4.1-channel Electronic Volume with 5 Bands Parametric Equalizer

■GENERAL DESCRIPTION

The NJW1221 is a 4.1-channel electronic volume with input selector. It includes master volume, fader volume, 5 band parametric equalizer, 7-input stereo audio selector, loudness, and sub-woofer function. The NJW1221 performs low noise and low distortion characteristics with resistance ladder circuit.

All of functions are controlled by I^2C BUS interface.

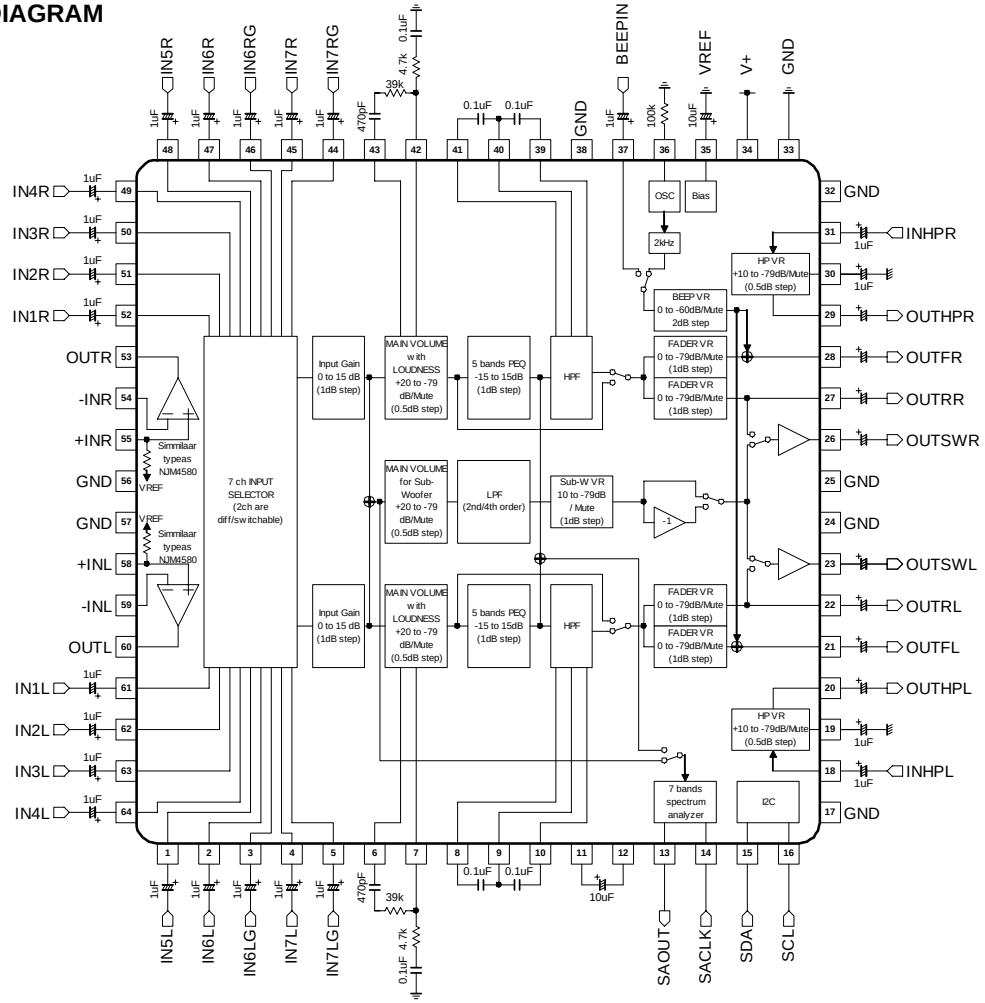
■PACKAGE OUTLINE

NJW1221FH2

■ FEATURES

- Operating Voltage +7.5 to +10V
- I^2C BUS Control
- Low output noise -103dBVtyp.
- Low THD 0.01%typ.
- 7-Input Selector
- Input Gain 0 to +15dB/1dBstep
- Main Volume +23.5 to -79.5dB / 0.5dBstep, MUTE
- Headphone Volume +15.5 to -79.5dB / 0.5dBstep, MUTE
- Graphic Equalizer 0 to ±15dB/1dBstep
- Fader Volume 0 to -79dB/1dBstep,MUTE
- Sub-Woofer Output +15 to -79dB/1dBstep,MUTE
- Bi-CMOS Technology
- Package Outline QFP64

■ BLOCK DIAGRAM



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

PARAMETER	SYMBOL	RATING	UNIT
Power Supply Voltage	V_+	10.5	V
Power Dissipation	P_D	1900 NOTE: EIA/JEDEC STANDARD Test board (76.2x114.3x1.6mm, 2layer, FR-4) mounting	mW
Operating Temperature Range	Topr	-40 ~ +85	°C
Storage Temperature Range	Tstg	-40 ~ +125	°C

■**ELECTRICAL CHARACTERISTICS**

(Ta=25°C,V^+=9V, Rg=600Ω, RL=47kΩ, Vin=1.5Vrms, f=1kHz,all controls flat unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Voltage	V_+		7.5	9.0	10.0	V
Supply Current	I_{DD}	No signal	-	40	50	mA
Reference Voltage	V_{REF}	No signal	4.0	4.5	5.0	V
Maximum Input Voltage	V_{IM}	MAIN VOLUME=-20dB THD=1%	2.2	2.4	-	Vrms
Maximum Output Voltage 1	V_{OM1}	THD=1%	2.2	2.4	-	Vrms
Maximum Output Voltage 2	V_{OM2}	THD=1%, f=50kHz	1.5	2.4	-	Vrms
Voltage Gain 1	G_{V1}	MAIN VOLUME=0dB INPUT GAIN=+15dB Vin=100mVrms	13	15	17	dB
Voltage Gain 2	G_{V2}		-1	0	1	dB
Voltage Gain 3	G_{V3}	MAIN VOLUME=-79dB	-82	-79	-76	dB
Voltage Gain 4	G_{V4}	FADER VOLUME FL, FR, RL, RR =-79dB	-82	-79	-76	dB
Voltage Gain 5	G_{V5}	f=100kHz	-6	-3	1	dB
Mute Level	Mute	MAIN VOLUME=Mute Filter : 400Hz-30kHz	-	-100	-90	dB
Channel Balance	G_{CB}	MAIN VOLUME=0dB	-1	0	1	dB
Total Harmonic Distortion	THD	V_O=1.5Vrms, BW=400Hz-30kHz	-	0.01	0.05	%
Output Noise Voltage 1	V_{NO1}	Rg=0Ω, Filter : A-Weighted	-	-103 (7)	-96.5 (15)	dBV (uVrms)
Output Noise Voltage 2	V_{NO2}	Fader Volume=Mute Rg=0Ω, Filter : A-Weighted	-	-110 (3)	-100 (10)	dBV (uVrms)
Cross Talk	CT	Selected Input : Rg=0Ω Unselected Input : Signal	90	100	-	dB
Channel Separation	CS	Rg=0Ω	90	100	-	dB

♦**Loudness**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Maximum Low Boost Level	G_{LDL}	Loudness=ON Main Volume=-24dB, f=40Hz	9.5	12	14.5	dB
Maximum High Boost Level	G_{LDH}	Loudness=ON Main Volume=-24dB, f=10kHz	2.5	5	7.5	dB

♦**Graphic Equalizer**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Band 1 Boost Level	G_{1BST}	Band1=+15dB, f_{C1}=100Hz Vin=0.1Vrms, f=100Hz	12.5	15.0	17.5	dB
Band 1 Cut Level	G_{1CUT}	Band1=-15dB, f_{C1}=100Hz f=100Hz	-17.5	-15.0	-12.5	dB
Band 2 Boost Level	G_{2BST}	Band2=+15dB, f_{C2}=320Hz Vin=0.1Vrms, f=320Hz	12.5	15.0	17.5	dB
Band 2 Cut Level	G_{2CUT}	Band2=-15dB, f_{C2}=320Hz f=320Hz	-17.5	-15.0	-12.5	dB
Band 3 Boost Level	G_{3BST}	Band3=+15dB, f_{C3}=1kHz Vin=0.1Vrms, f=1kHz	12.5	15.0	17.5	dB
Band 3 Cut Level	G_{3CUT}	Band3=-15dB, f_{C3}=1kHz f=1kHz	-17.5	-15.0	-12.5	dB
Band 4 Boost Level	G_{4BST}	Band4=+15dB, f_{C4}=3.2kHz Vin=0.1Vrms, f=3.2kHz	12.5	15.0	17.5	dB
Band 4 Cut Level	G_{4CUT}	Band4=-15dB, f_{C4}=3.2kHz f=3.2kHz	-17.5	-15.0	-12.5	dB
Band 5 Boost Level	G_{5BST}	Band5=+15dB, f_{C5}=10kHz Vin=0.1Vrms, f=10kHz	12.5	15.0	17.5	dB
Band 5 Cut Level	G_{5CUT}	Band5=-15dB, f_{C5}=10kHz f=10kHz	-17.5	-15.0	-12.5	dB
Center Frequency Band 1	f_{C11}	Band1=+15dB, f_{C1}=68Hz Vin=0.1Vrms	-	68	-	Hz
	f_{C12}	Band1=+15dB, f_{C1}=100Hz Vin=0.1Vrms	-	100	-	Hz
	f_{C13}	Band1=+15dB, f_{C1}=150Hz Vin=0.1Vrms	-	150	-	Hz
Center Frequency Band 2	f_{C21}	Band2=+15dB, f_{C2}=210Hz Vin=0.1Vrms	-	210	-	Hz
	f_{C22}	Band2=+15dB, f_{C2}=320Hz Vin=0.1Vrms	-	320	-	Hz
	f_{C23}	Band2=+15dB, f_{C2}=460Hz Vin=0.1Vrms	-	460	-	Hz
Center Frequency Band 3	f_{C31}	Band3=+15dB, f_{C3}=0.68kHz Vin=0.1Vrms	-	0.68	-	kHz
	f_{C32}	Band3=+15dB, f_{C3}=1kHz Vin=0.1Vrms	-	1	-	kHz
	f_{C33}	Band3=+15dB, f_{C3}=1.5kHz Vin=0.1Vrms	-	1.5	-	kHz
Center Frequency Band 4	f_{C41}	Band4=+15dB, f_{C4}=2.1kHz Vin=0.1Vrms	-	2.1	-	kHz
	f_{C42}	Band4=+15dB, f_{C4}=3.2kHz Vin=0.1Vrms	-	3.2	-	kHz
	f_{C43}	Band4=+15dB, f_{C4}=6.4kHz Vin=0.1Vrms	-	4.6	-	kHz
Center Frequency Band 5	f_{C51}	Band5=+15dB, f_{C5}=6.8kHz Vin=0.1Vrms	-	6.8	-	kHz
	f_{C52}	Band5=+15dB, f_{C5}=10kHz Vin=0.1Vrms	-	10	-	kHz
	f_{C53}	Band5=+15dB, f_{C5}=15kHz Vin=0.1Vrms	-	15	-	kHz
Quality Factor	Q_1		-	0.7	-	
	Q_2		-	1	-	
	Q_3		-	1.4	-	
	Q_4		-	2.0	-	

♦**Spectrum Analyzer**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Voltage Range	V_O		0	-	3.3	V
Center Frequency 1	f_{C1}		-	62	-	Hz
Center Frequency 2	f_{C2}		-	157	-	Hz
Center Frequency 3	f_{C3}		-	392	-	Hz
Center Frequency 4	f_{C4}		-	1	-	Hz
Center Frequency 5	f_{C5}		-	2.51	-	Hz
Center Frequency 6	f_{C6}		-	6.34	-	kHz
Center Frequency 7	f_{C7}		-	16	-	kHz
Quality Factor	Q		-	2	-	

♦**Sub Woofer**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Maximum Gain	G_{SWMAX}	FADER VOLUME=0dB	-2	0	2	dB
Minimum Gain	G_{SWMIN}	FADER VOLUME=-79dB	-82	-79	-76	dB
Maximum Input Voltage	V_{IM}	THD=1%	2.2	2.4	-	Vrms
Maximum Output Voltage	V_{OM}	THD=1%	2.2	2.4	-	Vrms
Total Harmonic Distortion	THD	f=100Hz, Vin=1.5Vrms	-	0.05	0.1	%
Cut off Frequency	f_{CSW1}	f_C=55Hz Setting	-	55	-	Hz
	f_{CSW2}	f_C=85Hz Setting	-	85	-	Hz
	f_{CSW3}	f_C=120Hz Setting	-	120	-	Hz
Order	-	Order=2 Setting	-	2	-	
	-	Order=4 Setting	-	4	-	
Phase Changer	-	Phase SW=OFF	-	0	-	deg.
	-	Phase SW=ON	-	180	-	deg.

♦**High Pass Filter**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Cut off Frequency	f_{CHP1}	f_C=62Hz Setting	-	62	-	Hz
	f_{CHP2}	f_C=95Hz Setting	-	95	-	Hz
	f_{CHP3}	f_C=135Hz Setting	-	135	-	Hz

♦**Beep Control**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Voltage Gain	G_{B1}	External input BEEP VOLUME=0dB	-1	0	1	dB
	G_{B2}	External input BEEP VOLUME=-60dB	-63	-60	-57	dB
Beep Level	V_B	Internal Beep BEEP VOLUME = 0dB	2.8	3.3	3.8	Vpp
Beep Frequency	f_B	Internal Beep BEEP VOLUME = 0dB	1.7	2.0	2.3	kHz

♦**Headphone Volume**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Maximum Input Voltage	V_{IM}	HP VOLUME=0dB THD=1%	2.2	2.4	-	Vrms
Voltage Gain 1	G_{V1}	HP VOLUME=15dB	13	15	17	dB
Voltage Gain 2	G_{V2}		-1	0	1	dB
Voltage Gain 3	G_{V3}	HP VOLUME=-79dB	-	-79	-	dB
Total Harmonic Distortion	THD	V_O=1.5Vrms BW=400-30kHz	-	0.01	0.05	%
Output Noise Voltage 1	V_{NO1}	FADER VOLUME=Mute Rg=0Ω, Filter : A-Weighted	-	-110 (3)	-	dBV (uVrms)
Output Noise Voltage 2	V_{NO2}	Rg=0Ω, Filter : A-Weighted	-	-110 (3)	-	dBV (uVrms)

♦**Operational Amplifier**

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Output Noise Voltage	V_{NO}	Rg=0Ω, Filter : A-Weighted	-	-120 (1)	-	dBV (uVrms)
Maximum Input Voltage	V_{IM}	THD=1%	2.2	2.4	-	Vrms

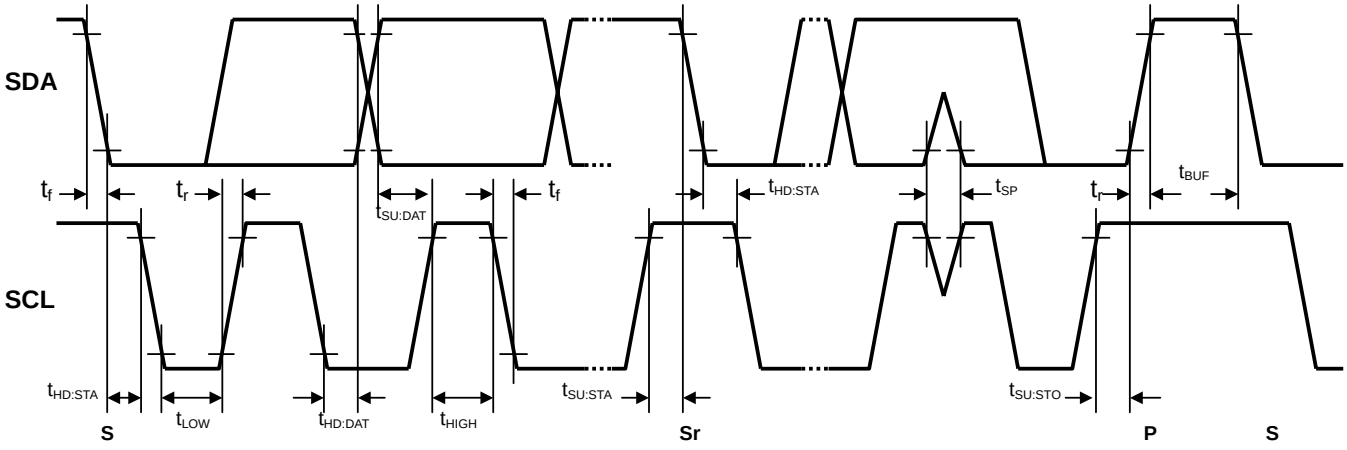
■ I²C BUS CHARACTERISTICS (SDA, SCL)

I²C BUS Load Conditions:
Standard mode : Pull up resistance 4kΩ (Connected to +5V), Load capacitance 200pF (Connected to GND)
Fast mode : Pull up resistance 4kΩ (Connected to +5V), Load capacitance 50pF (Connected to GND)

PARAMETER	SYMBOL	Standard mode			Fast mode			UNIT
		MIN.	TYP.	MAX.	MIN.	TYP.	MAX.	
Low Level Input Voltage	V_{IL}	0	-	1.5	0	-	1.5	V
High Level Input Voltage	V_{IH}	2.7	-	5.5	2.7	-	5.5	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 NOTE)	$t_{HD:DAT}$	0	-	-	0	-	-	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.

NOTE). Please hold the Data Hold Time ($t_{HD:DAT}$) to 300ns or more to avoid status of unstable at SCL falling edge.



■ 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

Slave Address								Hex
MSB							LSB	-
1	0	0	0	0	0	0	0	80(h)

♦CONTROL REGISTER TABLE

The select address sets each function (Input Selector, Input Gain, Main Volume, Loudness, Parametric Equalizer, High Pass Filter, Low Pass Filter, Fader Volume, Subwoofer Volume, Headphone Volume, Beep Control, Other Settings).
The auto increment function cycles the select address as follows.
00H→01H→02H→03H→04H→05H→06H→07H→08H→09H→0AH→0BH→0CH→0DH→0EH→0FH→10H→11H→00H

<Write Mode>

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	INPUT SELECTOR				INPUT GAIN			
01H	MAIN VOL							
02H	LOUDNESS	EQPASS	HPF		PHASE	LPFORDER	LPF	
03H	*	EQ1Q		BCEQ1	EQ1LVL			
04H	*	EQ2Q		BCEQ2	EQ2LVL			
05H	*	EQ3Q		BCEQ3	EQ3LVL			
06H	*	EQ4Q		BCEQ4	EQ4LVL			
07H	*	EQ5Q		BCEQ5	EQ5LVL			
08H	EQ1FC		EQ2FC		EQ3FC		EQ4FC	
09H	EQ5FC		BSEL	BEEP VOL				
0AH	*	FADER FL						
0BH	*	FADER FR						
0CH	*	FADER RL						
0DH	*	FADER RR						
0EH	EQTEST	SUBW VOL						
0FH	HP VOL							
10H	SM SP	SM HP	SSMAIN	SSEQ	SSFADER	SS SW	SS TIME	
11H	SA RST	SA DET	SUBW SW	BEEP	SATEST	HPTEST	VR1TEST	VR2TEST

* : 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
06H	0	0	0	0	0	0	0	0
07H	0	0	0	0	0	0	0	0
08H	0	0	0	0	0	0	0	0
09H	0	0	0	0	0	0	0	0
0AH	0	0	0	0	0	0	0	0
0BH	0	0	0	0	0	0	0	0
0CH	0	0	0	0	0	0	0	0
0DH	0	0	0	0	0	0	0	0
0EH	0	0	0	0	0	0	0	0
0FH	0	0	0	0	0	0	0	0
10H	0	0	0	0	0	0	0	0
11H	0	0	0	0	0	0	0	0

*The control resistor setting may not be above values when power is turned on due to the noise of power supply. Please send initial data after power on.

■INSTRUCTION CODE

a) INPUT SELECTOR, INPUT GAIN SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	INPUT SELECTOR				INPUT GAIN			

•INPUT SELECTOR : INPUT 1 to 5 (Single Ended), INPUT 6,7 (Single Ended/Differential), Mute
•INPUT GAIN : 0 to +15 dB (1dB/Step)

b) MAIN VOLUME SETTING

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

•MAIN VOL: Main volume setting +23.5 to -79.5 dB (0.5dB/Step) / Mute

c) LOUDNESS, HPF, LPF SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
01H	LOUDNESS	EQPASS	HPF		PHASE	LPFORDER	LPF	

•LOUDNESS : Loudness ON/OFF setting
• EQPASS : Equalizer pass switch ON/OFF setting
• LPFORDER : Low pass filter 2nd/4th order setting
• HPF : High pass filter cut off frequency setting
•PHASE : Sub woofer phase switch setting
• LPF : Low pass filter cut off frequency setting

d) EQUALIZER QUALITY FACTOR, GAIN SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
03H	*	EQ1Q		BCEQ1	EQ1LVL			
04H	*	EQ2Q		BCEQ2	EQ2LVL			
05H	*	EQ3Q		BCEQ3	EQ3LVL			
06H	*	EQ4Q		BCEQ4	EQ4LVL			
07H	*	EQ5Q		BCEQ5	EQ5LVL			

•EQ1Q, EQ2Q, EQ3Q, EQ4Q, EQ5Q : Equalizer quality factor setting
Quality Factor: 0.7, 1.0, 1.4, 2.0
•BCEQ1, BCEQ2, BCEQ3, BCEQ4, BCEQ5 : Boost cut select for equalizer control
"0" : Cut
"1" : Boost
•EQ1LVL, EQ2LVL, EQ3LVL, EQ4LVL, EQ5LVL : Equalizer Level Setting
Cut Level : -15 to 0dB(1dB/Step)
Boost Level : 0 to +15dB(1dB/Step)

e) EQUALIZER CENTER FREQUENCY/BEEP VOLUME SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
08H	EQ1FC		EQ2FC		EQ3FC		EQ4FC	
09H	EQ5FC		BSEL	BEEP VOL				

•EQ1FC, EQ2FC, EQ3FC, EQ4FC, EQ5FC : Equalizer center frequency setting
•BSEL : Beep signal source (External/Internal) setting
•BEEP VOL : Beep volume setting 0 to -60 (2dB/step) / Mute

f) FADER VOLUME SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
0AH	*	FADER FL						
0BH	*	FADER FR						
0CH	*	FADER RL						
0DH	*	FADER RR						

•FADER FL, FADER FR, FADER RL, FADER RR : Fader volume setting 0 to -79 (1dB/step) / Mute

g) SUB WOOFER VOLUME SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
0EH	EQTEST	SUBW VOL						

•EQ TEST* : "0" : Normal operation
"1" : Test mode
*For device check use only. Set {D7}={0} in usual.
•SUBW VOL : Sub woofer volume setting +15 to -79 (1dB/step) / Mute

h) HEADPHONE VOLUME SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
0FH	HP VOL							

•HP VOL : Headphone volume setting +15.5 to -79.5 (0.5dB/step) / Mute

i) SOFT MUTE, SOFT STEP SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
10H	SM SP	SM HP	SSMAIN	SSEQ	SSFADER	SS SW	SS TIME	

•SM SP : Soft mute for fader volume and subwoofer volume
•SM HP : Soft mute for headphone volume
•SSMAIN : Soft step ON/OFF setting for main volume
•SSEQ : Soft step ON/OFF setting for equalizer
•SSFADER : Soft step ON/OFF setting for fader volume
•SS SW : Soft step ON/OFF setting sub woofer volume
•SSTIME : Soft step time setting

j) SPECTRUM ANALYZER, SUB WOOFER OUTPUT, TEST MODE SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
11H	SA RST	SA DET	SUBW SW	BEEP	SA TEST	HP TEST	VR1TEST	VR2TEST

•SA RST : Reset signal for spectrum analyzer
•SADET : Spectrum analyzer detect point selector
•SUBW SW : Sub woofer output switch control
•BEEP : BEEP ON/OFF setting
•SA TEST* : "0" : Normal operation, "1" : Test mode
•HP TEST* : "0" : Normal operation, "1" : Test mode
•VR1TEST* : "0" : Normal operation, "1" : Test mode
•VR2TEST* : "0" : Normal operation, "1" : Test mode
*For device check use only. Set {D3,D2,D1,D0}={0,0,0,0} in usual.

■INPUT SELECTOR (Select Address : 00H)

	INPUT SELECTOR			
	D7	D6	D5	D4
INPUT 1	0	0	0	0
INPUT 2	0	0	0	1
INPUT 3	0	0	1	0
INPUT 4	0	0	1	1
INPUT 5	0	1	0	0
INPUT 6 (Single Ended)	0	1	0	1
INPUT 7 (Single Ended)	0	1	1	0
INPUT 6 (Differential)	1	1	0	1
INPUT 7 (Differential)	1	1	1	0
MUTE	1	1	1	1

*: Default Value

■INPUT GAIN (Select Address : 00H)

	INPUT GAIN			
Gain(dB)	D3	D2	D1	D0
0*	0	0	0	0
+1	0	0	0	1
+2	0	0	1	0
+3	0	0	1	1
+4	0	1	0	0
+5	0	1	0	1
+6	0	1	1	0
+7	0	1	1	1
+8	1	0	0	0
+9	1	0	0	1
+10	1	0	1	0
+11	1	0	1	1
+12	1	1	0	0
+13	1	1	0	1
+14	1	1	1	0
+15	1	1	1	1

*: Default Value

■MAIN VOLUME (Select Address : 01H)

		MAIN VOL							
Gain (dB)	HEX	D7	D6	D5	D4	D3	D2	D1	D0
+23.5	FE	1	1	1	1	1	1	1	0
+23	FD	1	1	1	1	1	1	0	1
+22.5	FC	1	1	1	1	1	1	0	0
+22	FB	1	1	1	1	1	0	1	1
+21.5	FA	1	1	1	1	1	0	1	0
+21	F9	1	1	1	1	1	0	0	1
+20.5	F8	1	1	1	1	1	0	0	0
+20	F7	1	1	1	1	0	1	1	1
+19.5	F6	1	1	1	1	0	1	1	0
⋮	⋮				⋮				
+3	D5	1	1	0	1	0	1	0	1
+2.5	D4	1	1	0	1	0	1	0	0
+2	D3	1	1	0	1	0	0	1	1
+1.5	D2	1	1	0	1	0	0	1	0
+1	D1	1	1	0	1	0	0	0	1
+0.5	D0	1	1	0	1	0	0	0	0
0	CF	1	1	0	0	1	1	1	1
-0.5	CE	1	1	0	0	1	1	1	0
-1	CD	1	1	0	0	1	1	0	1
-1.5	CC	1	1	0	0	1	1	0	0
-2	CB	1	1	0	0	1	0	1	1
-2.5	CA	1	1	0	0	1	0	1	0
-3	C9	1	1	0	0	1	0	0	1
⋮	⋮				⋮				
-75	39	0	0	1	1	1	0	0	1
-75.5	38	0	0	1	1	1	0	0	0
-76	37	0	0	1	1	0	1	1	1
-76.5	36	0	0	1	1	0	1	1	0
-77	35	0	0	1	1	0	1	0	1
-77.5	34	0	0	1	1	0	1	0	0
-78	33	0	0	1	1	0	0	1	1
-78.5	32	0	0	1	1	0	0	1	0
-79	31	0	0	1	1	0	0	0	1
-79.5	30	0	0	1	1	0	0	0	0
Mute*	00	0	0	0	0	0	0	0	0

*: Default Value

■LOUDNESS (Select Address : 02H)

	LOUDNESS
Loudness Setting	D7
OFF*	0
ON	1

*: Default Value

■EQUALIZER PASS SWITCH (Select Address : 02H)

	EQPASS
Switch Setting	D6
OFF*	0
ON	1

*: Default Value

■HIGH PASS FILTER (Select Address : 02H)

Cut Off Frequency	HPF	
	D5	D4
Flat*	0	0
62 Hz	0	1
95 Hz	1	0
135 Hz	1	1

*: Default Value

■LOW PASS FILTER (Select Address : 02H)

Phase	PHASE
	D3
0 degrees*	0
180 degrees	1

*: Default Value

	LPFORDER
LPF Order Setting	D2
2nd Order*	0
4th Order	1

*: Default Value

Cut Off Frequency	LPF	
	D1	D0
Flat*	0	0
55 Hz	0	1
85 Hz	1	0
120 Hz	1	1

*: Default Value

■EQUALIZER QUALITY FACTOR (Select Address : 03H, 04H, 05H, 06H, 07H)

	EQ1Q EQ2Q EQ3Q EQ4Q EQ5Q	
Quality Factor	**D1**	**D0**
0.7*	0	0
1.0	0	1
1.4	1	0
2.0	1	1

*: Default Value

■EQUALIZER BOOST/CUT LEVEL (Select Address : 03H, 04H, 05H, 06H, 07H)

	BCEQ1 BCEQ2 BCEQ3 BCEQ4 BCEQ5
Equalizer Cut or Boost	**D4**
Cut*	0
Boost	1

*: Default Value

		EQ1LVL EQ2LVL EQ3LVL EQ4LVL EQ5LVL			
Cut Gain(dB)	**Boost Gain(dB)**	**D3**	**D2**	**D1**	**D0**
-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

*: Default Value

■EQUALIZER BAND 1, BAND 2, BAND 3, BAND 4 CENTER FREQUENCY (Select Address : 08H)

Equalizer Band 1 Center Frequency	EQ1FC	
	D7	D6
68Hz*	0	0
100Hz	0	1
150Hz	1	0

*: Default Value

Equalizer Band 2 Center Frequency	EQ2FC	
	D5	D4
210Hz*	0	0
320Hz	0	1
460Hz	1	0

*: Default Value

Equalizer Band 3 Center Frequency	EQ3FC	
	D3	D2
0.68kHz*	0	0
1kHz	0	1
1.5kHz	1	0

*: Default Value

Equalizer Band 4 Center Frequency	EQ4FC	
	D1	D0
2.1kHz*	0	0
3.2kHz	0	1
4.6kHz	1	0

*: Default Value

■EQUALIZER BAND 5 CENTER FREQUENCY (Select Address : 09H)

Equalizer Band 5 Center Frequency	EQ5FC	
	D7	D6
6.8kHz*	0	0
10kHz	0	1
15kHz	1	0

*: Default Value

■**BEEP SOURCE SELECTOR(Select Address : 09H)]**

Beep Source	BSEL
	D5
External*	0
Internal	1

*: Default Value

■**BEEP VOLUME (Select Address : 09H)**

		BEEP VOL				
Gain(dB)	HEX	D4	D3	D2	D1	D0
0	1F	1	1	1	1	1
-2	1E	1	1	1	1	0
-4	1D	1	1	1	0	1
-6	1C	1	1	1	0	0
-8	1B	1	1	0	1	1
-10	1A	1	1	0	1	0
:	:			:		
-52	05	0	0	1	0	1
-54	04	0	0	1	0	0
-56	03	0	0	0	1	1
-58	02	0	0	0	1	0
-60	01	0	0	0	0	1
Mute*	00	0	0	0	0	0

*: Default Value

■**FADER VOLUME (Select Address : 0AH, 0BH, 0CH, 0DH)**

		FADER FL						
		FADER FR						
		FADER RL						
		FADER RR						
Gain(dB)	HEX	D6	D5	D4	D3	D2	D1	D0
0	7F	1	1	1	1	1	1	1
-1	7E	1	1	1	1	1	1	0
-2	7D	1	1	1	1	1	0	1
-3	7C	1	1	1	1	1	0	0
-4	7B	1	1	1	1	0	1	1
-5	7A	1	1	1	1	0	1	0
:	:				:			
-76	33	0	1	1	0	0	1	1
-77	32	0	1	1	0	0	1	0
-78	31	0	1	1	0	0	0	1
-79	30	0	1	1	0	0	0	0
Mute*	00	0	0	0	0	0	0	0

*: Default Value

■ **EQUALIZER TEST MODE (Select Address : 0EH)**

Phase	EQTEST
	D7
OFF*	0
ON	1

*: Default Value

■**SUB WOOFER VOLUME (Select Address : 0EH)**

		SUBW VOL						
Gain(dB)	HEX*	D6	D5	D4	D3	D2	D1	D0
+15	7E	1	1	1	1	1	1	0
+14	7D	1	1	1	1	1	0	1
+13	7C	1	1	1	1	1	0	0
+12	7B	1	1	1	1	0	1	1
+11	7A	1	1	1	1	0	1	0
:	:				:			
+2	71	1	1	1	0	0	0	1
+1	70	1	1	1	0	0	0	0
0	6F	1	1	0	1	1	1	1
-1	6E	1	1	0	1	1	1	0
-2	6D	1	1	0	1	1	0	1
:	:				:			
-75	24	0	1	0	0	1	0	0
-76	23	0	1	0	0	0	1	1
-77	22	0	1	0	0	0	1	0
-78	21	0	1	0	0	0	0	1
-79	20	0	1	0	0	0	0	0
Mute*	00	0	0	0	0	0	0	0

*: Default Value

■HEADPHONE VOLUME (Select Address : 0FH)

		HP VOL							
Gain (dB)	HEX	D7	D6	D5	D4	D3	D2	D1	D0
+15.5	FE	1	1	1	1	1	1	1	0
+15	FD	1	1	1	1	1	1	0	1
+14.5	FC	1	1	1	1	1	1	0	0
+14	FB	1	1	1	1	1	0	1	1
+13.5	FA	1	1	1	1	1	0	1	0
+13	F9	1	1	1	1	1	0	0	1
+12.5	F8	1	1	1	1	1	0	0	0
+12	F7	1	1	1	1	1	1	1	1
+11.5	F6	1	1	1	1	1	1	1	0
⋮	⋮				⋮				
+3	E5	1	1	1	0	0	1	0	1
+2.5	E4	1	1	1	0	0	1	0	0
+2	E3	1	1	1	0	0	0	1	1
+1.5	E2	1	1	1	0	0	0	1	0
+1	E1	1	1	1	0	0	0	0	1
+0.5	E0	1	1	1	0	0	0	0	0
0	DF	1	1	0	1	1	1	1	1
-0.5	DE	1	1	0	1	1	1	1	0
-1	DD	1	1	0	1	1	1	0	1
-1.5	DC	1	1	0	1	1	1	0	0
-2	DB	1	1	0	1	1	0	1	1
-2.5	DA	1	1	0	1	1	0	1	0
-3	D9	1	1	0	1	1	0	0	1
⋮	⋮				⋮				
-75	49	0	1	0	0	1	0	0	1
-75.5	48	0	1	0	0	1	0	0	0
-76	47	0	1	0	0	0	1	1	1
-76.5	46	0	1	0	0	0	1	1	0
-77	45	0	1	0	0	0	1	0	1
-77.5	44	0	1	0	0	0	1	0	0
-78	43	0	1	0	0	0	0	1	1
-78.5	42	0	1	0	0	0	0	1	0
-79	41	0	1	0	0	0	0	0	1
-79.5	40	0	1	0	0	0	0	0	0
Mute*	00	0	0	0	0	0	0	0	0

*: Default Value

■SPEAKER OUTPUT SOFT MUTE (Select Address : 10H)

	SM SP
Soft Mute Setting	D7
OFF*	0
ON	1

*: Default Value

■HEADPHONE OUTPUT SOFT MUTE (Select Address : 10H)

	SM HP
Soft Mute Setting	D6
OFF*	0
ON	1

*: Default Value

■MAIN VR SOFT STEP (Select Address : 10H)

	SSMAIN
Soft Step Setting	D5
OFF*	0
ON	1

*: Default Value

■EQUALIZER SOFT STEP (Select Address : 10H)

	SSEQ
Soft Step Setting	D4
OFF*	0
ON	1

*: Default Value

■FADER SOFT STEP (Select Address : 10H)

	SSFADER
Soft Step Setting	D3
OFF*	0
ON	1

*: Default Value

■SUB WOOFER SOFT STEP (Select Address : 10H)

	SSSW
Soft Step Setting	D2
OFF*	0
ON	1

*: Default Value

■SOFT STEP TIME (Select Address : 10H)

	SS TIME	
Soft Step Time	D1	D0
10msec*	0	0
20msec	0	1
50msec	1	0
100msec	1	1

*: Default Value

■SPECTRUM ANALYZER RESET (Select Address : 11H)

	SA RST
Reset	D7
OFF*	0
ON	1

*: Default Value

■SPECTRUM ANALYZER DETECT POINT (Select Address : 11H)

	SA DET
Detect Point	D6
Before Main VR*	0
Before Fader VR*	1

*: Default Value

■SUB WOOFER OUTPUT SWITCH (Select Address : 11H)

	SUBW SW
Detect Point	D5
Sub Woofer Signal*	0
Rear Signal	1

*: Default Value

■BEEP ON/FF SWITCH (Select Address : 11H)

	BEEP
Detect Point	D4
OFF*	0
ON	1

*: Default Value

■TEST MODE (Select Address : 11H)

	TEST MODE			
TEST MODE	D3	D2	D1	D0
OFF*	0	0	0	0

*: Default Value

[CAUTION]
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