in this document such as product data, diagrams, charts, programs, algorithms, and application circuit examples, 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 products listed in this document, please confirm the latest product information with a Renesas sales office. Also, please pay regular and careful attention to additional and different information to be disclosed by Renesas such as that disclosed through our website. (<http://www.renesas.com>)
5. Renesas has used reasonable care in compiling the information included in this document, but Renesas assumes no liability whatsoever for any damages incurred as a result of errors or omissions in the information included in this document.
6. When using or otherwise relying on the information in this document, you should evaluate the information in light of the total system before deciding about the applicability of such information to the intended application. Renesas makes no representations, warranties or guarantees regarding the suitability of its products for any particular application and specifically disclaims any liability arising out of the application and use of the information in this document or Renesas products.
7. With the exception of products specified by Renesas as suitable for automobile applications, Renesas products are not designed, manufactured or tested for applications or otherwise in systems the failure or malfunction of which may cause a direct threat to human life or create a risk of human injury or which require especially high quality and reliability such as safety systems, or equipment or systems for transportation and traffic, healthcare, combustion control, aerospace and aeronautics, nuclear power, or undersea communication transmission. If you are considering the use of our products for such purposes, please contact a Renesas sales office beforehand. Renesas shall have no liability for damages arising out of the uses set forth above.
8. Notwithstanding the preceding paragraph, you should not use Renesas products for the purposes listed below:
 - (1) artificial life support devices or systems
 - (2) surgical implantations
 - (3) healthcare intervention (e.g., excision, administration of medication, etc.)
 - (4) any other purposes that pose a direct threat to human lifeRenesas shall have no liability for damages arising out of the uses set forth in the above and purchasers who elect to use Renesas products in any of the foregoing applications shall indemnify and hold harmless Renesas Technology Corp., its affiliated companies and their officers, directors, and employees against any and all damages arising out of such applications.
9. You should use the products described herein within the range specified by Renesas, especially with respect to the maximum rating, operating supply voltage range, movement power voltage range, heat radiation characteristics, installation and other product characteristics. Renesas shall have no liability for malfunctions or damages arising out of the use of Renesas products beyond such specified ranges.
10. Although Renesas endeavors to improve the quality and reliability of its products, IC products have specific characteristics such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Please be sure to implement safety measures to guard against the possibility of physical injury, and injury or damage caused by fire in the event of the failure of a Renesas 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 applicable measures. Among others, since the evaluation of microcomputer software alone is very difficult, please evaluate the safety of the final products or system manufactured by you.
11. In case Renesas products listed in this document are detached from the products to which the Renesas products are attached or affixed, the risk of accident such as swallowing by infants and small children is very high. You should implement safety measures so that Renesas products may not be easily detached from your products. Renesas shall have no liability for damages arising out of such detachment.
12. This document may not be reproduced or duplicated, in any form, in whole or in part, without prior written approval from Renesas.
13. Please contact a Renesas sales office if you have any questions regarding the information contained in this document, Renesas semiconductor products, or if you have any other inquiries.



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, AZIA Center, 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