

M61503FP

Tone Control/Volume Control

REJ03F0214-0201
Rev.2.01
Mar 31, 2008

Description

The M61503FP is a sound controller IC with the “BBE sound” sound technology.

It can realize articulation of reconstruction sound by BBE surround built-in reproduce tone more naturally.

Note: This device is produced under license from BBE sound Lab, Inc.(USA) and available to only licenses.

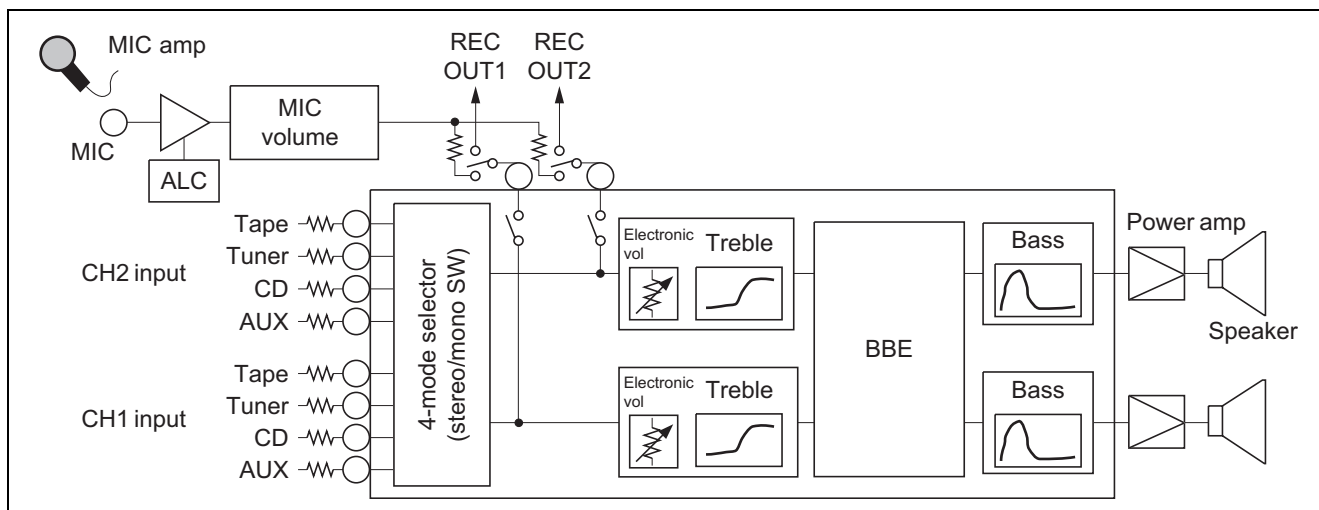
Features

- Built-in “BBE sound” sound technology
- Electronic volume.
0 to -84 dB, the infinitesimal.
- 2-band tone control
Bass (0 to +21 dB/3 dB STEP)
Treble (0 to +9 dB/3 dB STEP)

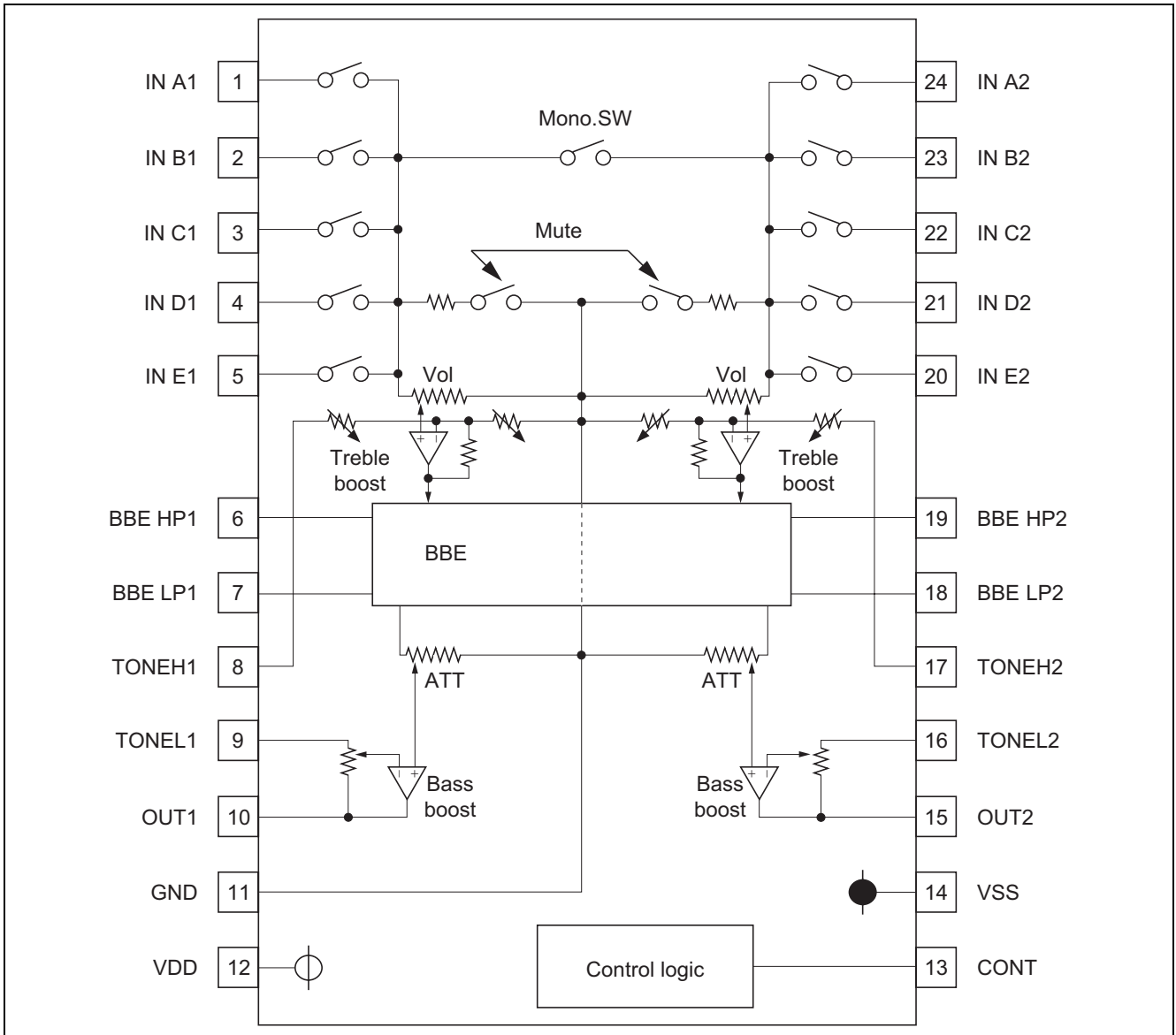
Recommended Operating Condition

Supply voltage range: ± 2.25 to ± 2.75 V

System Block Diagram



Block Diagram



Pin Description

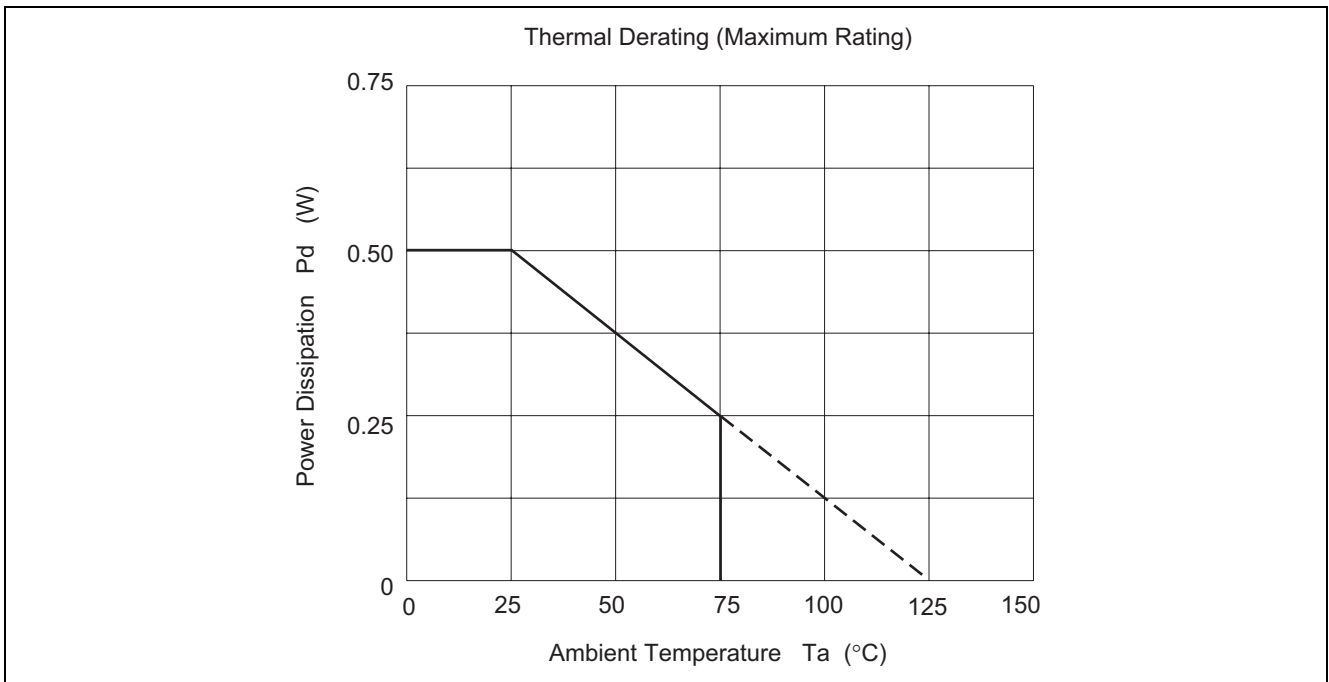
Pin No.	Name	Function
1	IN A1	INPUTs of the channel 1 The switch of INE can be controlled in dependently. Please set "ALL OFF" mode when the switch of E is only ON.
2	IN B1	
3	IN C1	
4	IN D1	
5	IN E1	
6	BBE HP1	BBE high pass filter 1
7	BBE LP1	BBE low pass filter 1
8	TOHEH1	Treble control adjustment of the channel 1
9	TONEL1	Bass control adjustment of the channel 1
10	OUT1	OUTPUT of the channel 1
11	GND	Ground
12	VDD	Supply voltage (+)
13	CONT	Control data input from a microcontroller
14	VSS	Supply voltage (-)
15	OUT2	OUTPUT of the channel 2
16	TONEL2	Bass control adjustment of the channel 2
17	TOHEH2	Treble control adjustment of the channel 2
18	BBE HP2	BBE high pass filter 2
19	BBE LP2	BBE low pass filter 2
20	IN E2	INPUTs of the channel 2 The switch of INE can be controlled independently. Please set "ALL OFF" mode when the switch of E is only ON.
21	IN D2	
22	IN C2	
23	IN B2	
24	IN A2	

Absolute Maximum Ratings

(Ta = 25°C, unless otherwise noted)

Item	Symbol	Ratings	Unit	Test Conditions
Supply voltage	VDD-VSS	6.0	V	
Thermal derating	Kθ	5	mW/°C	(Note)
Power dissipation	Pd	500	mW	
Operating temperature	Topr	-20 to 75	°C	
Storage temperature	Tstg	-40 to 125	°C	

Note: reference PC Board
 Size: 70 mm × 70 mm
 Thickness: 1.6 mm
 Material: glass epoxy
 Copper pattern dimension
 Width: 0.25 mm
 Length: 25 to 30 mm/lead
 Thickness: 18 μm

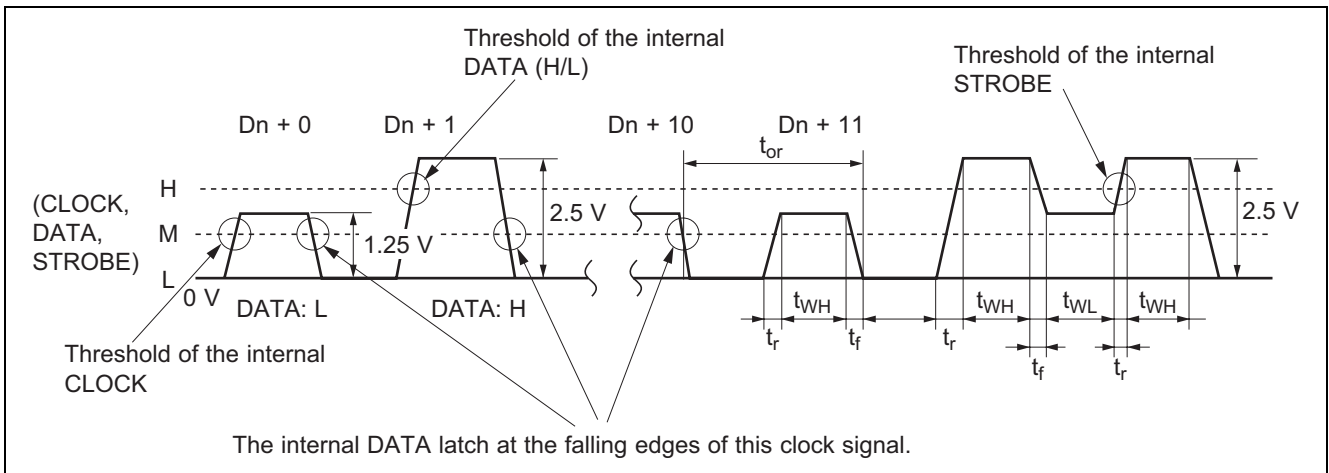


Recommended Operating Conditions

Item	Symbol	Pin No.	Limits			Unit	Condition
			Min	Typ	Max		
Supply voltage (+)	VDD	12	2.25	2.5	2.75	V	
Supply voltage (-)	VSS	14	-2.75	-2.5	-2.25		
Control data input voltage	CONT	13	GND	—	VDD		

Control Signals Specification

(1) Wave Form



(2) Voltage Control Signal

Digital input signal		Limits			Unit	Condition
		Min	Typ	Max		
L signal	L	GND	—	0.4	V	VDD = 2.5 V, VSS = -2.5 V
M signal	M	1.0	1.25 (VDD/2)	1.5		VDD = 2.5 V, VSS = -2.5 V
H signal	H	2.1	—	VDD		VDD = 2.5 V, VSS = -2.5 V

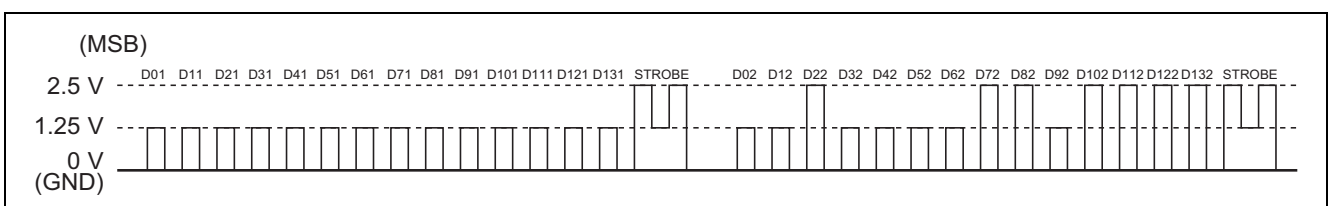
(3) Timing Control Signal

Item	Symbol	Limits			Unit
		Min	Typ	Max	
Cycle time of digital signal	t_{cr}	4	—	—	μs
Pulse width of digital signal ("H" level)	t_{WH}	1.6	—	—	
Pulse width of digital signal ("L" level)	t_{WLC}	1.6	—	—	
Rise time of digital signal	t_r	—	—	0.4	
Fall time of digital signal	t_f	—	—	0.4	

(4) Control Signal Example (Refer to the "Control Data Format")

An example of the mode control

- VOL/TREBLE Share AMP Gain: 20 dB
- Input: IN A,
- Volume: 0 dB
- Mute: OFF
- BBE Effect: High level (+3 dB)
- Mode: STEREO
- Bass: 18 dB
- Treble: 6 dB
- Recout: ON (IN E)



Control Data Format

It is necessary to set up the all control data after power on.

(1) Input data

(MSB) ← input order

Slot1

D01	D11	D21	D31	D41	D51	D61	D71	D81	D91	D101	D111	D121	D131
0	0	Vol/Treble share amp gain SW 0: 20 dB 1: 18 dB 2: 16 dB 3: 14 dB		Input 0: IN A 1: IN B 2: IN C 3: IN D		D2 to D6: (a) Master volume condition				Mute ON/OFF 0: OFF 1: ON (Input ALL OFF)	CHIP/SLOT Select 0: select 1: no select 2: no select 3: no select		

Slot2

D02	D12	D22	D32	D42	D52	D62	D72	D82	D92	D102	D112	D122	D132
0	0	BBE effect		Mode select 0: stereo 1: mono1 only 2: mono2 only 3: mono 1+2		Bass (boost) 0: 0 dB, 1: 3 dB, 2: 6 dB, 3: 9 dB, 4: 12 dB, 5: 15 dB, 6: 18 dB, 7: 21 dB			Treble (boost) 0: 0 dB, 1: 3 dB, 2: 6 dB, 3: 9 dB		IN E ON/OFF 0: OFF 1: ON	CHIP/SLOT Select 0: no select 1: no select 2: no select 3: select	

(a) Master volume

ATT	D61	D71	D81	D91	D101
-0.0 dB	0	0	0	0	0
-2.0 dB	1	0	0	0	0
-4.0 dB	0	1	0	0	0
-6.0 dB	1	1	0	0	0
-8.0 dB	0	0	1	0	0
-10.0 dB	1	0	1	0	0
-12.0 dB	0	1	1	0	0
-14.0 dB	1	1	1	0	0
-16.0 dB	0	0	0	1	0
-18.0 dB	1	0	0	1	0
-20.0 dB	0	1	0	1	0
-22.0 dB	1	1	0	1	0
-24.0 dB	0	0	1	1	0
-26.0 dB	1	0	1	1	0
-28.0 dB	0	1	1	1	0
-30.0 dB	1	1	1	1	0
-32.0 dB	0	0	0	0	1
-34.0 dB	1	0	0	0	1
-36.0 dB	0	1	0	0	1
-40.0 dB	1	1	0	0	1
-44.0 dB	0	0	1	0	1
-48.0 dB	1	0	1	0	1
-52.0 dB	0	1	1	0	1
-56.0 dB	1	1	1	0	1
-60.0 dB	0	0	0	1	1
-64.0 dB	1	0	0	1	1
-68.0 dB	0	1	0	1	1
-72.0 dB	1	1	0	1	1
-76.0 dB	0	0	1	1	1
-80.0 dB	1	0	1	1	1
-84.0 dB	0	1	1	1	1
the infinitesimal	1	1	1	1	1

(b) Input select

Input select		D41	D51	D111	D112
IN A	IN E off	0	0	0	0
IN B		1	0		
IN C		0	1		
IN D		1	1		
IN A to D all OFF	IN E on	*	*	1	1 ^(Note 1)
IN A-D select		A: 0	0	0	1 ^(Note 2)
		B: 1	0		
		C: 0	1		
	D: 1	1			

Notes: 1. The input impedance is about 5 k as input IN E.
 2. IN E can be controlled independently.
 It can be used as Rec output.

(c) Mode control

Mode	D42	D52
stereo	0	0
mono 1 only	1	0
mono 2 only	0	1
mono1+2	1	1

(d) Treble control

Treble	D92	D102
0 dB	0	0
3 dB	1	0
6 dB	0	1
9 dB	1	1

(e) Bass control

Bass	D62	D72	D82
0 dB	0	0	0
3 dB	1	0	0
6 dB	0	1	0
9 dB	1	1	0
12 dB	0	0	1
15 dB	1	0	1
18 dB	0	1	1
21 dB	1	1	1

(f) Chip/Slot control

Chip/Slot	D12*	D13*
select (slot1)	0	0
no select	1	0
no select	0	1
select (slot1)	1	1

(g) Treble amp gain SW

Gain SW	D21	D31
20 dB	0	0
18 dB	1	0
16 dB	0	1
14 dB	1	1

(i) BBE effect

Effect	D22	D32
Bypass	0	0
BEE 1 high level +3dB	1	0
BEE 2 high level +7dB	0	1
BEE 3 high level +11dB	1	1

(2) Notice of Control Data

1. Input only the control data at (1) Input Data.
2. It is necessary to set up the all control data after power-on, although the internal circuit forced as follows, when $(VDD-VSS) \leq 3.3 \text{ V (Typ)}$.
3. The interval of data transmission from the microcontroller is over 0.1s. This is waiting time for soft-switching to reduce the shocknoise.

Item	Condition
Gain SW	18 dB
Input select	ALL OFF
Master volume	the infinitesimal
MUTE	ON (Input ALL OFF)
BBE effect	Bypass
Mode select	Stereo
Bass	0 dB
Treble	0 dB
IN E	ON

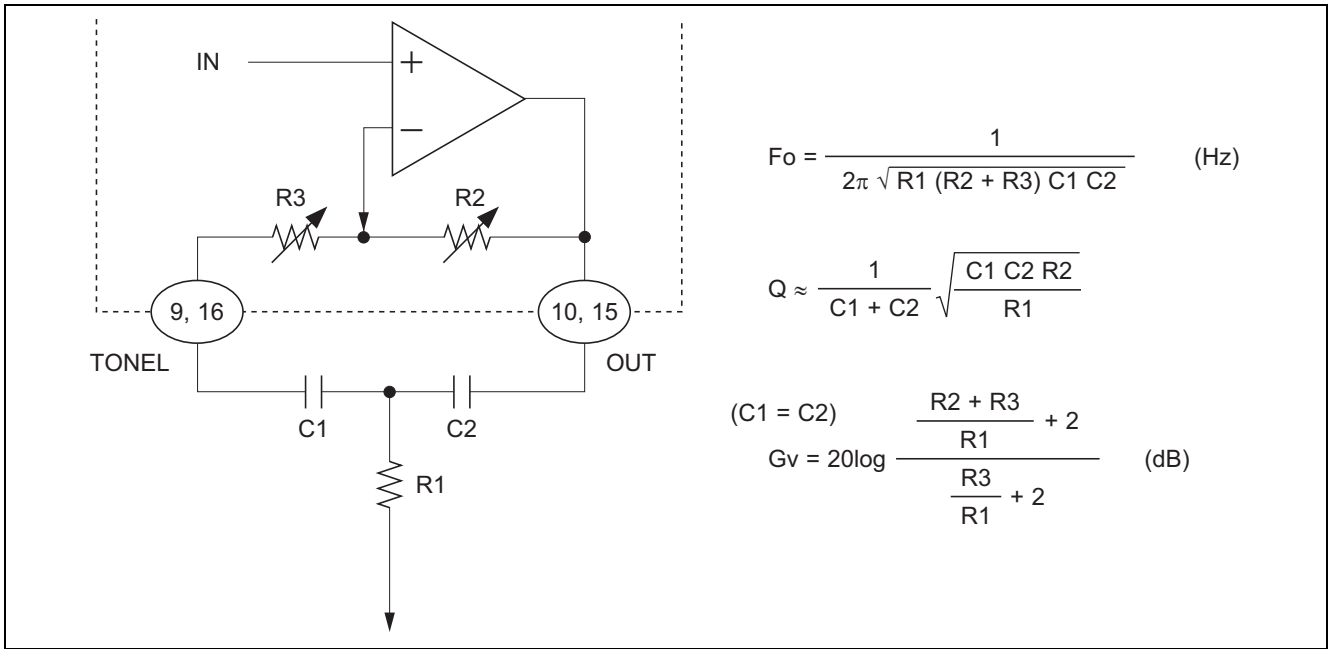
Electrical Characteristics

(VDD = 2.5 V, VSS = -2.5 V, f = 1 kHz, Vi = 100 mV(rms), Vol = 0 dB, Bass = 0 dB, Treble = 0 dB, Vol/Treble Share AMP = 18 dB, Surround = Bypass, RL = 10 kΩ, Ta = 25°C, unless otherwise noted)

Item	Symbol	Limits			Unit	Conditions	
		Min	Typ	Max			
Circuit current of positive power supply	IDD	—	30	45	mA	Quiescent	
Circuit current of negative power supply	ISS	—	-30	-45	mA	Quiescent	
Voltage gain (selector)	Gv1	16	18	20	dB	Vol/Treble share amp gain = 18 dB Bypass	
Voltage gain (tone control)	Gv2	25.5	27.5	29.5	dB	Vol/Treble share amp gain = 18 dB Q surround mode Vi = 20mVrms	
Maximum output voltage	Vomax	1.2	1.6	—	Vrms	RL = 10 k, THD = 1%	
Total harmonic distortion	THD	—	0.02	0.08	%	BW = 400 to 30 kHz	
Output noise voltage	No1	—	8	20	μVrms	JIS-A, Rg = 5.1 k, VOL = the infinitesimal BYPASS	
	No2	—	15	40	μVrms	JIS-A, Rg = 5.1 k, VOL = the infinitesimal BBE3 (High level +11 dB) mode	
Maximum attenuation	ATTmax	—	-95	-90	dB	Output referencelevel (Vo = 1 Vrms), ATT = the infinitesimal, JIS-A	
Bass boost	GB1	1.5	3	4.5	dB	3 dB	f = 1 kHz, Vo = 80 mVrms
	GB2	4.5	6	7.5		6 dB	
	GB3	7.5	9	10.5		9 dB	
	GB4	10.5	12	13.5		12 dB	
	GB5	13.5	15	16.5		15 dB	
	GB6	16.5	18	19.5		18 dB	
	GB7	19.5	21	22.5		21 dB	
Treble boost	GT1	1.5	3	4.5	dB	3 dB	f = 1 kHz, Vo = 80 mVrms
	GT2	4.5	6	7.5		6 dB	
	GT3	7.5	9	10.5		9 dB	
Low level boost (f = 20Hz)	BBE1	—	3	—	dB	f = 20 Hz, Vo = 80 mVrms	
High level boost (f = 10kHz)	BBE2	—	11	—		f = 10 kHz, Vo = 80 mVrms	

Function Description

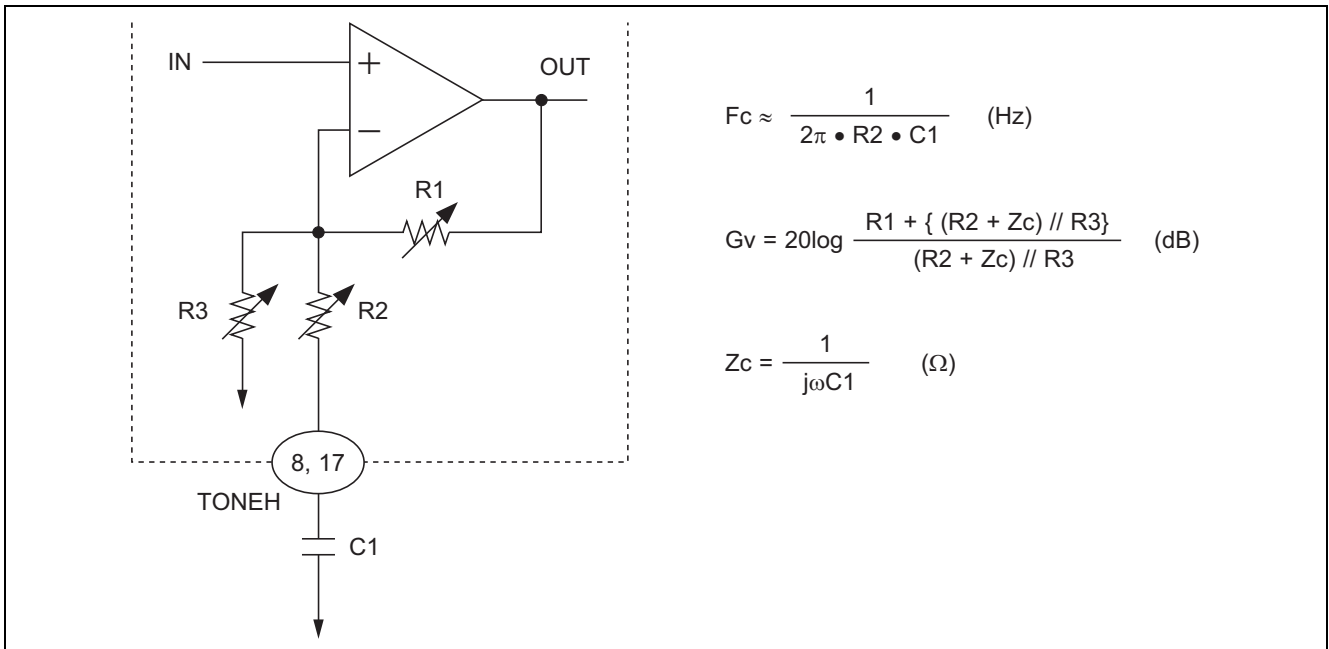
(1) Equivalent Circuit of the Bass Boost



R2, R3 (typical)

Bass boost		3 dB	6 dB	9 dB	12 dB	15 dB	18 dB	21 dB
Resistor (k)	R2	15.4	25.7	32.9	38.7	41.6	44.2	46
	R3	30.6	20.3	13.1	7.3	4.4	1.8	0

(2) Equivalent Circuit of the Treble Boost



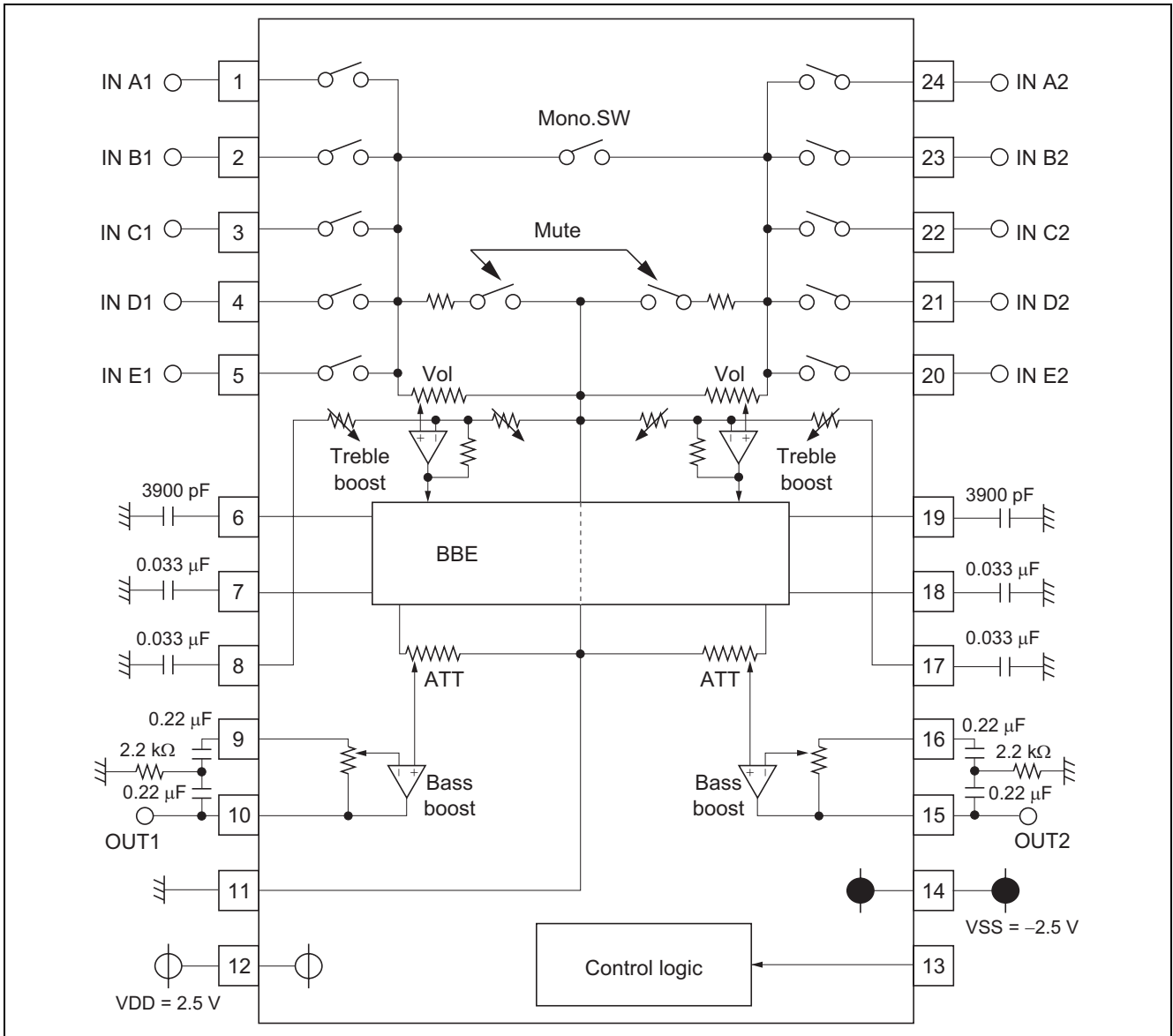
R2 (typical)

Treble boost	3 dB	6 dB	9 dB
R2 (k)	5.3	2.2	1.2

R1, R3 (typical)

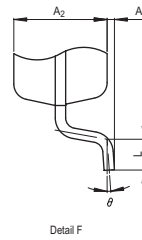
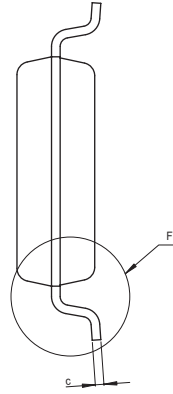
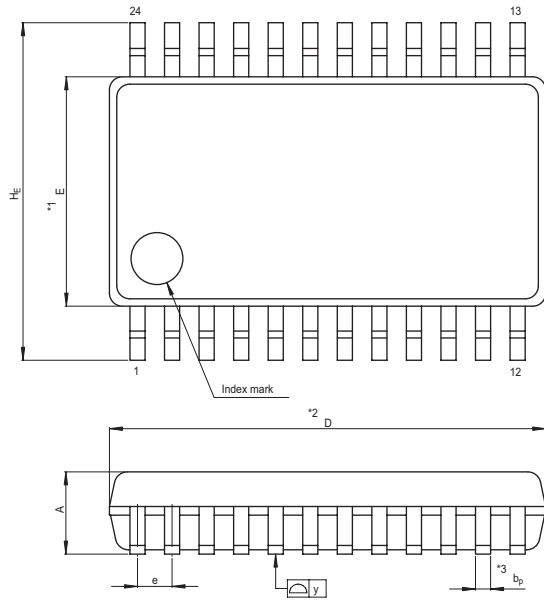
Gain	14 dB	16 dB	18 dB	20 dB
R1 (k)	10.88	13.65	17.21	21.60
R3 (k)	2.72	2.57	2.48	2.40

Application Example



Package Dimensions

JEITA Package Code	RENESAS Code	Previous Code	MASS[Typ.]
P-SSOP24-5.3x10.1-0.80	PRSP0024GA-A	24P2Q-A	0.2g



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	10.0	10.1	10.2
E	5.2	5.3	5.4
A ₂	—	1.8	—
A	—	—	2.1
A ₁	0	0.1	0.2
b _p	0.3	0.35	0.45
c	0.18	0.2	0.25
θ	0°	—	8°
H _E	7.5	7.8	8.1
e	0.65	0.8	0.95
y	—	—	0.10
L	0.4	0.6	0.8

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