

M62421SP/FP

Tone and Volume Controller with 2 Line Control

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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

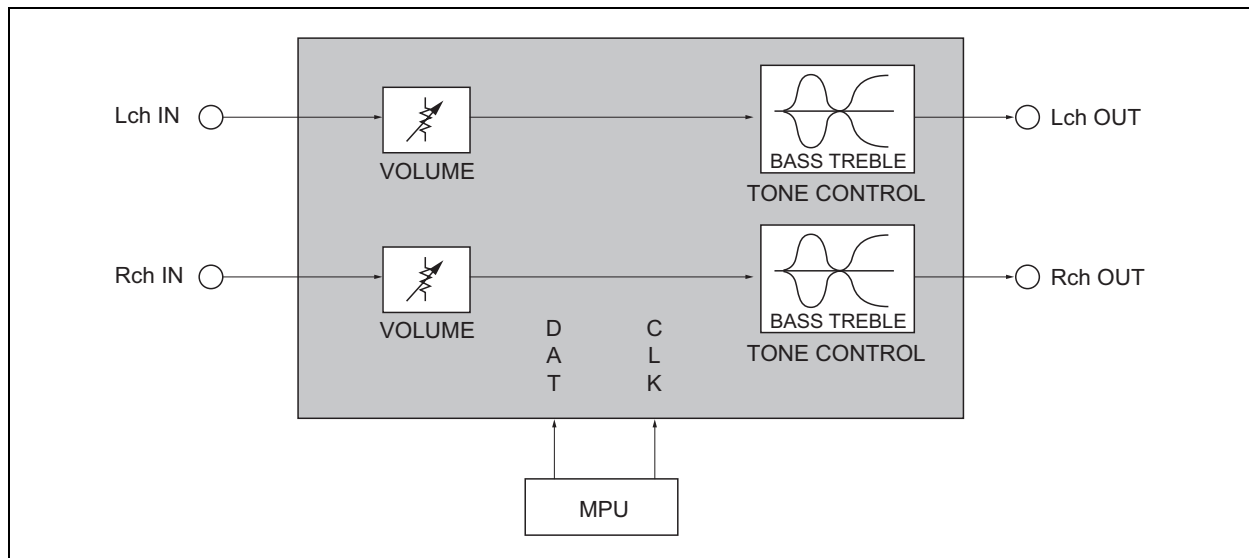
- Mini-Stereo, etc

Recommended Operating Condition

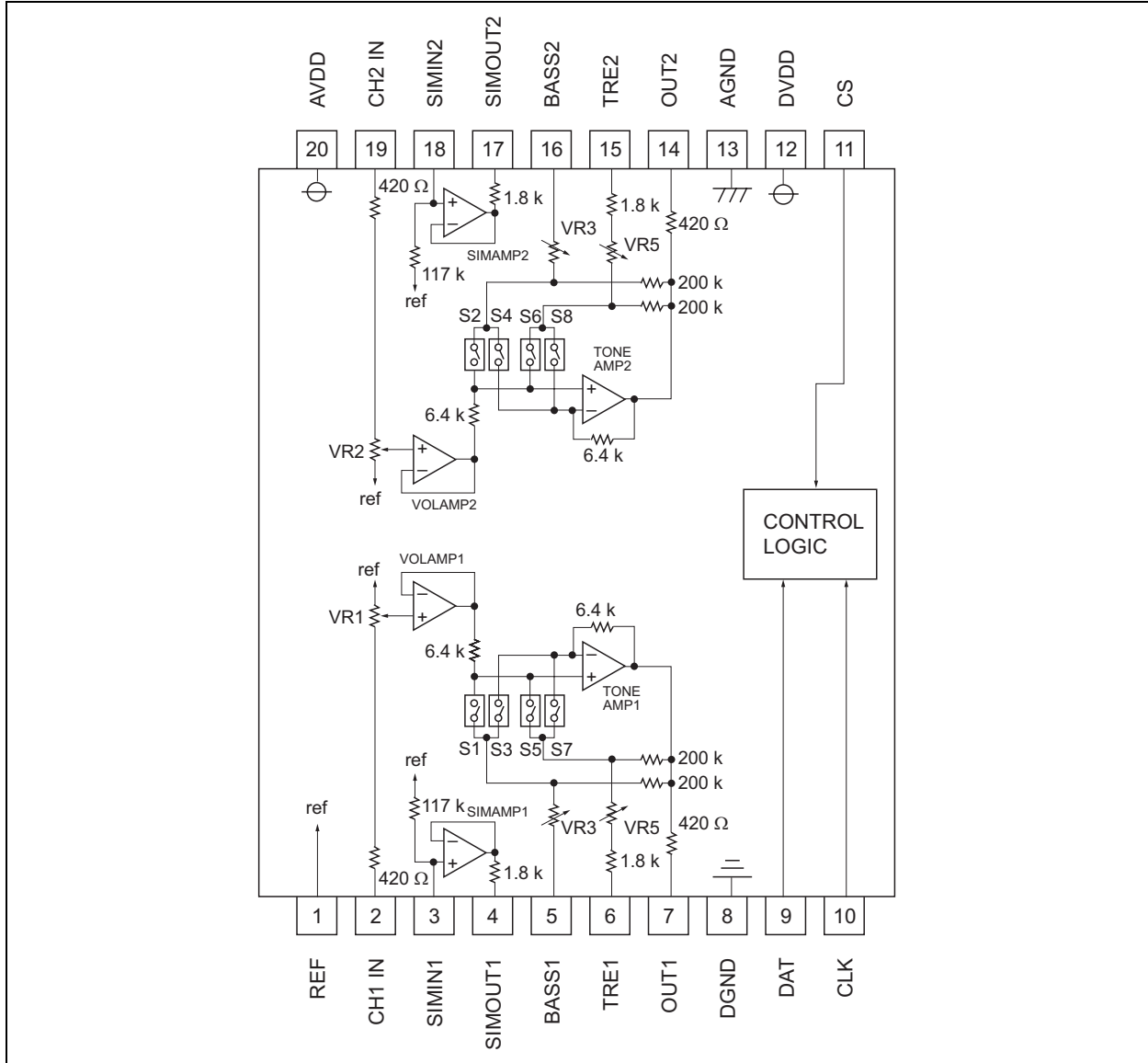
Supply voltage range: 5.5 ~ 9.5 V (analog), 4.5 ~ 5.5 V (digital)

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

System Block Diagram



Block Diagram

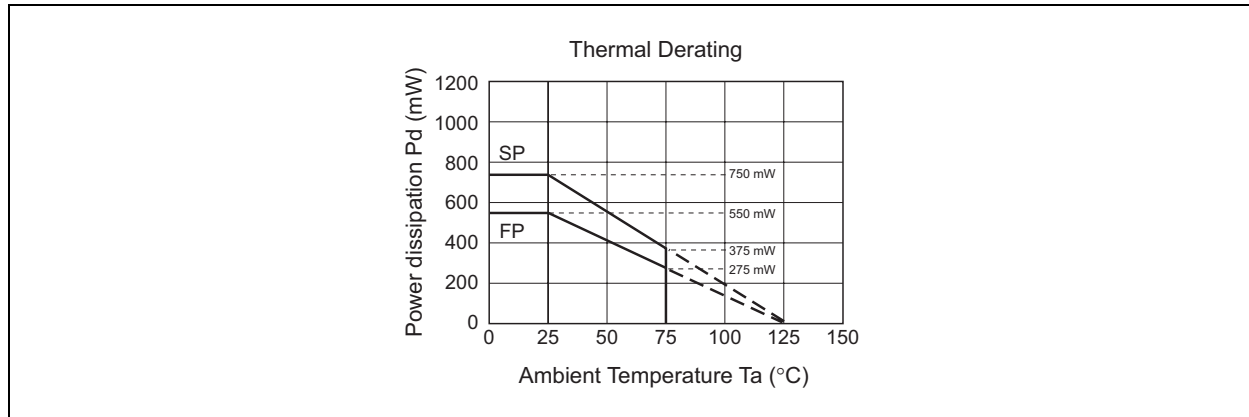


Pin Description

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

($T_a = 25^\circ\text{C}$, $AV_{dd} = 9\text{ V}$, $DV_{dd} = 5\text{ V}$ 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	<ul style="list-style-type: none"> AV_{dd} = 9.0 V measure terminal = 20 pin no signal input
Digital supply current	I _{dd}	—	0	2	μA	<ul style="list-style-type: none"> DV_{dd} = 5 V measure terminal = 12 pin no signal input

(2) I/O Characteristics

Item	Symbol	Limit			Unit	Condition
		Min	Typ	Max		
Maximum input voltage	V _{IM}	2.0	3.2	—	V _{rms}	2, 19 pin input 7, 14 pin output R _L = 10 kΩ, THD = 1%, f = 1 kHz ATT = -6 dB
Output voltage	V _{odc}	4.35	4.5	4.65	V	7 pin, 14 pin, no signal
Gain	G _v	-2	0	2	dB	V _{in} = 0 dBm, FLAT, f = 1 kHz 2 ~ 7 pin, 19 ~ 14 pin gain
Output noise voltage	V _{ono}	—	4.5	10	μV _{rms}	IHF-A filter no signal R _g = 10 kΩ 7, 14 pin
Total harmonic distortion	THD	—	0.007	0.1	%	7 pin, 14 pin f = 1 kHz V _o = 0.5 V _{rms} , R _L = 10 kΩ LPF = 30 kHz
Channel separation	CT	—	-100	-70	dB	R _L = 10 kΩ S: V _{in} = 1 V _{rms} , f = 1 kHz M: R _g = 10 kΩ, IHF-A filter

(3) Tone Characteristics

Item	Symbol	Limit			Unit	Condition
		Min	Typ	Max		
Tone control gain (bass)	G _{bassb}	9	12	15	dB	f = 100 Hz
	G _{bassc}	-15	-12	-9	dB	
Tone control gain (treble)	G _{trebb}	9	12	15	dB	f = 10 kHz
	G _{trebc}	-15	-12	-9	dB	

(4) Volume Characteristics

Item	Symbol	Limit			Unit	Condition
		Min	Typ	Max		
Maximum attenuation	ATT _{max}	-108	-100	-80	dB	f = 1 kHz, V _{in} = 0 dBm
Minimum attenuation	ATT _{min}	-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)

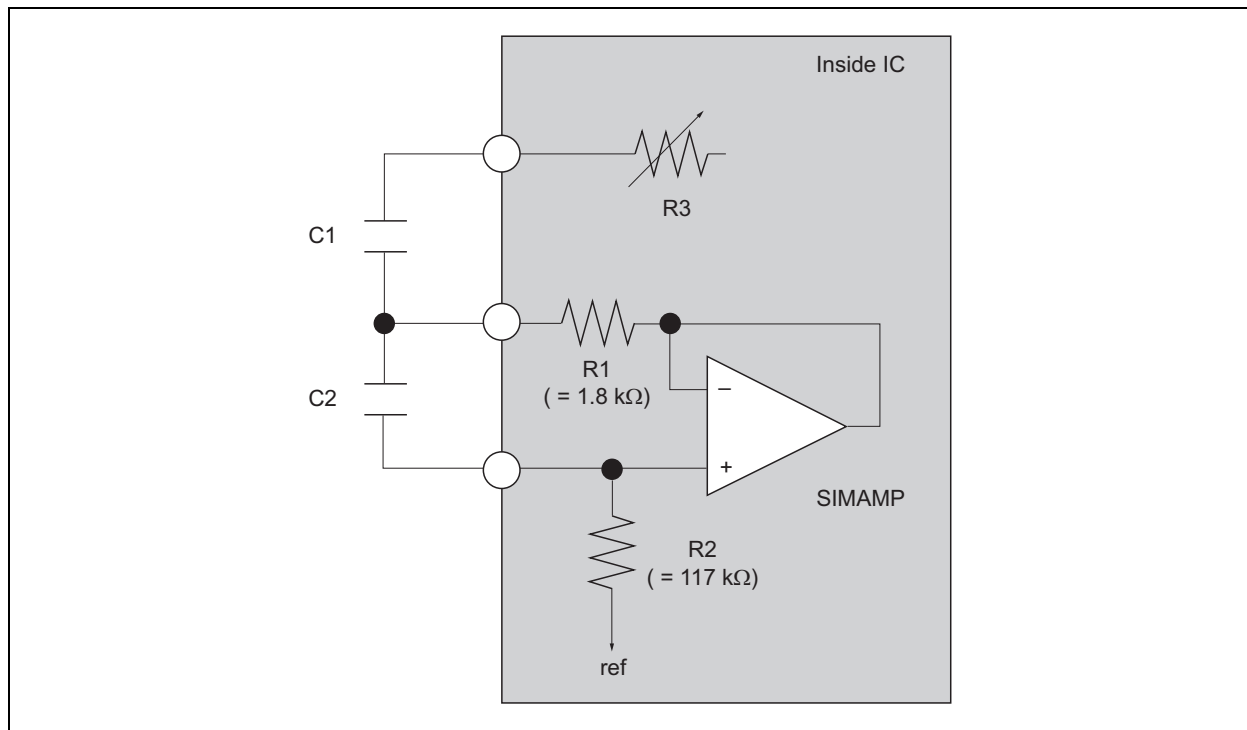


Figure 1 The circuit used simulated inductor

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 ($f \approx 100$ Hz)

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

$$C1 = 0.47 \mu, C2 = 0.022 \mu$$

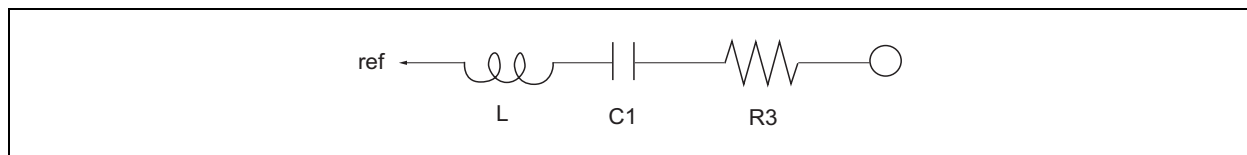


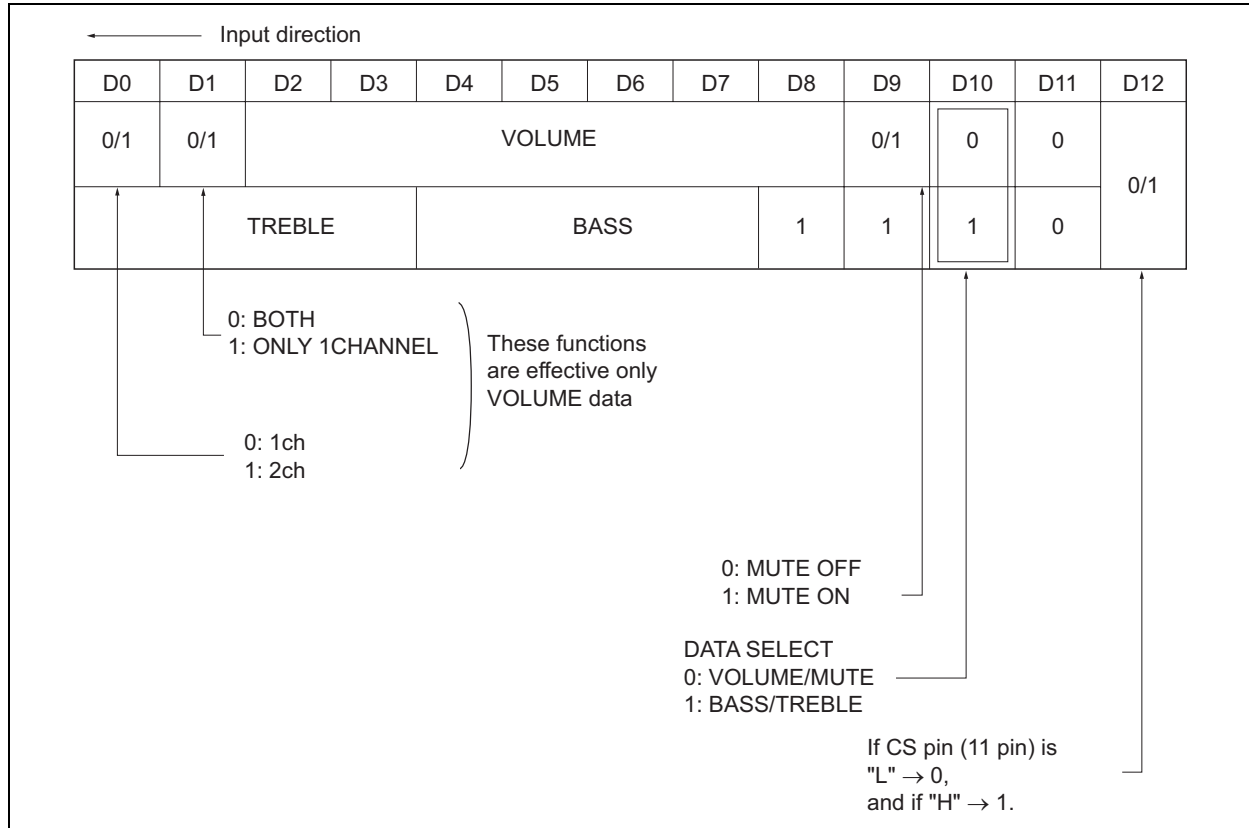
Figure 2 The equivalent circuit used L

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
-∞ 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

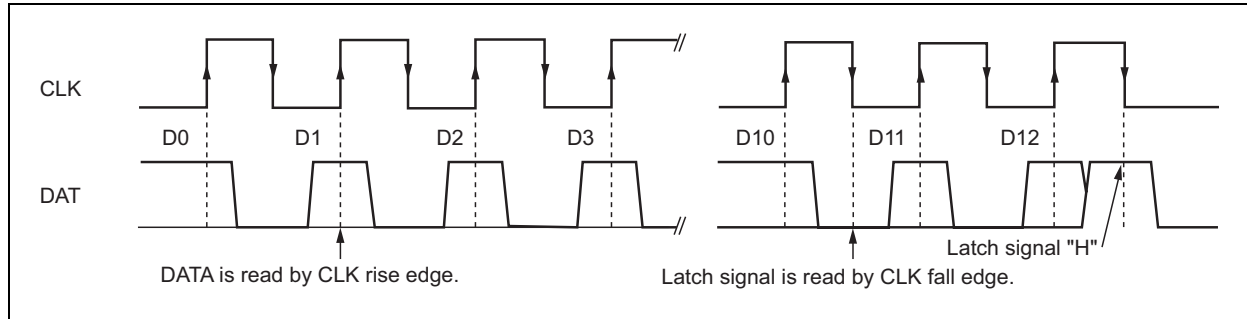
Note: Not used "HHHH", "LHHH", "HLLL"

Mute Control

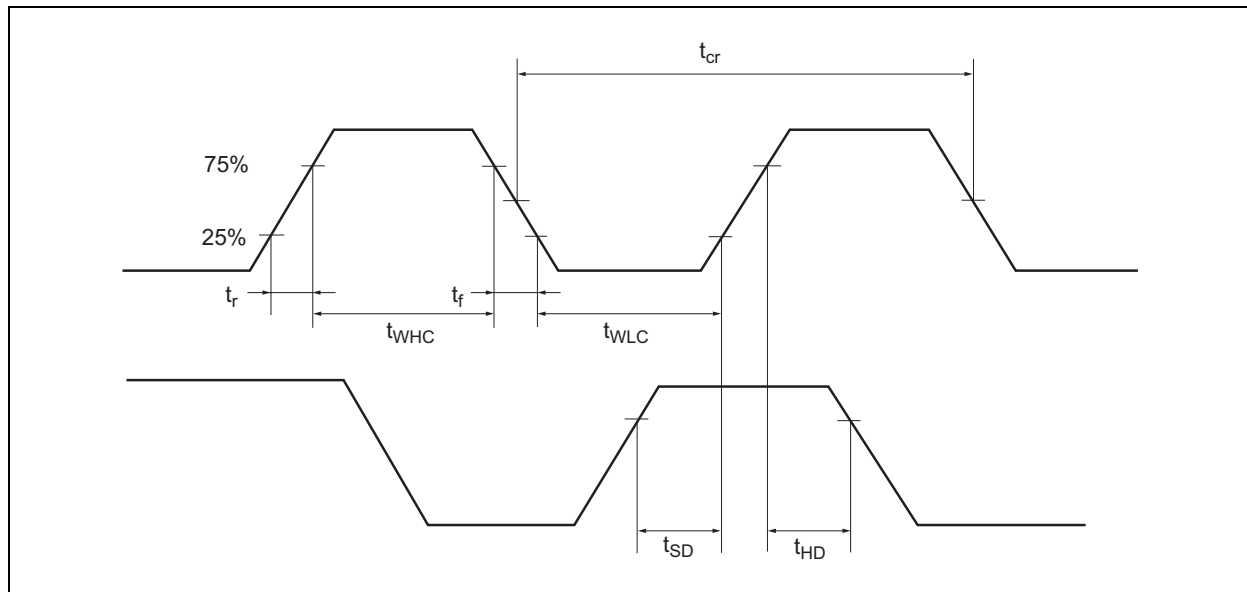
On condition D9 = 1, MUTE can be set up.

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

Data and Clock

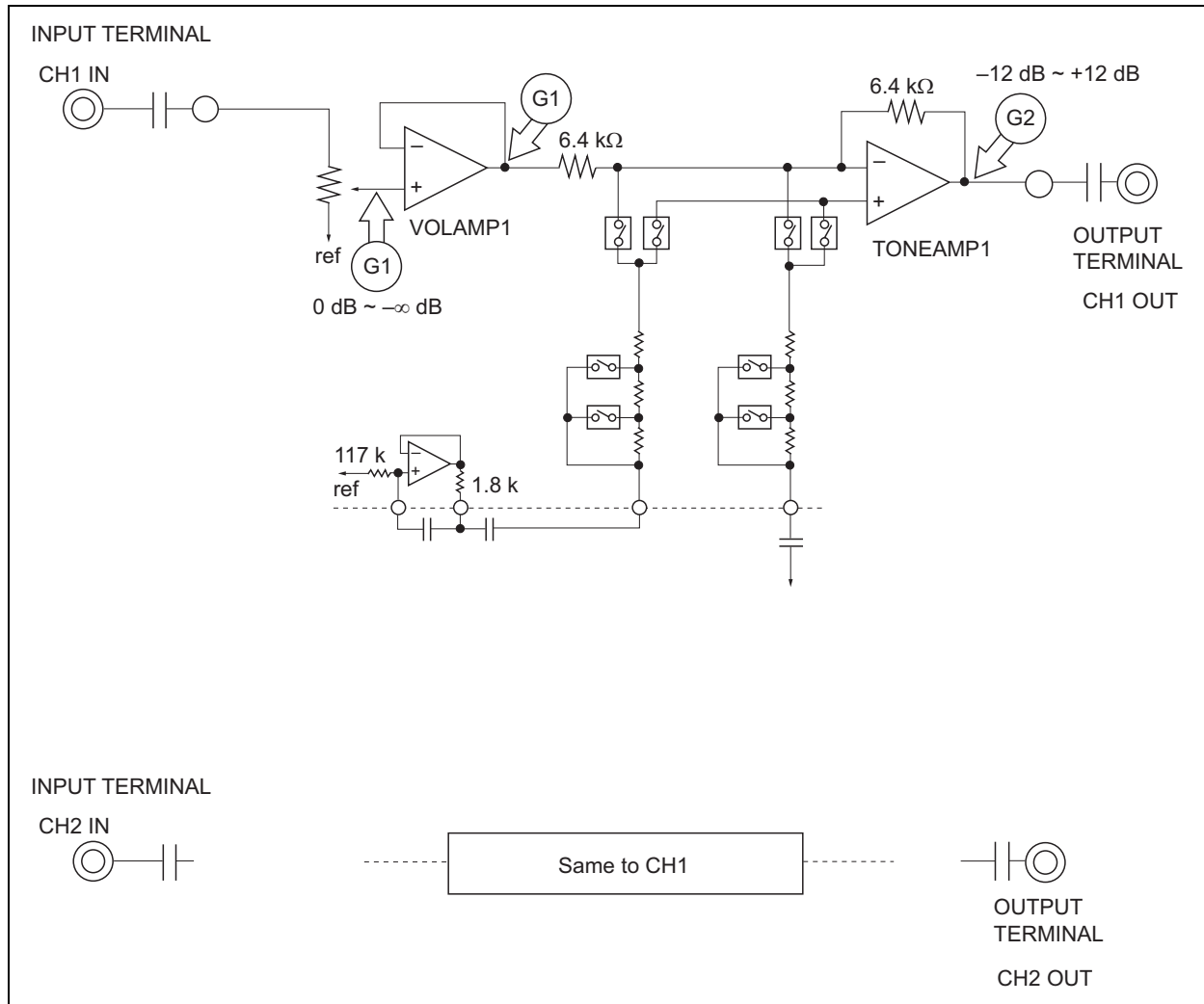


Bus Line Timing Specification

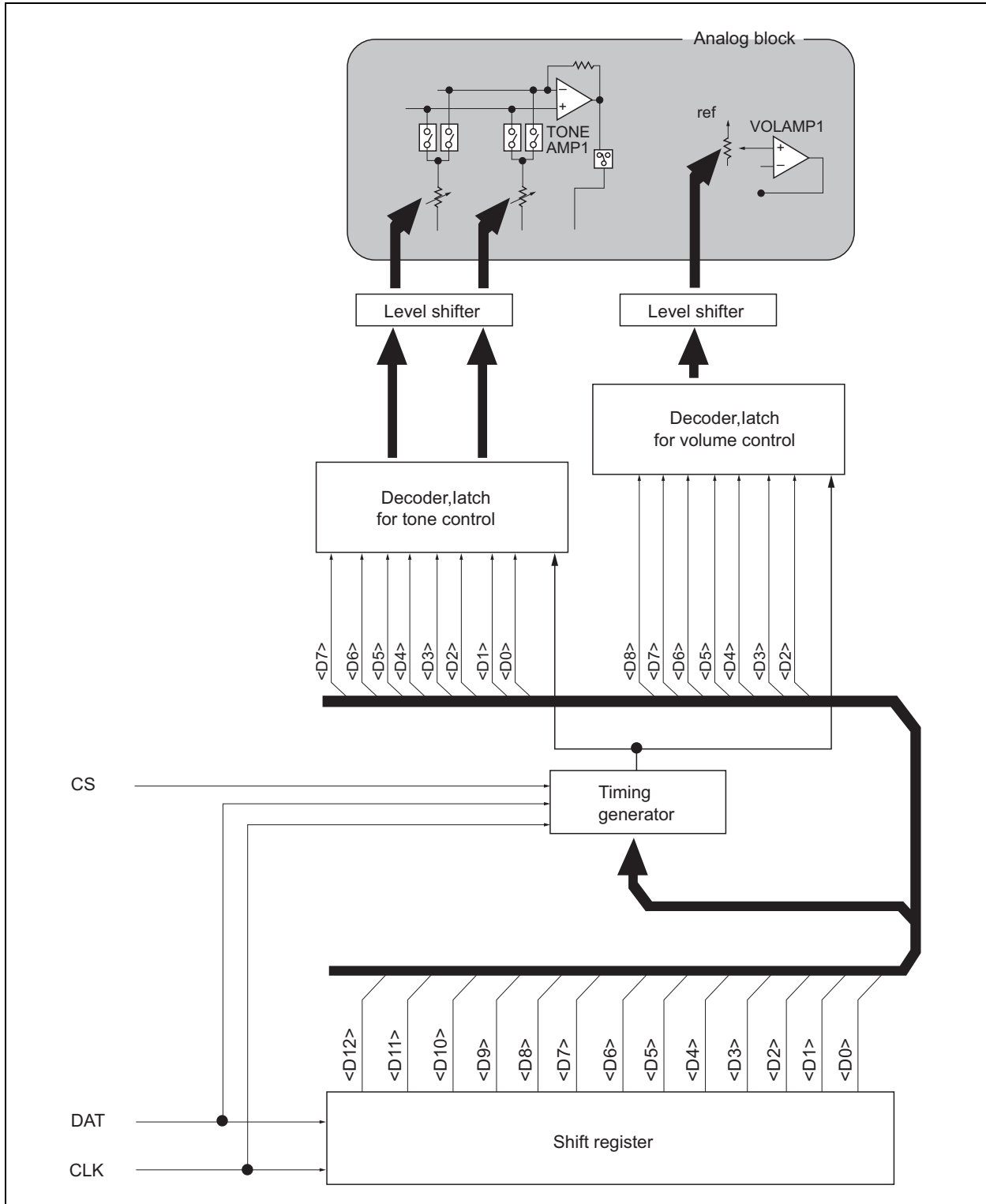


Item	Symbol	Min	Max	Units
CLK clock frequency	t_{cr}	4	—	μs
The HIGH period of the clock	t_{whc}	1.6	—	μs
The LOW period of the clock	t_{twlc}	1.6	—	μs
Rise time of CLK line	t_r	—	0.4	μs
Fall time of CLK line	t_f	—	0.4	μs
Set-up time DATA	t_{SD}	0.8	—	μs
Hold time DATA	t_{HD}	0.8	—	μs

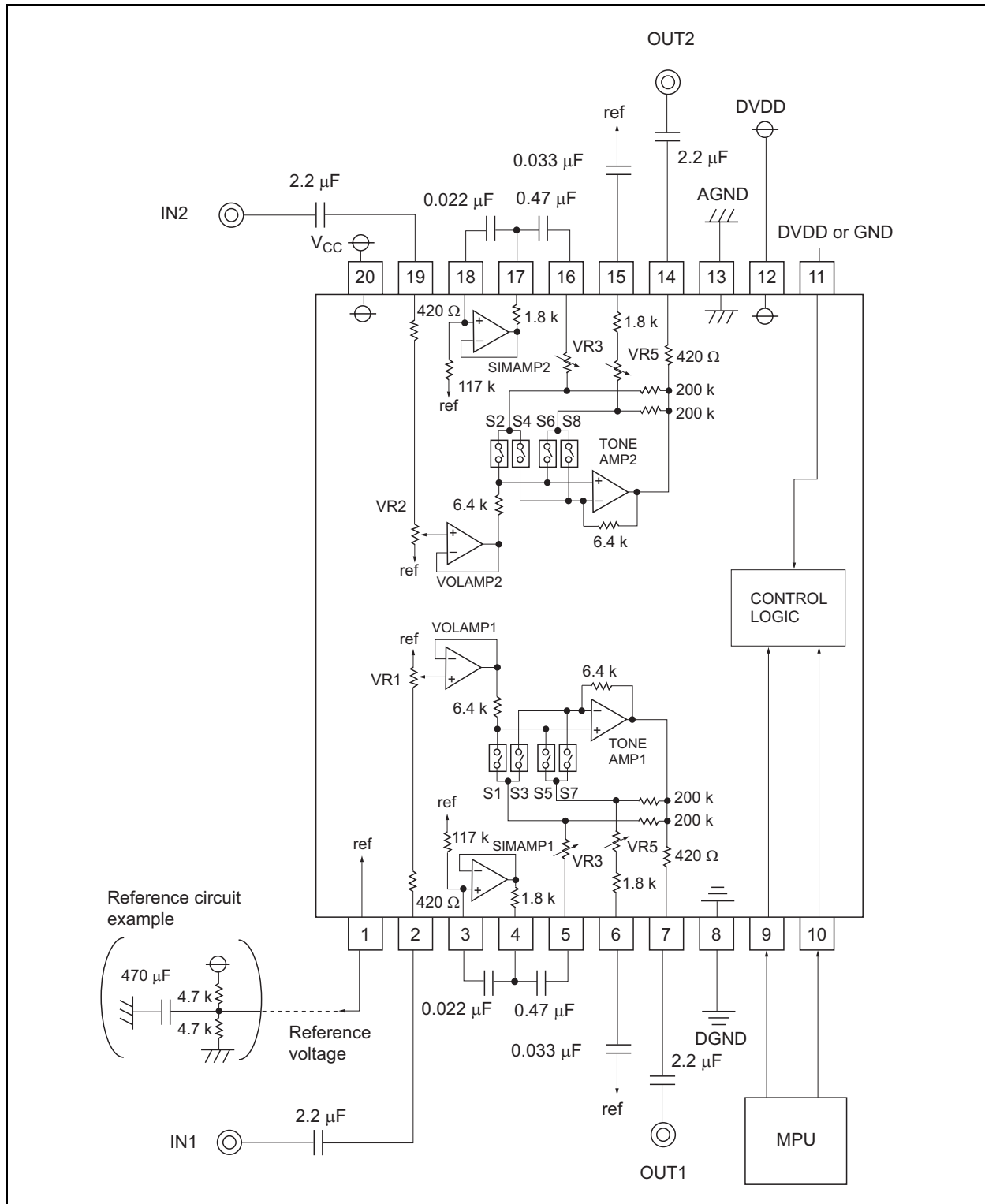
Level Diagram



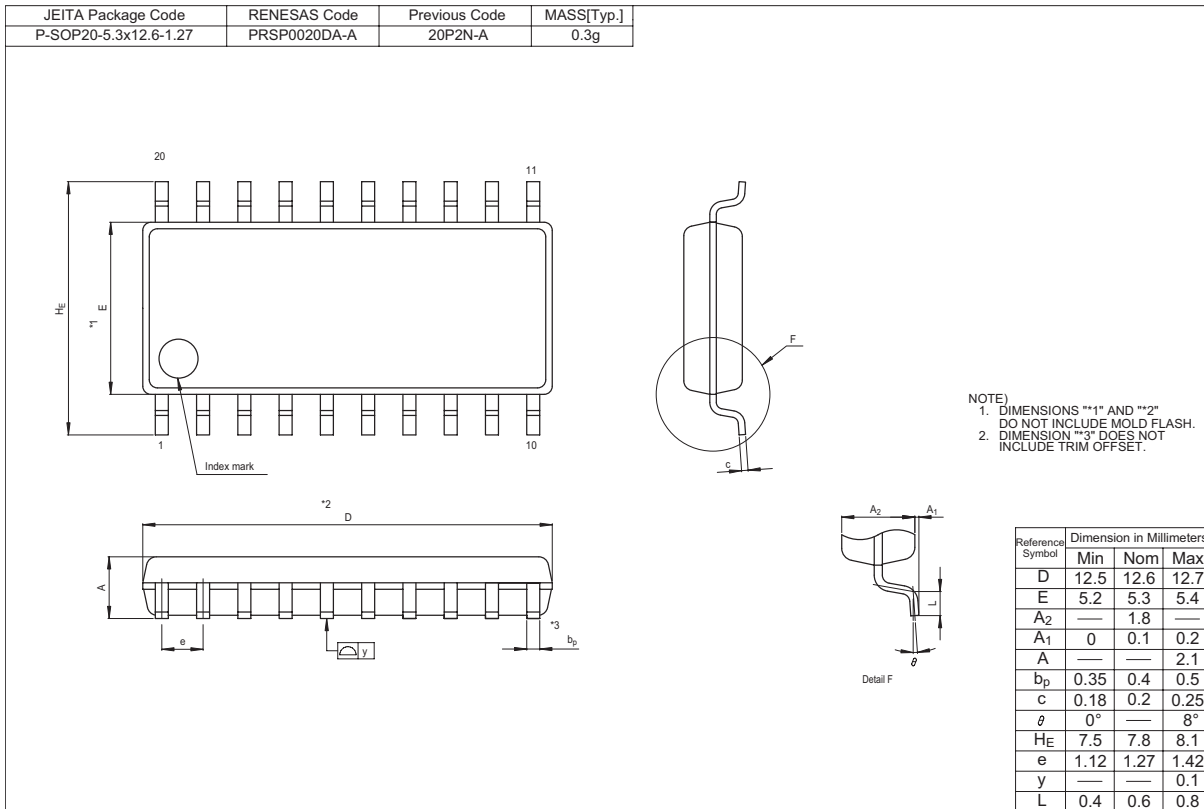
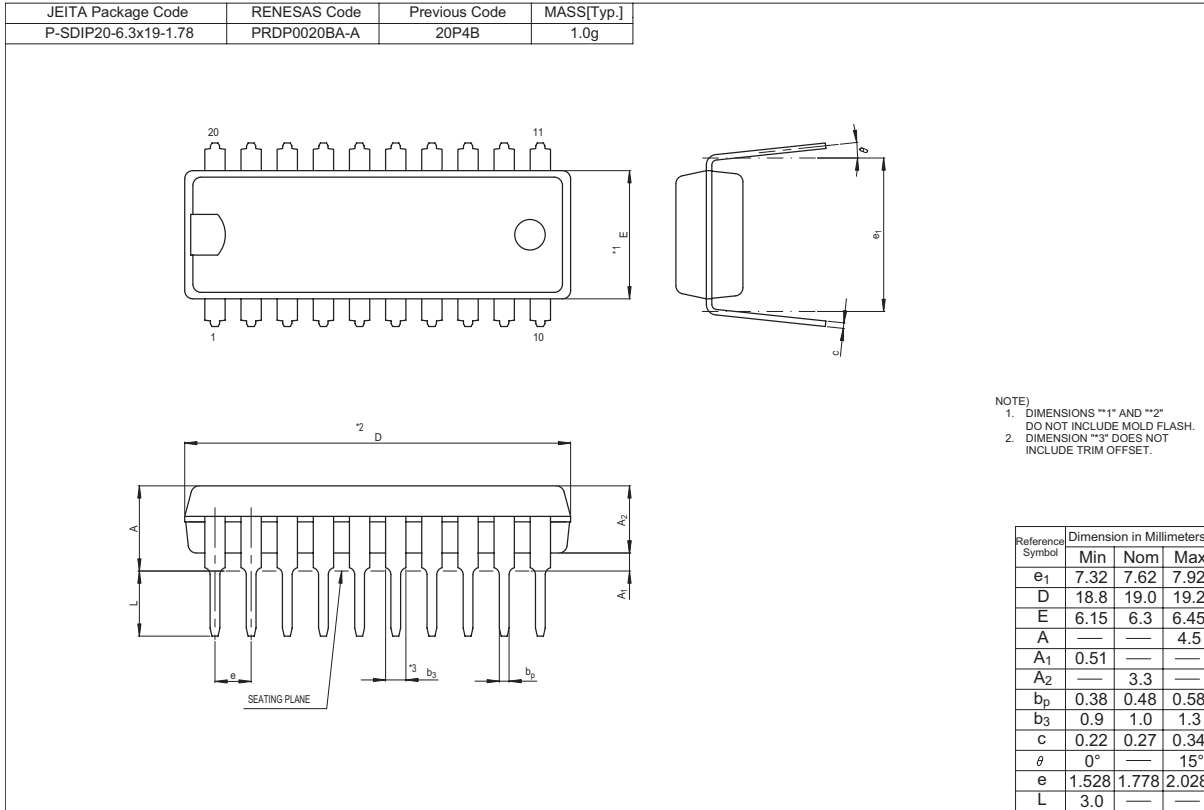
Logic Circuit



Application Example



Package Dimensions



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