AUDIO PROCESSOR with Subwoofer Output

■ GENERAL DESCRIPTION

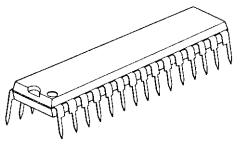
The **NJW1176** is a sound processor with subwoofer output includes all of functions processing audio signal for TV, such as tone control, balance, volume, mute, and AGC functions.

Also the **NJW1176** includes the LPF for subwoofer output and bass boost function.

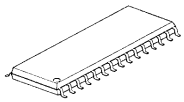
The original surround system reproduces natural surround sound and clear vocal orientation.

All of internal status and variables are controlled by I^2C BUS interface.

■ PACKAGE OUTLINE



NJW1176L



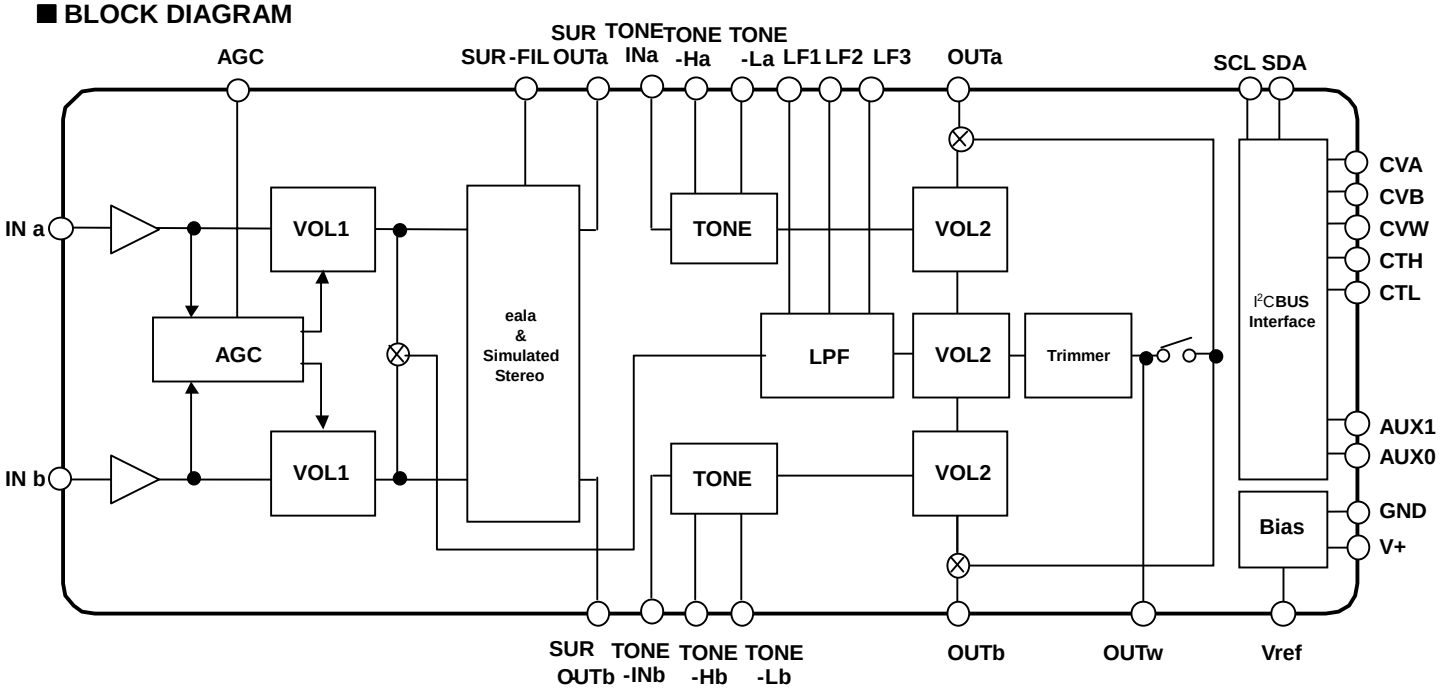
NJW1176M

NJW1176V

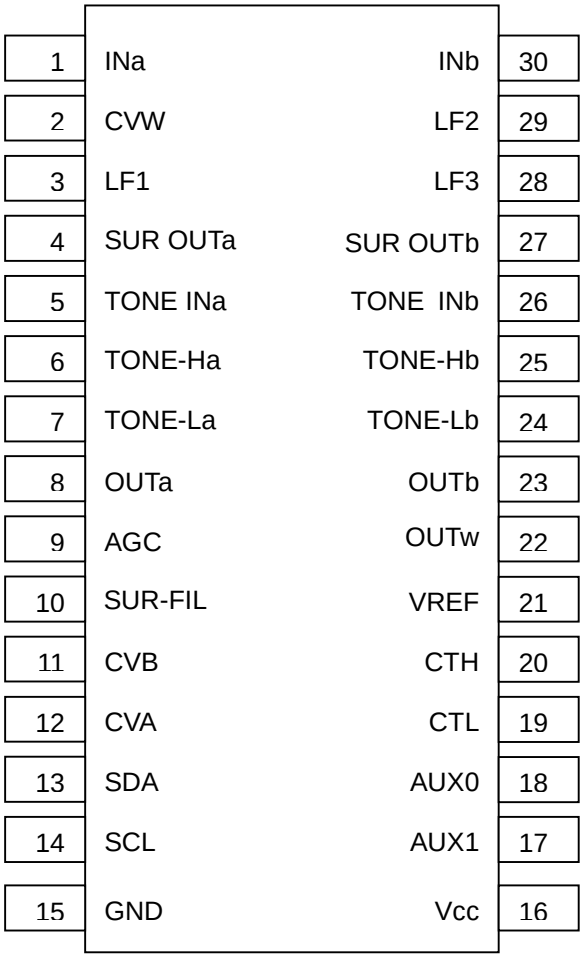
■ FEATURES

- Operating Voltage 7.5 to 13V
- 3ch Output (Lch, Rch, Subwoofer ch) / 2ch Output(Lch, Rch)
- LPF Filter (Adjustable cut off frequency by external parts)
- AGC Circuit (It reduces volume difference among input sources.)
  Adjustable AGC compression level by I^2C BUS
- eala(NJRC Original Surround System)
- Simulated Stereo
- I^2C BUS Interface
- Bi-CMOS Technology
- Package Outline SDIP30, SDMP30, SSOP32

■ BLOCK DIAGRAM



■PIN CONFIGURATION (SDIP30, SDMP30)



No.	Symbol	Function	No	Symbol	Function
1	INa	Ach Input	16	Vcc	Power Supply Pin
2	CVW	Wch DAC output terminal for LPF trimmer	17	AUX1	Auxiliary Output1
3	LF1	LPF filter1 terminal	18	AUX0	Auxiliary Output0
4	SUR OUTa	Ach Output for the Other Accessories	19	CTL	DAC Output for Tone Low Frequency
5	TONE INa	Ach Input From the Other Accessories	20	CTH	DAC Output for Tone High Frequency
6	TONE-Ha	Ach Treble Filter	21	VREF	Reference Voltage
7	TONE-La	Ach Bass Filter	22	OUTw	Wch Output
8	OUTa	Ach Output	23	OUTb	Bch Output
9	AGC	AGC Filter	24	TONE-Lb	Bch Bass Filter
10	SUR-FIL	eala and Simulated Stereo Filter	25	TONE-Hb	Bch Treble Filter
11	CVB	DAC Output for Bch Volume & Balance	26	TONE INb	Bch Input from the Other Accessories
12	CVA	DAC Output for Ach Volume & Balance	27	SUR OUTb	Bch Output for the Other Accessories
13	SDA	SDA Data Input (I^2C BUS)	28	LF3	LPF filter3 terminal
14	SCL	SCL Data Input (I^2C BUS)	29	LF2	LPF filter2terminal
15	GND	GND	30	INb	Bch Input

(*) The AUX0 terminal should be connected via the protection resistance to 5V device.

■PIN CONFIGURATION (SSOP32)

No.	Symbol	Function	No	Symbol	Function
1	INa	Ach Input	17	N.C.	No Connection
2	CVW	Wch DAC output terminal for LPF trimmer	18	Vcc	Power Supply Pin
3	LF1	LPF filter1 terminal	19	AUX1	Auxiliary Output1
4	SUR OUTa	Ach Output for the Other Accessories	20	AUX0	Auxiliary Output0
5	TONE INa	Ach Input From the Other Accessories	21	CTL	DAC Output for Tone Low Frequency
6	TONE-Ha	Ach Treble Filter	22	CTH	DAC Output for Tone High Frequency
7	TONE-La	Ach Bass Filter	23	VREF	Reference Voltage
8	OUTa	Ach Output	24	OUTw	Wch Output
9	AGC	AGC Filter	25	OUTb	Bch Output
10	SUR-FIL	eala and Simulated Stereo Filter	26	TONE-Lb	Bch Bass Filter
11	CVB	DAC Output for Bch Volume & Balance	27	TONE-Hb	Bch Treble Filter
12	CVA	DAC Output for Ach Volume & Balance	28	TONE INb	Bch Input from the Other Accessories
13	SDA	SDA Data Input (I^2C BUS)	29	SUR OUTb	Bch Output for the Other Accessories
14	SCL	SCL Data Input (I^2C BUS)	30	LF3	LPF filter3 terminal
15	GND	GND	31	LF2	LPF filter2terminal
16	N.C.	No Connection	32	INb	Bch Input

(*) The AUX0 terminal should be connected via the protection resistance to 5V device.

■ **ABSOLUTE MAXIMUM RATING (Ta=25°C)**

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V^+	15	V
Power Dissipation	P_D	(L, M type) 700	mW
		(V type) 800 NOTE: EIA/JEDEC STANDARD Test board (76.2x114.3x1.6mm, 2layer, FR-4) mounting	
Operating Temperature Range	Topr	-20 to +75	°C
Storage Temperature Range	Tstg	-40 to +125	°C

■ **ELECTRICAL CHARACTERISTICS**

(Ta=25°C, V+=9V, Rg=600Ω, R_L=47kΩ, Vin=100mVrms/1kHz unless otherwise specified)

PARAMETER	SYMBOL	Condition	Input		Output	MIN.	TYP.	MAX.	UNIT
			INa	INb					
Operating Voltage	V^+		-	-	-	7.5	9.0	13.0	V
Supply Current	I_{CC}	No Signal	-	-	-	-	13	25	mA
Reference Voltage	V_{REF}	No Signal	-	-	-	4.0	4.5	5.0	V
Maximum Input Voltage	V_{IM}	VOL=-20dB,THD=1%	V_{in}	-	OUTa	2.8	3.0	-	Vrms
			-	V_{in}	OUTb				
Maximum Output Voltage	V_{OM}	VOL=0dB, THD=1%	V_{in}	-	OUTa	-	2.5	-	Vrms
			-	V_{in}	OUTb				
Channel Balance	G_{CB}	VOL=0dB	-	-	-	-1.5	0.0	1.5	dB
Balance Boost A	BA_{BST}	CHS="0",BAL="111111"	V_{in}	V_{in}	OUTa	-2.0	0.0	2.0	dB
Balance Cut A	BA_{CUT}	CHS="1", BAL="111111" Vin = 1Vrms	V_{in}	V_{in}	OUTa	-	-	-70	dB
Balance Boost B	BB_{BST}	CHS="1",BAL="111111"	V_{in}	V_{in}	OUTb	-2.0	0.0	2.0	dB
Balance Cut B	BB_{CUT}	CHS="0", BAL="111111" Vin = 1Vrms	V_{in}	V_{in}	OUTb	-	-	-70	dB
Trimmer Boost	TR_{BST}	VOL=0dB TRIM = +18dB	V_{in}	V_{in}	OUTw	16.0	18.0	20.0	dB
Trimmer Cut	TR_{CUT}	VOL=0dB TRIM = Mute	V_{in}	V_{in}	OUTw	-	-	-70	dB
Total Harmonic Distortion	THD	Vo=0.5Vrms, BW=400Hz to 30kHz	V_{in}	-	OUTa	-	-	0.5	%
			-	V_{in}	OUTb				
Maximum Gain	G_{VMAX}	VOL=0dB	V_{in}	-	OUTa	-2.0	0.0	2.0	dB
			-	V_{in}	OUTb				
Minimum Gain	G_{VMIN}	VOL=MUTE Vin=1Vrms	V_{in}	-	OUTa	-	-	-70	dB
			-	V_{in}	OUTb				
Channel Separation	CS	Vin=1Vrms A-weighted	V_{in}	-	OUTb	-	-	-70	dB
			-	V_{in}	OUTa				
Output Noise 1	V_{NO1}	VOL=0dB A-weighted	-	-	-	-	-90 (31.6)	-85 (56.2)	dBV (μVrms)
Output Noise 2	V_{NO2}	VOL=MUTE A-weighted	-	-	-	-	-106 (5.0)	-96 (15.8)	dBV (μVrms)
Output Noise 3	V_{NO3}	VOL=MUTE,TRIM=MUTE A-weighted	-	-	-	-	-100 (10.0)	-90 (30.0)	dBV (μVrms)

BW : Band Width

■ **ELECTRICAL CHARACTERISTICS**

(Ta=25°C, V+=9V, Rg=600Ω, R_L=47kΩ, Vin=100mVrms/1kHz unless otherwise specified)

PARAMETER	SYMBOL	Condition	Input		Output	MIN.	TYP.	MAX.	UNIT
			INa	INb					
♦TONE									
High Frequency Boost	HF_{BST}	BCT="1" TREB=+15dB, f=10kHz	V_{in}	-	OUTa	12.5	15.0	17.5	dB
			-	V_{in}	OUTb				
High Frequency Flat	HF_{FLT}	TREB=0, f=10kHz	V_{in}	-	OUTa	-2.0	0.0	2.0	dB
			-	V_{in}	OUTb				
High Frequency Cut	HF_{CUT}	BCT="0" TREB=-15dB, f=10kHz	V_{in}	-	OUTa	-17.5	-15.0	-12.5	dB
			-	V_{in}	OUTb				
Low Frequency Boost	LF_{BST}	BCB="1" BASS=+15dB, f=100Hz	V_{in}	-	OUTa	12.5	15.0	17.5	dB
			-	V_{in}	OUTb				
Low Frequency Flat	LF_{FLT}	BASS=0, f=100Hz	V_{in}	-	OUTa	-2.0	0.0	2.0	dB
			-	V_{in}	OUTb				
Low Frequency Cut	LF_{CUT}	BCB="0" BASS=-15dB, f=100Hz	V_{in}	-	OUTa	-17.5	-15.0	-12.5	dB
			-	V_{in}	OUTb				
◆AGC									
AGC Boost	AGC_{BST}	Vin=50mVrms, f=1kHz AGC="1"	V_{in}		OUTa	1.5	3.5	5.5	dB
			V_{in}	V_{in}	OUTb				
AGC Flat1	AGC_{FLT1}	Vin=100mVrms,f=1kHz AGC="1", AGCL="00"	V_{in}	V_{in}	OUTa	-2.5	0.0	2.5	dB
			V_{in}	V_{in}	OUTb				
AGC Flat2	AGC_{FLT2}	Vin=200mVrms, f=1kHz AGC="1", AGCL="01"	V_{in}	V_{in}	OUTa	-2.5	0.0	2.5	dB
			V_{in}	V_{in}	OUTb				
AGC Flat3	AGC_{FLT3}	Vin=300mVrms, f=1kHz AGC="1", AGCL="10"	V_{in}	V_{in}	OUTa	-2.5	0.0	2.5	dB
			V_{in}	V_{in}	OUTb				
AGC Flat4	AGC_{FLT4}	Vin=400mVrms, f=1kHz AGC="1", AGCL="11"	V_{in}	V_{in}	OUTa	-2.5	0.0	2.5	dB
			V_{in}	V_{in}	OUTb				
AGC Cut	AGC_{CUT}	Vin=2Vrms, f=1kHz AGC="1"	V_{in}	V_{in}	OUTa	-14	-10	-6.0	dB
			V_{in}	V_{in}	OUTb				
◆SURROUND									
Surround Gain1	SR_{GAIN1}	f=100Hz Surround Effect1	V_{in}	-	OUTa	6.3	8.3	10.3	dB
			-	V_{in}	OUTb				
Surround Gain2	SR_{GAIN2}	f=100Hz Surround Effect1	V_{in}	-	OUTb	2.1	4.1	6.1	dB
			-	V_{in}	OUTa				
Surround Gain3	SR_{GAIN3}	f=100 Hz Surround Effect2	V_{in}	-	OUTa	10.7	12.7	14.7	dB
			-	V_{in}	OUTb				
Surround Gain4	$SR_{GAIN\ 4}$	f=100Hz Surround Effect2	V_{in}	-	OUTb	8.4	10.4	12.4	dB
			-	V_{in}	OUTa				
Simulated Stereo1	SR_{SIM1}	f=1kHz, Simulated Stereo	V_{in}	V_{in}	OUTa	1.0	3.0	5.0	dB
Simulated Stereo2	SR_{SIM2}	f=1kHz, Simulated Stereo	V_{in}	V_{in}	OUTb	1.0	3.0	5.0	dB
◆ AUX									
AUX0 Output Voltage	V_{AUX0}	Logic Output : High	-	-	-	4.5	-	5.5	V
		Logic Output : Mid				2.0	-	3.0	
		Logic Output : Low				0	-	0.5	
AUX1 Output Voltage	V_{AUX1}	Logic Output : High	-	-	-	3.5	-	V+	V
		Logic Output : Low				0	-	0.5	

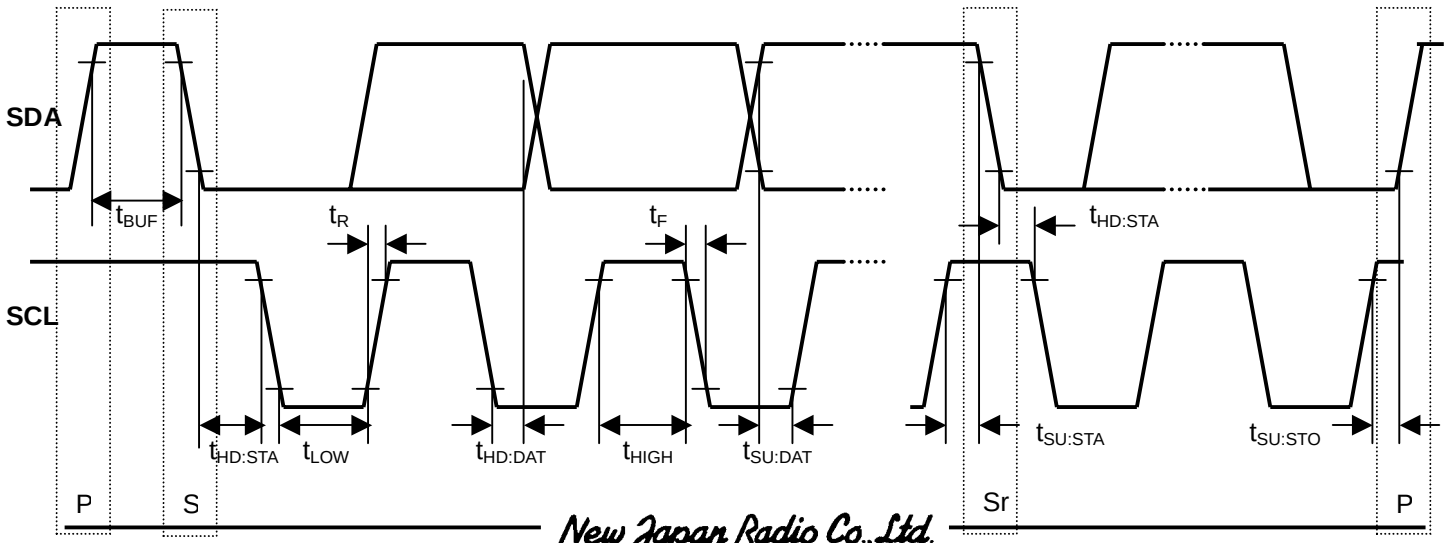
■ I²C BUS BLOCK CHARACTERISTICS (SDA,SCL)

I²C BUS Load Conditions: Pull up resistance 4kΩ (Connected to +5V), Load capacitance 200pF (Connected to GND)

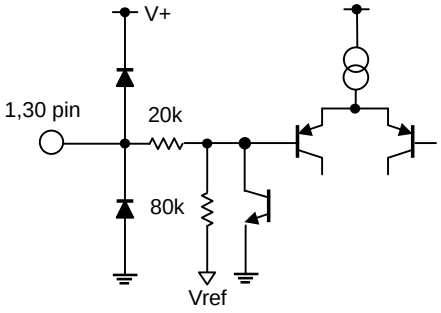
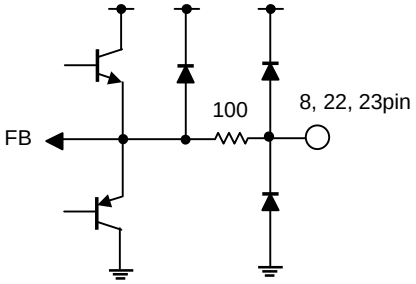
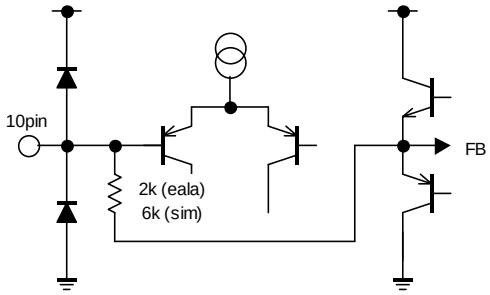
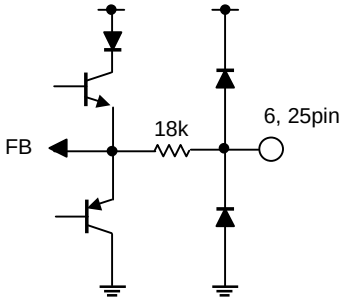
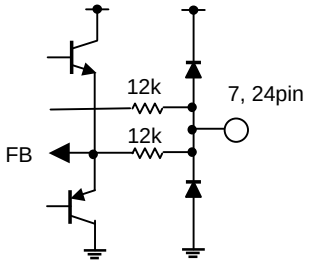
PARAMETER	SYMBOL	Standard mode			Fast mode			UNIT
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Low Level Input Voltage	V_{IL}	0.0	-	1.5	0.0	-	1.5	V
High Level Input Voltage	V_{IH}	2.7	-	5.0	2.7	-	5.0	V
Hysteresis of Schmitt trigger inputs	V_{hys}	-	-	-	0.25	-	-	V
Low level output voltage (3mA at SDA pin)	V_{OL}	0	-	0.4	0	-	0.4	V
Output fall time from V_{IHmin} to V_{ILmax} with a bus capacitance from 10pF to 400pF	t_{of}	-	-	250	$20 +0.1C_b$	-	250	ns
Pulse width of spikes which must be suppressed by the input filter	t_{SP}	-	-	-	0	-	50	ns
Input current each I/O pin with an input voltage between $0.1V_{DD}$ and $0.9V_{DDmax}$	I_i	-10	-	10	-10	-	10	μA
Capacitance for each I/O pin	C_i	-	-	10	-	-	10	pF
SCL clock frequency	f_{SCL}	-	-	100	-	-	400	kHz
Hold time (repeated) START condition.	$t_{HD:STA}$	4.0	-	-	0.6	-	-	μs
Low period of the SCL clock	t_{LOW}	4.7	-	-	1.3	-	-	μs
High period of the SCL clock	t_{HIGH}	4.0	-	-	0.6	-	-	μs
Set-up time for a repeated START condition	$t_{SU:STA}$	4.7	-	-	0.6	-	-	μs
Data hold time	$t_{HD:DAT}$	0	-	3.45	0	-	0.9	μs
Data set-up time	$t_{SU:DAT}$	250	-	-	100	-	-	ns
Rise time of both SDA and SCL signals	t_r	-	-	1000	-	-	300	ns
Fall time of both SDA and SCL signals	t_f	-	-	300	-	-	300	ns
Set-up time for STOP condition	$t_{SU:STO}$	4.0	-	-	0.6	-	-	μs
Bus free time between a STOP and START condition	t_{BUF}	4.7	-	-	1.3	-	-	μs
Capacitive load for each bus line	C_b	-	-	400	-	-	400	pF
Noise margin at the Low level	V_{nL}	0.5	-	-	0.5	-	-	V
Noise margin at the High level	V_{nH}	1	-	-	1	-	-	V

C_b ; total capacitance of one bus line in pF.

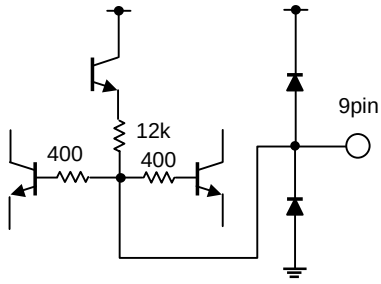
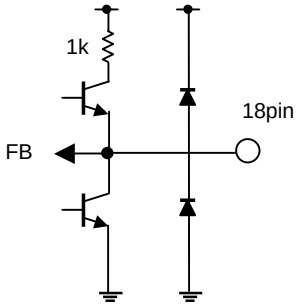
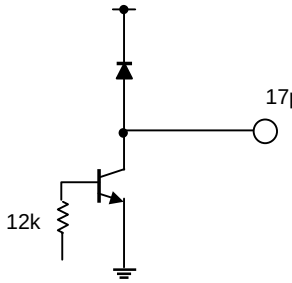
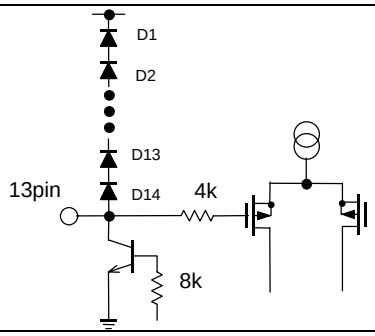
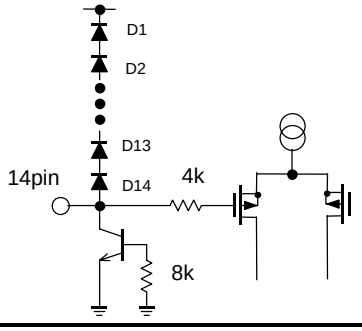
I²C BUS Load Condition: Pull up resistance 4kΩ (Connected to +5V)
Load capacitance 200pF (Connected to GND)



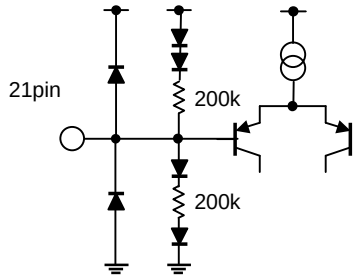
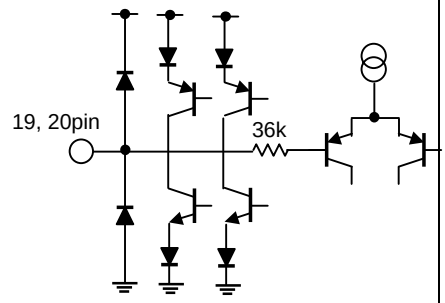
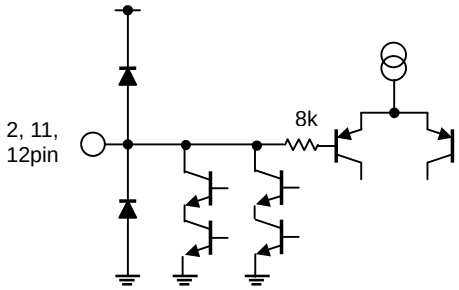
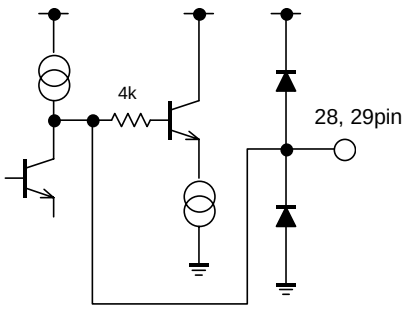
■TERMINAL DESCRIPTION

No. SDIP SDMP	No. SSOP	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	VOLTAGE
1 30	1 32	INa INb	Ach input terminal Bch input terminal		V+/2
22 8 23	24 8 25	OUTw OUTa OUTb	Subwoofer output terminal Ach output terminal Bch output terminal		V+/2
10	10	SUR-FIL	Surround filter terminal		V+/2
6 25	6 27	TONE-Ha TONE-Hb	Treble(tone control) filter terminal		V+/2
7 24	7 26	TONE-La TONE-Lb	Bass(tone control) filter terminal		V+/2

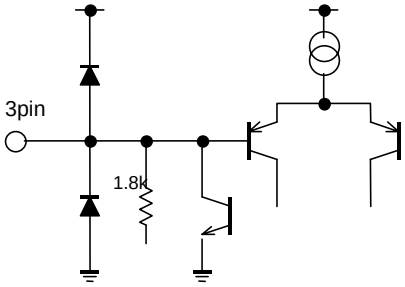
■TERMINAL DESCRIPTION

No. SDIP SDMP	No. SSOP	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	VOLTAGE
9	9	AGC	Capacitor connection terminal for AGC attack and recovery time setting		AGC; OFF=0.65V ON=1.4V
18	20	AUX0	Auxiliary 3 values voltage output terminal		Low=0V Mid=2.5V High= 5.0V
17	19	AUX1	Auxiliary 2 values voltage output terminal (Open collector type output)		Low=0V High=3.5V to V+
13	13	SDA	I^2C data terminal		-
14	14	SCL	I^2C clock terminal		-

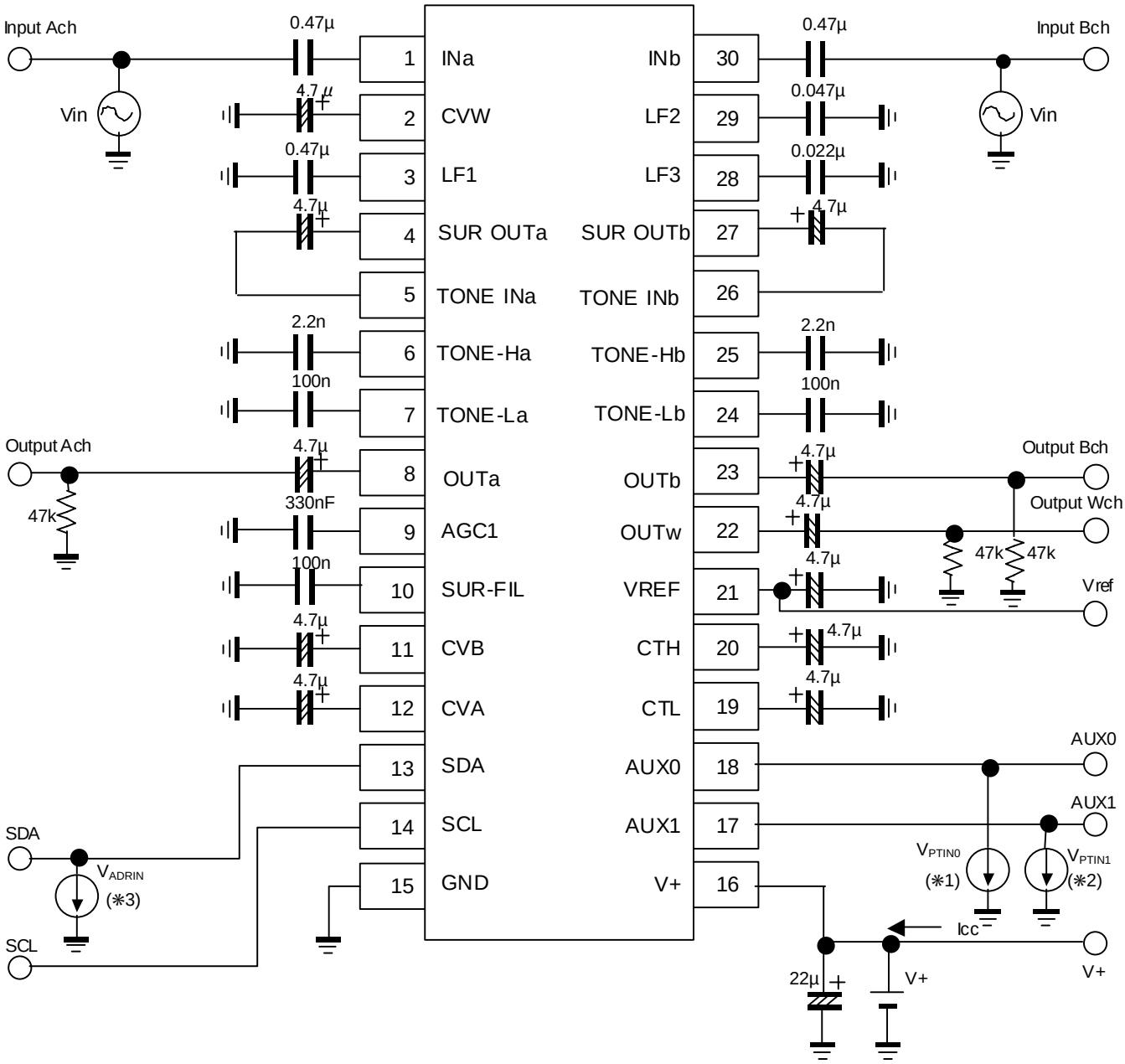
■TERMINAL DESCRIPTION

No. SDIP SDMP	No. SSOP	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	VOLTAGE
15 16	15 17	GND V+	Ground terminal Supply voltage terminal	-	0V V+
21	23	Vref	Reference voltage terminal		V+/2
19 20	21 22	CTL CTH	DAC output for tone control terminal		-
2 11 12	2 11 12	CVW CVB CVA	DAC output terminal for trimmer control DAC output terminal for Bch volume control DAC output terminal for Ach volume control		-
29 28	31 30	LF3 LF2	LPF filter terminal		V+/2+0.7V

■TERMINAL DESCRIPTION

No.		SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	VOLTAGE
SDIP SDMP	SSOP				
3	3	LF1	LPF filter terminal		V+/2

■ MEASUREMENT CIRCUIT



(✳1)

V_{AUX0}	I_{AUX0}
Output High	+1mA
Output Low	-120µA

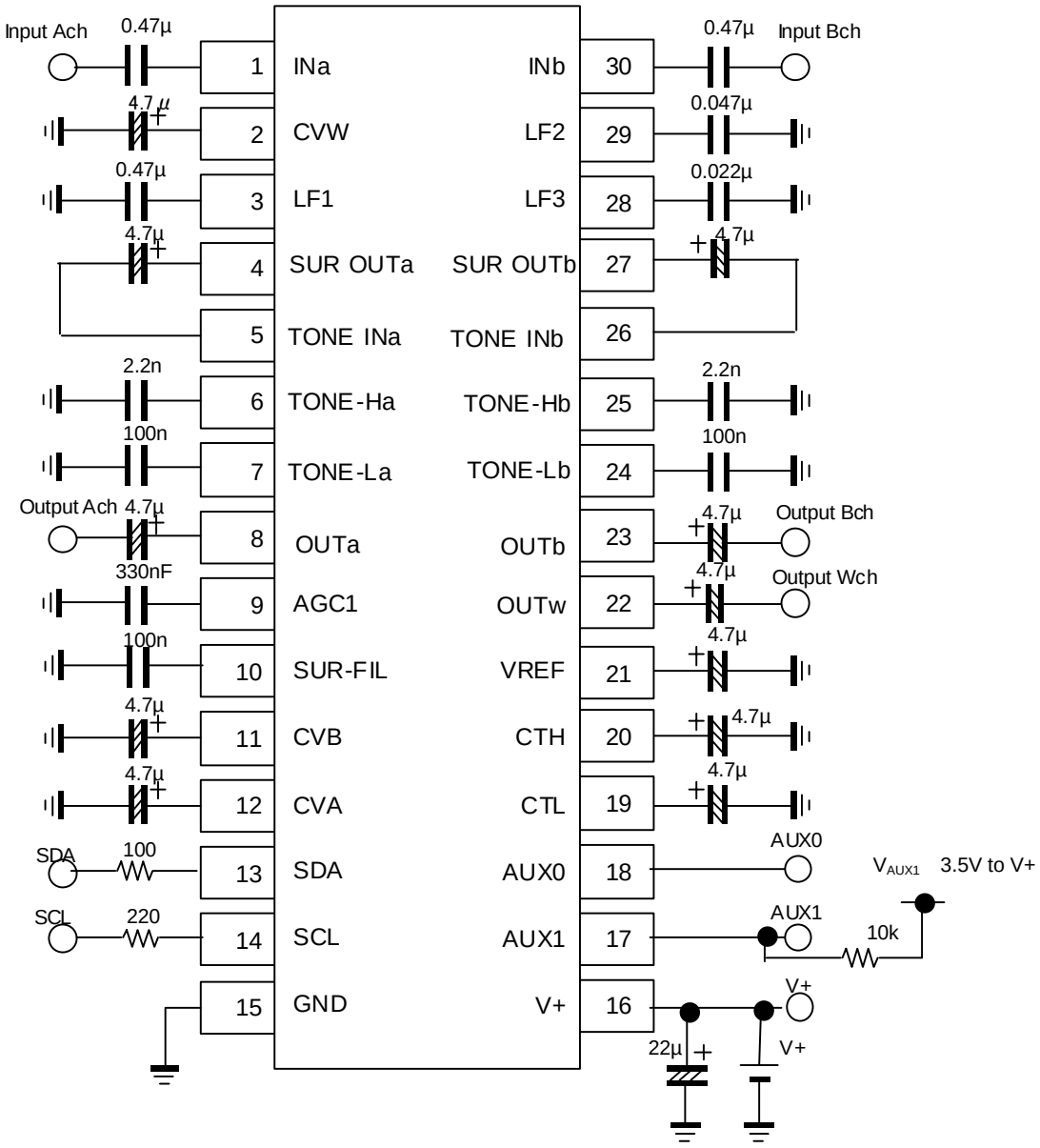
(✳2)

V_{AUX1}	I_{AUX1}
Output Low	-1mA

(✳3)

V_{OL}	I_{OL}
Output Low	-3mA

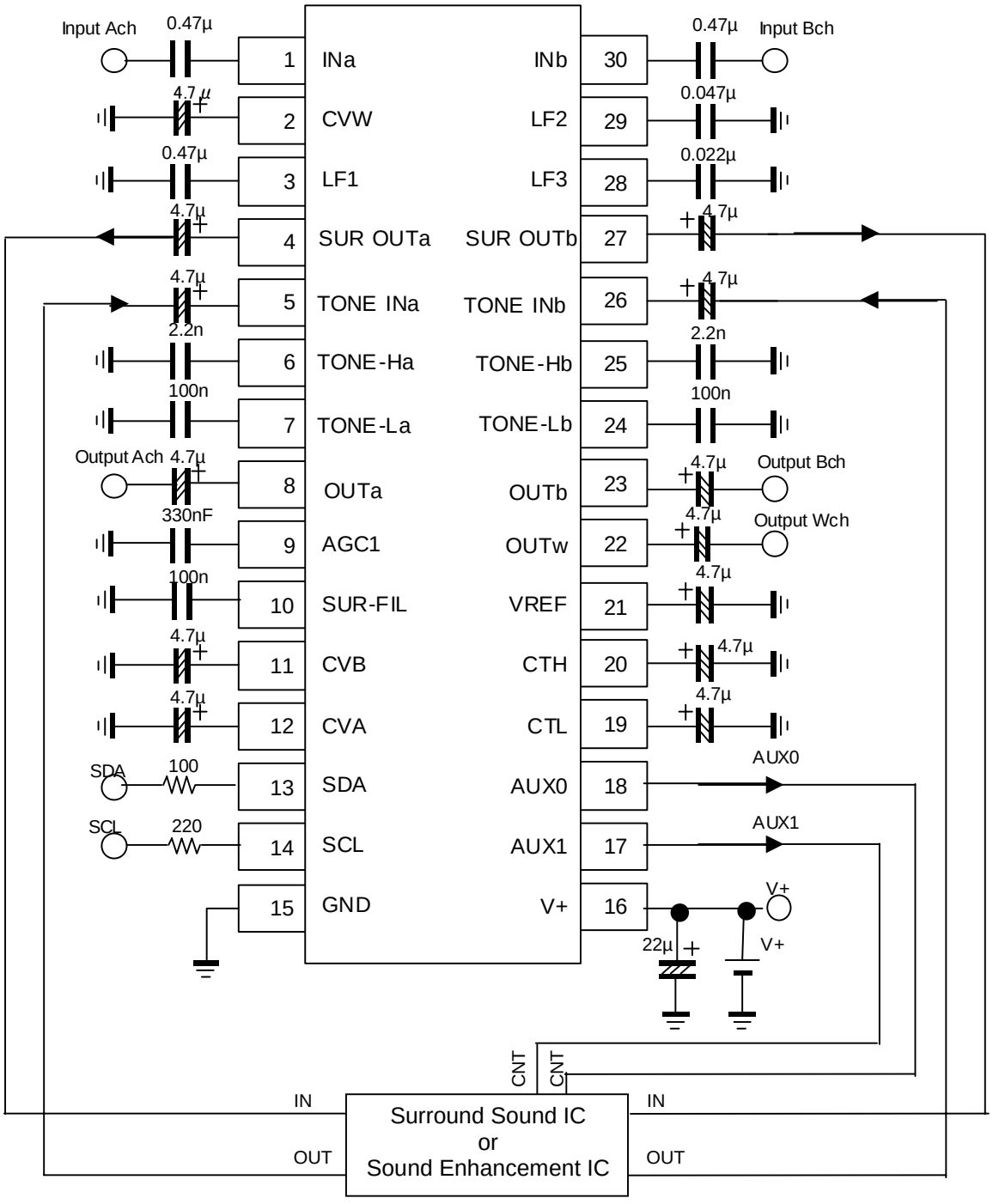
■ **APPLICATION CIRCUIT 1 (SDIP30, SDMP30)**



(∗4) Separate the I^2C bus line and Signal line from the following terminals for avoiding digital noise problem and cross talk.

Pin No.	Symbol	Pin No.	Symbol
3	LF1	24	TONE-Lb
6	TONE-Ha	25	TONE-Hb
7	TONE-La	28	LF3
10	SUR-FIL	29	LF2

■ **APPLICATION CIRCUIT 2 (SDIP30, SDMP30)**

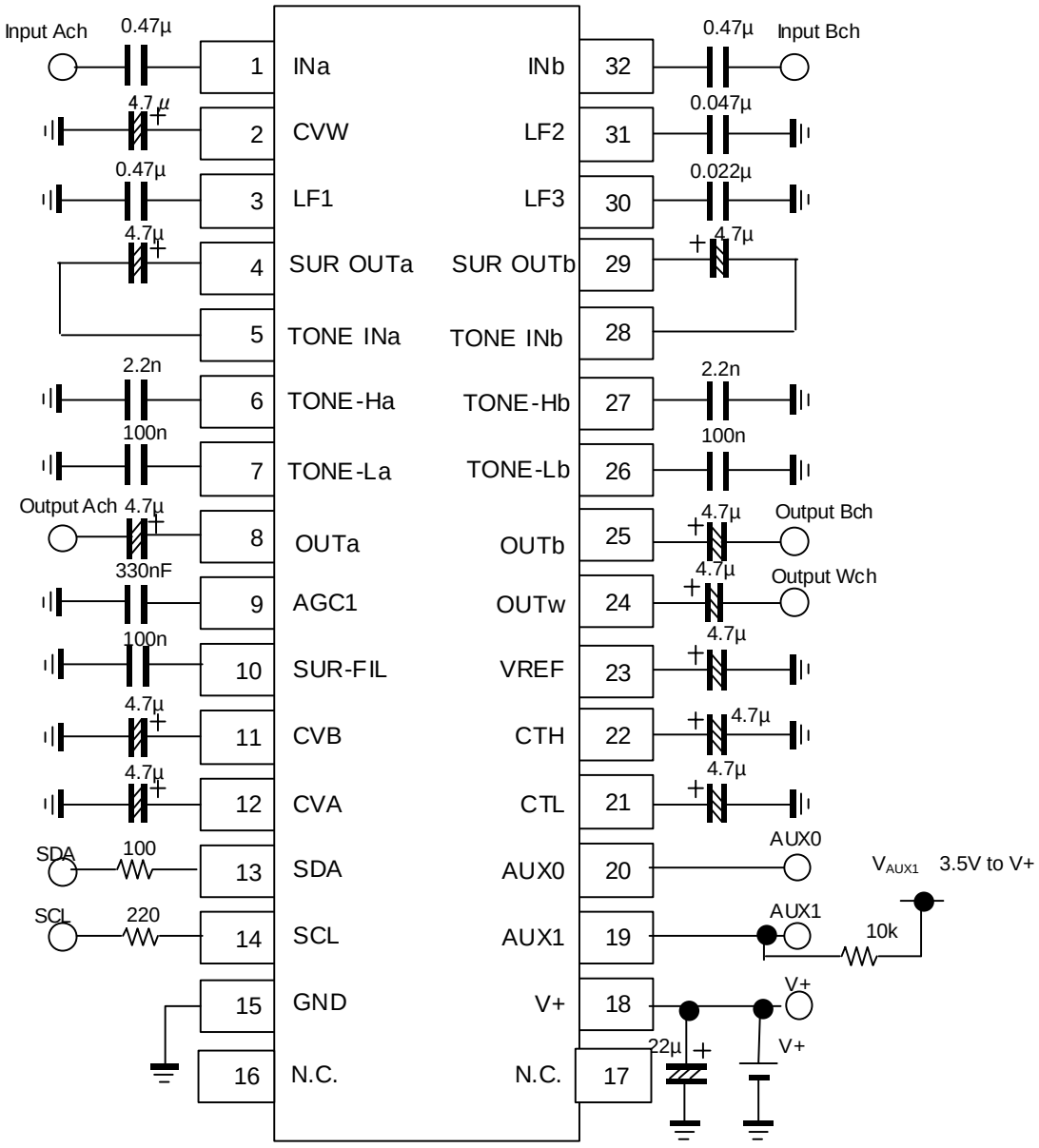


Ex.)
ealaBASS : NJM2706
BBE Mach3 : NJM2155
SRS TruBass : NJM2192A
SRS WOW : NJM2700, NJM2195, … , etc

(∗4) Separate the I^2C bus line and Signal line from the following terminals for avoiding digital noise problem and cross talk.

Pin No.	Symbol	Pin No.	Symbol
3	LF1	24	TONE-Lb
6	TONE-Ha	25	TONE-Hb
7	TONE-La	28	LF3
10	SUR-FIL	29	LF2

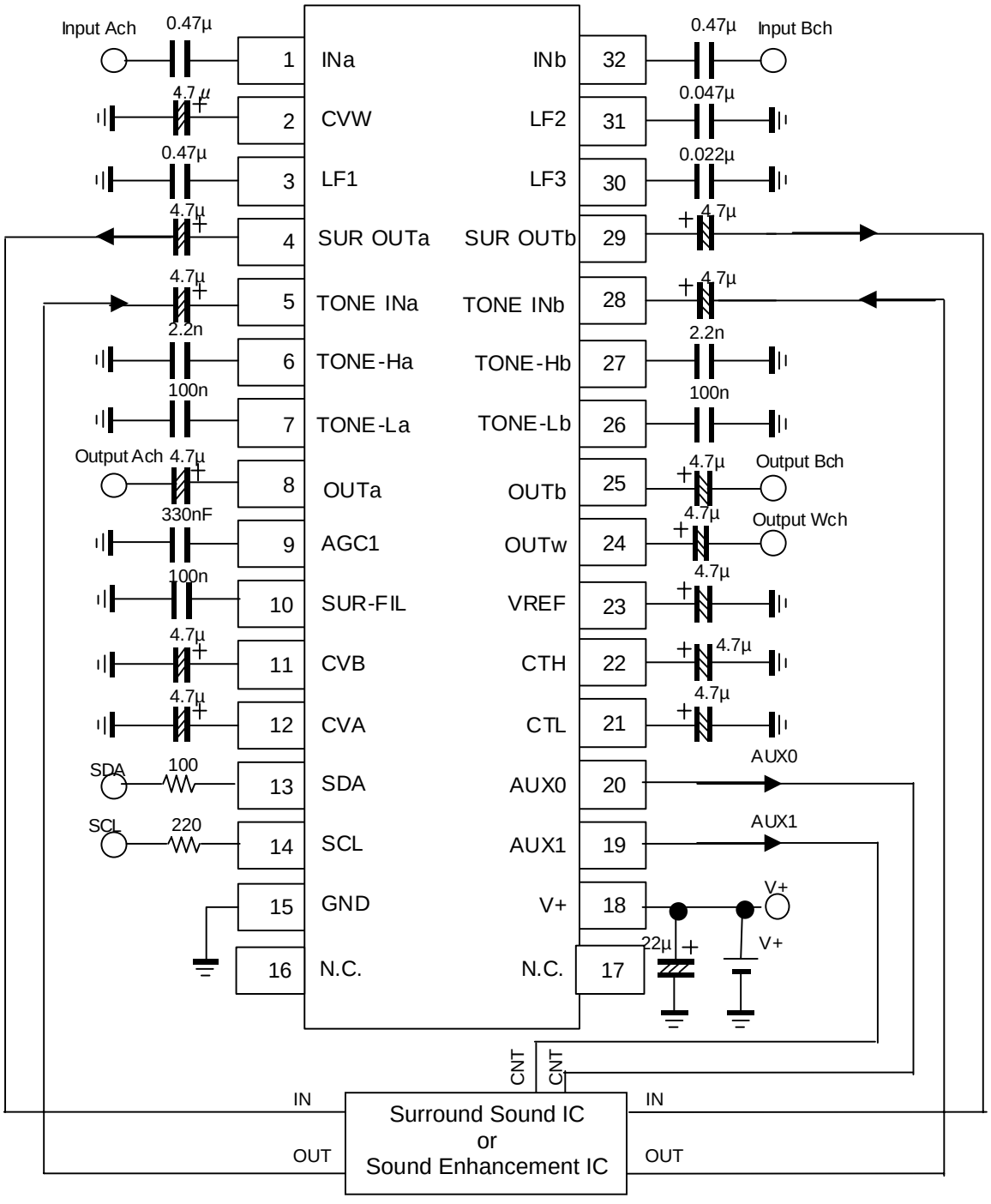
■ **APPLICATION CIRCUIT 3 (SSOP32)**



(✳4) Separate the I^2C bus line and Signal line from the following terminals for avoiding digital noise problem and cross talk.

Pin No.	Symbol	Pin No.	Symbol
3	LF1	26	TONE-Lb
6	TONE-Ha	27	TONE-Hb
7	TONE-La	30	LF3
10	SUR-FIL	31	LF2

■ **APPLICATION CIRCUIT 4 (SSOP32)**



Ex.)
ealaBASS : NJM2706
BBE Mach3 : NJM2155
SRS TruBass : NJM2192A
SRS WOW : NJM2700, NJM2195, … , etc

(∗4) Separate the I^2C bus line and Signal line from the following terminals for avoiding digital noise problem and cross talk.

Pin No.	Symbol	Pin No.	Symbol
3	LF1	26	TONE-Lb
6	TONE-Ha	27	TONE-Hb
7	TONE-La	30	LF3
10	SUR-FIL	31	LF2

■ DEFINITION OF I²C REGISTER

♦I²C BUS FORMAT

	MSB LSB		MSB LSB		MSB LSB		
S	Slave Address	A	Select Address	A	Data	A	P
1bit	8bit	1bit	8bit	1bit	8bit	1bit	1bit

S: Starting Term
A: Acknowledge Bit
P: Ending Term

♦SLAVE ADDRESS

R/$\overline{W}$ = 0: Receive Only.
R/$\overline{W}$ = 1: No Output Data

Slave Address								Hex
1	0	0	0	0	0	1	0	82(h)

♦CONTROL REGISTER TABLE

The select address sets each function (Volume, Balance, Bass Boost Select, AGC, Surround, Tone Control, AUX).
The auto increment function cycles the select address as follows.
00H→01H→02H→03H→04H→05H→00H

<Write Mode>

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	VOL							
01H	CHS	BAL						BBSW
02H	BCB	BASS						✳
03H	BCT	TREB						✳
04H	TRIM							✳
05H	SUR		AUX1	AUX0		AGCL		AGC

✳ : Don't Care

♦CONTROL REGISTER DEFAULT VALUE

Control register default value is all "0".

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	0	0	0	0	0	0	0	0
01H	0	0	0	0	0	0	0	0
02H	0	0	0	0	0	0	0	0
03H	0	0	0	0	0	0	0	0
04H	0	0	0	0	0	0	0	0
05H	0	0	0	0	0	0	0	0

■INSTRUCTION CODE

a) MASTER VOLUME SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	VOL							

•VOL Attenuation level : 0 to –80dB(0.33dB/step) , MUTE

The attenuator is consisted of both the VOL1(0.165dB/step)and VOL2(0.165dB/step) and is enable to adjust 0.33dB/step. The attenuation for both the VOL1and VOL2 are always synchronized to have the same attenuation levels for each other, and are not controllable independently for each other.

ex) VOL(-30dB) = VOL1(-15dB) + VOL2(-15dB)

b) BALANCE AND BASS BOOST FUNCTION SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
01H	CHS	BAL						BBSW

•CHS : Channel select for balance control

"0" : Ach "Bch is attenuated"

"1" : Bch "Ach is attenuated"

•BAL : Balance control for both Ach and Bch

Balance Level : 0 to –60dB (1dB/Step) , MUTE

•BBSW : Bass Boost ON/OFF Switch

"0" = Bass Boost OFF

"1" = Bass Boost ON

c) TONE CONTROL BASS SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
02H	BCB	BASS					Don't Care	

•BCB : Boost cut select for Bass control

"0" : Cut

"1" : Boost

•BASS : BASS Level Setting

Cut Level : -15 to 0dB(0.5dB/Step)

Boost Level : 0 to +15dB(0.5dB/Step)

d) TONE CONTROL TREBLE SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
03H	BCT	TREB					Don't Care	

•BCT : Boost cut select for Treble control

"0" : Cut

"1" : Boost

•TREB : TREBLE Level Setting

Cut Level : -15 to 0dB(0.5dB/Step)

Boost Level : 0 to +15dB(0.5dB/Step)

e) TRIMMER LEVEL SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
04H	TRIM							Don't Care

•TRIM : Trimmer Level

Trimmer Level : +18 to –44dB (0.5dB/Step) , MUTE

d) SURROUND, AUXILIARY, AGC LEVEL SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
05H	SUR		AUX1	AUX0		AGCL		AGC

<SUR : Surround Level Setting>

Surround Setting	D7	D6	Remarks
Surround Off	0	0	Surround Off
Simulated Stereo	0	1	Simulated Stereo
Surround Effect1	1	0	Surround Effect Low(8.3dB typ.)
Surround Effect2	1	1	Surround Effect High(12.7dB typ.)

<AUX1 : AUX1 Terminal Setting>

Auxiliary Setting	D5
Low (0.0V)	0
High (5.0V)	1

<AUX0 : AUX0 Terminal Setting>

Auxiliary Setting	D4	D3
Low (0.0V)	-	0
Mid (2.5V)	0	1
High (5.0V)	1	1

<AGCL : AGC Level Setting>

AGC Level Setting	D2	D1
100mVrms	0	0
200mVrms	0	1
300mVrms	1	0
400mVrms	1	1

<AGC : AGC Setting>

AGC Setting	D0
OFF	0
ON	1

■Master Volume (Select Address : 00H)

		VOL							
Gain(dB)	HEX	D7	D6	D5	D4	D3	D2	D1	D0
0	FF	1	1	1	1	1	1	1	1
-1	FC	1	1	1	1	1	1	0	0
-2	F9	1	1	1	1	1	0	0	1
-3	F6	1	1	1	1	0	1	1	0
-4	F3	1	1	1	1	0	0	1	1
-5	F0	1	1	1	1	0	0	0	0
-6	ED	1	1	1	0	1	1	0	1
-7	EA	1	1	1	0	1	0	1	0
-8	E7	1	1	1	0	0	1	1	1
-9	E4	1	1	1	0	0	1	0	0
-10	E1	1	1	1	0	0	0	0	1
-11	DE	1	1	0	1	1	1	1	0
-12	DB	1	1	0	1	1	0	1	1
-13	D8	1	1	0	1	1	0	0	0
-14	D5	1	1	0	1	0	1	0	1
-15	D2	1	1	0	1	0	0	1	0
-16	CF	1	1	0	0	1	1	1	1
-17	CC	1	1	0	0	1	1	0	0
-18	C9	1	1	0	0	1	0	0	1
-19	C6	1	1	0	0	0	1	1	0
-20	C3	1	1	0	0	0	0	1	1
-21	C0	1	1	0	0	0	0	0	0
-22	BD	1	0	1	1	1	1	0	1
-23	BA	1	0	1	1	1	0	1	0
-24	B7	1	0	1	1	0	1	1	1
-25	B4	1	0	1	1	0	1	0	0
-26	B1	1	0	1	1	0	0	0	1
-27	AE	1	0	1	0	1	1	1	0
-28	AB	1	0	1	0	1	0	1	1
-29	A8	1	0	1	0	1	0	0	0
-30	A5	1	0	1	0	0	1	0	1
-31	A2	1	0	1	0	0	0	1	0
-32	9F	1	0	0	1	1	1	1	1
-33	9C	1	0	0	1	1	1	0	0
-34	99	1	0	0	1	1	0	0	1
-35	96	1	0	0	1	0	1	1	0
-36	93	1	0	0	1	0	0	1	1
-37	90	1	0	0	1	0	0	0	0
-38	8D	1	0	0	0	1	1	0	1
-39	8A	1	0	0	0	1	0	1	0
-40	87	1	0	0	0	0	1	1	1
-41	84	1	0	0	0	0	1	0	0
-42	81	1	0	0	0	0	0	0	1

		VOL							
Gain(dB)	**HEX**	**D7**	**D6**	**D5**	**D4**	**D3**	**D2**	**D1**	**D0**
-43	7E	0	1	1	1	1	1	1	0
-44	7B	0	1	1	1	1	0	1	1
-45	78	0	1	1	1	1	0	0	0
-46	75	0	1	1	1	0	1	0	1
-47	72	0	1	1	1	0	0	1	0
-48	6F	0	1	1	0	1	1	1	1
-49	6C	0	1	1	0	1	1	0	0
-50	69	0	1	1	0	1	0	0	1
-51	66	0	1	1	0	0	1	1	0
-52	63	0	1	1	0	0	0	1	1
-53	60	0	1	1	0	0	0	0	0
-54	5D	0	1	0	1	1	1	0	1
-55	5A	0	1	0	1	1	0	1	0
-56	57	0	1	0	1	0	1	1	1
-57	54	0	1	0	1	0	1	0	0
-58	51	0	1	0	1	0	0	0	1
-59	4E	0	1	0	0	1	1	1	0
-60	4B	0	1	0	0	1	0	1	1
-61	48	0	1	0	0	1	0	0	0
-62	45	0	1	0	0	0	1	0	1
-63	42	0	1	0	0	0	0	1	0
-64	3F	0	0	1	1	1	1	1	1
-65	3C	0	0	1	1	1	1	0	0
-66	39	0	0	1	1	1	0	0	1
-67	36	0	0	1	1	0	1	1	0
-68	33	0	0	1	1	0	0	1	1
-69	30	0	0	1	1	0	0	0	0
-70	2D	0	0	1	0	1	1	0	1
-71	2A	0	0	1	0	1	0	1	0
-72	27	0	0	1	0	0	1	1	1
-73	24	0	0	1	0	0	1	0	0
-74	21	0	0	1	0	0	0	0	1
-75	1E	0	0	0	1	1	1	1	0
-76	1B	0	0	0	1	1	0	1	1
-77	18	0	0	0	1	1	0	0	0
-78	15	0	0	0	1	0	1	0	1
-79	12	0	0	0	1	0	0	1	0
-80	0F	0	0	0	0	1	1	1	1
MUTE*	00	0	0	0	0	0	0	0	0

✳ : Default Value

■**Balance, Bass Boost Setting (Select Address : 01H)**

Channel Setting (CHS)	D7
Decrease Bch Gain	0
Decrease Ach Gain	1

Gain(dB)	BAL					
	D6	D5	D4	D3	D2	D1
0*	0	0	0	0	0	0
-1	0	0	0	0	0	1
-2	0	0	0	0	1	0
-3	0	0	0	0	1	1
-4	0	0	0	1	0	0
-5	0	0	0	1	0	1
-6	0	0	0	1	1	0
-7	0	0	0	1	1	1
-8	0	0	1	0	0	0
-9	0	0	1	0	0	1
-10	0	0	1	0	1	0
-11	0	0	1	0	1	1
-12	0	0	1	1	0	0
-13	0	0	1	1	0	1
-14	0	0	1	1	1	0
-15	0	0	1	1	1	1
-16	0	1	0	0	0	0
-17	0	1	0	0	0	1
-18	0	1	0	0	1	0
-19	0	1	0	0	1	1
-20	0	1	0	1	0	0
-21	0	1	0	1	0	1
-22	0	1	0	1	1	0
-23	0	1	0	1	1	1
-24	0	1	1	0	0	0
-25	0	1	1	0	0	1
-26	0	1	1	0	1	0
-27	0	1	1	0	1	1
-28	0	1	1	1	0	0
-29	0	1	1	1	0	1
-30	0	1	1	1	1	0

✳ : Default Value

Gain(dB)	BAL					
	D6	D5	D4	D3	D2	D1
-31	0	1	1	1	1	1
-32	1	0	0	0	0	0
-33	1	0	0	0	0	1
-34	1	0	0	0	1	0
-35	1	0	0	0	1	1
-36	1	0	0	1	0	0
-37	1	0	0	1	0	1
-38	1	0	0	1	1	0
-39	1	0	0	1	1	1
-40	1	0	1	0	0	0
-41	1	0	1	0	0	1
-42	1	0	1	0	1	0
-43	1	0	1	0	1	1
-44	1	0	1	1	0	0
-45	1	0	1	1	0	1
-46	1	0	1	1	1	0
-47	1	0	1	1	1	1
-48	1	1	0	0	0	0
-49	1	1	0	0	0	1
-50	1	1	0	0	1	0
-51	1	1	0	0	1	1
-52	1	1	0	1	0	0
-53	1	1	0	1	0	1
-54	1	1	0	1	1	0
-55	1	1	0	1	1	1
-56	1	1	1	0	0	0
-57	1	1	1	0	0	1
-58	1	1	1	0	1	0
-59	1	1	1	0	1	1
-60	1	1	1	1	0	0
MUTE	1	1	1	1	1	1

Bass Boost Setting (BBSW)	D0
Bass Boost Off*	0
Bass Boost On	1

* : Default Value

■Tone Control(Bass Setting) (Select Address : 02H)

Bass Cut or Boost	BCB D7
Cut	0
Boost	1

		BASS				
Cut Gain(dB)	Boost Gain(dB)	D6	D5	D4	D3	D2
-15.0	15.0	1	1	1	1	0
-14.5	14.5	1	1	1	0	1
-14.0	14.0	1	1	1	0	0
-13.5	13.5	1	1	0	1	1
-13.0	13.0	1	1	0	1	0
-12.5	12.5	1	1	0	0	1
-12.0	12.0	1	1	0	0	0
-11.5	11.5	1	0	1	1	1
-11.0	11.0	1	0	1	1	0
-10.5	10.5	1	0	1	0	1
-10.0	10.0	1	0	1	0	0
-9.5	9.5	1	0	0	1	1
-9.0	9.0	1	0	0	1	0
-8.5	8.5	1	0	0	0	1
-8.0	8.0	1	0	0	0	0
-7.5	7.5	0	1	1	1	1
-7.0	7.0	0	1	1	1	0
-6.5	6.5	0	1	1	0	1
-6.0	6.0	0	1	1	0	0
-5.5	5.5	0	1	0	1	1
-5.0	5.0	0	1	0	1	0
-4.5	4.5	0	1	0	0	1
-4.0	4.0	0	1	0	0	0
-3.5	3.5	0	0	1	1	1
-3.0	3.0	0	0	1	1	0
-2.5	2.5	0	0	1	0	1
-2.0	2.0	0	0	1	0	0
-1.5	1.5	0	0	0	1	1
-1.0	1.0	0	0	0	1	0
-0.5	0.5	0	0	0	0	1
0.0*	0.0*	0	0	0	0	0

✳ : Default value

■Tone Control(Treble Setting) (Select Address : 03H)

Treble Cut or Boost	BCT
	D7
Cut	0
Boost	1

		TREB				
Cut Gain(dB)	Boost Gain(dB)	D6	D5	D4	D3	D2
-15.0	15.0	1	1	1	1	0
-14.5	14.5	1	1	1	0	1
-14.0	14.0	1	1	1	0	0
-13.5	13.5	1	1	0	1	1
-13.0	13.0	1	1	0	1	0
-12.5	12.5	1	1	0	0	1
-12.0	12.0	1	1	0	0	0
-11.5	11.5	1	0	1	1	1
-11.0	11.0	1	0	1	1	0
-10.5	10.5	1	0	1	0	1
-10.0	10.0	1	0	1	0	0
-9.5	9.5	1	0	0	1	1
-9.0	9.0	1	0	0	1	0
-8.5	8.5	1	0	0	0	1
-8.0	8.0	1	0	0	0	0
-7.5	7.5	0	1	1	1	1
-7.0	7.0	0	1	1	1	0
-6.5	6.5	0	1	1	0	1
-6.0	6.0	0	1	1	0	0
-5.5	5.5	0	1	0	1	1
-5.0	5.0	0	1	0	1	0
-4.5	4.5	0	1	0	0	1
-4.0	4.0	0	1	0	0	0
-3.5	3.5	0	0	1	1	1
-3.0	3.0	0	0	1	1	0
-2.5	2.5	0	0	1	0	1
-2.0	2.0	0	0	1	0	0
-1.5	1.5	0	0	0	1	1
-1.0	1.0	0	0	0	1	0
-0.5	0.5	0	0	0	0	1
0.0*	0.0*	0	0	0	0	0

* : Default value

■Trimmer Setting (Select Address: 04H)

	TRIM						
Gain(dB)	D7	D6	D5	D4	D3	D2	D1
+18.0	1	1	1	1	1	1	1
+17.5	1	1	1	1	1	1	0
+17.0	1	1	1	1	1	0	1
+16.5	1	1	1	1	1	0	0
+16.0	1	1	1	1	0	1	1
+15.5	1	1	1	1	0	1	0
+15.0	1	1	1	1	0	0	1
+14.5	1	1	1	1	0	0	0
+14.0	1	1	1	0	1	1	1
+13.5	1	1	1	0	1	1	0
+13.0	1	1	1	0	1	0	1
+12.5	1	1	1	0	1	0	0
+12.0	1	1	1	0	0	1	1
+11.5	1	1	1	0	0	1	0
+11.0	1	1	1	0	0	0	1
+10.5	1	1	1	0	0	0	0
+10.0	1	1	0	1	1	1	1
+9.5	1	1	0	1	1	1	0
+9.0	1	1	0	1	1	0	1
+8.5	1	1	0	1	1	0	0
+8.0	1	1	0	1	0	1	1
+7.5	1	1	0	1	0	1	0
+7.0	1	1	0	1	0	0	1
+6.5	1	1	0	1	0	0	0
+6.0	1	1	0	0	1	1	1
+5.5	1	1	0	0	1	1	0
+5.0	1	1	0	0	1	0	1
+4.5	1	1	0	0	1	0	0
+4.0	1	1	0	0	0	1	1
+3.5	1	1	0	0	0	1	0
+3.0	1	1	0	0	0	0	1
+2.5	1	1	0	0	0	0	0
+2.0	1	0	1	1	1	1	1
+1.5	1	0	1	1	1	1	0
+1.0	1	0	1	1	1	0	1
+0.5	1	0	1	1	1	0	0
0.0	1	0	1	1	0	1	1
-0.5	1	0	1	1	0	1	0
-1.0	1	0	1	1	0	0	1
-1.5	1	0	1	1	0	0	0
-2.0	1	0	1	0	1	1	1
-2.5	1	0	1	0	1	1	0
-3.0	1	0	1	0	1	0	1
-3.5	1	0	1	0	1	0	0
-4.0	1	0	1	0	0	1	1
-4.5	1	0	1	0	0	1	0
-5.0	1	0	1	0	0	0	1
-5.5	1	0	1	0	0	0	0
-6.0	1	0	0	1	1	1	1

	TRIM						
Gain(dB)	D7	D6	D5	D4	D3	D2	D1
-6.5	1	0	0	1	1	1	0
-7.0	1	0	0	1	1	0	1
-7.5	1	0	0	1	1	0	0
-8.0	1	0	0	1	0	1	1
-8.5	1	0	0	1	0	1	0
-9.0	1	0	0	1	0	0	1
-9.5	1	0	0	1	0	0	0
-10.0	1	0	0	0	1	1	1
-10.5	1	0	0	0	1	1	0
-11.0	1	0	0	0	1	0	1
-11.5	1	0	0	0	1	0	0
-12.0	1	0	0	0	0	1	1
-12.5	1	0	0	0	0	1	0
-13.0	1	0	0	0	0	0	1
-13.5	1	0	0	0	0	0	0
-14.0	0	1	1	1	1	1	1
-14.5	0	1	1	1	1	1	0
-15.0	0	1	1	1	1	0	1
-15.5	0	1	1	1	1	0	0
-16.0	0	1	1	1	0	1	1
-16.5	0	1	1	1	0	1	0
-17.0	0	1	1	1	0	0	1
-17.5	0	1	1	1	0	0	0
-18.0	0	1	1	0	1	1	1
-18.5	0	1	1	0	1	1	0
-19.0	0	1	1	0	1	0	1
-19.5	0	1	1	0	1	0	0
-20.0	0	1	1	0	0	1	1
-20.5	0	1	1	0	0	1	0
-21.0	0	1	1	0	0	0	1
-21.5	0	1	1	0	0	0	0
-22.0	0	1	0	1	1	1	1
-22.5	0	1	0	1	1	1	0
-23.0	0	1	0	1	1	0	1
-23.5	0	1	0	1	1	0	0
-24.0	0	1	0	1	0	1	1
-24.5	0	1	0	1	0	1	0
-25.0	0	1	0	1	0	0	1
-25.5	0	1	0	1	0	0	0
-26.0	0	1	0	0	1	1	1
-26.5	0	1	0	0	1	1	0
-27.0	0	1	0	0	1	0	1
-27.5	0	1	0	0	1	0	0
-28.0	0	1	0	0	0	1	1
-28.5	0	1	0	0	0	1	0
-29.0	0	1	0	0	0	0	1
-29.5	0	1	0	0	0	0	0
-30.0	0	0	1	1	1	1	1
-30.5	0	0	1	1	1	1	0
-31.0	0	0	1	1	1	0	1

	TRIM						
Gain(dB)	D7	D6	D5	D4	D3	D2	D1
-31.5	0	0	1	1	1	0	0
-32.0	0	0	1	1	0	1	1
-32.5	0	0	1	1	0	1	0
-33.0	0	0	1	1	0	0	1
-33.5	0	0	1	1	0	0	0
-34.0	0	0	1	0	1	1	1
-34.5	0	0	1	0	1	1	0
-35.0	0	0	1	0	1	0	1
-35.5	0	0	1	0	1	0	0
-36.0	0	0	1	0	0	1	1
-36.5	0	0	1	0	0	1	0
-37.0	0	0	1	0	0	0	1
-37.5	0	0	1	0	0	0	0
-38.0	0	0	0	1	1	1	1
-38.5	0	0	0	1	1	1	0
-39.0	0	0	0	1	1	0	1
-39.5	0	0	0	1	1	0	0
-40.0	0	0	0	1	0	1	1
-40.5	0	0	0	1	0	1	0
-41.0	0	0	0	1	0	0	1
-41.5	0	0	0	1	0	0	0
-42.0	0	0	0	0	1	1	1
-42.5	0	0	0	0	1	1	0
-43.0	0	0	0	0	1	0	1
-43.5	0	0	0	0	1	0	0
-44.0	0	0	0	0	0	1	1
MUTE*	0	0	0	0	0	0	0

* : Default value