

## AUDIO PROCESSOR

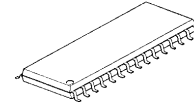
### ■ GENERAL DESCRIPTION

The **NJW1142** is a sound processor includes all of the functions required to process the audio signal for TV, such as tone control, balance, volume, mute, and AGC functions.

Also the **NJW1142** performs eala (NJRC Original Surround) which is regenerated 3D surround sound with only two speakers.

All of the internal status and variables are controlled by I<sup>2</sup>C BUS interface.

### ■ PACKAGE OUTLINE

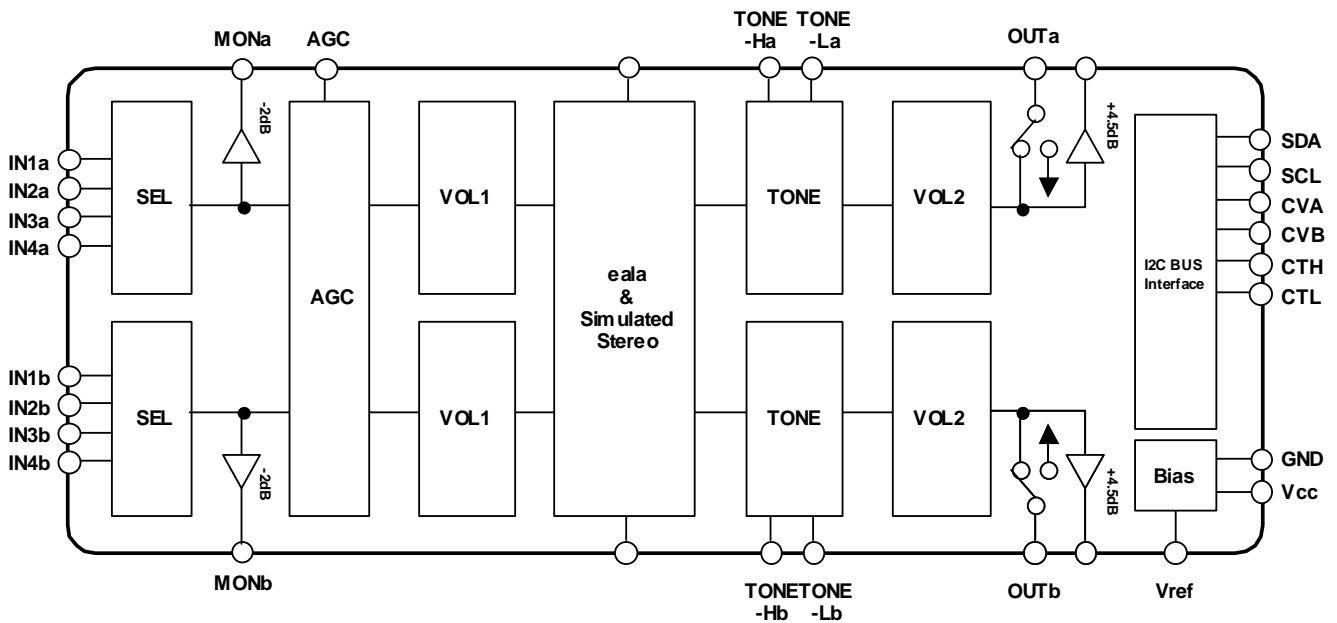


**NJW1142M**

### ■ FEATURES

- Operating Voltage 8 to 10V
- Internal 4 Input Audio Selectors and Monitor Output
- Low Noise VCA
- eala (NJRC Original Surround System)
- Simulated Stereo
- Variable AGC Compression Level via I<sup>2</sup>C (4-levels)
- Bi-CMOS Technology
- Package Outline SDMP30

### ■ BLOCK DIAGRAM



## ■ PIN CONFIGURATION



No.	Symbol	Function	No.	Symbol	Function
1	IN1a	Ach Input1	16	V+	Power Supply Pin
2	IN2a	Ach Input2	17	Vref	Reference Voltage
3	IN3a	Ach Input3	18	CTL	DAC Output for Tone Low Frequency
4	IN4a	Ach Input4	19	CTH	DAC Output for Tone High Frequency
5	MONa	Ach Monitor Output	20	AGC	AGC Filter
6	SS FIL	Surround Filter	21	OUTb	Bch Output
7	TONE-Ha	Ach Treble Filter	22	LINEb	Bch LINE Output(+4.5dB)
8	TONE-La	Ach Bass Filter	23	TONE-Lb	Bch Bass Filter
9	LINEa	Ach LINE Output(+4.5dB)	24	TONE-Hb	Bch Treble Filter
10	OUTa	Ach Output	25	SR FIL	Surround Filter
11	CVA	DAC Output for Ach Volume & Balance	26	MONb	Bch Monitor Output
12	CVB	DAC Output for Bch Volume & Balance	27	IN4b	Bch Input4
13	SDA	SDA Data Input (I <sup>2</sup> C BUS)	28	IN3b	Bch Input3
14	SCL	SCL Data Input (I <sup>2</sup> C BUS)	29	IN2b	Bch Input2
15	GND	GND	30	IN1b	Bch Input1

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

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V <sup>+</sup>	12	V
Power Dissipation	P <sub>D</sub>	700	mW
Operating Temperature Range	Topr	-20 to +75	°C
Storage Temperature Range	Tstg	-40 to +125	°C

## ■ ELECTRICAL CHARACTERISTICS ( Ta=25°C, V<sup>+</sup>=9V, R<sub>g</sub>=600Ω, R<sub>L</sub>=47kΩ, Vin=100mVrms/1kHz)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Voltage	V <sup>+</sup>		8.0	9.0	10.0	V
Supply Current	I <sub>CC</sub>	No Signal	-	30	50	mA
Reference Voltage	V <sub>REF</sub>	No Signal	4.0	4.5	5.0	V
Maximum Input Voltage	V <sub>IM</sub>	VOL=-20dB, THD=3%	2.8	3.0	-	Vrms
Maximum Output Voltage1	V <sub>OM1</sub>	OUTPUT VOL=0dB, THD=1%	-	2.5	-	Vrms
Maximum Output Voltage2	V <sub>OM2</sub>	LINEOUT VOL=0dB, THD=1%	-	2.5	-	Vrms
MON OUT Gain	G <sub>VMON</sub>	MON OUT	-	-2.0	-	dB
LINEOUT Gain	G <sub>VLINE</sub>	LINEOUT, VOL=0dB	2.5	4.5	6.5	dB
Maximum Gain	G <sub>VMAX</sub>	VOL=0dB	-2.0	0.0	2.0	dB
Minimum Gain	G <sub>VMIN</sub>	VOL=Mute, Vin=1Vrms BW=400Hz to 30kHz	-	-	-70	dB
Channel Balance	G <sub>CB</sub>	VOL=0dB	-1.5	0.0	1.5	dB
Balance Boost A	BA <sub>BST</sub>	CHS="0",BAL="11111"	-2.0	0.0	2.0	dB
Balance Cut A	BA <sub>CUT</sub>	CHS="1",BAL="11111" Vin = 1Vrms	-	-	-70	dB
Balance Boost B	BB <sub>BST</sub>	CHS="1",BAL="11111"	-2.0	0.0	2.0	dB
Balance Cut B	BB <sub>CUT</sub>	CHS="0",BAL="11111" Vin = 1Vrms	-	-	-70	dB
Total Harmonic Distortion	THD	Vo=0.5Vrms BW=400Hz to 30kHz	-	-	0.5	%
Input Selector Cross Talk	CT	Vin=1Vrms BW=400Hz to 30kHz	-	-	-70	dB
Channel Separation	CS	Vin=1Vrms BW=400Hz to 30kHz	-	-	-70	dB
Output Noise 1	V <sub>NO1</sub>	VOL=0dB BW=400Hz to 30kHz	-	-90 (31.6)	-85 (56.2)	dBV (μVrms)
Output Noise 2	V <sub>NO2</sub>	VOL=Mute BW=400Hz to 30kHz	-	-106 (5.0)	-96 (15.8)	dBV (μVrms)
Output Noise 3	V <sub>NO3</sub>	LINEOUT, VOL=0dB BW=400Hz to 30kHz	-	-85 (56.2)	-80 (100)	dBV (μVrms)
Output Noise 4	V <sub>NO4</sub>	LINEOUT, VOL=Mute BW=400Hz to 30kHz	-	-101 (8.9)	-91 (28.2)	dBV (μVrms)

■ **ELECTRICAL CHARACTERISTICS** ( Ta=25°C, V<sup>+</sup>=9V, R<sub>g</sub>=600Ω, R<sub>L</sub>=47kΩ, Vin=100mVrms/1kHz)

● **● TONE CONTROL** (Tone Control-ON)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
High Frequency Boost	HF <sub>BST</sub>	TREBLE=+15dB, f=10kHz	12.5	15.0	17.5	dB
High Frequency Flat	HF <sub>FLT</sub>	TRBE=0dB, f=10kHz	-2.0	0.0	2.0	dB
High Frequency Cut	HF <sub>CUT</sub>	TREBLE=-15dB, f=10kHz	-17.5	-15.0	-12.5	dB
Low Frequency Boost	LF <sub>BST</sub>	BASS=+15dB, f=100Hz	12.5	15.0	17.5	dB
Low Frequency Flat	LF <sub>FLT</sub>	BASS=0dB, f=100Hz	-2.0	0.0	2.0	dB
Low Frequency Cut	LF <sub>CUT</sub>	BASS=-15dB, f=100Hz	-17.5	-15.0	-12.5	dB

● **● SUB-TONE CONTROL** (Sub-Tone Control-ON)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
High Frequency Boost	SHF <sub>BST</sub>	SUB-TREBLE=+3dB, f=10kHz	2.0	3.0	4.0	dB
High Frequency Flat	SHF <sub>FLT</sub>	SUB-TREBLE=0dB, f=10kHz	-2.0	0.0	2.0	dB
High Frequency Cut	SHF <sub>CUT</sub>	SUB-TREBLE=-3dB, f=10kHz	-4.0	-3.0	-2.0	dB
Low Frequency Boost	SLF <sub>BST</sub>	SUB-BASS=+3dB, f=100Hz	2.0	3.0	4.0	dB
Low Frequency Flat	SLF <sub>FLT</sub>	SUB-BASS=0dB, f=100Hz	-2.0	0.0	2.0	dB
Low Frequency Cut	SLF <sub>CUT</sub>	SUB-BASS=-3dB, f=100Hz	-4.0	-3.0	-2.0	dB

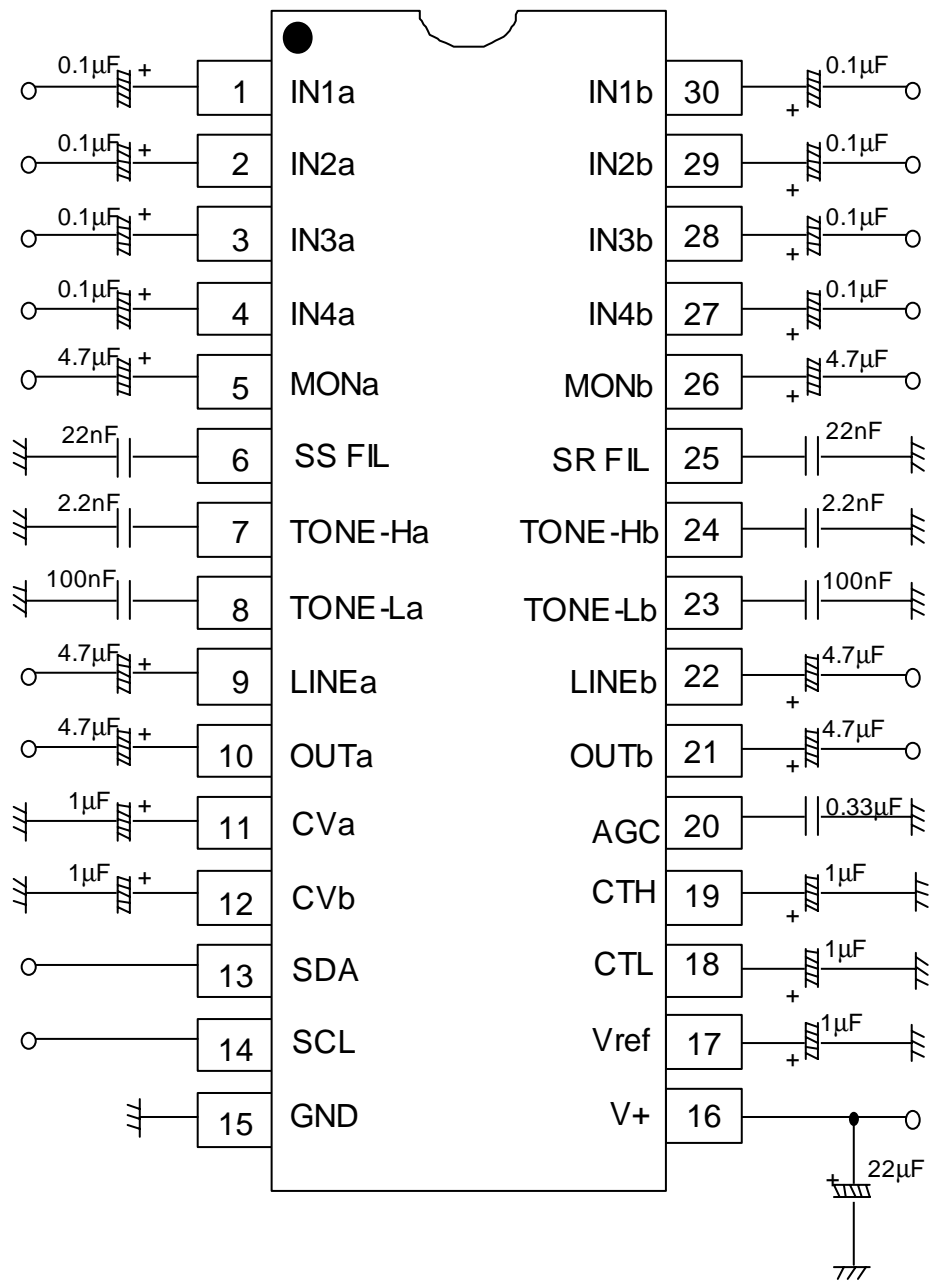
● **● AGC** (AGC-ON)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
AGC BOOST	AGC <sub>BST</sub>	Vin=50mVrms	1.5	3.5	5.5	dB
AGC FLAT 1	AGC <sub>FLT1</sub>	Vin=300mVrms	-2.5	0.0	2.5	dB
AGC FLAT 2	AGC <sub>FLT2</sub>	Vin=400mVrms	-2.5	0.0	2.5	dB
AGC FLAT 3	AGC <sub>FLT3</sub>	Vin=500mVrms	-2.5	0.0	2.5	dB
AGC FLAT 4	AGC <sub>FLT4</sub>	Vin=600mVrms	-2.5	0.0	2.5	dB
AGC CUT	AGC <sub>CUT</sub>	Vin=2Vrms	-14	-10	-6.0	dB

● **● SURROUND** (SURROUND-ON)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Simulated Stereo A	SR <sub>SIMA</sub>	Ain+Bin → Aout, f=1kHz	1.0	3.0	5.0	dB
Simulated Stereo B	SR <sub>SIMB</sub>	Ain+Bin → Bout, f=1kHz	1.0	3.0	5.0	dB
Surround 3D1	SR <sub>3D1</sub>	Ain → Aout, f=100Hz	8.0	10.0	12.0	dB
Surround 3D2	SR <sub>3D2</sub>	Ain → Aout, f=10kHz	-2.0	0.0	2.0	dB
Surround 3D3	SR <sub>3D3</sub>	Ain → Bout, f=100Hz	4.5	6.5	8.5	dB

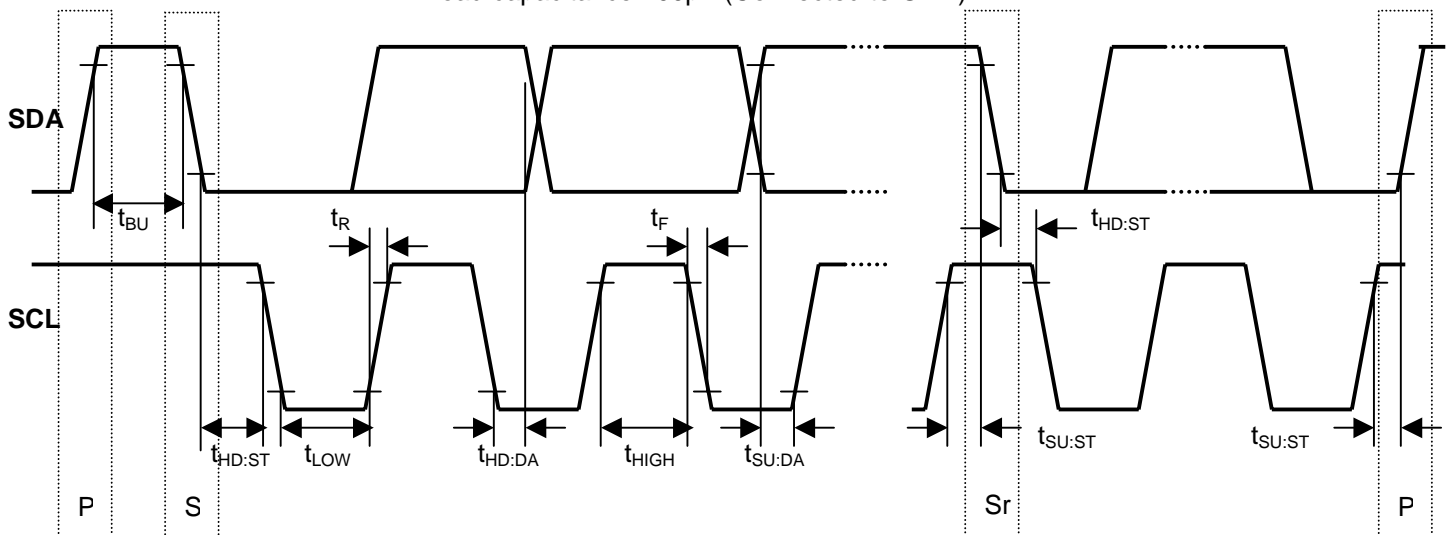
## APPLICATION CIRCUIT



## ■ I<sup>2</sup>C BUS BLOCK CHARACTERISTICS (SDA,SCL)

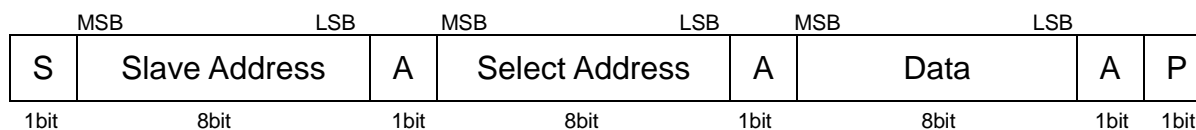
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
High Level Input Voltage	V <sub>IH</sub>	3.0	-	5.0	V
Low Level Input Voltage	V <sub>IL</sub>	0	-	1.5	V
High Level Input Current	I <sub>IH</sub>	-	-	10	μA
Low Level Input Current	I <sub>IL</sub>	-	-	10	μA
Low Level Output Voltage (3mA at SDA pin)	V <sub>OL</sub>	0	-	0.4	V
Maximum Output Current	I <sub>OL</sub>	-3.0	-	-	mA
Maximum Clock Frequency	f <sub>SCL</sub>	0	-	100	kHz
Data Change Minimum Waiting Time	t <sub>BUF</sub>	4.7	-	-	μs
Data Transfer Start Minimum Waiting Time	t <sub>HD:STA</sub>	4.0	-	-	μs
Low Level Clock Pulse Width	t <sub>LOW</sub>	4.7	-	-	μs
High Level Clock Pulse Width	T <sub>HIGH</sub>	4.0	-	-	μs
Minimum Start Preparation Waiting Time	t <sub>SU:STA</sub>	4.7	-	-	μs
Minimum Data Hold Time	t <sub>HD:DAT</sub>	5.0	-	-	μs
Minimum Data Preparation Time	t <sub>SU:DAT</sub>	250	-	-	ns
Rise Time	t <sub>R</sub>	-	-	1.0	μs
Fall Time	t <sub>F</sub>	-	-	300	ns
Minimum Stop Preparation Waiting Time	t <sub>SU:STO</sub>	4.7	-	-	μs

I<sup>2</sup>C BUS Load Condition: Pull up resistance 4kΩ (Connected to +5V)  
Load capacitance 200pF (Connected to GND)



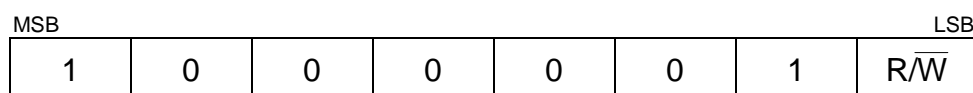
## ■ DEFINITION OF I<sup>2</sup>C REGISTER

### ◆ I<sup>2</sup>C BUS FORMAT



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

### ◆ SLAVE ADDRESS



R/W=0: Receive Only  
R/W=1: No Output Data

### ◆ CONTROL REGISTER TABLE

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

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	VOL							
01H	CHS	BAL					SUR1	SUR0
02H	BCB	BASS			BCSB	SUB-BASS		
03H	BCT	TREB			BCST	SUB-TREB		
04H	Don't Care							
05H	OUT	SEL			AGC1	AGC0	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							

The volume control for both Ach and Bch(0.33dB/step).

The volume is consisted of volume1 and volume2 and the level is divided into half to each volume1 and volume2.

### b) BALANCE, AGC AND SURROUND SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
01H	CHS	BAL					SR1	SR0

- CHS : Channel select for balance control

“0” : Ach “Bch is attenuated”

“1” : Bch “Ach is attenuated”

- BAL : Balance control for both Ach and Bch(1dB/Step)

The balance is consisted of volume1 and volume2 and the level is divided into half to each volume1 and volume2.

- “SR1”, “SR0” : Surround Mode select

Surround Mode	SR1 (D1)	SR0 (D0)
Surround Off(Bypass)	0	0
Simulated Stereo	0	1
eala effect large	1	0
eala effect small	1	1

### c)TONE CONTROL BASS SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
02H	BCB	BASS				BCSB	SUB-BASS	

- BCB : Boost cut select for Bass control

“0” : Cut

“1” : Boost

- BASS: BASS control

Cut Level : -15dB to 0dB(1dB/Step)

Boost Level : 0dB to +15dB(1dB/Step)

- BCSB : Boost cut select for SUB-BASS control

“0” : Cut

“1” : Boost

- SUB-BASS: SUB- BASS control(1dB/Step)

Sub-Cut Level : -3dB to 0dB(1dB/Step)

Sub-Boost Level : 0dB to +3dB(1dB/Step)



### d) TONE CONTROL TREBLE SETTING

Select Address	BIT								
	D7	D6	D5	D4	D3	D2	D1	D0	
03H	BCT	TREB				BCST	SUB-TREB		

- BCT : Boost cut select for Treble control  
   "0" : Cut  
   "1" : Boost
- TREB: Treble control(1dB/step)  
   Cut Level : -15dB to 0dB(1dB/Step)  
   Boost Level : 0dB to +15dB(1dB/Step)
- BCST : Boost cut select for Sub-Treble control  
   "0" : Cut  
   "1" : Boost
- SUB-TREB: Sub-Treble control(1dB/step)  
   Sub-Cut Level : -3dB to 0dB(1dB/Step)  
   Sub-Boost Level : 0dB to +3dB(1dB/Step)

### e) OUTPUT AND AUXILIARY SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
05H	OUT	SEL			AGC1	AGC0	AGC	Don't Care

- OUT: ON/OFF Switch for OUTPUT  
   "0" : OFF(MUTE)  
   "1" : ON

- SEL: Input Selector

Input Channel Selector	SEL		
	D6	D5	D4
1	0	1	0
2	0	1	1
3	1	0	0
4	1	0	1

- AGC1: AGC Level Setting

AGC Level	AGC1(D3)	AGC0(D2)	AGC (D1)
300mVrms	0	0	1
400mVrms	0	1	1
500mVrms	1	0	1
600mVrms	1	1	1
AGC Off	*	*	0

\* Don't Care

## ■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

■MASTER VOLUME (Select Address : 00H)

		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
-81	0C	0	0	0	0	1	1	0	0
-82	09	0	0	0	0	1	0	0	1
-83	06	0	0	0	0	0	1	1	0
-84	03	0	0	0	0	0	0	1	1
Mute	00	0	0	0	0	0	0	0	0

■BALANCE(Select Address : 01H)

Channel Select (CHS)	D7
Ach(Bch is attenuated)	0
Bch(Ach is attenuated)	1

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

■TONE CONTROL BASS (Select Address : 02H)

Bass Cut or Boost	BCB D7
Cut	0
Boost	1

		BASS			
Cut Gain(dB)	Boost Gain(dB)	D6	D5	D4	D3
-15	15	1	1	1	1
-14	14	1	1	1	0
-13	13	1	1	0	1
-12	12	1	1	0	0
-11	11	1	0	1	1
-10	10	1	0	1	0
-9	9	1	0	0	1
-8	8	1	0	0	0
-7	7	0	1	1	1
-6	6	0	1	1	0
-5	5	0	1	0	1
-4	4	0	1	0	0
-3	3	0	0	1	1
-2	2	0	0	1	0
-1	1	0	0	0	1
0	0	0	0	0	0

■TONE CONTROL SUB-BASS (Select Address : 02H)

Sub-Bass Cut or Boost	BCSB D2
Cut	0
Boost	1

		SUB-BASS	
Cut Gain(dB)	Boost Gain(dB)	D1	D0
-3	3	1	1
-2	2	1	0
-1	1	0	1
0	0	0	0

## ■TONE CONTROL TREBLE (Select Address : 03H)

Treble Cut or Boost	BCT
	D7
Cut	0
Boost	1

		TREB			
		D6	D5	D4	D3
Cut Gain(dB)	Boost Gain(dB)				
-15	15	1	1	1	1
-14	14	1	1	1	0
-13	13	1	1	0	1
-12	12	1	1	0	0
-11	11	1	0	1	1
-10	10	1	0	1	0
-9	9	1	0	0	1
-8	8	1	0	0	0
-7	7	0	1	1	1
-6	6	0	1	1	0
-5	5	0	1	0	1
-4	4	0	1	0	0
-3	3	0	0	1	1
-2	2	0	0	1	0
-1	1	0	0	0	1
0	0	0	0	0	0

## ■TONE CONTROL SUB-TREBLE (Select Address : 03H)

Sub-Treble Cut or Boost	BCST
	D2
Cut	0
Boost	1

		SUB-TREB	
		D1	D1
Cut Gain(dB)	Boost Gain(dB)		
-3	3	1	1
-2	2	1	0
-1	1	0	1
0	0	0	0

### ■NOTE

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