

BBE[®]



SOUND PROCESSOR with SOUND ENHANCEMENT

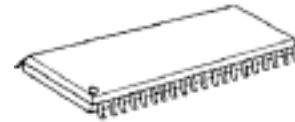
■ GENERAL DESCRIPTION

The **NJW1130A** is a sound processor with sound enhancement (BBE). It includes all of functions processing audio signal for TV, such as tone control, balance, volume, mute, and AGC functions.

Also the **NJW1130A** performs surround and sound enhancement. The sound enhancement regenerates high definitive and nearly real sound.

All of internal status and variables are controlled by I²C BUS interface.

■ PACKAGE OUTLINE

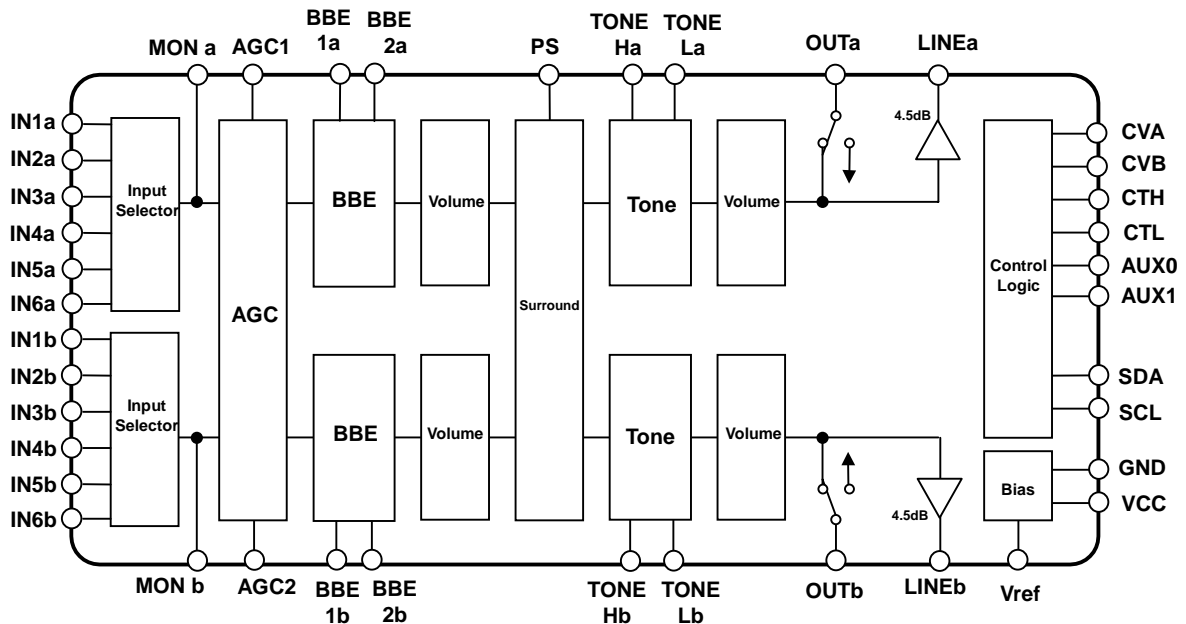


NJW1130G

■ FEATURES

- Operating Voltage (8 to 13V)
- I²C BUS Interface
- BBE Sound Enhancement (Low Boost and High Boost: 15dB max.)
- Internal 6 Input Audio Selectors and Monitor Output
- The AGC circuit reduces volume difference among input sources.
- Matrix Surround
- Bi-CMOS Technology
- Package Outline SOP40

■ BLOCK DIAGRAM



■ PIN FUNCTION

Ach Input Selector1	1	IN1a	IN1b	40	Bch Input Selector1
Ach Input Selector2	2	IN2a	IN2b	39	Bch Input Selector2
Ach Input Selector3	3	IN3a	IN3b	38	Bch Input Selector3
Ach Input Selector4	4	IN4a	IN4b	37	Bch Input Selector4
Ach Input Selector5	5	IN5a	IN5b	36	Bch Input Selector5
Ach Input Selector6	6	IN6a	IN6b	35	Bch Input Selector6
Ach BBE Filter1	7	BBE1a	BBE1b	34	Bch BBE Filter1
Ach BBE Filter2	8	BBE2a	BBE2b	33	Bch BBE Filter2
Ach High Frequency	9	TONE-Ha	TONE-Hb	32	Bch High Frequency
Ach Low Frequency	10	TONE-La	TONE-Lb	31	Bch Low Frequency
Ach Monitor Output	11	MONa	MONb	30	Bch Monitor Output
Ach Line Output (4.5dB)	12	LINEa	LINEb	29	Bch Line Output(4.5dB)
Ach Output (0dB)	13	OUTa	OUTb	28	Bch Output(0dB)
AGC1	14	AGC1	PS	27	Phase Shift
AGC2	15	AGC2	VREF	26	Reference Voltage
DAC Output for Bch Volume & Balance	16	CVB	CTH	25	DAC Output for Tone High Frequency
DAC Output for Ach Volume & Balance	17	CVA	CTL	24	DAC Output for Tone Low Frequency
I ² C BUS SDA	18	SDA	AUX0	23	AUX Output0
I ² C BUS SCL	19	SCL	AUX1	22	AUX Output1
GND	20	GND	Vcc	21	Power Supply

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

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V ⁺	14	V
Power Dissipation	P _D	700	mW
Operating Temperature Range	Topr	-20 to +75	°C
Storage Temperature Range	Tstg	-40 to +125	°C

■ **ELECTRICAL CHARACTERISTICS (Ta=25°C V⁺=9V, R_g=600Ω, R_L=47kΩ, Vin=100mVrms/1kHz)**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Voltage	V ⁺		8.0	9.0	13.0	V
Supply Current	I _{CC}	No Signal	-	30	50	mA
Reference Voltage	V _{REF}	No Signal	4.0	4.5	5.0	V
Maximum Input Voltage	V _{IM}	VOL=C3H,THD=1%	2.6	2.8	-	Vrms
Maximum Output Voltage1	V _{OM1}	OUTPUT VOL=FFH,THD=1%	-	2.5	-	Vrms
Maximum Output Voltage2	V _{OM2}	LINEOUT VOL=FFH,THD=1%	-	2.5	-	Vrms
MON OUT Gain	G _{VMON}	MON OUT	-	-2.0	-	dB
LINEOUT Gain	G _{VLINE}	LINEOUT,VOL=FFH	2.5	4.5	6.5	dB
Maximum Gain	G _{VMAX}	VOL=FFH	-2.0	0.0	2.0	dB
Minimum Gain	G _{VMIN}	VOL=00H	-	-	-70	dB
Channel Balance	G _{CB}	VOL=FFH	-1.5	0.0	1.5	dB
Balance Boost A	BA _{BST}	CHS="0",BAL="11111"	-2.0	0.0	2.0	dB
Balance Cut A	BA _{CUT}	CHS="1",BAL="11111"	-	-	-70	dB
Balance Boost B	BB _{BST}	CHS="1",BAL="11111"	-2.0	0.0	2.0	dB
Balance Cut B	BB _{CUT}	CHS="0",BAL="11111"	-	-	-70	dB
Total Harmonic Distortion	THD	Vo=0.5Vrms BW=400Hz to 30kHz	-	-	0.5	%
Cross Talk1	CT1	SEL="000" Vin=2Vrms In2/in3/in4/in5/In6 → out	-	-	-70	dB
Cross Talk 2	CT2	SEL="001" Vin=2Vrms in1/in3/in4/in5/In6 → out	-	-	-70	dB
Cross Talk 3	CT3	SEL="010" Vin=2Vrms in1/in2/in4/in5/In6 → out	-	-	-70	dB
Cross Talk 4	CT4	SEL="011" Vin=2Vrms in1/in2/in3/in5/In6 → out	-	-	-70	dB
Cross Talk 5	CT5	SEL="100" Vin=2Vrms in1/in2/in3/in4/In6 → out	-	-	-70	dB
Cross Talk 6	CT6	SEL="101" Vin=2Vrms in1/in2/in3/in4/In5 → out	-	-	-70	dB
Channel Separation	CS	Vin=2Vrms	-	-	-70	dB

■ **ELECTRICAL CHARACTERISTICS** (Ta=25°C, V⁺=9V, R_g=600Ω, R_L=47kΩ, Vin=100mVrms/1kHz)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Noise 1	V _{NO1}	VOL=FFH BW=400Hz to 30kHz	- -	- -	-60 (1.0)	dBV (mVrms)
Output Noise 2	V _{NO2}	VOL=00H BW=400Hz to 30kHz	- -	-90 (31.6)	-82 (79.4)	dBV (μVrms)
Output Noise 3	V _{NO3}	LINEOUT VOL=FFH BW=400Hz to 30kHz	- -	- -	-55 (1.8)	dBV (mVrms)
Output Noise 4	V _{NO4}	LINEOUT VOL=00H BW=400Hz to 30kHz	- -	-85 (56.2)	-77 (141)	dBV (μVrms)

● **TONE CONTROL**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
High Frequency Boost	HF _{BST}	BCT="1", TREB="1111", f=10kHz	12.5	15.0	17.5	dB
High Frequency Flat	HF _{FLT}	TRBE="0000", f=10kHz	-2.0	0.0	2.0	dB
High Frequency Cut	HF _{CUT}	BCT="0", TRBE="1111", f=10kHz	-12.5	-15.0	-17.5	dB
Low Frequency Boost	LF _{BST}	BCB="1", BASS="1111", f=100Hz	12.5	15.0	17.5	dB
Low Frequency Flat	LF _{FLT}	BASS="0000", f=100Hz	-2.0	0.0	2.0	dB
Low Frequency Cut	LF _{CUT}	BCB="0", BASS="1111", f=100Hz	-12.5	-15.0	-17.5	dB
High Frequency Cut DC Offset1	HF _{DC1}	BCT="0", TREB="1111" →"0000"	-1.0	0.0	1.0	V
High Frequency Boost DC Offset2	HF _{DC2}	BCT="1", TREB="1111" →"0000"	-1.0	0.0	1.0	V
Low Frequency Cut DC Offset1	LF _{DC1}	BCB="0", BASS="1111" →"0000"	-1.0	0.0	1.0	V
Low Frequency Boost DC Offset2	LF _{DC2}	BCB="1", BASS="1111" →"0000"	-1.0	0.0	1.0	V

● **SUB-TONE CONTROL**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
High Frequency Boost	SHF _{BST}	BCST="0", SUB- TREB="11", f=10kHz	2.0	3.0	4.0	dB
High Frequency Flat	SHF _{FLT}	SUB-TREB="00", f=10kHz	-2.0	0.0	2.0	dB
High Frequency Cut	SHF _{CUT}	BCST="0", SUB- TREB="11", f=10kHz	-4.0	-3.0	-2.0	dB
Low Frequency Boost	SLF _{BST}	BCSB="1", SUB- BASS="11", f=100Hz	2.0	3.0	4.0	dB
Low Frequency Flat	SLF _{FLT}	SUB-BASS="00", f=100Hz	-2.0	0.0	2.0	dB
Low Frequency Cut	SLF _{CUT}	BCSB="1", SUB- BASS="11", f=100Hz	-4.0	-3.0	-2.0	dB

● **AGC CONTROL: AGC="1" (AGC-ON)**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
AGC BOOST	AGC _{BST}	Vin=50mVrms	1.5	3.5	5.5	dB
AGC FLAT	AGC _{FLT}	Vin=200mVrms	-2.5	0.0	2.5	dB
AGC CUT	AGC _{CUT}	Vin=2Vrms	-14	-10	-6.0	dB

● **SURROUND CONTROL: SUR="1" (SURROUND-ON)**

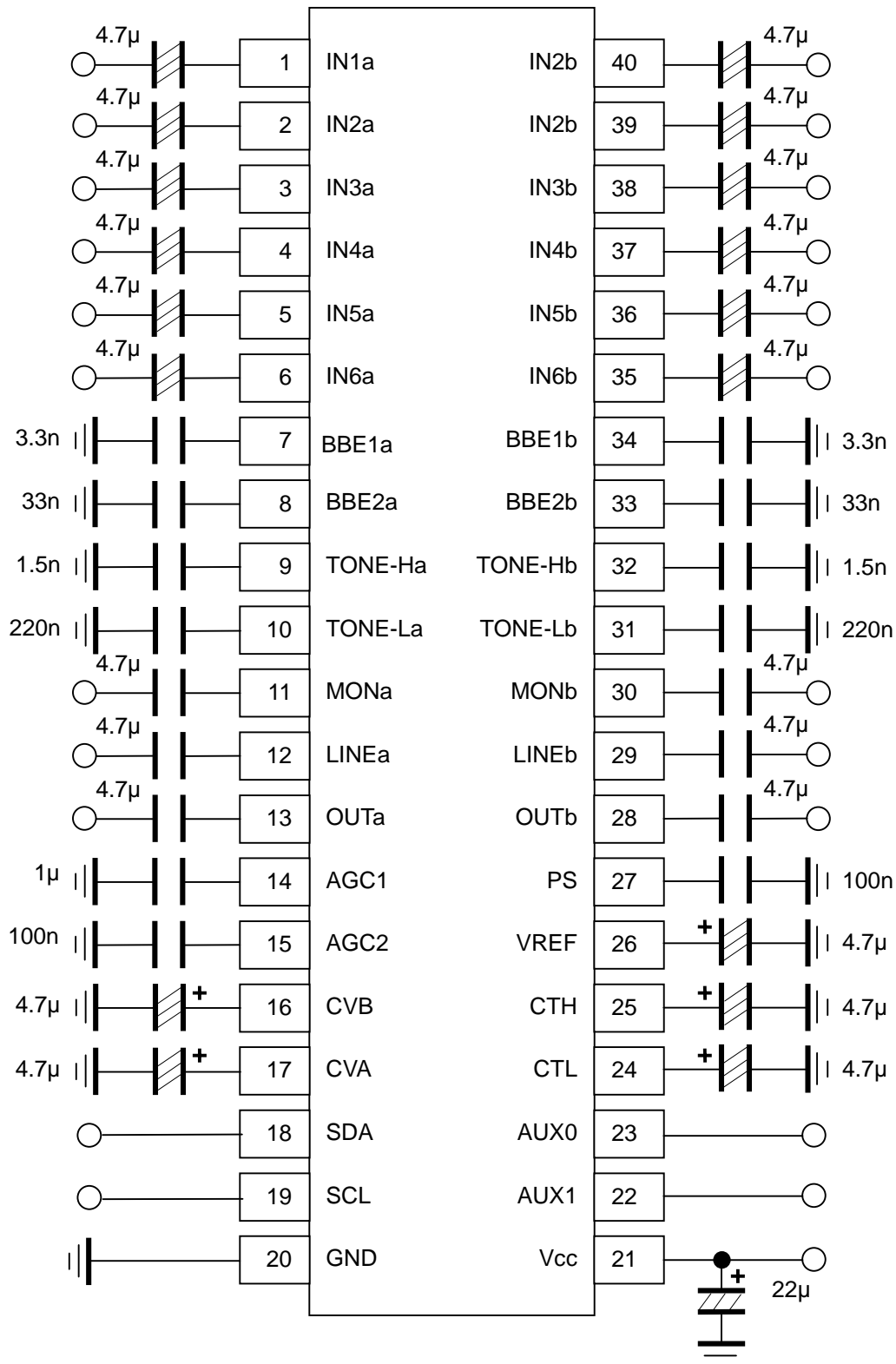
PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
SURROUND MIX 1	SR _{MIX1}	Ain → Bout	-2.0	0.0	2.0	dB
SURROUND MIX 2	SR _{MIX2}	Bin → Aout	-2.0	0.0	2.0	dB
SURROUND DEF	SR _{DEF}	Ain-Bin(-180deg)	8.0	10.0	12.0	dB
DC Offset	SR _{DC}	SUR="0" → "1"	-1.0	0.0	1.0	V

● **BBE (BBE-ON)**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
BBE Low Frequency Boost Range	BBE _{LOW}	BBE-Low="1111"	-	15.0	-	dB
BBE High Frequency Boost Range	BBE _{HIGH}	BBE-High="1111"	-	15.0	-	dB

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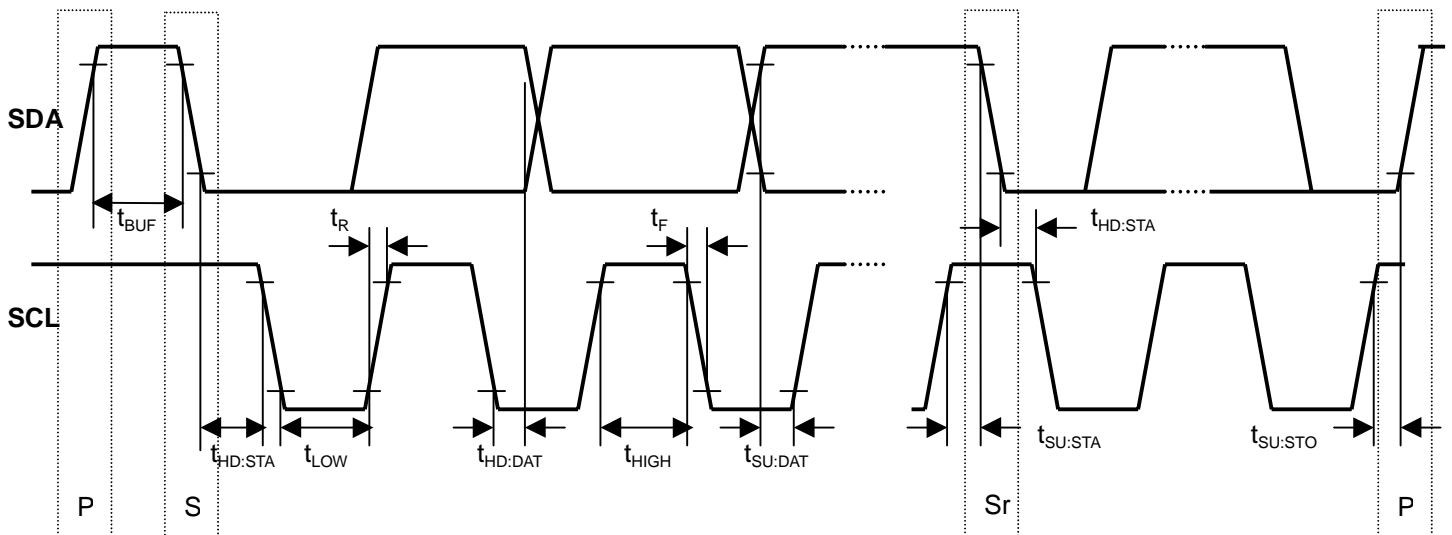
APPLICATION CIRCUIT



■ I²C BUS Block CHARACTERISTICS (SDA, SCL)

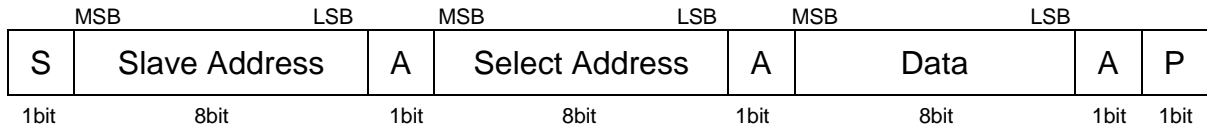
PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
High Level Input Voltage	V_{IH}	3.0	-	5.0	V
Low Level Input Voltage	V_{IL}	0	-	1.5	V
High Level Input Current	I_{IH}	-	-	10	μ A
Low Level Input Current	I_{IL}	-	-	10	μ A
Low Level Output Voltage (3mA at SDA pin)	V_{OL}	0	-	0.4	dB
Maximum Output Current	I_{OL}	-3.0	-	-	mA
Maximum Clock Frequency	f_{SCL}	0	-	100	kHz
Data Change Minimum Waiting Time	t_{BUF}	4.7	-	-	μ S
Data Transfer Start Minimum Waiting Time	$t_{HD:STA}$	4.0	-	-	μ S
Low Level Clock Pulse Width	t_{LOW}	4.7	-	-	μ S
High Level Clock Pulse Width	T_{HIGH}	4.0	-	-	μ S
Minimum Start Preparation Waiting Time	$t_{SU:STA}$	4.7	-	-	μ S
Minimum Data Hold Time	$t_{HD:DAT}$	5.0	-	-	μ S
Minimum Data Preparation Time	$t_{SU:DAT}$	250	-	-	nS
Rise Time	t_R	-	-	1.0	μ S
Fall Time	t_F	-	-	300	nS
Minimum Stop Preparation Waiting Time	$t_{SU:STO}$	4.7	-	-	μ S

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



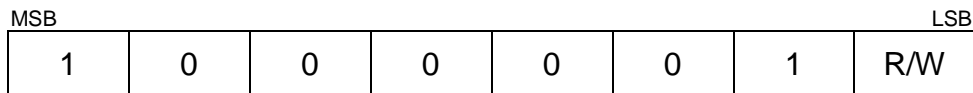
■ DEFINITION OF I²C REGISTER

● I²C BUS FORMAT



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

● SLAVE ADDRESS



R/W=0: Receive Only

● CONTROL REGISTER TABLE

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	VOL							
01H	CHS	BAL					AGC	SUR
02H	BCB	BASS				BCSB	SUB-BASS	
03H	BCT	TREB				BCST	SUB-TREB	
04H	BBE-Low				BBE-High			
05H	OUT	SEL			*		AUX1	AUX0

* : Don't care.

● CONTROL REGISTER DEFAULT VALUE

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

● CONTROL COMMAND TABLE

Select Address	BIT								REMARKS	
	D7	D6	D5	D4	D3	D2	D1	D0		
00H	VOL								VOL : Volume control for both Ach and Bch (0.33dB/step) Ex.) FFH=0dB FEH=-0.33dB FDH=-0.66dB FCH=-1.0dB : : 03H=-84dB 00H=MUTE	
		F					F			
		F					E			
		F					D			
		F					C			
		:					:			
		:					:			
		0					3			
01H	CHS	BAL					AGC	SUR		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) Ex.) "00000"=0dB "00001"=-1dB : : "11110"=-30dB "11111"=MUTE AGC : AGC switch "0"=AGC OFF "1"=AGC ON SUR : Surround mode switch "0"=Surround OFF "1"=Surround ON
	0/1	0	0	0	0	0	0/1	0/1		
		0	0	0	0	1				
		0	0	0	1	0				
		0	0	0	1	1				
		:	:	:	:	:				
		:	:	:	:	:				
		1	1	1	0	0				
1	1	1	0	1						
1	1	1	1	0						
1	1	1	1	1						
02H	BCB	BASS				BCSB	SUB-BASS		BCB : Boost-cut select for Bass control "0"=Cut "1"=Boost BASS : Bass control (1dB/step) Ex.) "0000"=0dB "0001"=1dB : : "1110"=14dB "1111"=15dB BCSB : Boost-cut select for Sub-Bass control "0"=Cut "1"=Boost SUB-BASS : Sub-Bass control (1dB/step) "00"=0dB "01"=1dB "10"=2dB "11"=3dB	
	0/1	0	0	0	0	0/1	0	0		
		0	0	0	1		0	1		
		0	0	1	0		1	0		
		0	0	1	1		1	1		
		:	:	:	:		:	:		
		:	:	:	:		:	:		
		1	1	0	0					
1	1	0	1							
1	1	1	0							
1	1	1	1							
03H	BCT	TREB				BCST	SUB-TREB		BCT : Boost-cut select for Treble control "0"=Cut "1"=Boost TREB : Treble control (1dB/step) Ex.) "0000"=0dB "0001"=1dB : : "1110"=14dB "1111"=15dB BCST : Boost-cut select for Sub-Treble control "0"=Cut "1"=Boost SUB-TREB : Sub-Treble control (1dB/step) "00"=0dB "01"=1dB "10"=2dB "11"=3dB	
	0/1	0	0	0	0	0/1	0	0		
		0	0	0	1		0	1		
		0	0	1	0		1	0		
		0	0	1	1		1	1		
		:	:	:	:		:	:		
		:	:	:	:		:	:		
		1	1	0	0					
1	1	0	1							
1	1	1	0							
1	1	1	1							

● CONTROL COMMAND TABLE

Select Address	BIT								REMARKS
	D7	D6	D5	D4	D3	D2	D1	D0	
04H	BBE-Low				BBE-High				BBE-Low : Boost level control for BBE Lo-Contour (1dB/step) Ex.) "0000"=0dB "0001"=1dB : "1110"=14dB "1111"=15dB BBE-High : Boost level control for BBE Process (1dB/step) Ex.) "0000"=0dB "0001"=1dB : "1110"=14dB "1111"=15dB When all bits are "0"(=00H), BBE becomes off.
	0	0	0	0	0	0	0	0	
	0	0	0	1	0	0	0	1	
	0	0	1	0	0	0	1	0	
	:	:	:	:	:	:	:	:	
	:	:	:	:	:	:	:	:	
	1	1	0	1	1	1	0	1	
	1	1	1	0	1	1	1	0	
1	1	1	1	1	1	1	1		
05H	OUT	SEL			don't care	AUX1	AUX2	OUT : ON / OFF switch for OUTPUT "0"=OFF "1"=ON SEL : Input selector "000"=Input 1 "001"=Input 2 "010"=Input 3 "011"=Input 4 "100"=Input 5 "101"=Input 6 AUX1/AUX2 : Auxiliary port ON/OFF "0"=OFF "1"=ON	
	0/1	0	0	0		AUX1	AUX2		
		0	0	1		0/1	0/1		
		0	1	0					
		0	1	1					
1	0	0							

■ NOTE

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