



AUDIO PROCESSOR with Input Selector and Subwoofer Output

■ GENERAL DESCRIPTION

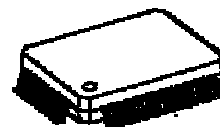
The **NJW1168** is a sound processor with subwoofer output includes all of functions processing audio signal for TV, such as input selector, tone control, balance, volume, mute, and AGC functions.

Also the **NJW1168** includes the LPF for subwoofer output and bass boost function.

The eala reproduces a natural surround sound with clear vocal orientation. And also, voice enhancement gives clear sound such as dialogs.

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

■ PACKAGE OUTLINE

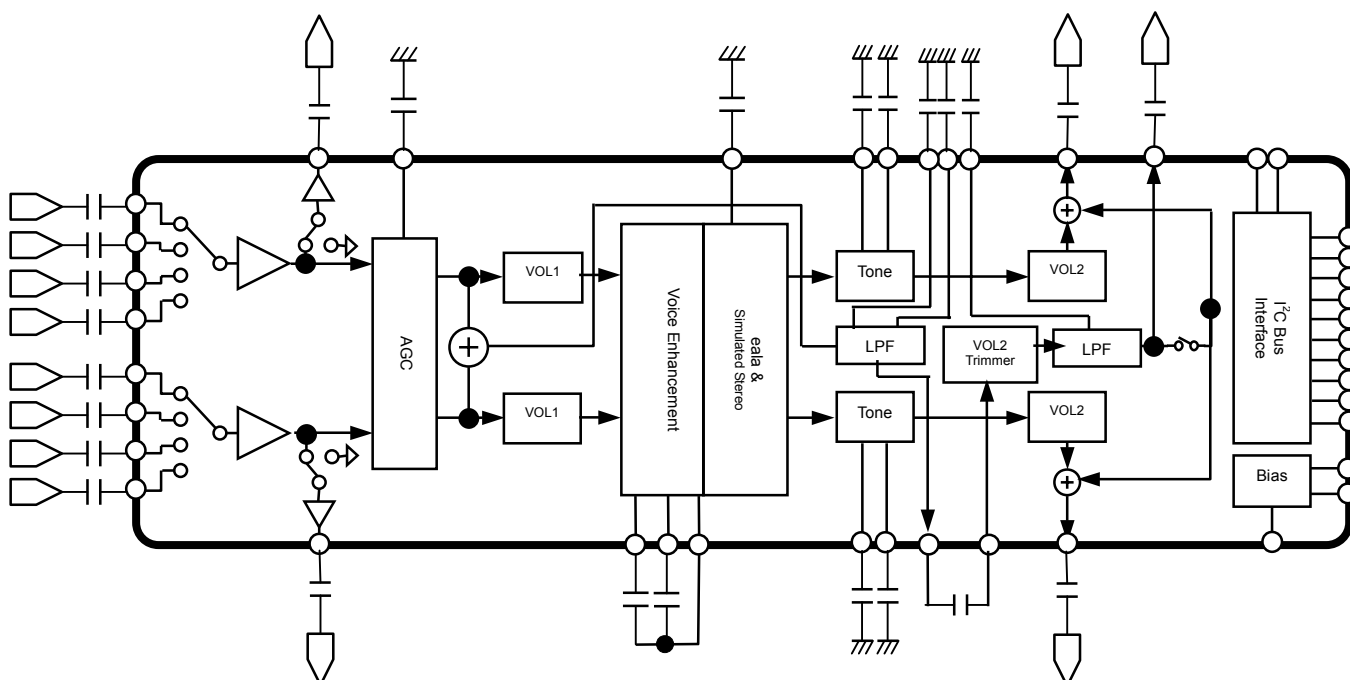


NJW1168FP1

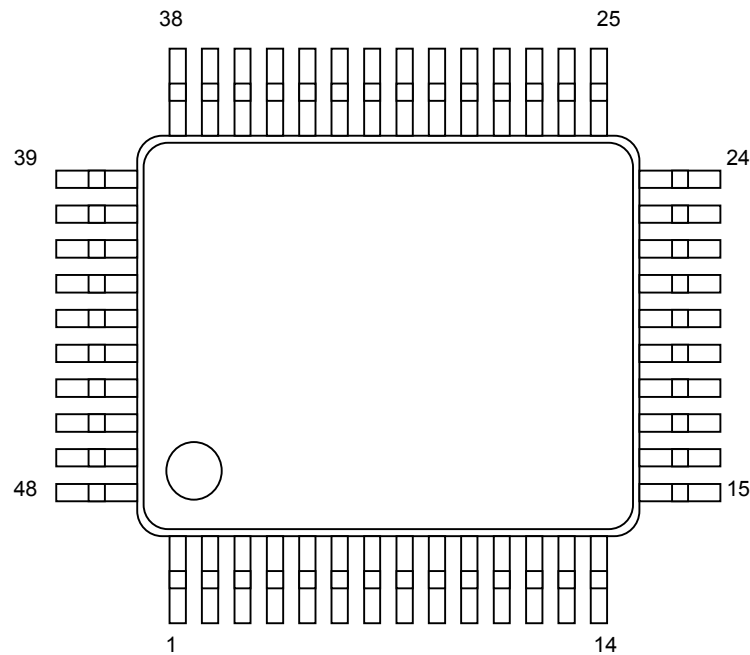
■ FEATURES

- Operating Voltage 7.5 to 13V
- 3ch Output(Lch, Rch, Subwoofer ch) / 2ch Output(Lch, Rch)
- 4ch Input Selector
- LPF Filter (Adjustable cut off frequency by external parts)
- AGC Circuit (It reduces volume difference among input sources.)
Adjustable AGC compression level by I²C BUS
- eala(NJRC Original Surround System)
- Simulated Stereo
- Voice Enhancement System
- I²C BUS Interface
- Bi-CMOS Technology
- Package Outline QFP48-P1

■ BLOCK DIAGRAM



■ PIN FUNCTION



No.	SYMBOL	FUNCTION	No.	SYMBOL	FUNCTION
1	MONa	A ch Input Selector Monitor Output	25	CVb	Bch Volume switching noise rejection Capacitor
2	N.C.	No Connection	26	N.C.	No Connection
3	CMON	MONa/b switching noise rejection Capacitor	27	OUTb	Bch Output
4	LF1	Low Pass Filter Capacitor 1	28	TONE-Lb	Bch TONE Bass Filter Capacitor
5	OUTw	Sub Woofer Output	29	TONE-Hb	Bch TONE Treble Filter Capacitor
6	VE-FIL3	Voice Enhancement Filter Capacitor 3	30	CSR	eala switching noise rejection Capacitor
7	VE-FIL2	Voice Enhancement Filter Capacitor 2	31	eala-FIL	eala Filter Capacitor
8	VE-FIL1	Voice Enhancement Filter Capacitor 1	32	AGC	AGC Smoothing Filter Capacitor
9	CVE	VE switching noise rejection Capacitor	33	DCC2	Coupling Capacitor 2
10	TONE-Ha	Ach TONE Treble Filter Capacitor	34	DCC1	Coupling Capacitor 1
11	TONE-La	Ach TONE Bass Filter Capacitor	35	LF2	Low Pass Filter Capacitor 2
12	OUTa	Ach Output	36	LF3	Low Pass Filter Capacitor 3
13	N.C.	No Connection	37	N.C.	No Connection
14	CVa	Ach Volume switching noise rejection Capacitor	38	MONb	B ch Input Selector Monitor Output
15	AUX0	Auxiliary Output 0	39	N.C.	No Connection
16	AUX1	Auxiliary Output 1	40	IN4b	B ch Input 4
17	SDA	I ² C Data Input	41	IN3b	B ch Input 3
18	SCL	I ² C Clock Input	42	IN2b	B ch Input 2
19	GND	Ground	43	IN1b	B ch Input 1
20	V+	Power Supply	44	IN1a	A ch Input 1
21	VREF	Reference Voltage stabilizing Capacitor	45	IN2a	A ch Input 2
22	CTL	Tone Control Bass switching noise rejection Capacitor	46	IN3a	A ch Input 3
23	CTH	Tone Control Treble switching noise rejection Capacitor	47	IN4a	A ch Input 4
24	CVw	SWch Trimmer switching noise rejection Capacitor	48	N.C.	No Connection

■ ABSOLUTE MAXIMUM RATING (Ta=25°C)

PARAMETER	SYMBOL	RATING	UNIT
Supply Voltage	V ⁺	15	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_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				
			-	V _{in}	OUTb				
Maximum Output Voltage	V _{OM}	VOL=0dB, THD=1%	V _{in}	-	OUTa	-	2.5	-	Vrms
			-	V _{in}	OUTb				
Monitor Output Gain	G _{VMON}	MON OUT	V _{in}	-	OUTa	-	2.5	-	dB
			-	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, f=50Hz TRIM = +30dB	V _{in}	V _{in}	OUTw	28.0	30.0	32.0	dB
Trimmer Cut	TR _{CUT}	VOL=0dB, f=50Hz TRIM = -6dB	V _{in}	V _{in}	OUTw	-11.0	-6.0	-1.0	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	-	-	-80	dB
			-	V _{in}	OUTb				
Cross Talk	CT	Vin=1Vrms BW=400Hz to 30kHz Selected Input : No signal Unselected Inputs : Signal	V _{in}	-	OUTa	-	-	-70	dB
			-	V _{in}	OUTb				
Channel Separation	CS	Vin=1Vrms BW=400Hz to 30kHz	V _{in}	-	OUTb	-	-80	-70	dB
			-	V _{in}	OUTa				
Output Noise Voltage 1	V _{NO1}	VOL=0dB A-Weighted	-	-	-	-	-90 (31.6)	-85 (56.2)	dBV (μVrms)
Output Noise Voltage 2	V _{NO2}	VOL=MUTE A-Weighted	-	-	-	-	-106 (5.0)	-96 (15.8)	dBV (μVrms)
Output Noise Voltage 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, R_L=47kΩ, Vin=100mVrms/1kHz unless otherwise specified)

PARAMETER	SYMBOL		Condition			MIN.	TYP.	MAX.	UNIT
			Input		Output				
			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 Boost1	AGC _{BST1}	Vin=100mVrms, f=1kHz AGC="10010"	V _{in}	V _{in}	OUTa	1.0	3.0	5.0	dB
			V _{in}	V _{in}	OUTb				
AGC Boost2	AGC _{BST2}	Vin=100mVrms,f=1kHz AGC="10110"	V _{in}	V _{in}	OUTa	4.0	6.0	8.0	dB
			V _{in}	V _{in}	OUTb				
AGC Flat1	AGC _{FLT1}	Vin=200mVrms, f=1kHz AGC="10000"	V _{in}	V _{in}	OUTa	-2.5	0.0	2.5	dB
			V _{in}	V _{in}	OUTb				
AGC Flat2	AGC _{FLT2}	Vin=350mVrms, f=1kHz AGC="10001"	V _{in}	V _{in}	OUTa	-2.5	0.0	2.5	dB
			V _{in}	V _{in}	OUTb				
AGC Flat3	AGC _{FLT3}	Vin=500mVrms, f=1kHz AGC="10010"	V _{in}	V _{in}	OUTa	-2.5	0.0	2.5	dB
			V _{in}	V _{in}	OUTb				
AGC Flat4	AGC _{FLT4}	Vin=650mVrms, f=1kHz AGC="10011"	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="10000"	V _{in}	V _{in}	OUTa	-14	-10	-6.0	dB
			V _{in}	V _{in}	OUTb				
◆SURROUND									
Surround Gain1	SR _{GAIN1}	f=100Hz, SUR1 Surround Effect1	V _{in}	-	OUTa	6.3	8.3	10.3	dB
			-	V _{in}	OUTb				
Surround Gain2	SR _{GAIN2}	f=100Hz, SUR1 Surround Effect1	V _{in}	-	OUTb	2.1	4.1	6.1	dB
			-	V _{in}	OUTa				
Surround Gain3	SR _{GAIN3}	f=100 Hz, SUR1 Surround Effect2	V _{in}	-	OUTa	10.7	12.7	14.7	dB
			-	V _{in}	OUTb				
Surround Gain4	SR _{GAIN4}	f=100Hz, SUR1 Surround Effect2	V _{in}	-	OUTb	8.4	10.4	12.4	dB
			-	V _{in}	OUTa				
Surround Gain5	SR _{GAIN5}	f=100Hz, SUR1 Surround Effect3	V _{in}	-	OUTa	14.0	16.0	18.0	dB
			-	V _{in}	OUTb				
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

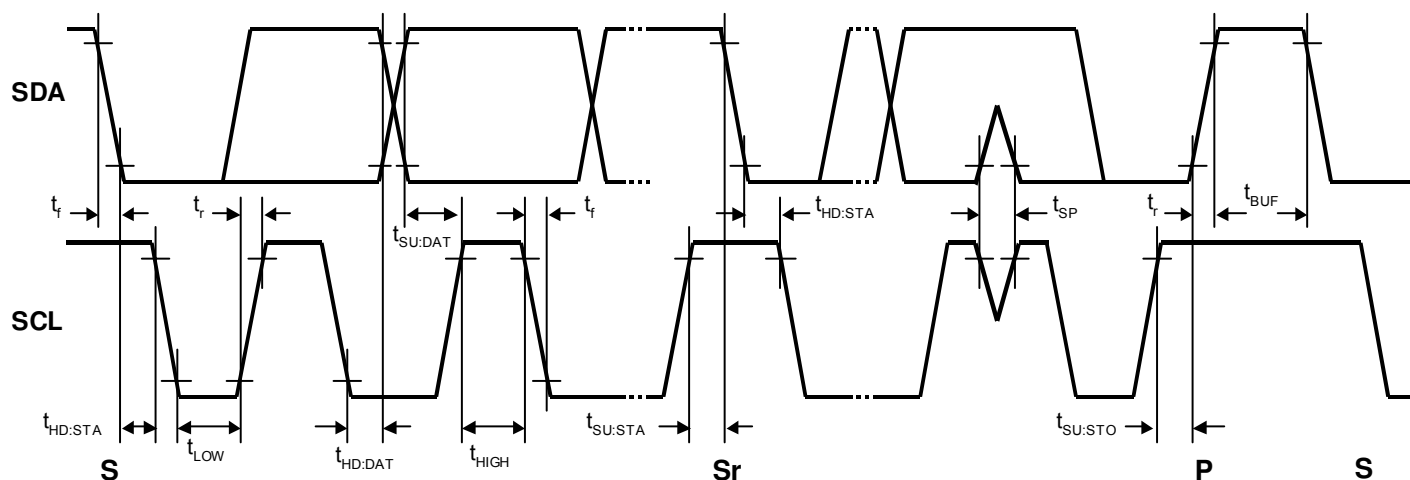
◆ VOICE ENHANCEMENT

PARAMETER	SYMBOL	Condition	Input		Output	MIN.	TYP.	MAX.	UNIT
			INa	INb					
			V _{in}	V _{in}	OUTa				
Voice Enhancement Gain 1	VE _{GAIN1}	f=5kHz, VE1 Voice Enhancement Effect 1	V _{in}	V _{in}	OUTa	3.5	6.0	8.5	dB
			V _{in}	V _{in}	OUTb				
Voice Enhancement Gain 2	VE _{GAIN2}	f=5kHz, VE2 Voice Enhancement Effect 2	V _{in}	V _{in}	OUTa	7.5	10.0	12.5	dB
			V _{in}	V _{in}	OUTb				
Voice Enhancement Gain 3	VE _{GAIN3}	f=5kHz, VE3 Voice Enhancement Effect 3	V _{in}	V _{in}	OUTa	11.5	13.0	15.5	dB
			V _{in}	V _{in}	OUTb				

◆ 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	

■TIMING ON THE I²C BUS (SDA,SCL)



■CHARACTERISTICS OF I/O STAGES FOR I²C BUS (SDA,SCL)

I²C BUS Load Conditions

STANDARD MODE : Pull up resistance 4k Ω (Connected to +5V), Load capacitance 200pF (Connected to GND)

PARAMETER	SYMBOL	Standard mode			UNIT
		MIN.	TYP.	MAX.	
Low Level Input Voltage	V_{IL}	0.0	-	1.5	V
High Level Input Voltage	V_{IH}	3.0	-	5.0	V
Low level output voltage (3mA at SDA pin)	V_{OL}	0	-	0.4	V
Input current each I/O pin with an input voltage between 0.1V _{DD} and 0.9V _{DDmax}	I_i	-10	-	10	μ A

■ CHARACTERISTICS OF BUS LINES (SDA,SCL) FOR I²C-BUS DEVICES

PARAMETER	SYMBOL	Standard mode			UNIT
		MIN.	TYP.	MAX.	
SCL clock frequency	f_{SCL}	-	-	100	kHz
Hold time (repeated) START condition.	$t_{HD:STA}$	4.0	-	-	μs
Low period of the SCL clock	t_{LOW}	4.7	-	-	μs
High period of the SCL clock	t_{HIGH}	4.0	-	-	μs
Set-up time for a repeated START condition	$t_{SU:STA}$	4.7	-	-	μs
Data hold time ^(NOTE)	$t_{HD:DAT}$	0	-	-	μs
Data set-up time	$t_{SU:DAT}$	250	-	-	ns
Rise time of both SDA and SCL signals	t_r	-	-	1000	ns
Fall time of both SDA and SCL signals	t_f	-	-	300	ns
Set-up time for STOP condition	$t_{SU:STO}$	4.0	-	-	μs
Bus free time between a STOP and START condition	t_{BUF}	4.7	-	-	μs
Capacitive load for each bus line	C_b	-	-	400	pF
Noise margin at the Low level	V_{nL}	0.5	-	-	V
Noise margin at the High level	V_{nH}	1	-	-	V

C_b ; total capacitance of one bus line in pF.

NOTE). Data hold time : $t_{HD:DAT}$

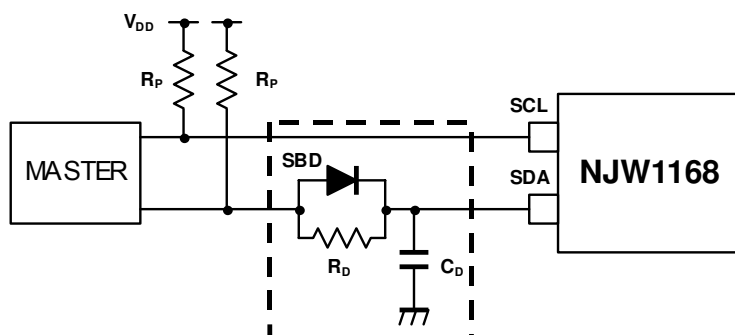
Please hold the Data Hold Time ($t_{HD:DAT}$) to 300ns or more to avoid status of unstable at SCL falling edge.

The SDA block in the NJW1168 does not hold data. Add external data-delay-circuit of the SDA terminal, in case of not providing a hold time of at least 300nsec for the SDA in the master device.

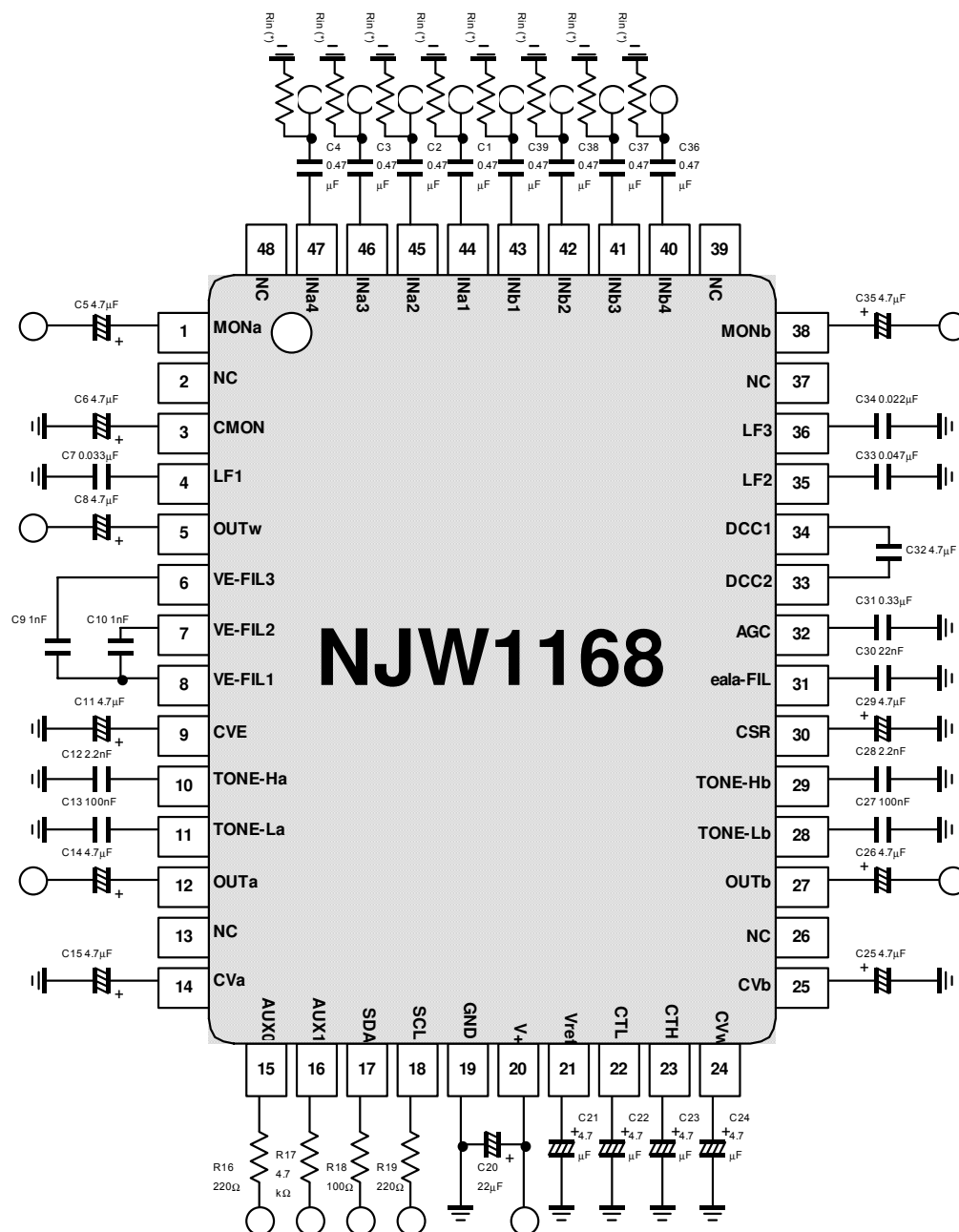
The time-consists of the data-delay-circuit of the SDA terminal are as follows.

- (a) Low level $\rightarrow$ High level : $T_{LH} \approx R_P \cdot C_D$
 (b) High level $\rightarrow$ Low level : $T_{HL} \approx R_D \cdot C_D$

In addition, Schottky barrier diode (SBD) influences a Low level at the Acknowledge. Therefore choose the low forward voltage (V_f) as much as possible.



APPLICATION CIRCUIT

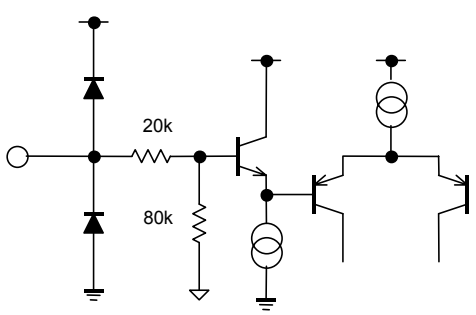
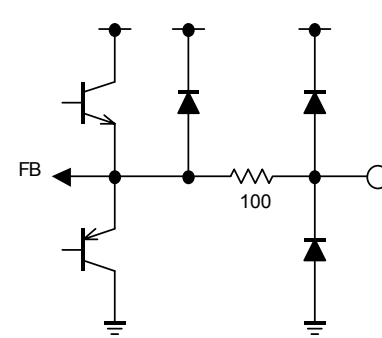
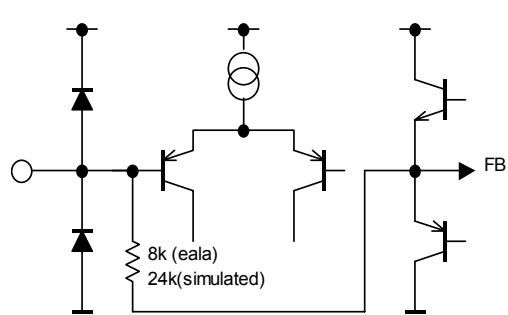
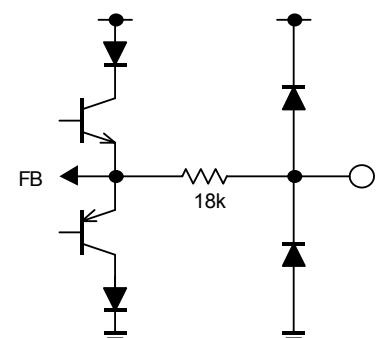


(*) Separate the I²C bus line and Signal line from the following terminals for avoiding digital noise problem and cross talk.

Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol
4	LF1	10	TONE-Ha	31	eala-FIL
6	VE-FIL3	11	TONE-La	35	LF2
7	VE-FIL2	28	TONE-Lb	36	LF3
8	VE-FIL1	29	TONE-Hb		

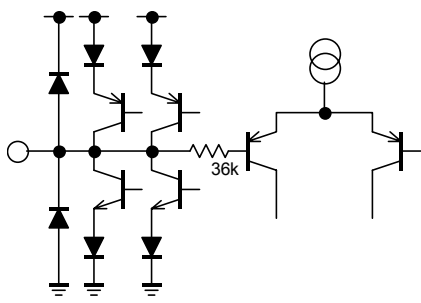
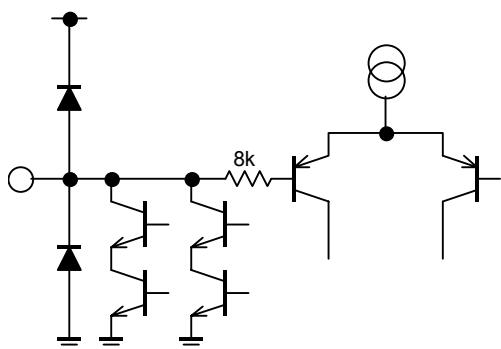
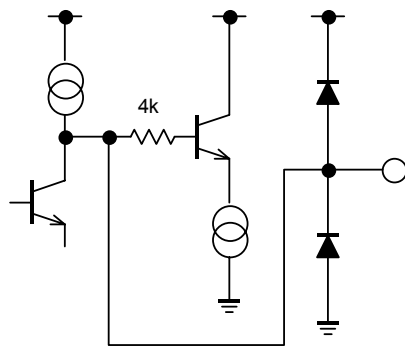
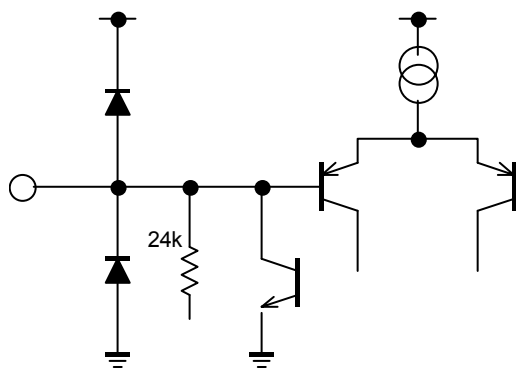
(*) Cross talk performance may be effected by PCB patterning and Input resistor "Rin" in relation to input impedance. Widen intervals of input lines (40pin to 47pin) and put guard patterns (ground patterns) among input lines for avoiding cross talk problem.
Further, cross talk performance may be effected by input resistor "Rin". The recommended "Rin" value is 20kΩ or less. In consideration of an actual operating condition, please decide Rin values after evaluating. (The NJW1168 input impedances are 100kΩtyp.)

■ TERMINAL DESCRIPTION

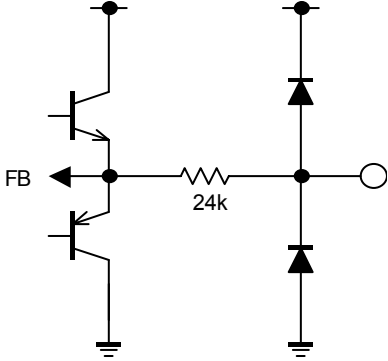
PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL VOLTAGE
44 45 46 47 43 42 41 40	INa1 INa2 INa3 INa4 INb1 INb2 INb3 INb4	Ach Input 1 Ach Input 2 Ach Input 3 Ach Input 4 Bch Input 1 Bch Input 2 Bch Input 3 Bch Input 4		V+/2
12 27 5 1 38 34	OUTa OUTb Outw MONa MONb DCC1	Ach Output Bch Output SWch Output A ch Input Selector Monitor Output B ch Input Selector Monitor Output Coupling Capacitor 1		V+/2
31	ealaFIL	eala Filter Capacitor		V+/2
10 29	TONE-Ha TONE-Hb	Ach TONE Treble Filter Capacitor Bch TONE Treble Filter Capacitor		V+/2

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL VOLTAGE
11 28	TONE-La TONE-Lb	Ach TONE Bass Filter Capacitor Bch TONE Bass Filter Capacitor		$V+/2$
32	AGC	AGC Smoothing Filter Capacitor		1.4V
15	AUX0	Auxiliary Output 0		Low ; 0 V Mid ; 2.5 V High ; 5V
16	AUX1	Auxiliary Output 1		Low ; 0V High ; 3.5 V to V^+

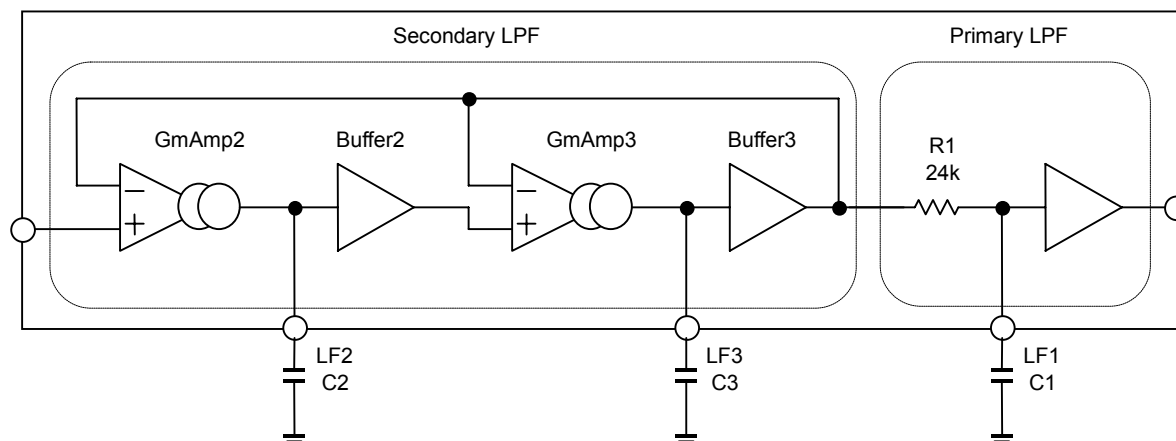
PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL VOLTAGE
17 18	SDA SCL	I ² C Data Input I ² C Clock Input		-
19 20	GND V+	Ground Power Supply	-	-
21	Vref	Reference Voltage stabilizing Capacitor		V+/2
30 9	CSR CVE	eala switching noise rejection Capacitor VE switching noise rejection Capacitor		0V

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL VOLTAGE
23	CTH	Tone Control Treble switching noise rejection Capacitor		V+/2
22	CTL	Tone Control Bass switching noise rejection Capacitor		
14	CVa	Ach Volume switching noise rejection Capacitor		V+/2
25	CVb	Bch Volume switching noise rejection Capacitor		
24	CVw	SWch Trimmer switching noise rejection Capacitor		
35	LF2	Low Pass Filter Capacitor 2		V+/2+0.7V
36	LF3	Low Pass Filter Capacitor 3		
4	LF1	Low Pass Filter Capacitor 1		V+/2

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL VOLTAGE
3	CMON	MONa/b switching noise rejection Capacitor		0V, 5V
33	DCC2	Coupling Capacitor 2		$V+/2$
6	VE-FIL3	Voice Enhancement Filter Capacitor 3		$V+/2$
7	VE-FIL2	Voice Enhancement Filter Capacitor 2		$V+/2$

PIN NO.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	TERMINAL VOLTAGE
8	VE-FIL1	Voice Enhancement Filter Capacitor 1		V+/2

LPF Characteristics



The **NJW1168** includes the LPF for subwoofer output and bass boost function. The LPF consists of primary and secondary LPF and it is enable to adjust “cut off frequency”, “Q” and “Roll off”. The expression of LPF characteristics is as follows.

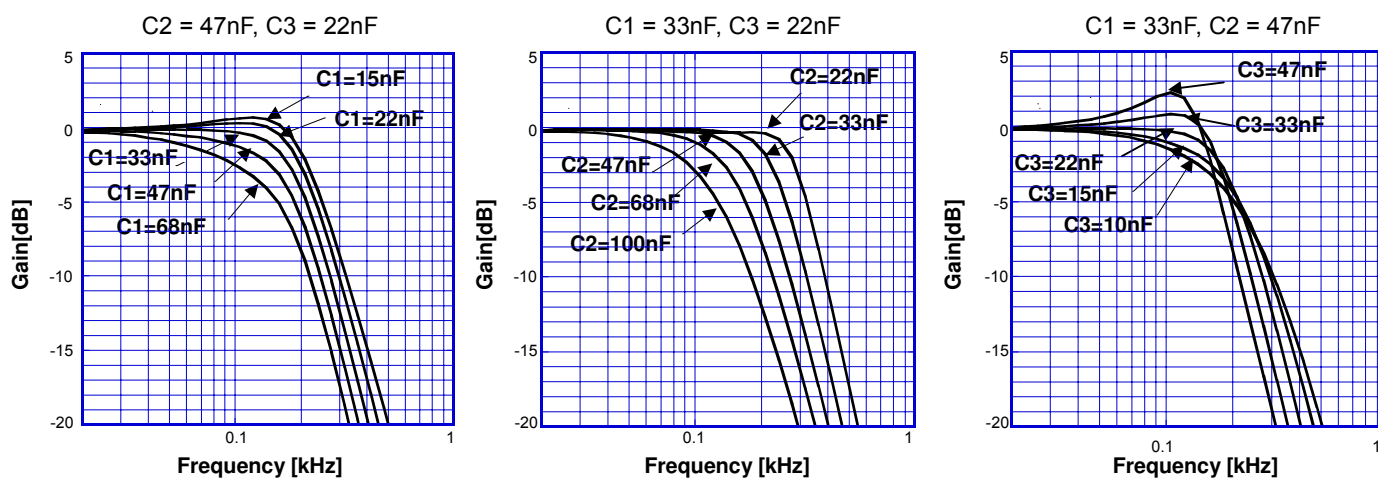
<Primary LPF>

$$f_{c1} = \frac{1}{2\pi * R * C1} = \frac{1}{2\pi * 24 * 10^3 * C1} \quad Q_1 = 0.5$$

<Secondary LPF>

$$f_{c2} = \frac{42.9 * 10^{-6}}{2\pi \sqrt{C2 * C3}} \quad Q_2 = 1.46 * \sqrt{\frac{C3}{C2}}$$

<LPF Frequency Response>



■ 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 (Volume, Balance, Trimmer, Bass Boost Select, Tone Control, Surround, AGC, Voice Enhancement, Input Selector, Monitor Out, AUX).

The auto increment function cycles the select address as follows.

00H→01H→02H→03H→04H→05H→06H→00H

<Write Mode>

Write Mode

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	VOL							
01H	CHS	BAL						*
02H	TRIM							BBSW
03H	BCB	BASS					*	
04H	BCT	TREB					*	
05H	SUR			AGC				
06H	VE		MOSW	AUX1	AUX0		SEL	

* : 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

■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 SETTING

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

- 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 (0.5dB/Step) , MUTE

c) TRIMMER LEVEL AND BASS BOOST FUNCTION SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
02H	TRIM							BBSW

- TRIM : Trimmer Level

Trimmer Level : +30 to -6dB (0.5dB/Step) , MUTE

- BBSW : Bass Boost ON/OFF Switch

“0” = Bass Boost OFF

“1” = Bass Boost ON

d) TONE CONTROL BASS SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
03H	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)

e) TONE CONTROL TREBLE SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
04H	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)

f) Surround, AGC LEVEL SETTING

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

<SUR : Surround Level Setting>

Surround Setting	D7	D6	D5	Remarks
Bypass	0	0	0	Bypass
Simulated Stereo	0	0	1	Simulated Stereo
eala Effect1	0	1	0	Surround Effect Low(8.3dB typ.)
eala Effect2	0	1	1	Surround Effect Mid(12.7dB typ.)
eala Effect3	1	0	0	Surround Effect High(16dB typ.)

<AGC : AGC Setting>

●AGC ON/OFF

AGC	D4
OFF	0
ON	1

●AGCBST1 : AGC Boost Start Point

AGCBST1	D3
Low (20mVrms Input)	0
High (100mVrms Input)	1

●AGCBST2 : AGC Boost Gain

AGCBST2	D2
Low (3dB)	0
High (6dB)	1

●AGCFLT : AGC Flat Level

AGCFLT	D1	D0
200mV	0	0
350mV	0	1
500mV	1	0
650mV	1	1

g) Input Selector, Monitor Out Switch, AUXILIARY SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
05H	VE		MOSW	AUX1	AUX0		SEL	

<VE : Voice Enhancement Setting>

VE Setting	D7	D6	Remarks
By-Pass	0	0	Bypass
VE Effect 1	0	1	Voice Enhancement Effect Low(9dB typ.)
VE Effect 2	1	0	Voice Enhancement Effect Mid(10dB typ.)
VE Effect 3	1	1	Voice Enhancement Effect High(13dB typ.)

<MOSW : Monitor Output Setting>

MOSW Setting	D5
Signal Output	0
Mute	1

<AUX1 : AUX1 Terminal Setting>

Auxiliary Setting	D4
Low (0.0V)	0
High (5.0V)	1

<AUX0 : AUX0 Terminal Setting>

Auxiliary Setting	D3	D2
Low (0.0V)	-	0
Mid (2.5V)	0	1
High (5.0V)	1	1

<SEL : Input Selector Setting>

SEL Setting	D1	D0
Input 1	0	0
Input 2	0	1
Input 3	1	0
Input 4	1	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 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

■Trimmer Setting (Select Address: 02H)

Gain(dB)	TRIM						
	D7	D6	D5	D4	D3	D2	D1
+30.0	1	1	1	1	1	1	1
+29.5	1	1	1	1	1	1	0
+29.0	1	1	1	1	1	0	1
+28.5	1	1	1	1	1	0	0
+28.0	1	1	1	1	0	1	1
+27.5	1	1	1	1	0	1	0
+27.0	1	1	1	1	0	0	1
+26.5	1	1	1	1	0	0	0
+26.0	1	1	1	0	1	1	1
+25.5	1	1	1	0	1	1	0
+25.0	1	1	1	0	1	0	1
+24.5	1	1	1	0	1	0	0
+24.0	1	1	1	0	0	1	1
+23.5	1	1	1	0	0	1	0
+23.0	1	1	1	0	0	0	1
+22.5	1	1	1	0	0	0	0
+22.0	1	1	0	1	1	1	1
+21.5	1	1	0	1	1	1	0
+21.0	1	1	0	1	1	0	1
+20.5	1	1	0	1	1	0	0
+20.0	1	1	0	1	0	1	1
+19.5	1	1	0	1	0	1	0
+19.0	1	1	0	1	0	0	1
+18.5	1	1	0	1	0	0	0
+18.0	1	1	0	0	1	1	1
+17.5	1	1	0	0	1	1	0
+17.0	1	1	0	0	1	0	1
+16.5	1	1	0	0	1	0	0
+16.0	1	1	0	0	0	1	1
+15.5	1	1	0	0	0	1	0
+15.0	1	1	0	0	0	0	1
+14.5	1	1	0	0	0	0	0
+14.0	1	0	1	1	1	1	1
+13.5	1	0	1	1	1	1	0
+13.0	1	0	1	1	1	0	1
+12.5	1	0	1	1	1	0	0
+12.0	1	0	1	1	0	1	1
+11.5	1	0	1	1	0	1	0
+11.0	1	0	1	1	0	0	1
+10.5	1	0	1	1	0	0	0
+10.0	1	0	1	0	1	1	1
+9.5	1	0	1	0	1	1	0
+9.0	1	0	1	0	1	0	1
+8.5	1	0	1	0	1	0	0
+8.0	1	0	1	0	0	1	1
+7.5	1	0	1	0	0	1	0
+7.0	1	0	1	0	0	0	1
+6.5	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
+5.5	1	0	0	1	1	1	0
+5.0	1	0	0	1	1	0	1
+4.5	1	0	0	1	1	0	0
+4.0	1	0	0	1	0	1	1
+3.5	1	0	0	1	0	1	0
+3.0	1	0	0	1	0	0	1
+2.5	1	0	0	1	0	0	0
+2.0	1	0	0	0	1	1	1
+1.5	1	0	0	0	1	1	0
+1.0	1	0	0	0	1	0	1
+0.5	1	0	0	0	1	0	0
0.0	1	0	0	0	0	1	1
-0.5	1	0	0	0	0	1	0
-1.0	1	0	0	0	0	0	1
-1.5	1	0	0	0	0	0	0
-2.0	0	1	1	1	1	1	1
-2.5	0	1	1	1	1	1	0
-3.0	0	1	1	1	1	0	1
-3.5	0	1	1	1	1	0	0
-4.0	0	1	1	1	0	1	1
-4.5	0	1	1	1	0	1	0
-5.0	0	1	1	1	0	0	1
-5.5	0	1	1	1	0	0	0
-6.0	0	1	1	0	1	1	1
MUTE*	0	0	0	0	0	0	0

* : Default value

■Bass Boost Setting (Select Address: 02H)

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

* : Default Value

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

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 : 04H)

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

TYPICAL CHARACTERISTICS

fig.1 Supply Current vs Supply Voltage

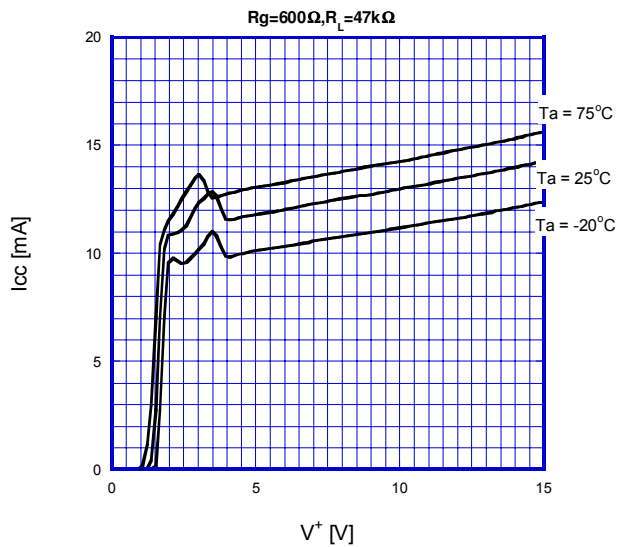


fig.2 Supply Current vs Temperature

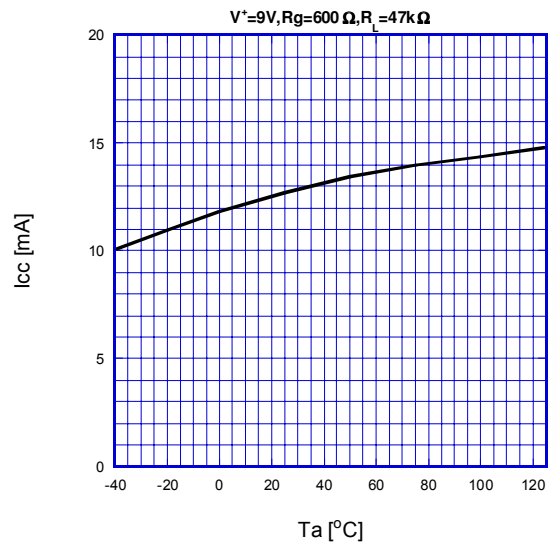


fig.3 Reference Voltage vs Supply Voltage

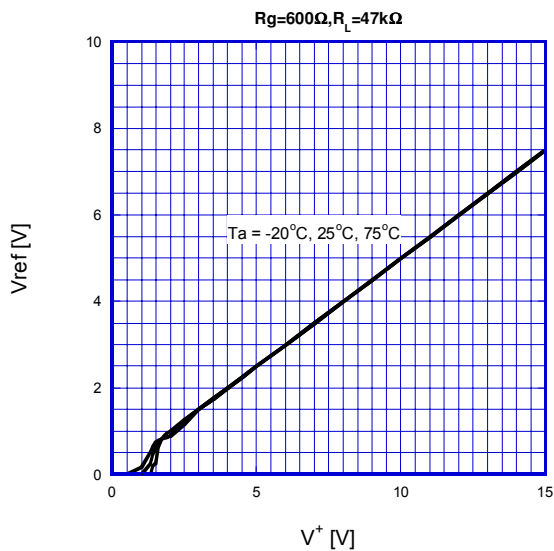


fig.4 Reference Voltage vs Temperature

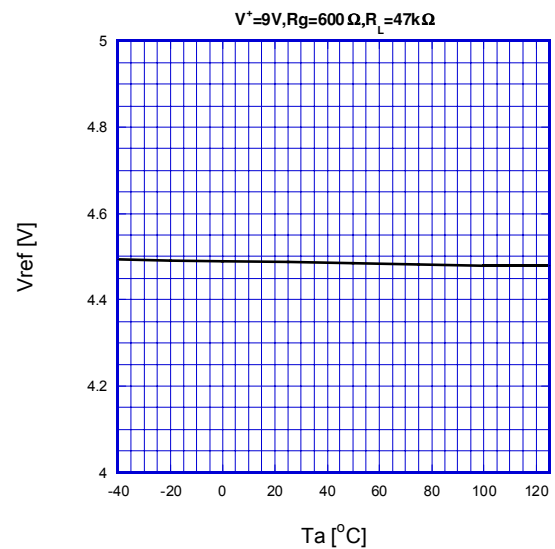


fig.5 Voltage Gain vs Volume Control

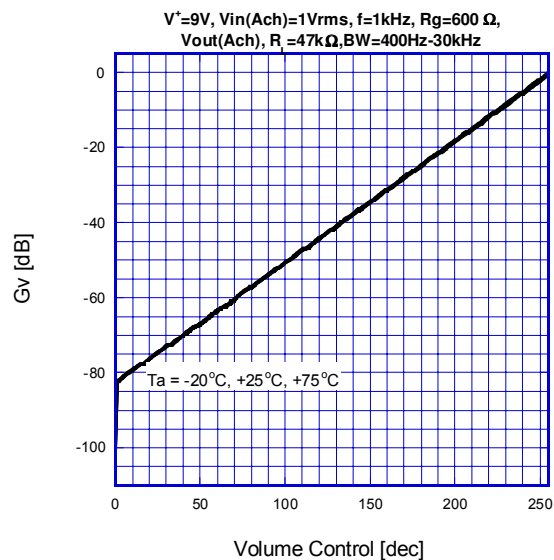
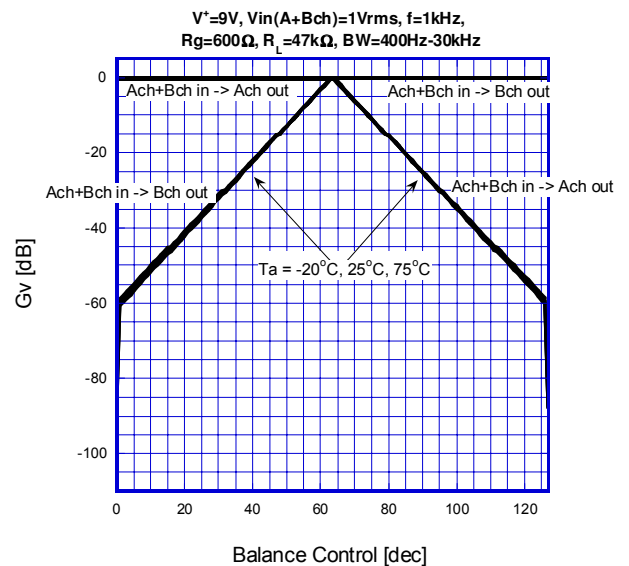


fig.6 Voltage Gain vs Balance Control



TYPICAL CHARACTERISTICS

fig.7 Voltage Gain vs Trimmer Control

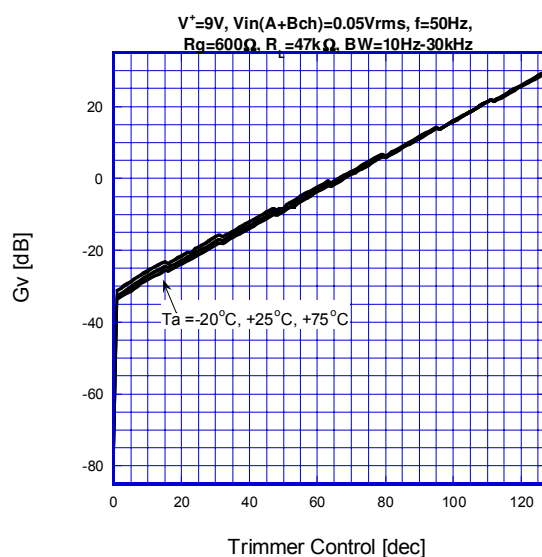


fig.9 THD+N vs Input Voltage (Wch)

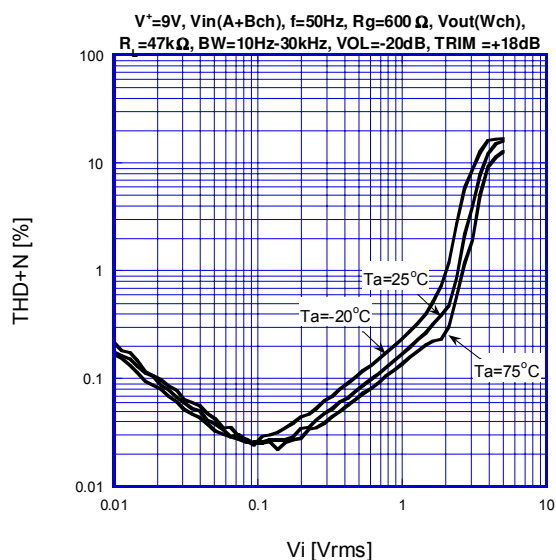


fig.11 THD+N vs Input Voltage (Wch)

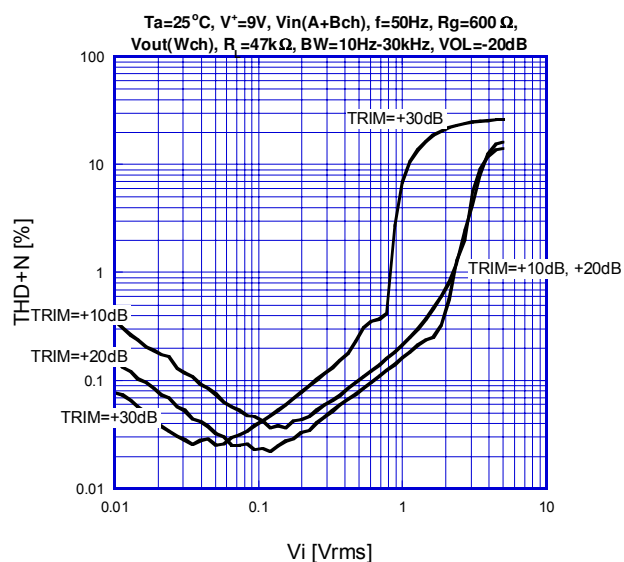


fig.8 THD+N vs Input Voltage(Ach,Bch)

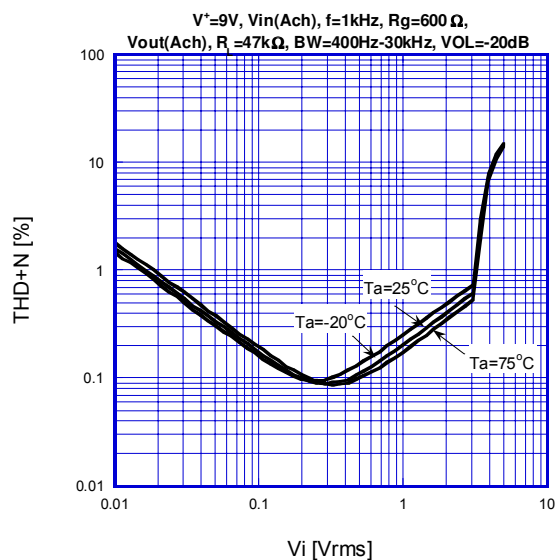


fig.10 THD+N vs Input Voltage (Ach, Bch)

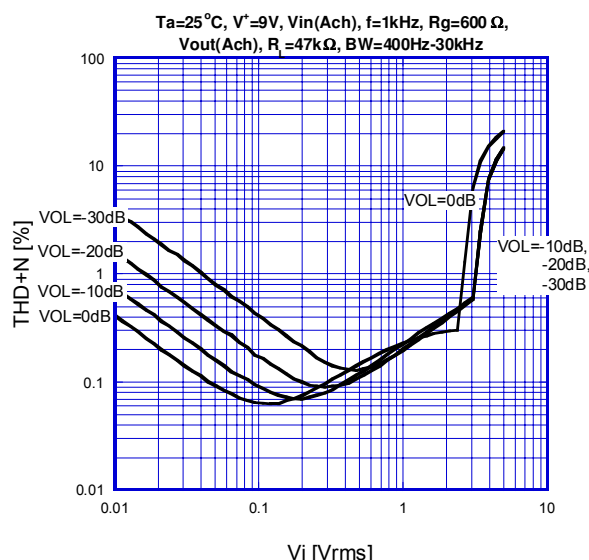
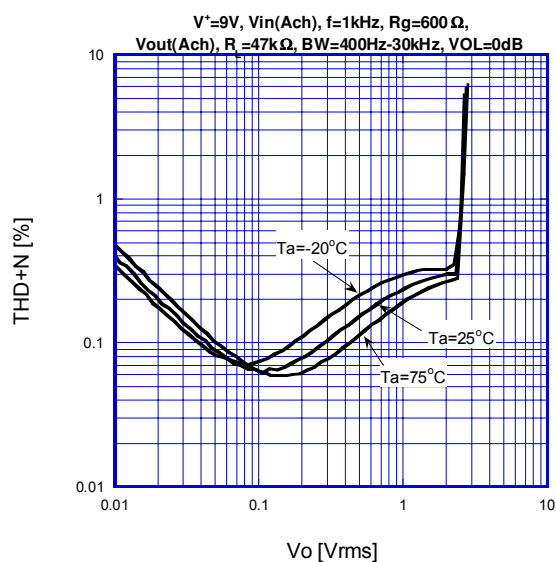


fig.12 THD+N vs Output Voltage (Ach, Bch)



TYPICAL CHARACTERISTICS

fig.13 THD+N vs OutPut Voltage (Wch)

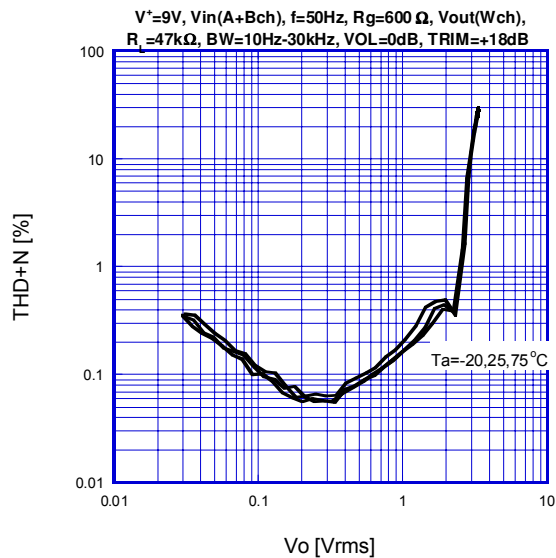


fig.15 Maximum Input Voltage vs Temperature

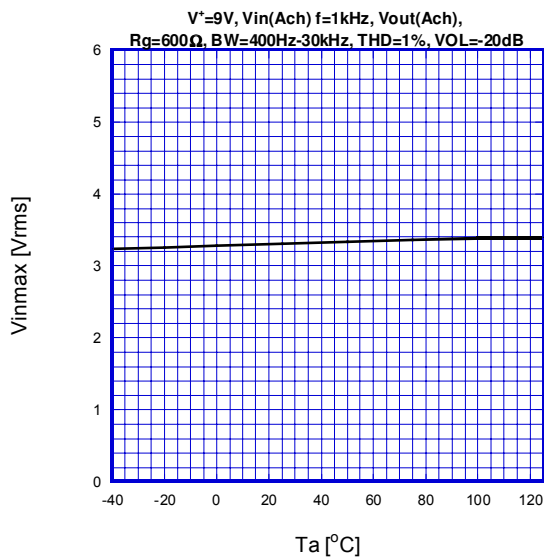


fig.17 Maximum Output Voltage vs Temperature

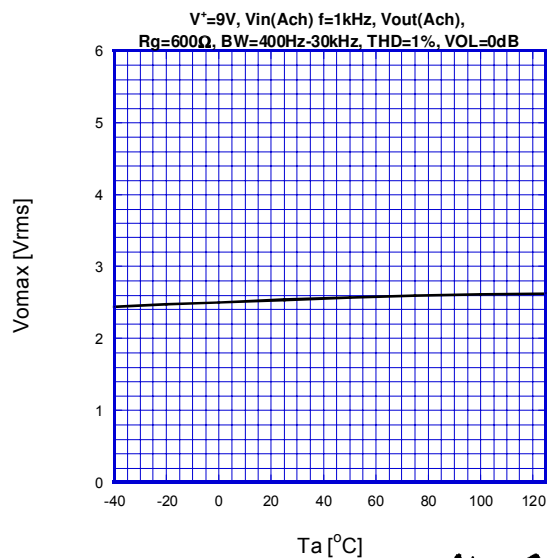


fig.14 Maximum Input Voltage vs Supply Voltage

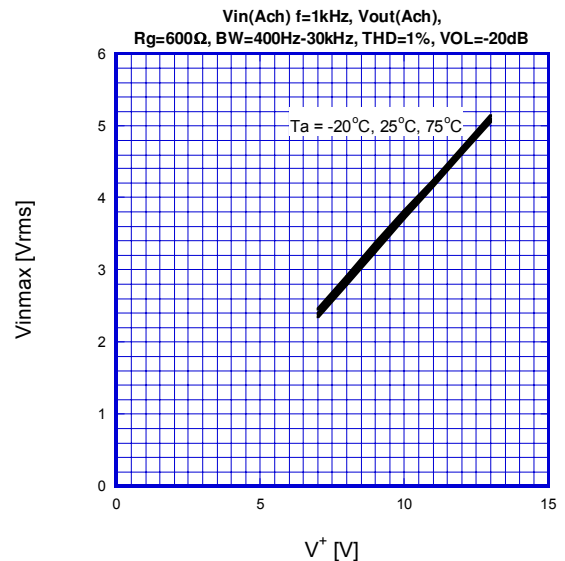


fig.16 Maximum Output Voltage vs Supply Voltage

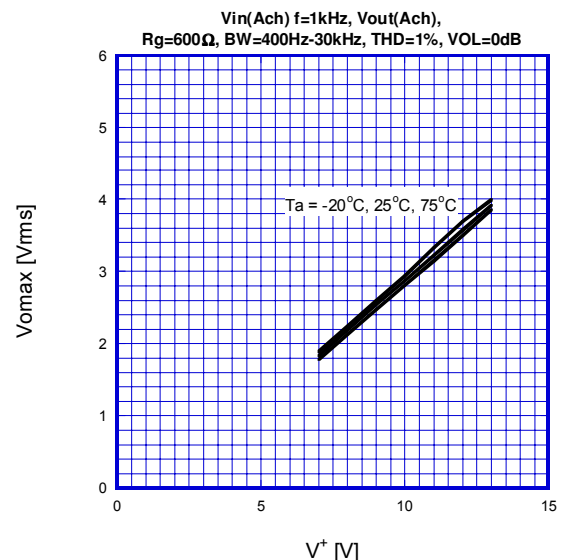
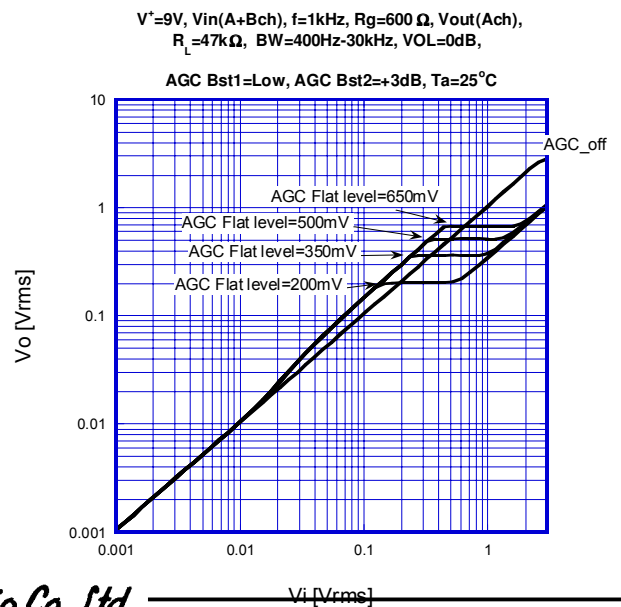


fig.18 AGC Characteristics (Flat level)



TYPICAL CHARACTERISTICS

fig.19 AGC Characteristics (Bst1)

$V^*=9V$, $V_{in}(A+Bch)$, $f=1kHz$, $R_g=600\Omega$, $V_{out}(Ach)$,
 $R_L=47k\Omega$, $BW=400Hz-30kHz$, $VOL=0dB$,

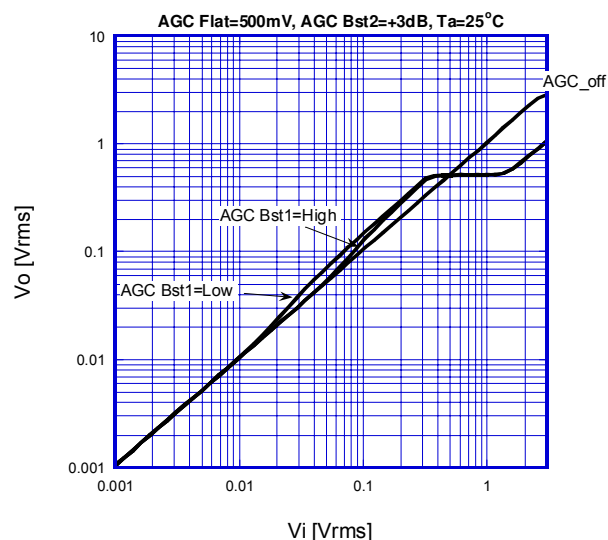


fig.21 AGC Characteristics (T_a)

$V^*=9V$, $V_{in}(A+Bch)$, $f=1kHz$, $R_g=600\Omega$, $V_{out}(Ach)$, $R_L=47k\Omega$,
 $BW=400Hz-30kHz$, $VOL=0dB$, AGC Flat=500mV, AGC Bst1=Low, AGC Bst2=+3dB

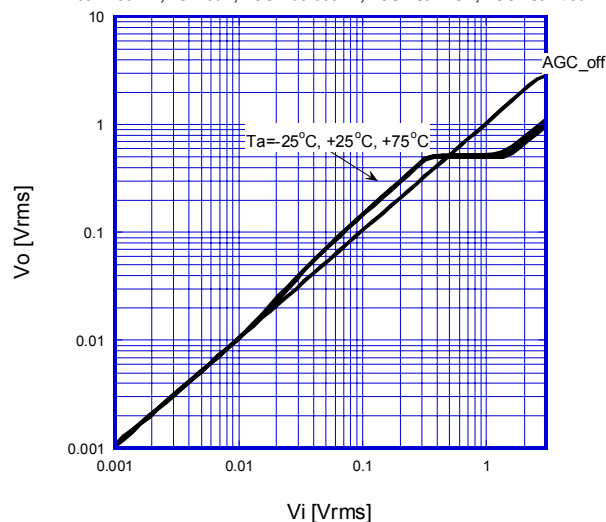


fig.23 AGC Characteristics (Recovery)

$V^*=9V$, $V_{in}(A+Bch)=1Vrms$, $f=10kHz$, $R_g=600\Omega$, $V_{out}(Ach)$, $R_L=47k\Omega$,
 $VOL=0dB$, $R_{EXT}=100k\Omega$, $C_{EXT}=330nF$, AGC level=200mV, $T_a=25^\circ C$

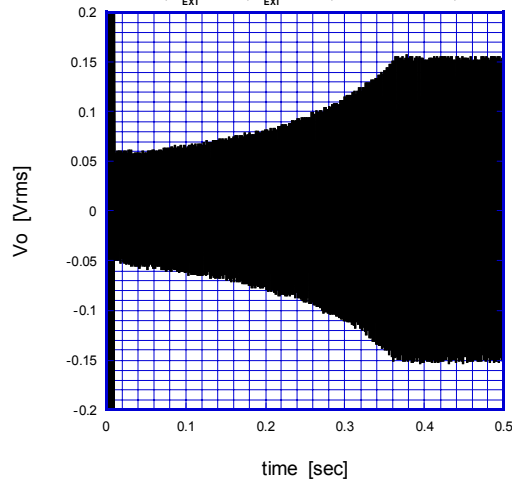


fig.20 AGC Characteristics (Bst2)

$V^*=9V$, $V_{in}(A+Bch)$, $f=1kHz$, $R_g=600\Omega$, $V_{out}(Ach)$,
 $R_L=47k\Omega$, $BW=400Hz-30kHz$, $VOL=0dB$, AGC Flat=500mV,

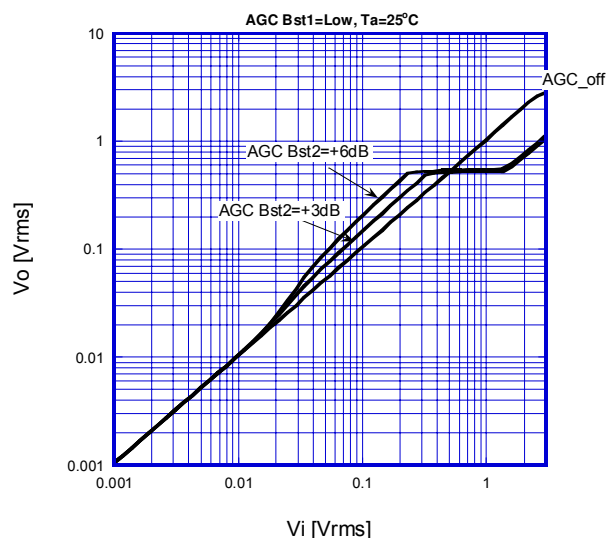


fig.22 AGC Characteristics (Attack)

$V^*=9V$, $V_{in}(A+Bch)=1Vrms$, $f=10kHz$, $R_g=600\Omega$, $V_{out}(Ach)$, $R_L=47k\Omega$,
 $VOL=0dB$, $R_{EXT}=100k\Omega$, $C_{EXT}=330nF$, AGC level=200mV, $T_a=25^\circ C$

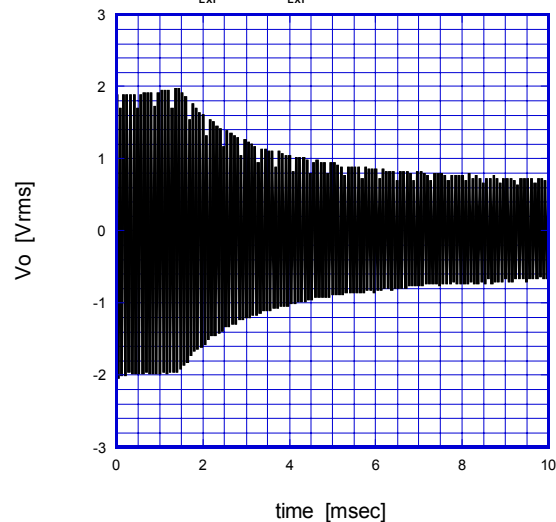
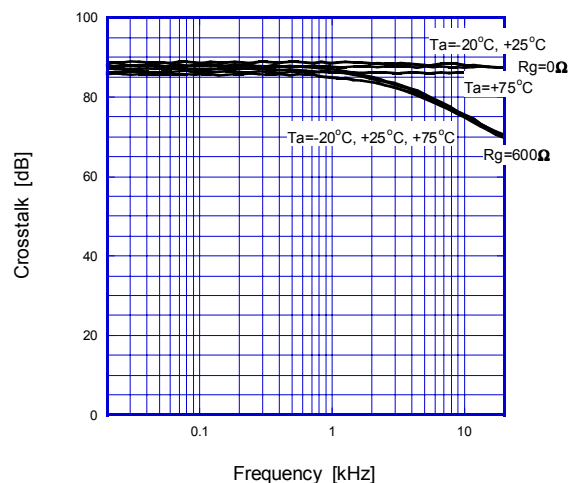


fig.24 Crosstalk vs Frequency

$V^*=9V$, $V_{in}(Ach \text{ IN2,IN3,IN4})=1Vrms$, $SEL=IN1$,
 $V_{out}(Ach)$, $R_L=47k\Omega$, $VOL=0dB$



TYPICAL CHARACTERISTICS

fig.25 Channel Separation vs Frequency

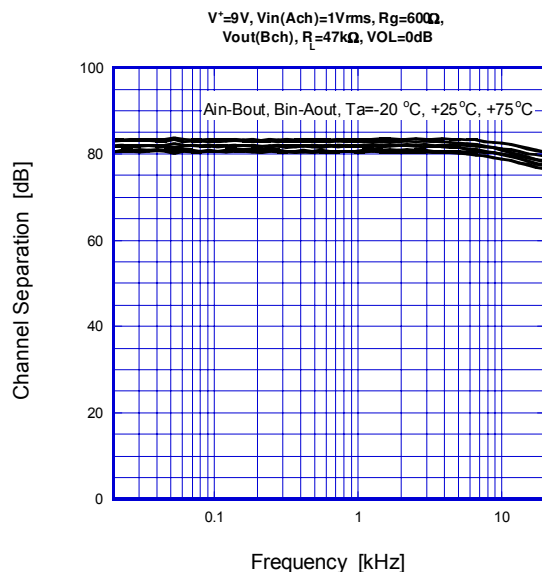


fig.27 Output Noise vs Temperature

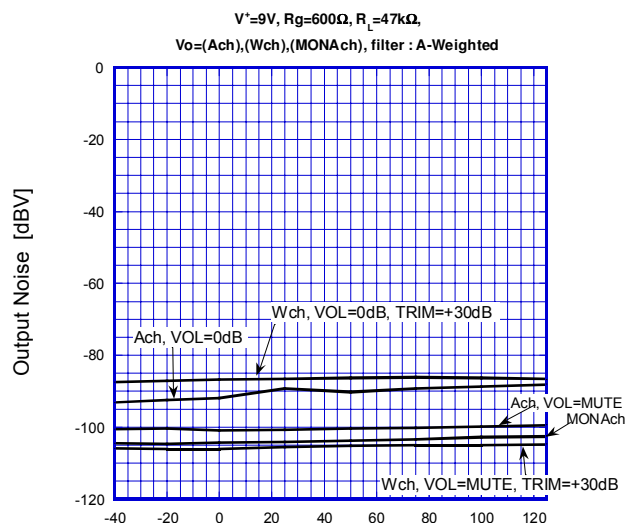


fig.29 Wch Voltage Gain vs Frequency (T_a)

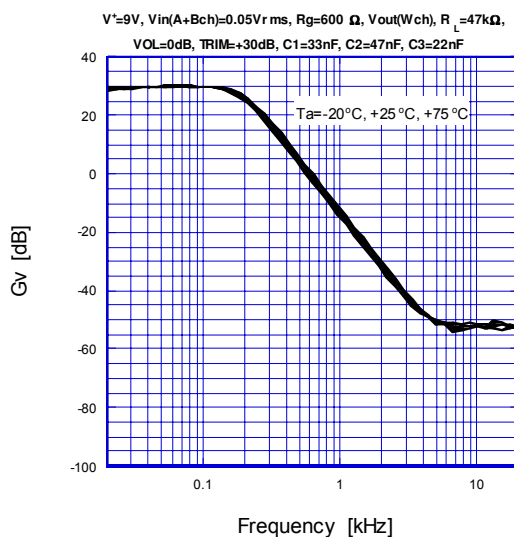


fig.26 Voltage Gain vs Frequency (MUTE)

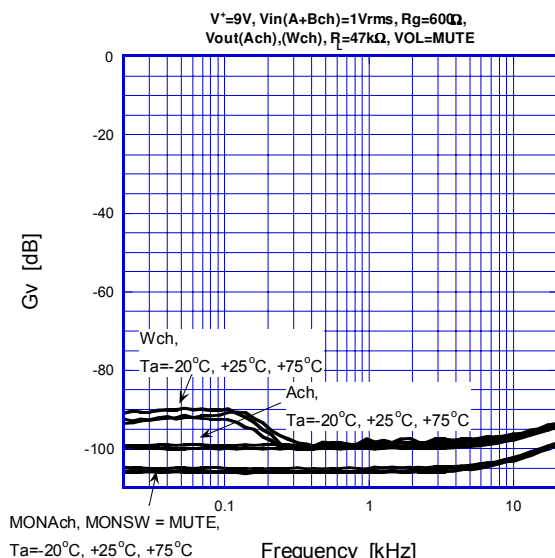


fig.28 Wch Voltage Gain vs Frequency (Trimmer)

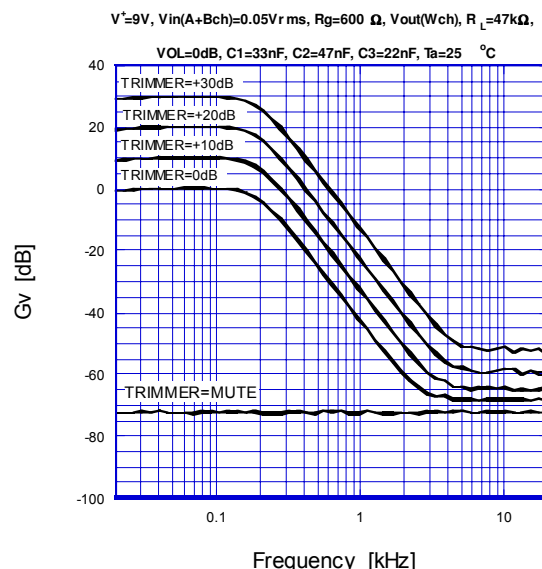
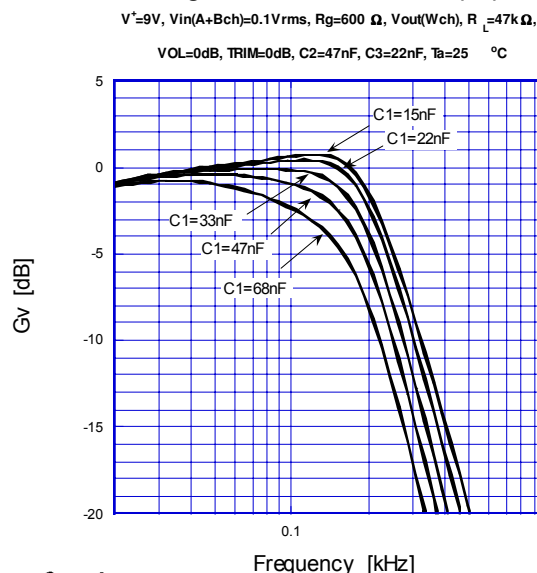


fig.30 LPF Characteristics (C_1)



TYPICAL CHARACTERISTICS

fig.31 LPF Characteristics (C2)

$V^+=9V$, $V_{in}(A+Bch)=0.1V_{rms}$, $R_g=600\Omega$, $V_{out}(Wch)$, $R_L=47k\Omega$,
 $VOL=0dB$, $TRIM=0dB$, $C1=33nF$, $C3=22nF$, $T_a=25^\circ C$

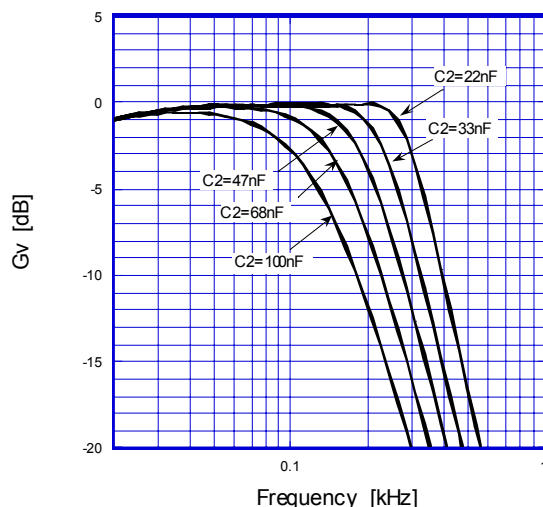


fig.32 LPF Characteristics (C3)

$V^+=9V$, $V_{in}(A+Bch)=0.1V_{rms}$, $R_g=600\Omega$, $V_{out}(Wch)$, $R_L=47k\Omega$,
 $VOL=0dB$, $TRIM=0dB$, $C1=33nF$, $C2=47nF$, $T_a=25^\circ C$

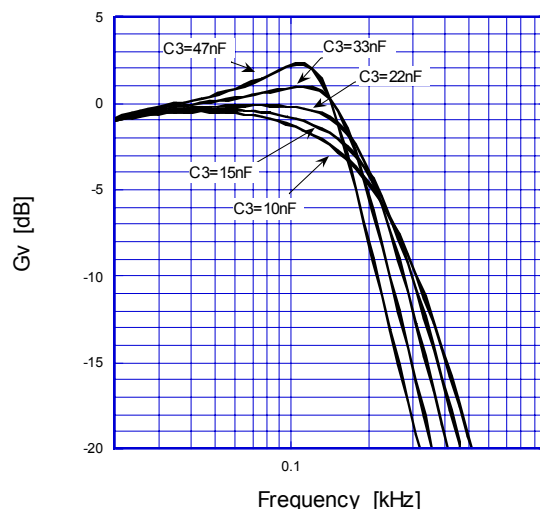


fig.33 Voltage Gain vs Frequency (Tone)

$V^+=9V$, $V_{in}(A)=0.1V_{rms}$, $R_g=600\Omega$, $V_{out}(Ach)$,
 $R_L=47k\Omega$, $VOL=0dB$, $T_a=25^\circ C$

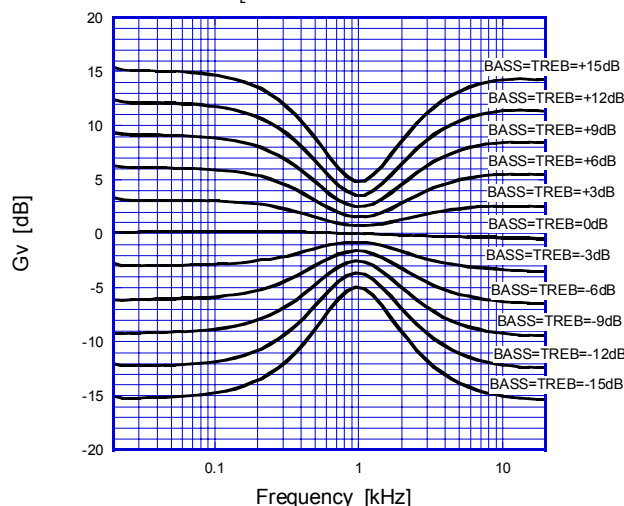


fig.34 Voltage Gain vs Frequency (Tone)

$V^+=9V$, $V_{in}(A)=0.1V_{rms}$, $R_g=600\Omega$, $V_{out}(Ach)$,
 $R_L=47k\Omega$, $VOL=0dB$

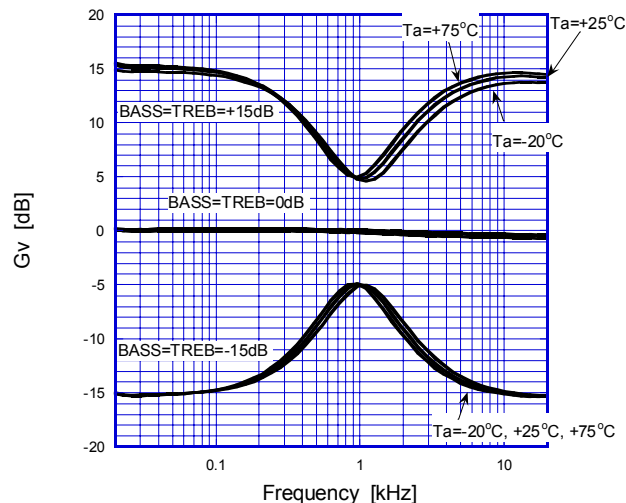


fig.35 Voltage Gain vs Frequency (eala effect1)

$V^+=9V$, $V_{in}=0.1V_{rms}$, $R_g=600\Omega$,
 $R_L=47k\Omega$, $VOL=0dB$

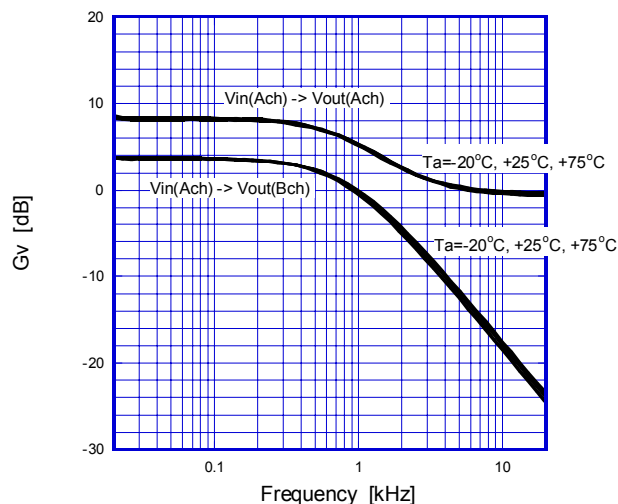
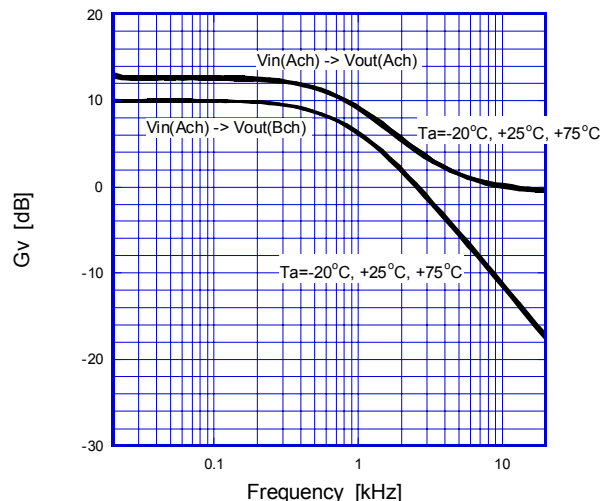


fig.36 Voltage Gain vs Frequency (eala effect2)

$V^+=9V$, $V_{in}=0.1V_{rms}$, $R_g=600\Omega$,
 $R_L=47k\Omega$, $VOL=0dB$



TYPICAL CHARACTERISTICS

fig.37 Voltage Gain vs Frequency (eala effect3)

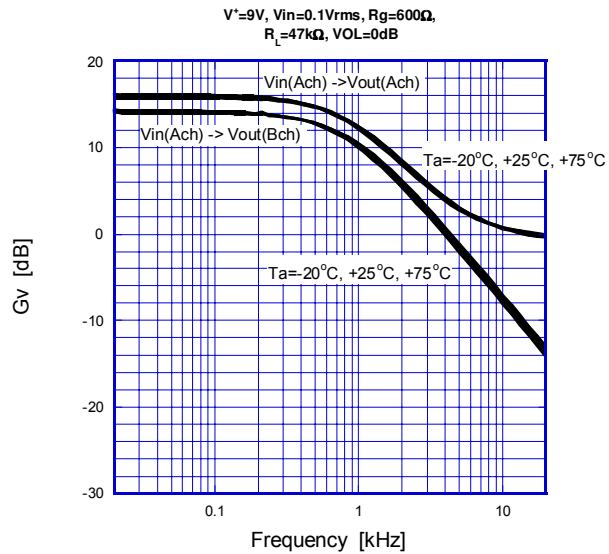


fig.39 Phase vs Frequency (Simulated Stereo)

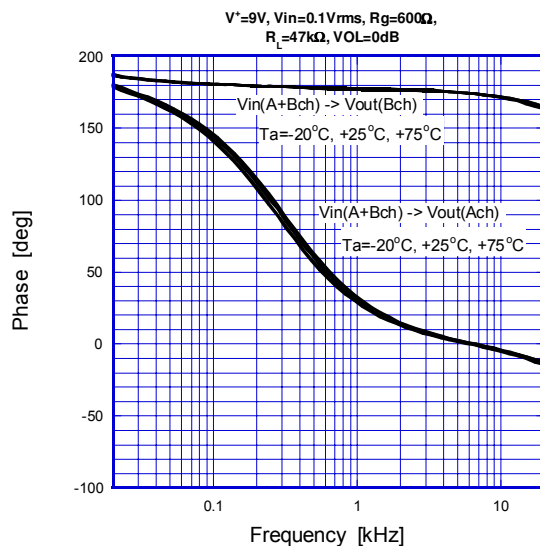


fig.41 Voltage Gain vs Frequency (Voice Enhancement)

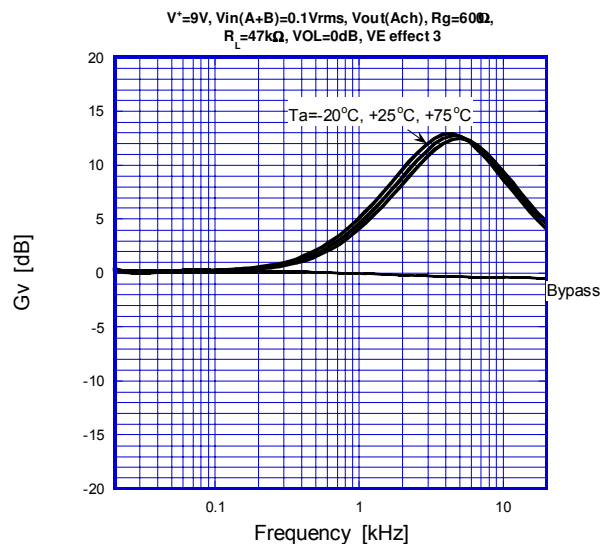


fig.38 Voltage Gain vs Frequency (Simulated Stereo)

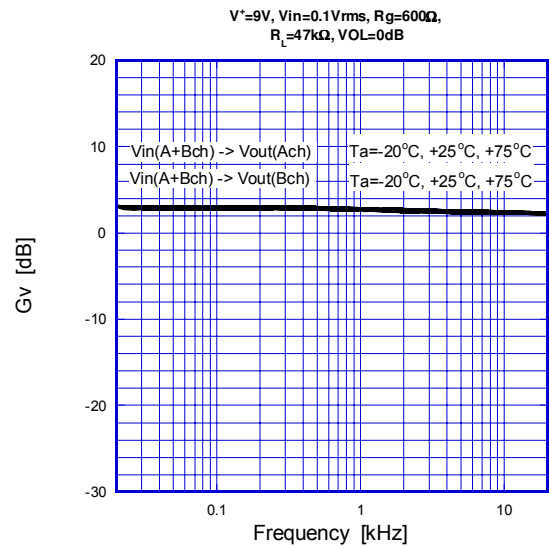
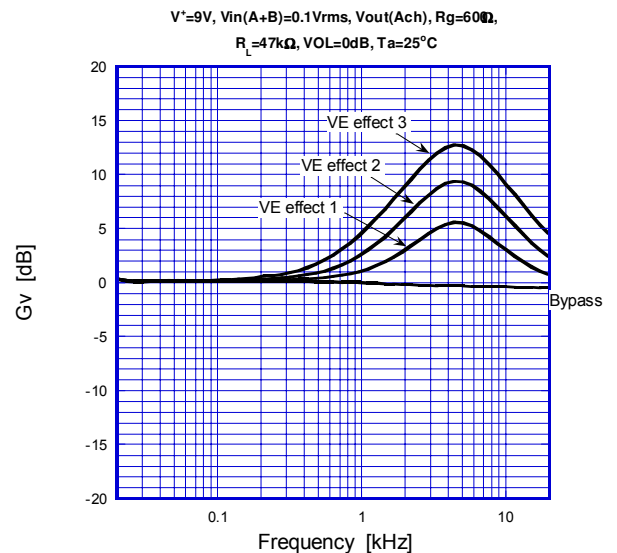


fig.40 Voltage Gain vs Frequency (Voice Enhancement)



[CAUTION]

The specifications on this databook are only given for information , without any guarantee as regards either mistakes or omissions. The application circuits in this databook are described only to show representative usages of the product and not intended for the guarantee or permission of any right including the industrial rights.