



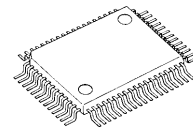
Audio Processor with Sound Enhancement and TruSurround 5.1ch Virtualizer

■ GENERAL DESCRIPTION

The NJW1149 is an audio processor with BBE sound enhancement and SRS Labs' TruSurround 5.1 channel virtualizer. It includes all of functions processing audio signal for TV, such as volume, balance, mute, tone control, eala NJRC surround and simulated stereo functions. All of internal status and variables are controlled by I²C BUS.

The NJW1149 is available for Virtual Dolby Surround or Virtual Dolby Digital with Dolby Pro Logic or Dolby Digital system*.

■ PACKAGE OUTLINE



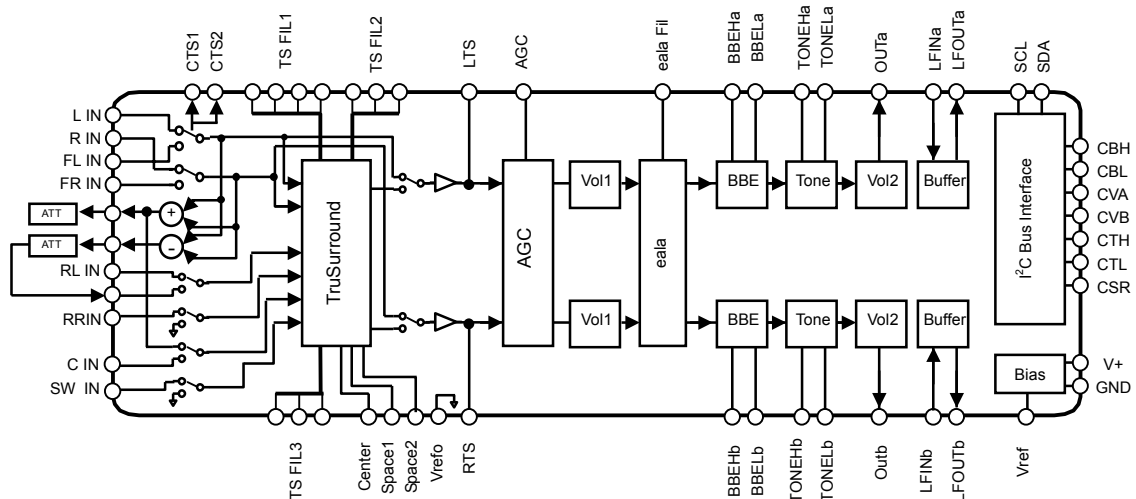
NJW1149FC2

*For use in Virtual Dolby Surround(VDS) and/or Virtual Dolby Digital(VDD) products, please contact Dolby Laboratories for licensing information. Dolby and the double-D symbol are trademarks of Dolby Laboratories Licensing Corporation. Licensing and application information may be obtained from Dolby Lab.

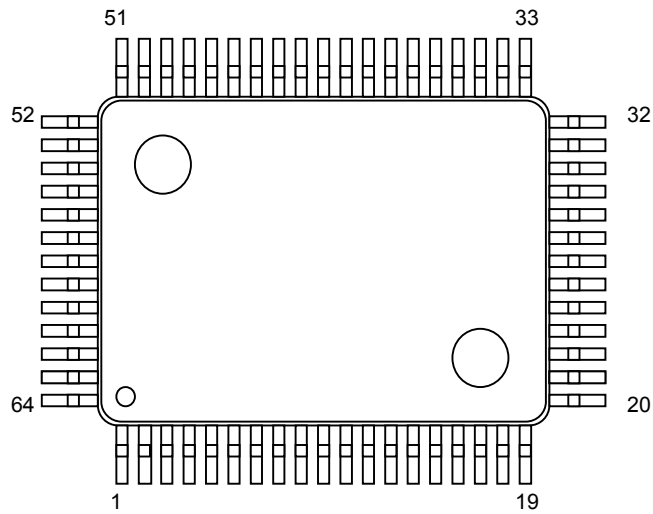
■ FEATURES

- Operating Voltage 8 to 10 V
- I²C BUS Interface
- TruSurround 5.1ch. / 4ch. / 2ch. Inputs
- BBE 0dB to +15dB(0.5dB/step)
- eala (surround effect ; 2 steps) and Simulated Stereo
- Volume 0 to -80dB, MUTE (0.33dB/step)
- Balance 0 to -30dB, MUTE (1dB/step)
- Tone Control -15dB to +15dB(0.5dB/step)
- Bi-CMOS Technology
- Package Outline QFP64-C2

■ BLOCK DIAGRAM



■ PIN FUNCTION



No.	SYMBOL	FUNCTION	No.	SYMBOL	FUNCTION
1	TS11	TruSurround Filter Capacitor 11	33	CBH	BBE High switching noise rejection Capacitor
2	TS12	TruSurround Filter Capacitor 12	34	LFOU T b	Buffer Output for Bch Low Pass Filter
3	TS13	TruSurround Filter Capacitor 13	35	LFIN b	Buffer Input for Bch Low Pass Filter
4	TS14	TruSurround Filter Capacitor 14	36	OUT b	Bch Output
5	SPACE1	SPACE Volume1	37	TONE-L b	Bch TONE Bass Filter Capacitor
6	SPACE2	SPACE Volume2	38	TONE-H b	Bch TONE Treble Filter Capacitor
7	CENTER	CENTER Volume	39	BBE2 b	Bch BBE Low-Pass Filter Capacitor
8	VREFO	Reference Voltage Output Capacitor	40	BBE1 b	Bch BBE High-Pass Filter Capacitor
9	N.C.	No Connection	41	CSR	eala switching noise rejection Capacitor
10	LTS	Lch TruSurround Output	42	RTS	Rch TruSurround Output
11	ealaFil	eala Filter Capacitor	43	N.C.	No Connection
12	BBE1a	Ach BBE High-Pass Filter Capacitor	44	CTS2	TruSurround switching noise rejection Capacitor 2
13	BBE2a	Ach BBE Low-Pass Filter Capacitor	45	CTS1	TruSurround switching noise rejection Capacitor 1
14	TONE-Ha	Ach TONE Treble Filter Capacitor	46	N.C.	No Connection
15	TONE-La	Ach TONE Bass Filter Capacitor	47	TS33	TruSurround Filter Capacitor 33
16	OUTa	Ach Output	48	TS32	TruSurround Filter Capacitor 32
17	LFINa	Buffer Input for Ach Low Pass Filter	49	TS31	TruSurround Filter Capacitor 31
18	LFOU T a	Buffer Output for Ach Low Pass Filter	50	N.C.	No Connection
19	AGC	AGC Smoothing Filter Capacitor	51	ATTC	Center Attenuation Resistor
20	CVA	Ach Volume switching noise rejection Capacitor	52	ATTS2	Surround Attenuation Resistor 2
21	CVB	Bch Volume switching noise rejection Capacitor	53	ATTS1	Surround Attenuation Resistor 1
22	SDA	I ² C Data Input	54	TS23	TruSurround Filter Capacitor 23
23	SCL	I ² C Clock Input	55	TS22	TruSurround Filter Capacitor 22
24	GND	Ground	56	TS21	TruSurround Filter Capacitor 21
25	N.C.	No Connection	57	SWIN	SW ch Input
26	N.C.	No Connection	58	CIN	C ch Input
27	N.C.	No Connection	59	RRIN	Rear-R ch Input
28	V+	Power Supply	60	RLIN	Rear-L ch Input
29	VREF	Reference Voltage stabilizing Capacitor	61	FRIN	Front-R ch Input
30	CTL	Tone Control Bass switching noise rejection Capacitor	62	FLIN	Front-L ch Input
31	CTH	Tone Control Treble switching noise rejection Capacitor	63	RIN	R ch Input
32	CBL	BBE Low switching noise rejection Capacitor	64	LIN	L ch Input

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

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V^+	12	V
Power Dissipation	P_D	1000	mW
Operating Temperature Range	Topr	-20 to +75	°C
Storage Temperature Range	Tstg	-40 to +125	°C

■ **ELECTRICAL CHARACTERISTICS** (Ta=25°C, $V^+=9V$, $R_L=47k\Omega$, $V_{in}=100mV_{rms}/1kHz$
MODE ; VOL=0dB, BAL=0dB, TS=By-Pass, AGC=OFF, BBE=OFF, Tone=0dB, eala=By-Pass)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Operating Voltage	V^+		8.0	9.0	10.0	V
Supply Current	I_{CC}	No Signal	-	30	45	mA
Reference Voltage	V_{REF}	No Signal	4.0	4.5	5.0	V
Maximum Input Voltage	V_{IM}	VOL=-20dB, THD=10%	2.8	3.0	-	Vrms
Maximum Output Voltage	V_{OM}	OUTPUT VOL=0dB, THD=1%	-	2.5	-	Vrms
Channel Balance	G_{CB}	VOL=0dB	-1.5	0.0	1.5	dB
Balance Boost A	G_{BBA}	CHS="0", BAL=Mute	-2.0	0.0	2.0	dB
Balance Cut A	G_{BCA}	CHS="1", BAL=Mute $V_{in} = 1V_{rms}$	-	-	-70	dB
Balance Boost B	G_{BBB}	CHS="1", BAL=Mute	-2.0	0.0	2.0	dB
Balance Cut B	G_{BCB}	CHS="0", BAL=Mute $V_{in} = 1V_{rms}$	-	-	-70	dB
Total Harmonic Distortion	THD	$V_o=0.5V_{rms}$ BW=400Hz to 30kHz	-	-	0.5	%
Maximum Voltage Gain	G_{VMAX}	VOL= 0dB	-2.0	0.0	2.0	dB
Minimum Voltage Gain	G_{VMIN}	VOL= Mute	-	-	-70	dB
Channel Separation	CS	$V_{in} = 1V_{rms}$	-	-	-70	dB
Output Noise 1	V_{NO1}	VOL = 0dB BW=400Hz to 30kHz	-	-90 (31.6)	-85 (56.2)	dBV (μV_{rms})
Output Noise 2	V_{NO2}	VOL = Mute BW = 400Hz to 30kHz	-	-106 (5.0)	-96 (15.8)	dBV (μV_{rms})

BW : Band Width

◆ **TONE CONTROL CHARACTERISTICS** (Ta=25°C, $V^+=9V$, $R_L=47k\Omega$, $V_{in}=100mV_{rms}/1kHz$
MODE ; VOL=0dB, BAL=0dB, TS=By-Pass, AGC=OFF, BBE=OFF, eala=By-Pass)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Treble Boost Gain	G_{HFBST}	TREB=+15dB, f=10kHz	12.5	15.0	17.5	dB
Treble Boost Flat	G_{HFFLT}	TREB=0dB, f=10kHz	-2.0	0.0	2.0	dB
Treble Boost Cut	G_{HFCUT}	TRBE=-15dB, f=10kHz	-17.5	-15.0	-12.5	dB
Bass Boost Gain	G_{LFBST}	BASS=+15dB, f=100Hz	12.5	15.0	17.5	dB
Bass Boost Flat	G_{LFFLT}	BASS=0dB, f=100Hz	-2.0	0.0	2.0	dB
Bass Boost Cut	G_{LFCUT}	BASS=-15dB, f=100Hz	-17.5	-15.0	-12.5	dB

◆**AGC CHARACTERISTICS** (Ta=25°C, V⁺=9V, R_L=47kΩ
MODE ; VOL=0dB, BAL=0dB, TS=By-Pass, AGC=ON, BBE=OFF, Tone=0dB, eala=By-Pass)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
AGC Boost	G _{AGCBST}	Vin=50mVrms, f=1kHz	1.5	3.5	5.5	dB
AGC Flat 1	G _{AGCFLT1}	Vin=300mVrms, f=1kHz	-2.5	0.0	2.5	dB
AGC Flat 2	G _{AGCFLT2}	Vin=400mVrms, f=1kHz	-2.5	0.0	2.5	dB
AGC Flat 3	G _{AGCFLT3}	Vin=500mVrms, f=1kHz	-2.5	0.0	2.5	dB
AGC Flat 4	G _{AGCFLT4}	Vin=600mVrms, f=1kHz	-2.5	0.0	2.5	dB
AGC Cut	G _{AGCCUT}	Vin=2Vrms, f=1kHz	-14	-10	-6.0	dB

◆**BBE CHARACTERISTICS** (Ta=25°C, V⁺=9V, R_L=47kΩ, Vin=100mVrms/1kHz
MODE ; VOL=0dB, BAL=0dB, TS=By-Pass, AGC=OFF, Tone=0dB, eala=By-Pass)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Low Boost Gain	G _{BBELOW}	BBE-LOW =+15dB, f=50Hz	12.5	15	17.5	dB
High Boost Gain	G _{BBEHIGH}	BBE-HIGH =+15dB, f=10kHz	12.5	15	17.5	dB

◆**eala CHARACTERISTICS** (Ta=25°C, V⁺=9V, R_L=47kΩ, Vin=100mVrms/1kHz
MODE ; VOL=0dB, BAL=0dB, TS=By-Pass, AGC=OFF, BBE=0dB, Tone=0dB)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Simulated Stereo A	G _{SIMA}	LIN+RIN→OUTa, f=1KHz, SIM	1.0	3.0	5.0	dB
Simulated Stereo B	G _{SIMB}	LIN+RIN→OUTb, f=1KHz, SIM	1.0	3.0	5.0	dB
Surround 3D1	G _{3D1}	LIN→OUTa, f=100Hz, SR2	5.5	7.5	9.5	dB
Surround 3D2	G _{3D2}	LIN→OUTa, f=10KHz, SR2	-2.0	0.0	2.0	dB
Surround 3D3	G _{3D3}	LIN→OUTb, f=100Hz, SR2	0.5	2.5	4.5	dB
Surround 3D4	G _{3D4}	LIN→OUTa, f=100Hz, SR1	3.5	5.5	7.5	dB

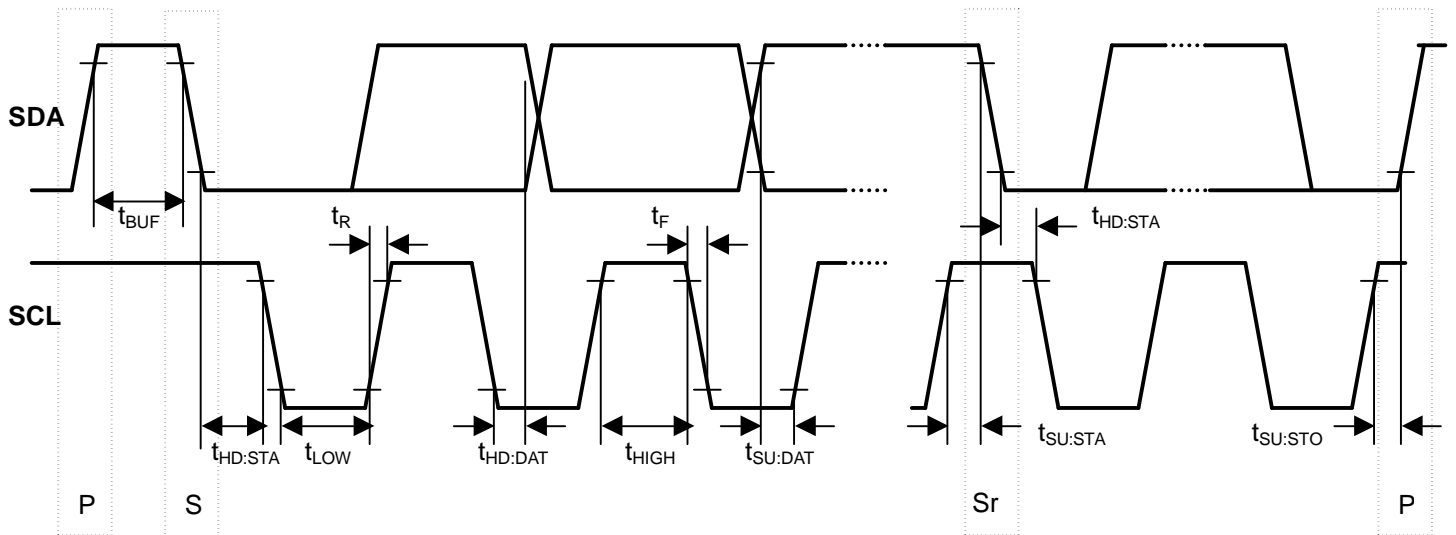
◆**TruSurround CHARACTERISTICS** (Ta=25°C, V⁺=9V, R_L=47kΩ, Vin=100mVrms/1kHz
MODE; VOL=0dB, BAL=0dB, AGC=OFF, BBE=OFF, Tone=0dB, eala=By-Pass)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Mix Down Gain	G _{TSMX}	FLIN→LTS, f=1KHz Mix Down	-5	-3	-1	dB
By-Pass Gain	G _{TSBP}	LIN→LTS, f=1KHz By-Pass	-2	0	2	dB
Tru Front Gain	G _{TSF}	FLIN→LTS, f=125Hz TS5.1ch	-0.5	1.5	3.5	dB
Tru Rear Gain 1	G _{TSR1}	RLIN→LTS, f=125Hz TS5.1ch	1	3	5	dB
Tru Rear Gain 2	G _{TSR2}	RLIN→LTS, f=125Hz TS4ch	2	4	6	dB
Center Gain	G _{TSC}	CIN→LTS, f=1KHz TS4ch	-5	-3	-1	dB
Sub Woofer Gain	G _{TSS}	SWIN→LTS, f=1KHz TS4ch	-2	0	2	dB
Feed Through Gain	G _{THROUGH}	LIN→LTS, f=1KHz SRS 3D,Space=Min, Center=Min	-20	-18	-16	dB
L+R Gain	G _{L+R}	LIN→RTS, f=1KHz SRS 3D,Space=Min, Center=Max	-15	-13	-11	dB
L-R Gain	G _{L-R}	LIN→LTS, f=125Hz SRS 3D,Space=Max, Center=Min	-2	0	2	dB
Passive Gain 1	G _{TSP1}	LIN→LTS, f=125Hz TS2ch, Space=Max, Center=Max	4.0	6.0	8.0	dB
Passive Gain 2	G _{TSP2}	LIN→RTS, f=125Hz TS2ch, Space=Max, Center=Max	-5.5	-3.5	-1.5	dB

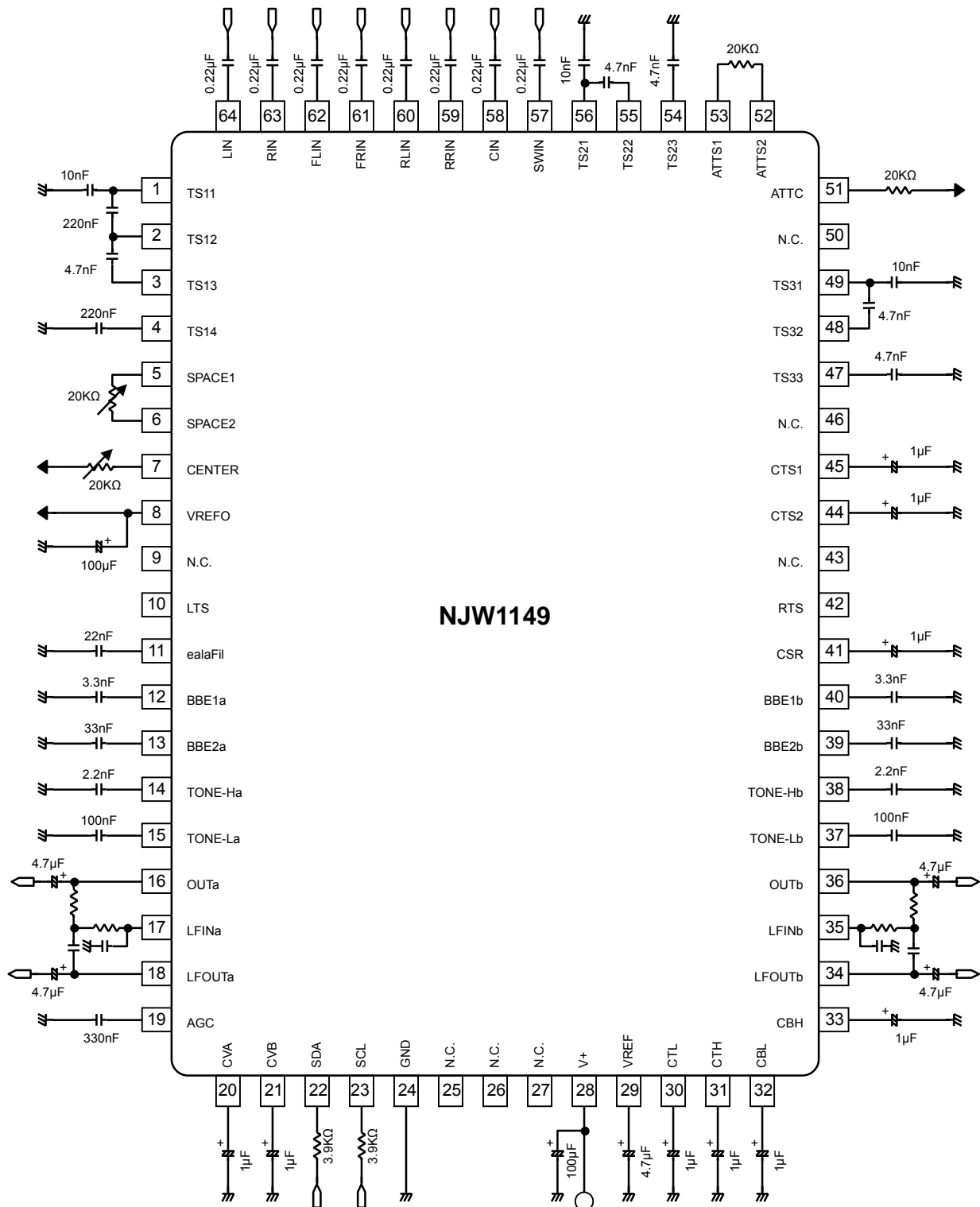
■ I²C BUS CHARACTERISTICS (SDA, SCL)

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

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	μA
Low Level Input Current	I _{IL}	-	-	10	μA
Low Level Output Voltage (3mA at SDA pin)	V _{OL}	0	-	0.4	V
Maximum Output Current	I _{OL}	-3.0	-	-	mA
Maximum Clock Frequency	f _{SCL}	-	-	100	kHz
Data Change Minimum Waiting Time	t _{BUF}	4.7	-	-	μs
Data Transfer Start Minimum Waiting Time	t _{HD:STA}	4.0	-	-	μs
Low Level Clock Pulse Width	t _{LOW}	4.7	-	-	μs
High Level Clock Pulse Width	t _{HIGH}	4.0	-	-	μs
Minimum Start Preparation Waiting Time	t _{SU:STA}	4.7	-	-	μs
Minimum Data Hold Time	t _{HD:DAT}	5.0	-	-	μs
Minimum Data Preparation Time	t _{SU:DAT}	250	-	-	ns
Rise Time	t _R	-	-	1.0	μs
Fall Time	t _F	-	-	300	ns
Minimum Stop Preparation Waiting Time	t _{SU:STO}	4.0	-	-	μs



APPLICATION CIRCUIT 1 (Bi-Amp outputs)



(NOTE)

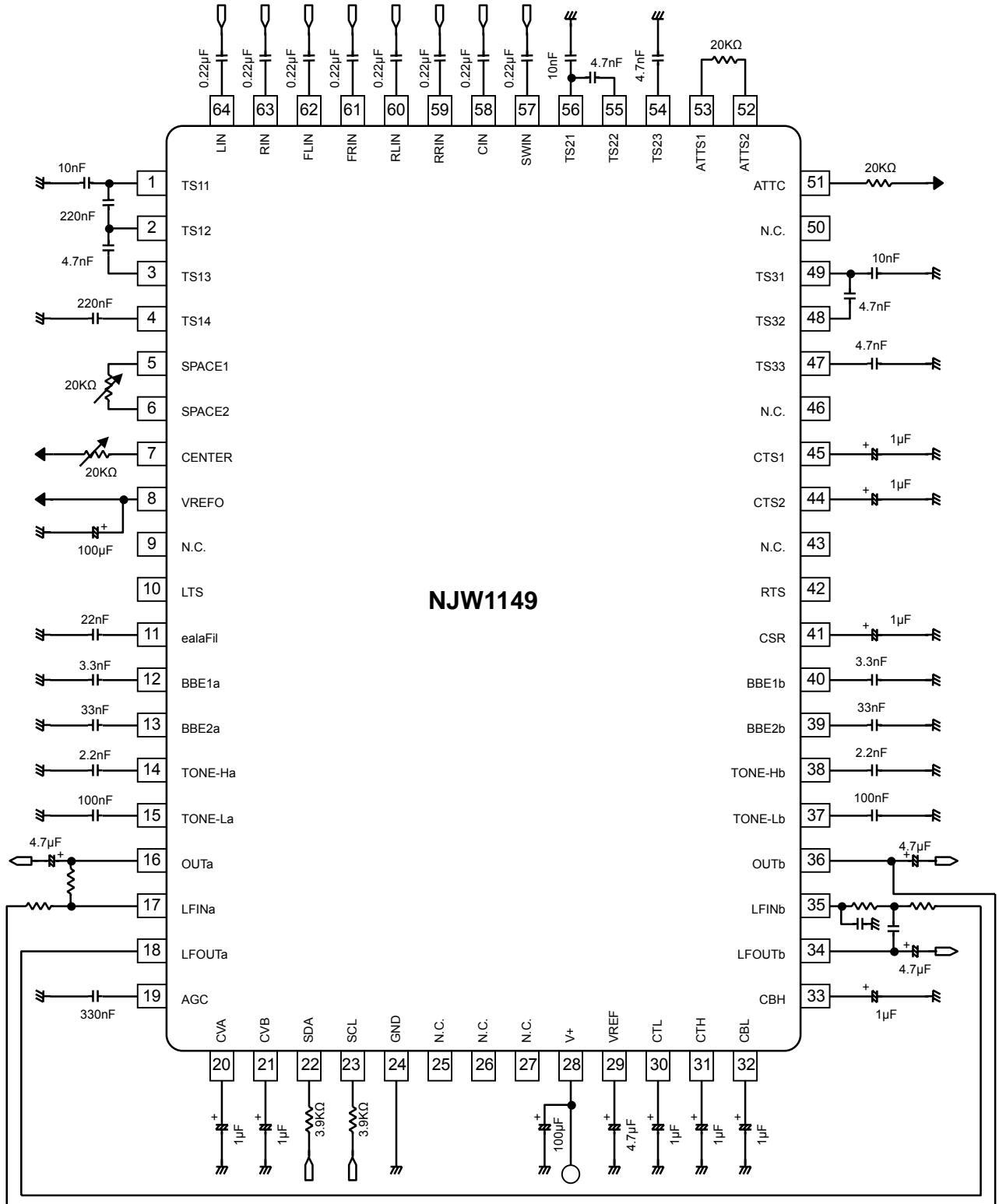
1. Separate the I²C bus line from the following terminals for avoiding digital noise problem.

Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol
1	TS11	11	eala Fil	15	TONE-La	40	BBE1b	54	TS23
2	TS12	12	BBE1a	37	TONE-Lb	47	TS33	55	TS22
3	TS13	13	BBE2a	38	TONE-Hb	48	TS32	56	TS21
4	TS14	14	TONE-Ha	39	BBE2b	49	TS31	-	-

2. The constant of capacitors connected to the terminals No.3, 4, 27 and 28 are designated by BBE Sound Inc.

3. The constant of capacitors connected to the terminals No.1,2,3,4,47,48,49,54,55 and 56 are designated by SRS Labs, Inc.

APPLICATION CIRCUIT 2 (Sub-Woofer output)



(NOTE)

1. Separate the I²C bus line from the following terminals for avoiding digital noise problem.

Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol
1	TS11	11	eala Fil	15	TONE-La	40	BBE1b	54	TS23
2	TS12	12	BBE1a	37	TONE-Lb	47	TS33	55	TS22
3	TS13	13	BBE2a	38	TONE-Hb	48	TS32	56	TS21
4	TS14	14	TONE-Ha	39	BBE2b	49	TS31	-	-

2. The constant of capacitors connected to the terminals No.3, 4, 27 and 28 are designated by BBE Sound Inc.

3. The constant of capacitors connected to the terminals No.1,2,3,4,47,48,49,54,55 and 56 are designated by SRS Labs, Inc.

< Output Type >

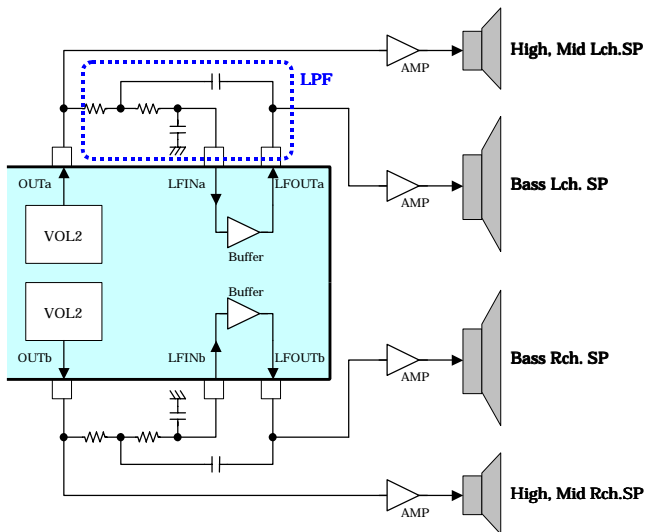


Fig 1. Bi-Amp

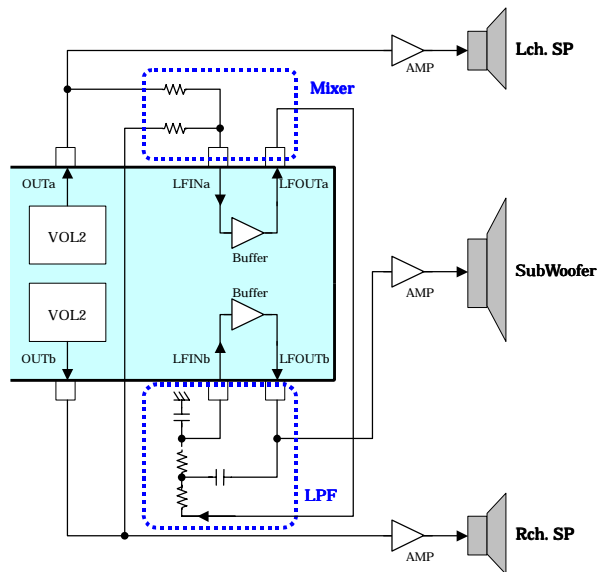
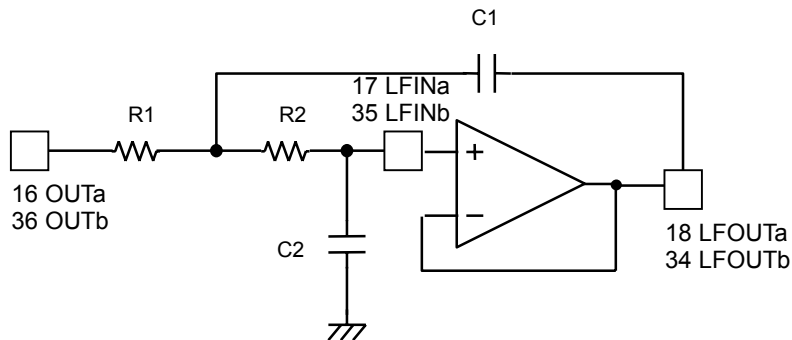


Fig 2. Sub-Woofers

< OUT, LFIN, LFOUT Low Pass Filter Setting >

LPF cut off frequency and quality factor are adjusted by the external parts and given by the following functions.



$$f_c = \frac{1}{2\pi\sqrt{R1 \cdot R2 \cdot C1 \cdot C2}} \text{ (Hz)}$$

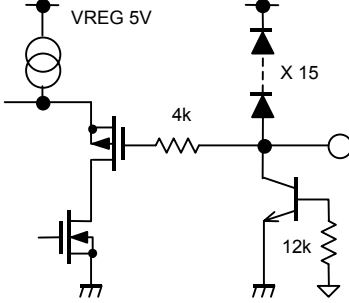
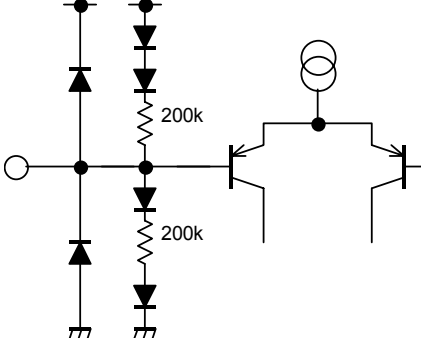
$$Q = \frac{1}{\sqrt{\frac{C2 \cdot R1}{C1 \cdot R2}} + \sqrt{\frac{C1 \cdot R2}{C2 \cdot R1}}}$$

■ TERMINAL DESCRIPTION

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL VOLTAGE
1	TS11	TruSurround Filter Capacitor 11		V+/2
2	TS12	TruSurround Filter Capacitor 12		V+/2
3	TS13	TruSurround Filter Capacitor 13		
4	TS14	TruSurround Filter Capacitor 14		
5	SPACE1	SPACE Volume1		
53	ATTS1	Surround Attenuation Resistor 1		
6	SPACE2	SPACE Volume2		V+/2
8	VREFO	Reference Voltage Output Capacitor		
52	ATTS2	Surround Attenuation Resistor 2		

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL VOLTAGE
7 11 17 35 51 57 58 59 60 61 62 63 64	CENTER ealaFil LFINa LFINb ATTC SWIN CIN RRIN RLIN FRIN FLIN RIN LIN	CENTER Volume eala Filter Capacitor Buffer Input for Ach Low Pass Filter Buffer Input for Bch Low Pass Filter Center Attenuation Resistor SW ch Input C ch Input Rear-R ch Input Rear-L ch Input Front-R ch Input Front-L ch Input R ch Input L ch Input		V+/2
9 25 26 27 43 46 50	N.C. N.C. N.C. N.C. N.C. N.C. N.C.	No Connection No Connection No Connection No Connection No Connection No Connection No Connection	-	-
10 16 18 34 36 42	LTS OUTa LFOUTa LFOUTb OUTb RTS	Lch TruSurround Output Ach Output Buffer Output for Ach Low Pass Filter Buffer Output for Bch Low Pass Filter Bch Output Rch TruSurround Output		V+/2
12 13 39 40	BBE1a BBE2a BBE2b BBE1b	Ach BBE High-Pass Filter Capacitor Ach BBE Low-Pass Filter Capacitor Bch BBE Low-Pass Filter Capacitor Bch BBE High-Pass Filter Capacitor		V+/2

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL VOLTAGE
14	TONE-Ha	Ach TONE Treble Filter Capacitor		V+/2
38	TONE-Hb	Bch TONE Treble Filter Capacitor		
15	TONE-La	Ach TONE Bass Filter Capacitor		V+/2
37	TONE-Lb	Bch TONE Bass Filter Capacitor		
19	AGC	AGC Smoothing Filter Capacitor		-
20	CVA	Ach Volume switching noise rejection Capacitor		VREF-0.7V
21	CVB	Bch Volume switching noise rejection Capacitor		

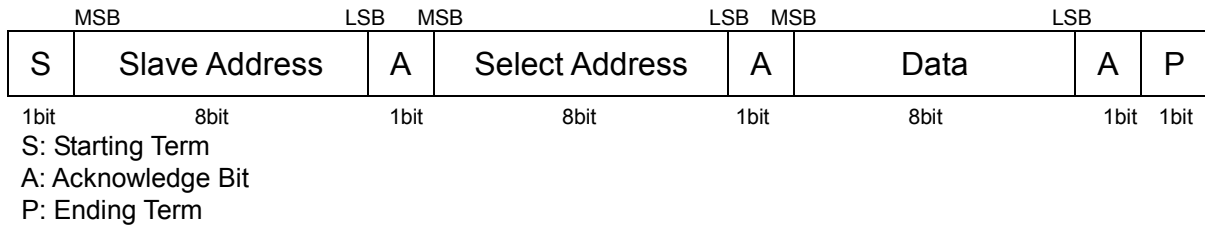
PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL VOLTAGE
22 23	SDA SCL	I ² C Data Input I ² C Clock Input		-
24	GND	Ground	-	-
28	V+	Power Supply	-	V+
29	VREF	Reference Voltage Capacitor		V+/2

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL VOLTAGE
30 31	CTL CTH	Tone Control Bass switching noise rejection Capacitor Tone Control Treble switching noise rejection Capacitor		VREF-0.7V
32 33	CBL CBH	BBE Low switching noise rejection Capacitor BBE High switching noise rejection Capacitor		VREF-0.7V
41 44	CSR CTS2	eala switching noise rejection Capacitor TruSurround switching noise rejection Capacitor 2		0.54V(CSR) 1.4V(CTS2)
45	CTS1	TruSurround switching noise rejection Capacitor 1		-

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL VOLTAGE
47	TS33	TruSurround Filter Capacitor 33		V+/2
48	TS32	TruSurround Filter Capacitor 32		
49	TS31	TruSurround Filter Capacitor 31		
54	TS23	TruSurround Filter Capacitor 23		
55	TS22	TruSurround Filter Capacitor 22		
56	TS21	TruSurround Filter Capacitor 21		

■ DEFINITION OF I²C REGISTER

● I²C BUS FORMAT



● SLAVE ADDRESS



● CONTROL REGISTER TABLE

The select address sets each function (Volume, Balance, AGC, Surround, BBE, Tone Control).
The auto-increment function cycles the select address as follows.
00H→01H→02H→03H→04H→05H→06H→00H

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	VOL							
01H	CHS	BAL					Don't Care	
02H	BCB	BASS					Don't Care	
03H	BCT	TREB					Don't Care	
04H	BBEL					BBE	Don't Care	
05H	BBEH					AGC	AGC LVL	
06H	eala		TS MODE				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

● CONTROL COMMAND TABLE

a) Master Volume

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

●VOL : Master Volume

Attenuation level : 0 to -80dB(0.33dB/step), MUTE

The volume is consisted of VOL1 and VOL2 and the level is divided into half to each VOL1 and VOL2.

ex) Volume setting is -2dB ; VOL1 and VOL2 is set -1dB each.

b) Balance

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
01H	CHS	BAL					Don't Care	

●CHS : Balance channel select

“0” : Ach “Bch is attenuated”

“1” : Bch “Ach is attenuated”

●BAL : Ach and Bch Balance

Balance Level : 0 to -30dB (1dB/Step) , MUTE

c) Tone Control BASS

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

●BCB : Bass Boost or Cut

“0” : Cut

“1” : Boost

●BASS : BASS Level

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

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

e) Tone Control TREBLE

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

●BCT : Treble Boost or Cut

“0” : Cut

“1” : Boost

●TREB : Treble Level

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

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

f) BBE-Low

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
05H	BBEL					BBE	Don't Care	

● BBEL:BBE-LOW Level

0dB to 15dB (0.5dB/step)

●BBE : BBE ON or OFF

g) BBE-High

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
05H	BBEH					AGC	AGC LVL	

- BBEH: BBE-HIGH Level**
0dB to 15dB (0.5dB/step)

- AGC : AGC ON or OFF**
- AGC LVL : AGC Level**
300mVrms, 400mVrms, 500mVrms, 600mVrms

h) Surround (eala, TruSurround)

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
06H	eala		TS MODE				Don't Care	

- eala : eala mode**
Surround effect small (SR1), large (SR2), Simulated Stereo (SIM), By-Pass
- TS MODE : TruSurround mode**
By-Pass, SRS 3D, TS2ch (Passive Matrix TruSurround), TS4ch (for Dolby Pro Logic), TS5.1ch (for Dolby Digital), Mix Down

■ 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

■ Balance (Select Address: 01H)

Channel Setting (CHS)	D7
Attenuated Bch Gain	0
Attenuated Ach Gain	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	BCB
Cut or Boost	D7
Cut	0
Boost	1

Cut Gain(dB) \ Boost Gain(dB)		BASS				
Cut Gain(dB)	Boost Gain(dB)	D6	D5	D4	D3	D2
-15	15	1	1	1	1	0
-14	14	1	1	1	0	0
-13	13	1	1	0	1	0
-12	12	1	1	0	0	0
-11	11	1	0	1	1	0
-10	10	1	0	1	0	0
-9	9	1	0	0	1	0
-8	8	1	0	0	0	0
-7	7	0	1	1	1	0
-6	6	0	1	1	0	0
-5	5	0	1	0	1	0
-4	4	0	1	0	0	0
-3	3	0	0	1	1	0
-2	2	0	0	1	0	0
-1	1	0	0	0	1	0
0	0	0	0	0	0	0

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

Treble	BCT
Cut or Boost	D7
Cut	0
Boost	1

Cut Gain(dB) \ Boost Gain(dB)		TREB				
Cut Gain(dB)	Boost Gain(dB)	D6	D5	D4	D3	D2
-15	15	1	1	1	1	0
-14	14	1	1	1	0	0
-13	13	1	1	0	1	0
-12	12	1	1	0	0	0
-11	11	1	0	1	1	0
-10	10	1	0	1	0	0
-9	9	1	0	0	1	0
-8	8	1	0	0	0	0
-7	7	0	1	1	1	0
-6	6	0	1	1	0	0
-5	5	0	1	0	1	0
-4	4	0	1	0	0	0
-3	3	0	0	1	1	0
-2	2	0	0	1	0	0
-1	1	0	0	0	1	0
0	0	0	0	0	0	0

■ BBE-LOW Gain Code (Select Address: 04H)

Gain(dB)	BBEL				
	D7	D6	D5	D4	D3
15	1	1	1	1	0
14	1	1	1	0	0
13	1	1	0	1	0
12	1	1	0	0	0
11	1	0	1	1	0
10	1	0	1	0	0
9	1	0	0	1	0
8	1	0	0	0	0
7	0	1	1	1	0
6	0	1	1	0	0
5	0	1	0	1	0
4	0	1	0	0	0
3	0	0	1	1	0
2	0	0	1	0	0
1	0	0	0	1	0
0	0	0	0	0	0

■ BBE (Select Address: 04H)

BBE ON/OFF	BBE
	D2
OFF	0
ON	1

■ BBE-HIGH Gain Code (Select Address: 05H)

Gain(dB)	BBEH				
	D7	D6	D5	D4	D3
15	1	1	1	1	0
14	1	1	1	0	0
13	1	1	0	1	0
12	1	1	0	0	0
11	1	0	1	1	0
10	1	0	1	0	0
9	1	0	0	1	0
8	1	0	0	0	0
7	0	1	1	1	0
6	0	1	1	0	0
5	0	1	0	1	0
4	0	1	0	0	0
3	0	0	1	1	0
2	0	0	1	0	0
1	0	0	0	1	0
0	0	0	0	0	0

■ AGC (Select Address: 05H)

AGC ON/OFF	AGC
	D2
OFF	0
ON	1

■ AGC Level (Select Address: 05H)

AGC Level	AGC LVL	
	D1	D0
300mVrms	0	0
400mVrms	0	1
500mVrms	1	0
600mVrms	1	1

■ eala mode (Select Address: 06H)

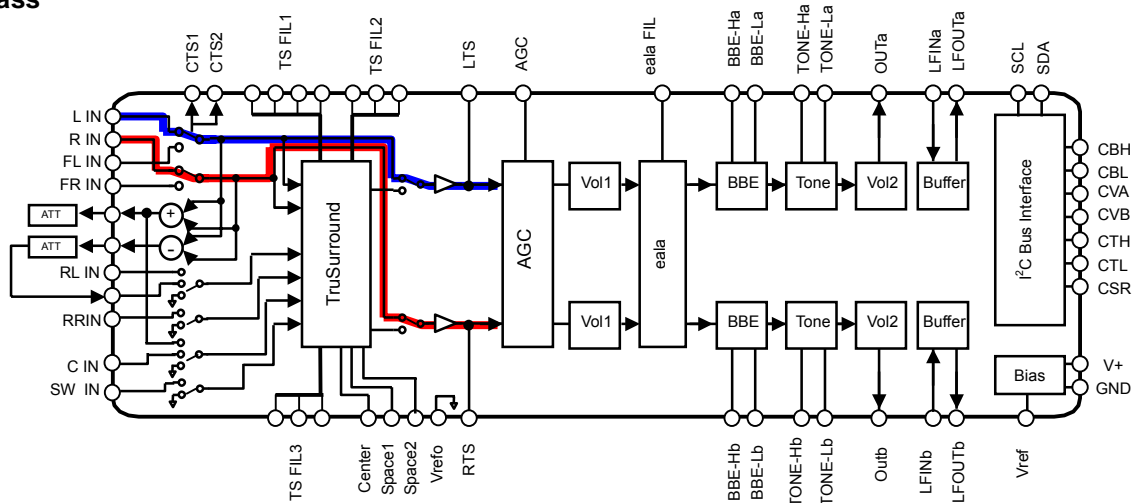
eala MODE	eala	
	D7	D6
By-Pass	0	0
Simulated Stereo (SIM)	0	1
3D Effect Large (SR2)	1	0
3D Effect Small (SR1)	1	1

■ TruSurround mode(Select Address: 06H)

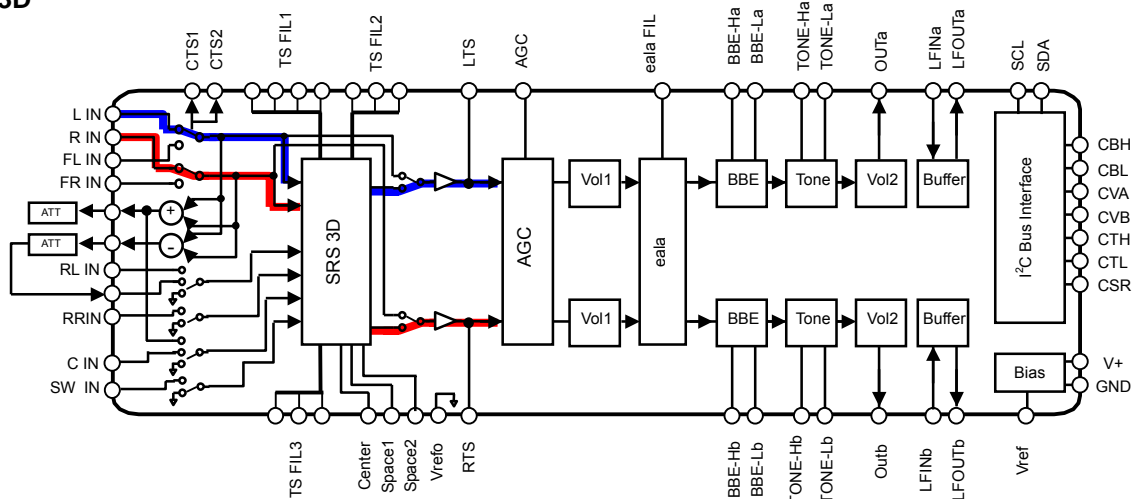
TruSurround MODE	TS MODE			
	D5	D4	D3	D2
By-Pass	0	0	0	0
SRS 3D	0	0	1	1
TS2ch	0	1	0	1
TS4ch	1	0	0	0
TS5.1ch	1	1	0	0
Mix Down	1	1	1	0

■ TruSurround Input Signal Root

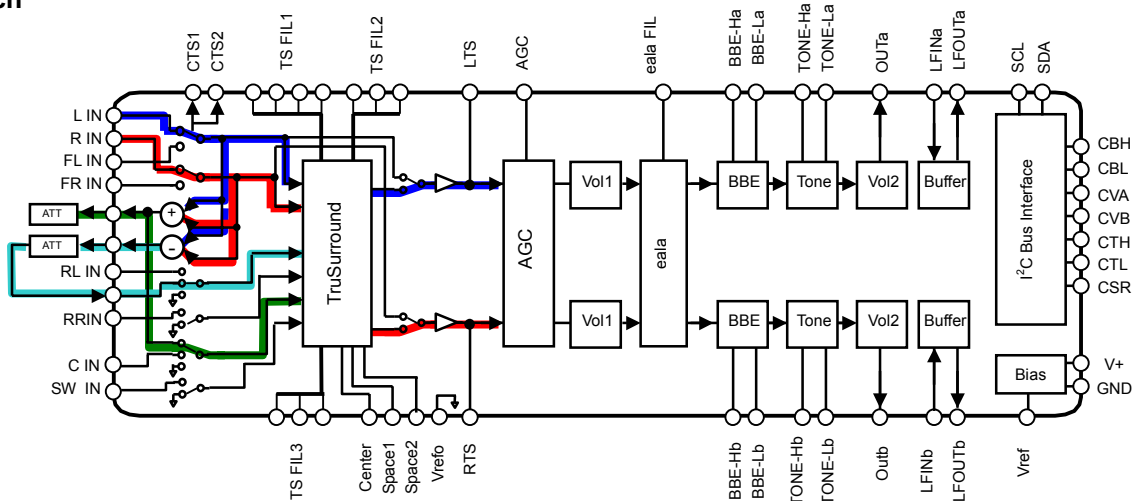
● By-Pass



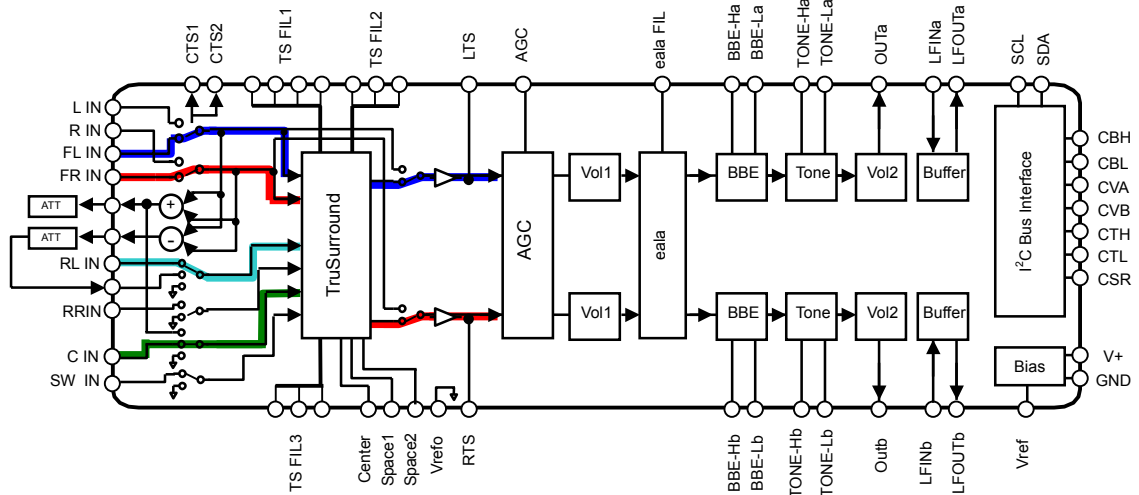
● SRS 3D



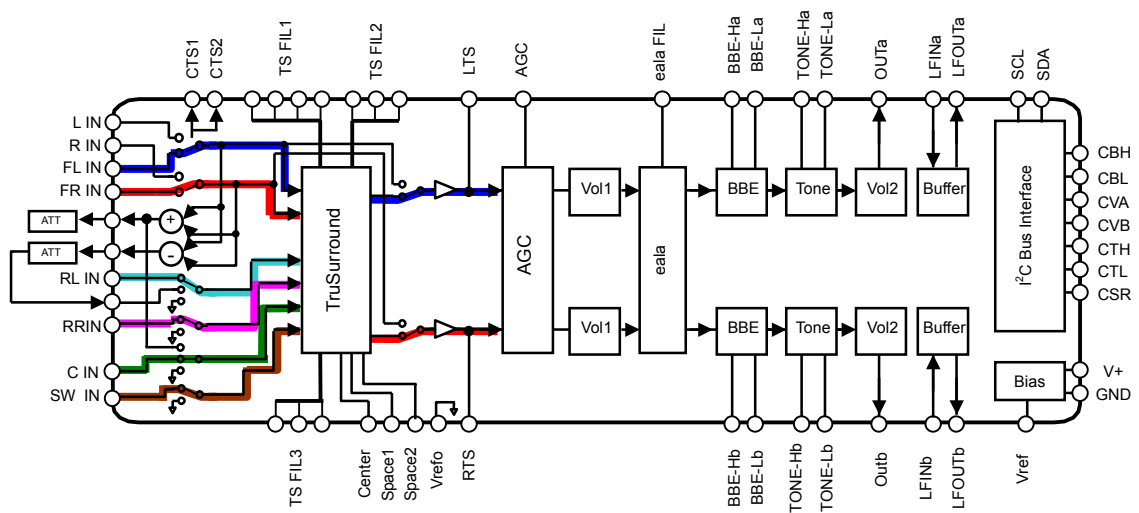
● TS 2ch



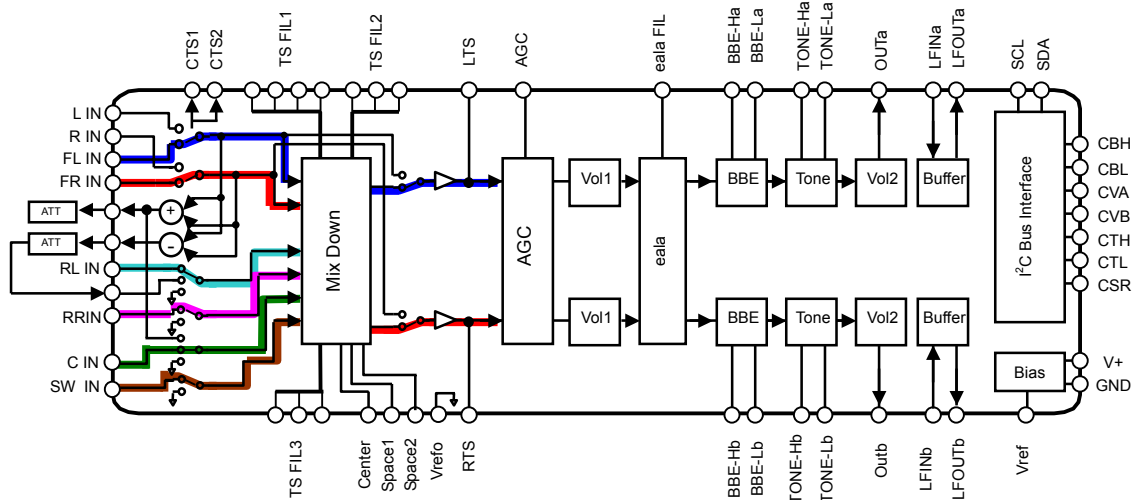
● TS 4ch



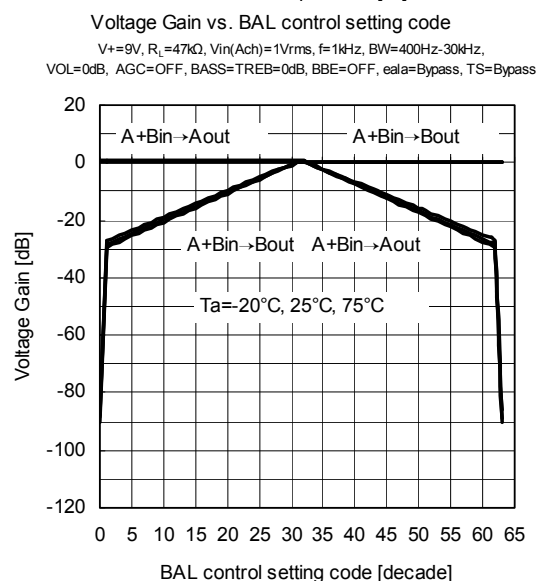
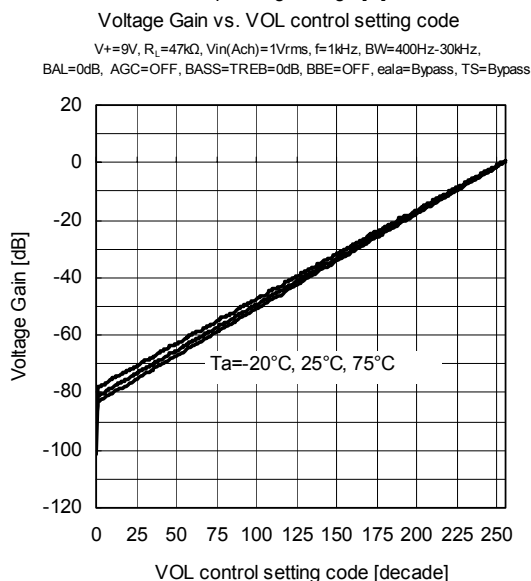
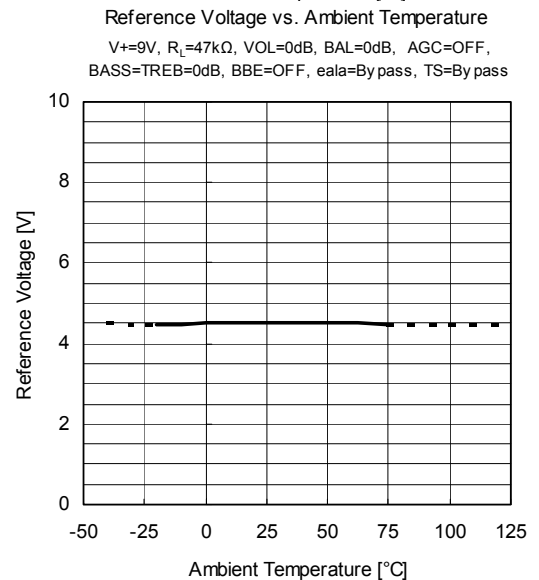
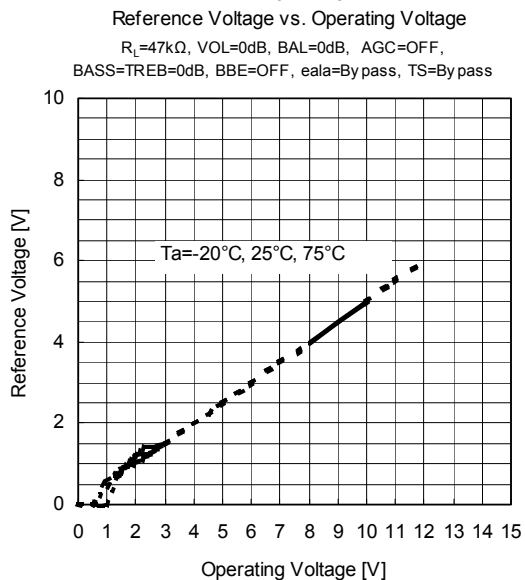
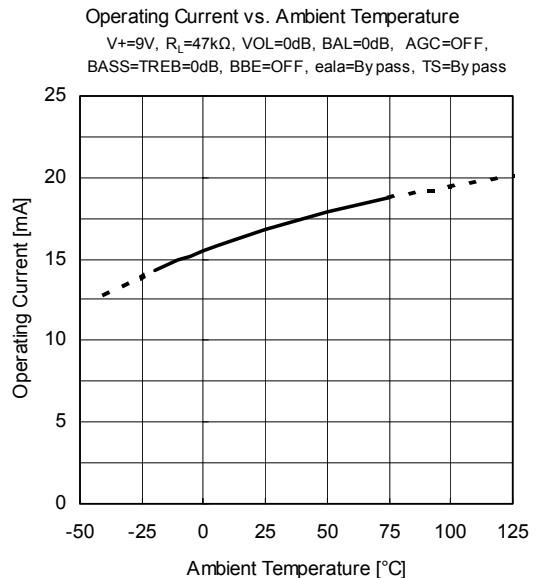
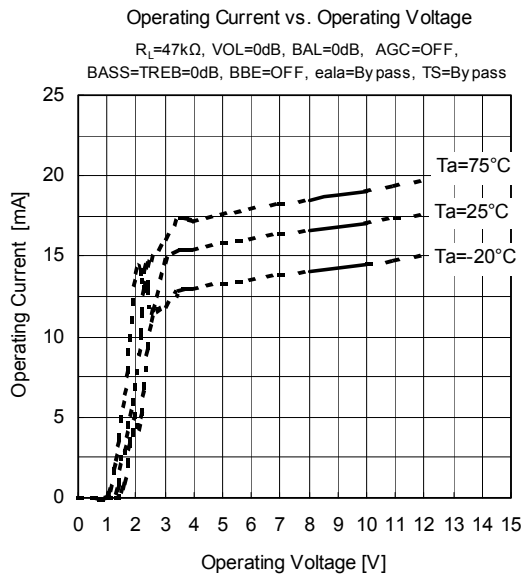
● TS 5.1ch



● Mix Down



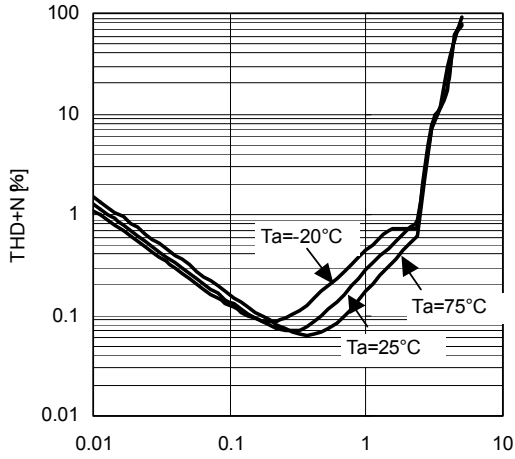
■ TYPICAL CHARACTERISTICS



■ TYPICAL CHARACTERISTICS

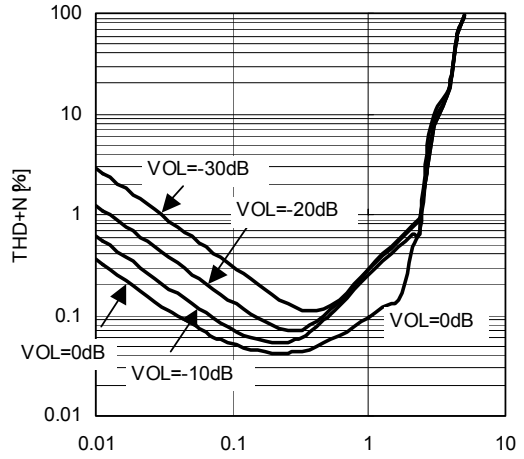
THD+N vs. Input Voltage

V+=9V, R_i=47kΩ, Vin(Ach), f=1kHz, BW=400Hz-30kHz, VOL=-20dB, BAL=0dB, AGC=OFF, BASS=TREB=0dB, BBE=OFF, eala=Bypass, TS=Bypass



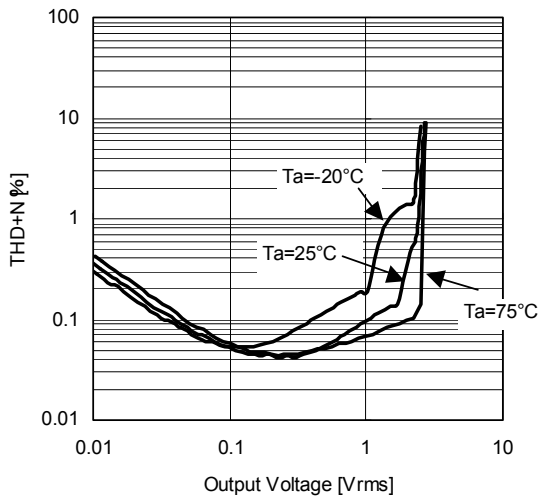
THD+N vs. Input Voltage

Ta=25°C, V+=9V, R_i=47kΩ, Vin(Ach), f=1kHz, BW=400Hz-30kHz, BAL=0dB, AGC=OFF, BASS=TREB=0dB, BBE=OFF, eala=Bypass, TS=Bypass



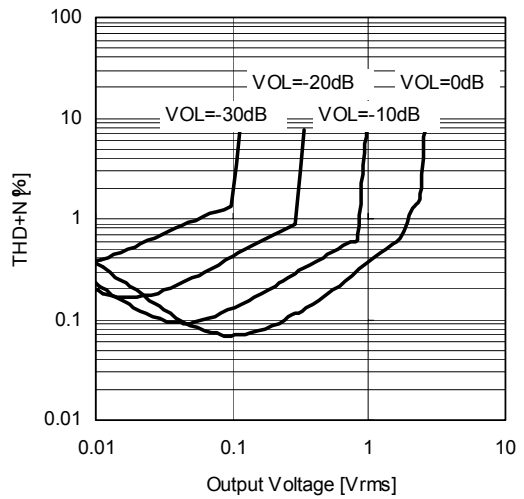
THD+N vs. Output Voltage

V+=9V, R_i=47kΩ, Vin(Ach), f=1kHz, BW=400Hz-30kHz, VOL=0dB, BAL=0dB, AGC=OFF, BASS=TREB=0dB, BBE=OFF, eala=Bypass, TS=Bypass



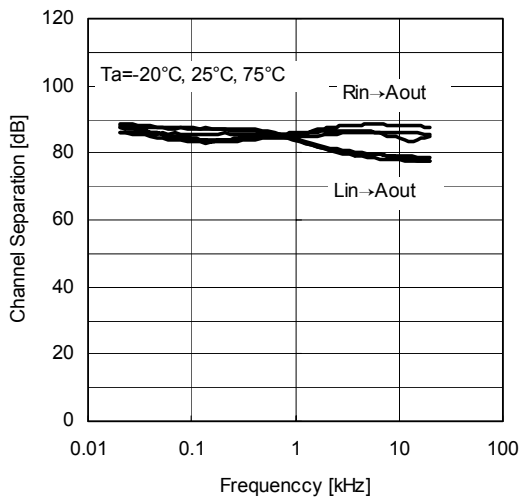
THD+N vs. Output Voltage

Ta=25°C, V+=9V, R_i=47kΩ, Vin(Ach), f=1kHz, BW=400Hz-30kHz, BAL=0dB, AGC=OFF, BASS=TREB=0dB, BBE=OFF, eala=Bypass, TS=Bypass



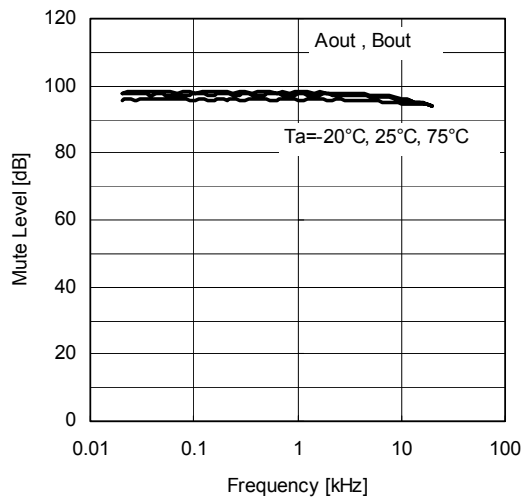
Channel Separation vs. Frequency

V+=9V, R_i=47kΩ, Vin=1Vrms, BW=10Hz-30kHz, VOL=0dB, BAL=0dB, AGC=OFF, BASS=TREB=0dB, BBE=OFF, eala=Bypass, TS=Bypass



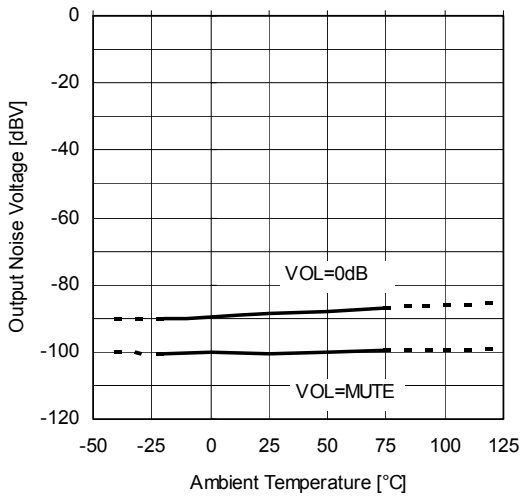
Mute Level vs. Frequency

V+=9V, R_i=47kΩ, Vin=1Vrms, BW=10Hz-30kHz, VOL=MUTE, BAL=0dB, AGC=OFF, BASS=TREB=0dB, BBE=OFF, eala=Bypass, TS=Bypass

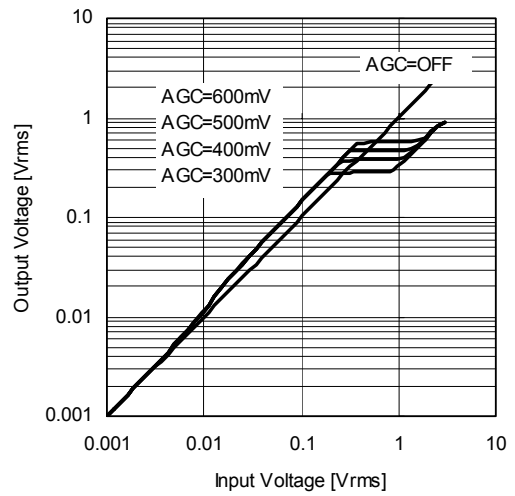


■ TYPICAL CHARACTERISTICS

Output Noise Voltage vs. Ambient Temperature
 V+=9V, R_L=47kΩ, BAL=0dB, AGC=OFF,
 BASS=TREB=0dB, BBE=OFF, eala=Bypass, TS=Bypass

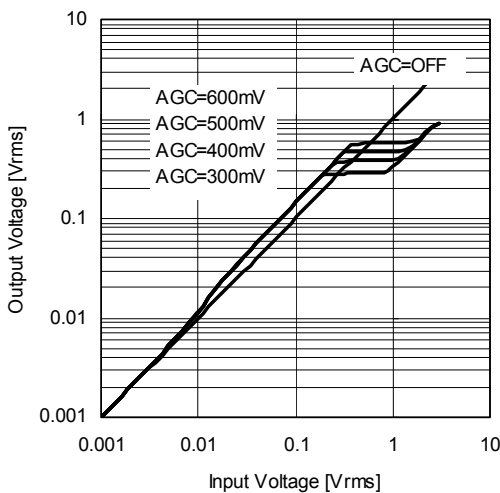


AGC Output Voltage vs. Input Voltage
 Ta=25°C, V+=9V, R_L=47kΩ, Vin(A+Bch), f=1kHz, Vout(Ach), BW=400Hz-30kHz,
 VOL=0dB, BAL=0dB, BASS=TREB=0dB, BBE=OFF, eala=Bypass, TS=Bypass



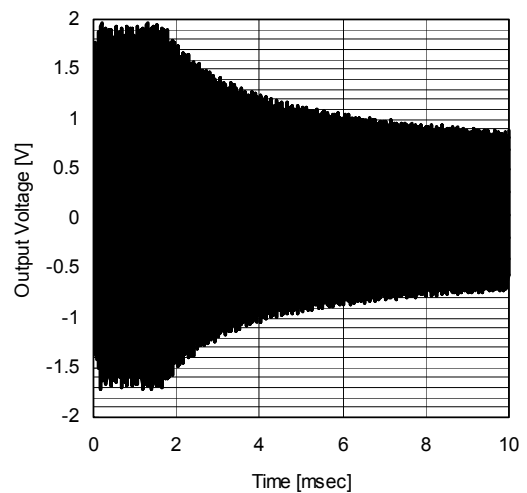
AGC Output Voltage vs. Input Voltage

Ta=25°C, V+=9V, R_L=47kΩ, Vin(A+Bch), f=1kHz, Vout(Ach), BW=400Hz-30kHz,
 VOL=0dB, BAL=0dB, BASS=TREB=0dB, BBE=OFF, eala=Bypass, TS=Bypass



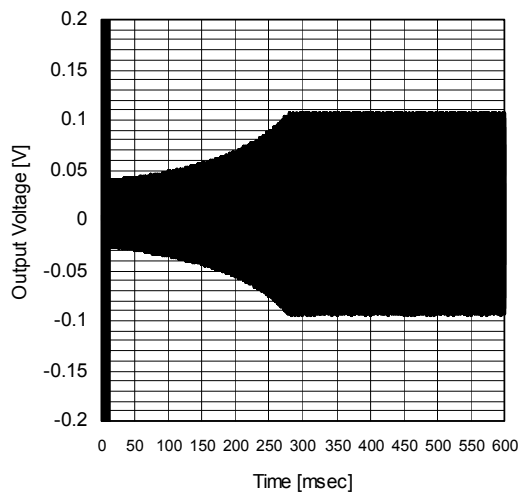
AGC - Attack Time Response

Ta=25°C, V+=9V, R_L=47kΩ, Vin(A+Bch), f=20kHz, Vout(Ach), BW=400Hz-30kHz,
 VOL=0dB, BAL=0dB, AGC=300mV, BASS=TREB=0dB, BBE=OFF, eala=Bypass, TS=Bypass



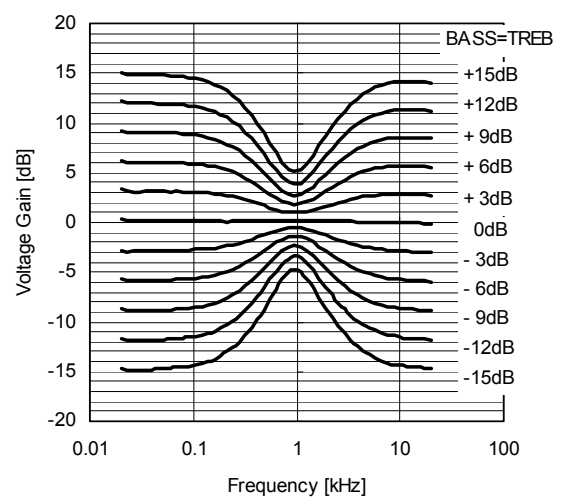
AGC - Recovery Time Response

Ta=25°C, V+=9V, R_L=47kΩ, Vin(A+Bch), f=10kHz, Vout(Ach), BW=400Hz-30kHz,
 VOL=0dB, BAL=0dB, AGC=300mV, BASS=TREB=0dB, BBE=OFF, eala=Bypass, TS=Bypass

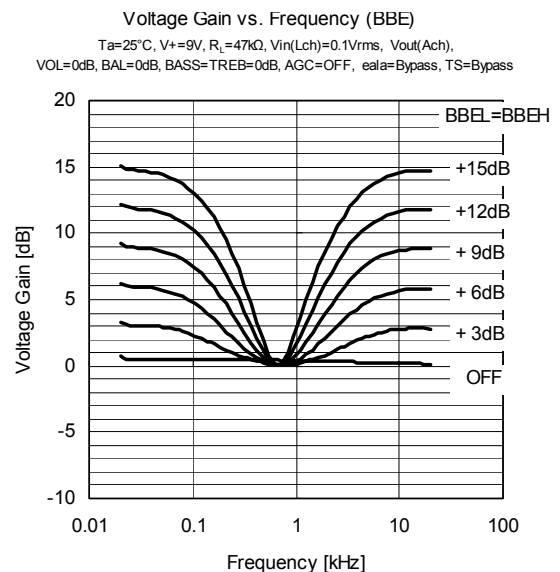
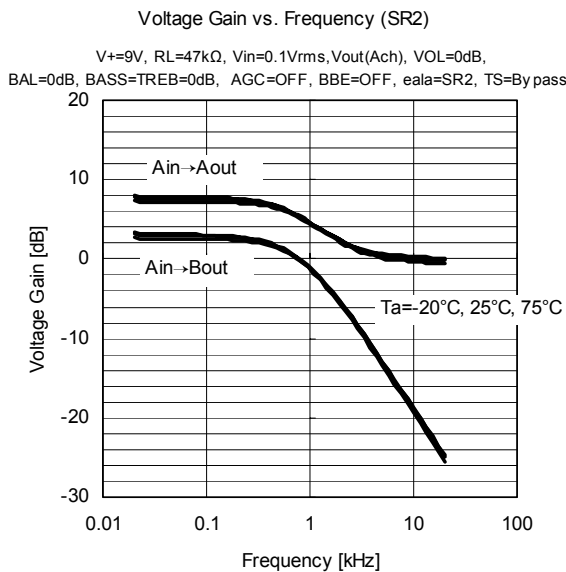
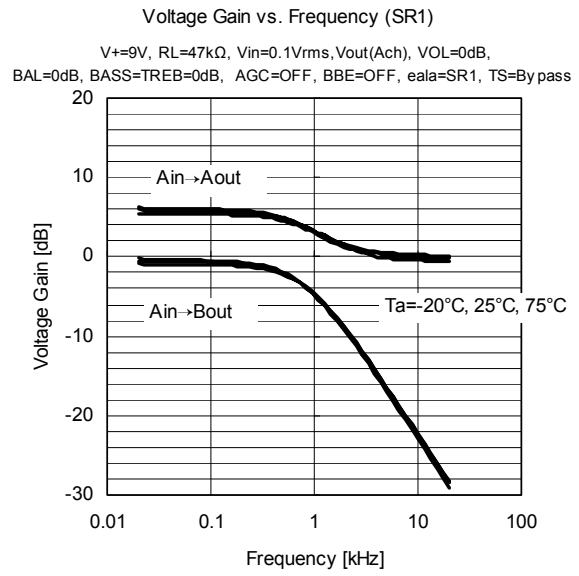
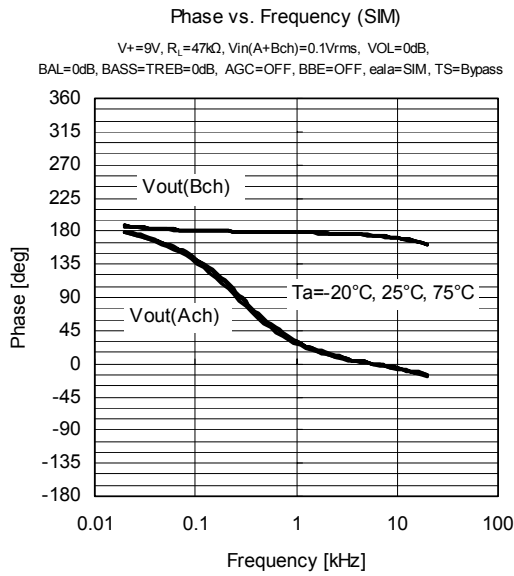
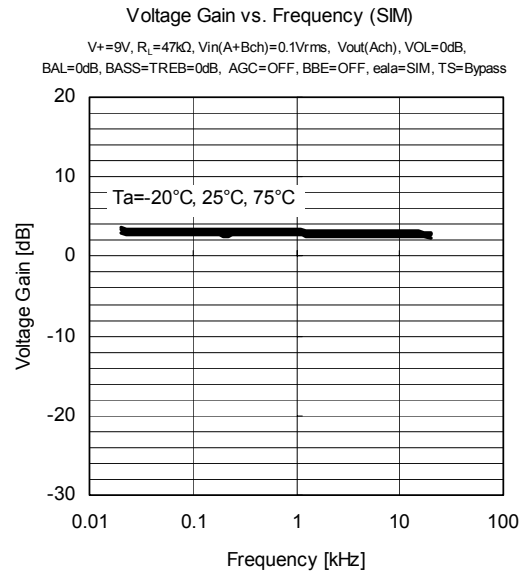
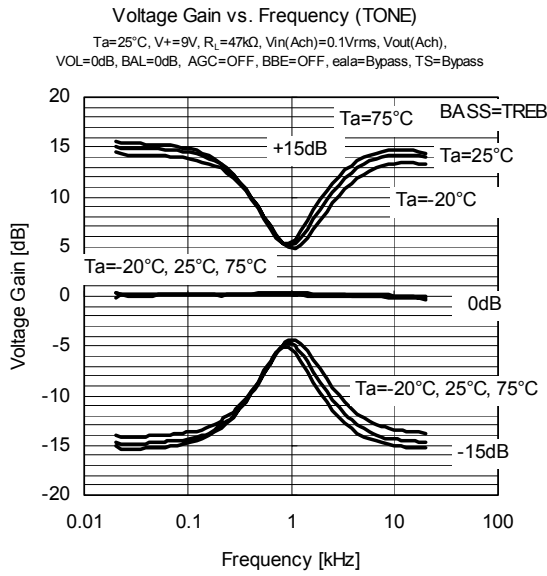


Voltage Gain vs. Frequency (TONE)

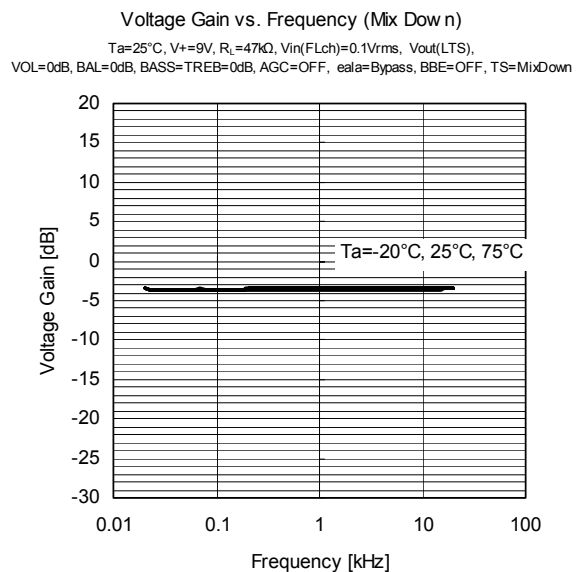
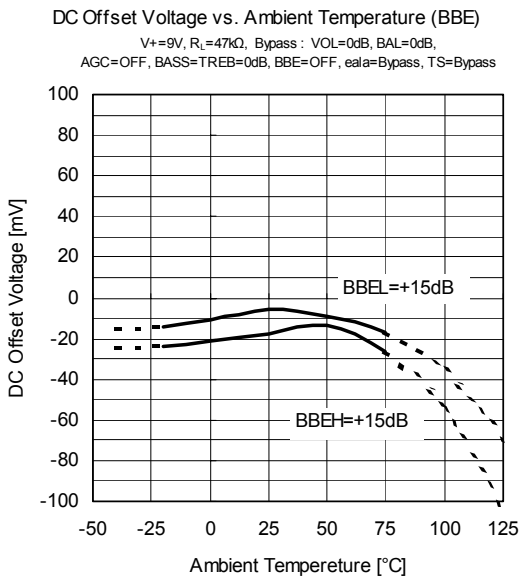
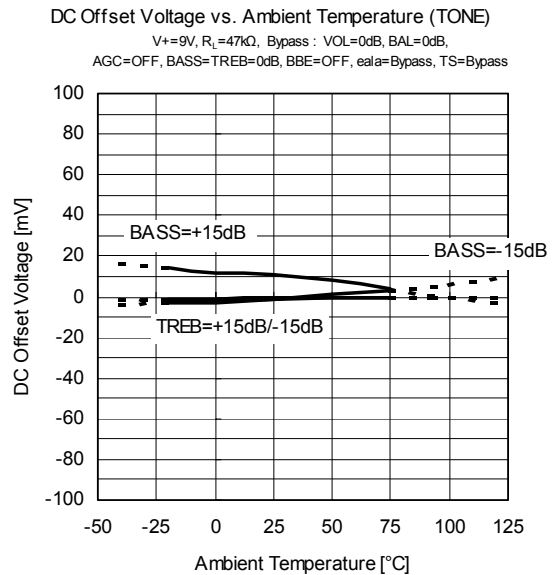
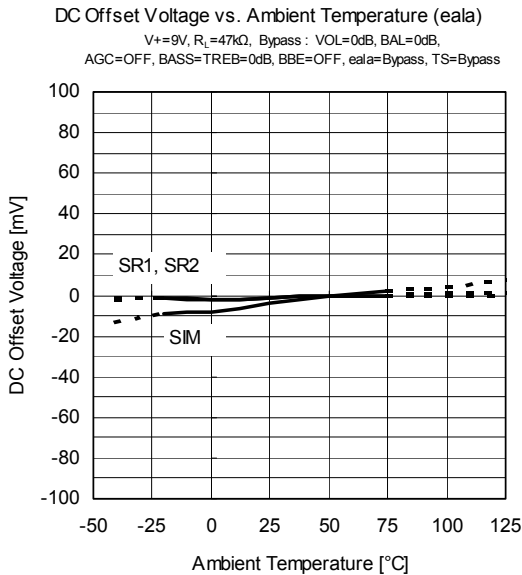
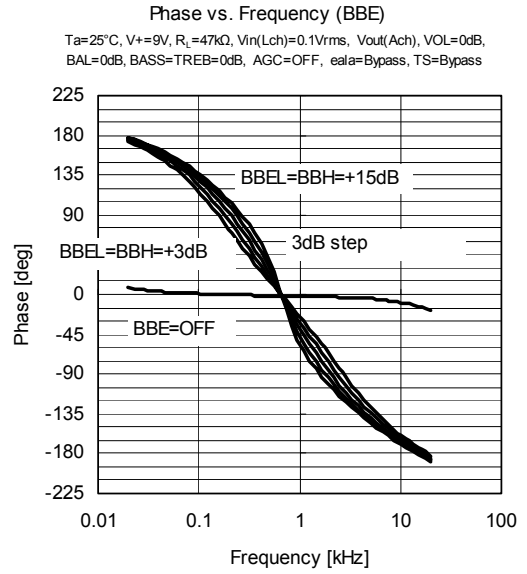
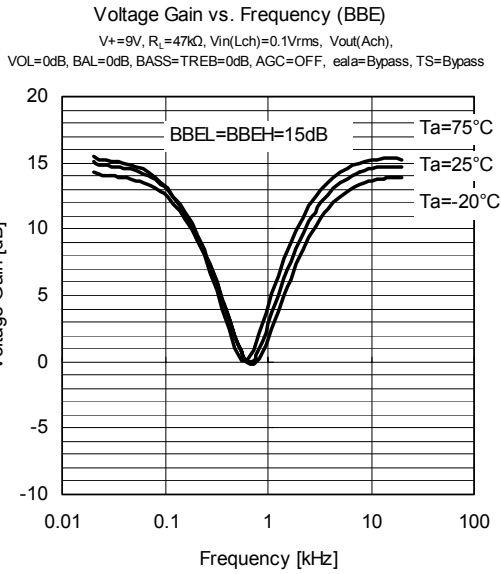
Ta=25°C, V+=9V, R_L=47kΩ, Vin(Ach)=0.1Vrms, Vout(Ach),
 VOL=0dB, BAL=0dB, AGC=OFF, BBE=OFF, eala=Bypass, TS=Bypass



■ TYPICAL CHARACTERISTICS



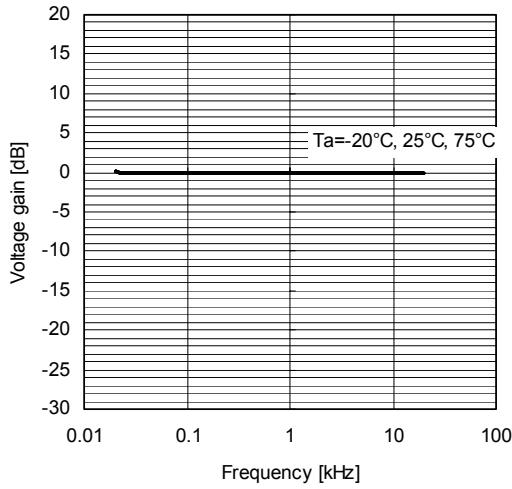
■ TYPICAL CHARACTERISTICS



■ TYPICAL CHARACTERISTICS

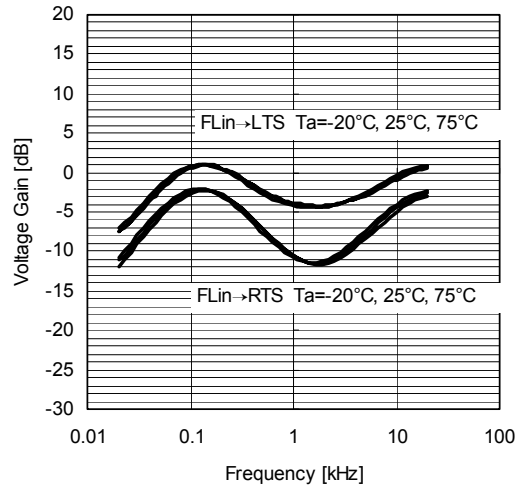
Voltage Gain vs. Frequency (By-pass)

Ta=25°C, V+=9V, R_i=47kΩ, Vin(Lch)=0.1Vrms, Vout(LTS),
VOL=0dB, BAL=0dB, BASS=TREB=0dB, AGC=OFF, eala=Bypass, BBE=OFF, TS=Bypass



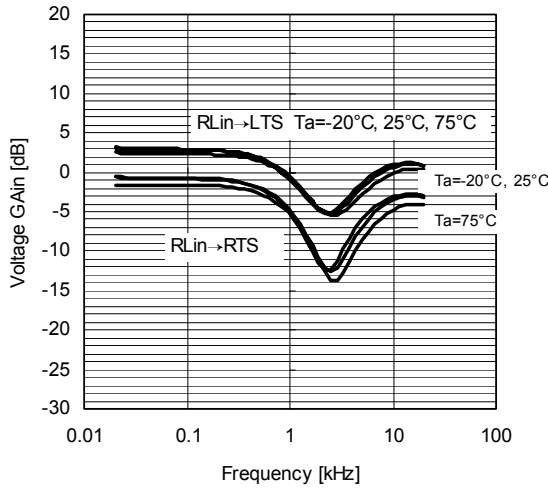
Voltage Gain vs. Frequency (TS5.1ch Front)

Ta=25°C, V+=9V, R_i=47kΩ, Vin=0.1Vrms, VOL=0dB, BAL=0dB, BASS=TREB=0dB,
AGC=OFF, eala=Bypass, BBE=OFF, TS=5.1ch FIX



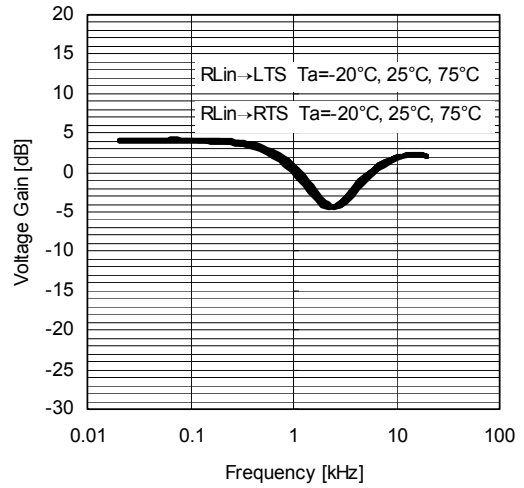
Voltage Gain vs. Frequency (TS5.1ch Rear)

Ta=25°C, V+=9V, R_i=47kΩ, Vin=0.1Vrms, VOL=0dB, BAL=0dB, BASS=TREB=0dB,
AGC=OFF, eala=Bypass, BBE=OFF, TS=5.1ch FIX



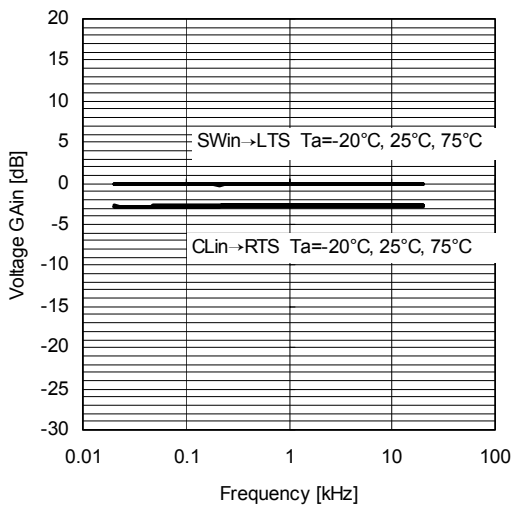
Voltage Gain vs. Frequency (TS4ch Rear)

Ta=25°C, V+=9V, R_i=47kΩ, Vin=0.1Vrms, VOL=0dB, BAL=0dB, BASS=TREB=0dB,
AGC=OFF, eala=Bypass, BBE=OFF, TS=4ch FIX



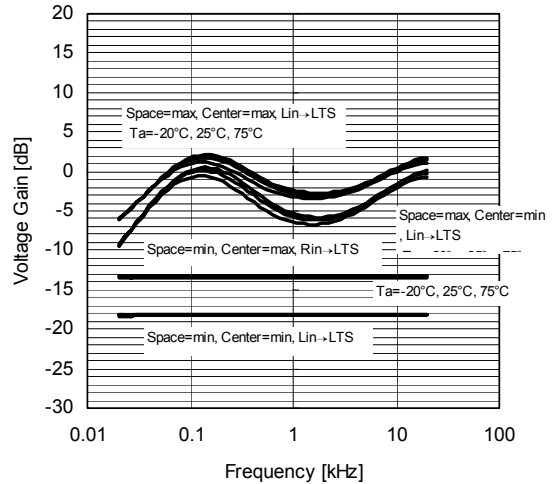
Voltage Gain vs. Frequency (TS4ch C, SW)

Ta=25°C, V+=9V, R_i=47kΩ, Vin=0.1Vrms, VOL=0dB, BAL=0dB, BASS=TREB=0dB,
AGC=OFF, eala=Bypass, BBE=OFF, TS=4ch FIX



Voltage Gain vs. Frequency (3D)

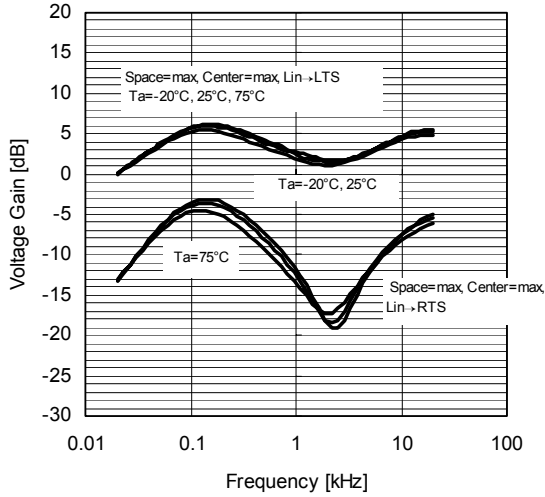
Ta=25°C, V+=9V, R_i=47kΩ, Vin=0.1Vrms, VOL=0dB, BAL=0dB, BASS=TREB=0dB,
AGC=OFF, eala=Bypass, BBE=OFF, TS=3D VAR



■ TYPICAL CHARACTERISTICS

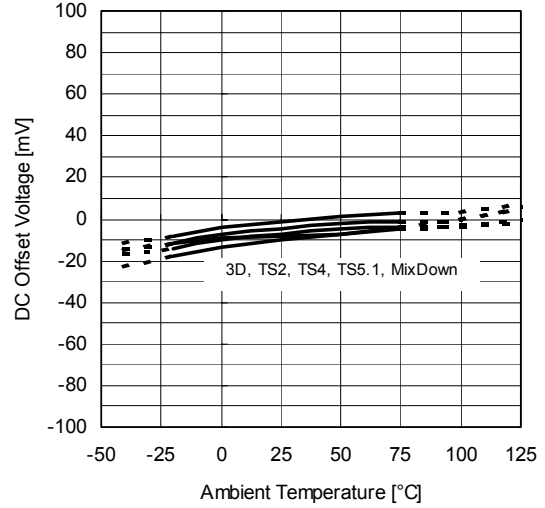
Voltage Gain vs. Frequency (TS2ch)

Ta=25°C, V+=9V, R_i=47kΩ, Vin=0.1Vrms, VOL=0dB, BAL=0dB, BASS=TREB=0dB, AGC=OFF, eala=Bypass, BBE=OFF, TS=2ch VAR



DC Offset Voltage vs. Ambient Temperature (TS)


V+=9V, R_i=47kΩ, Bypass : VOL=0dB, BAL=0dB, AGC=OFF, BASS=TREB=0dB, BBE=OFF, eala=Bypass



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