AUDIO PROCESSOR with BBE

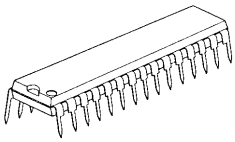
■ GENERAL DESCRIPTION

The **NJW1164** is a TV audio processor with sound enhancement (BBE).

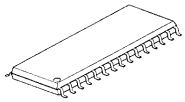
The **NJW1164** contains all necessary functions to process TV audio signal such as volume control, tone control, balance, mute, AGC and NJRC's proprietary surround sound process, eala. The eala reproduces a natural surround sound with clear vocal orientation.

The total modes and variables are controlled by the I^2C bus interface.

■ PACKAGE OUTLINE



NJW1164L

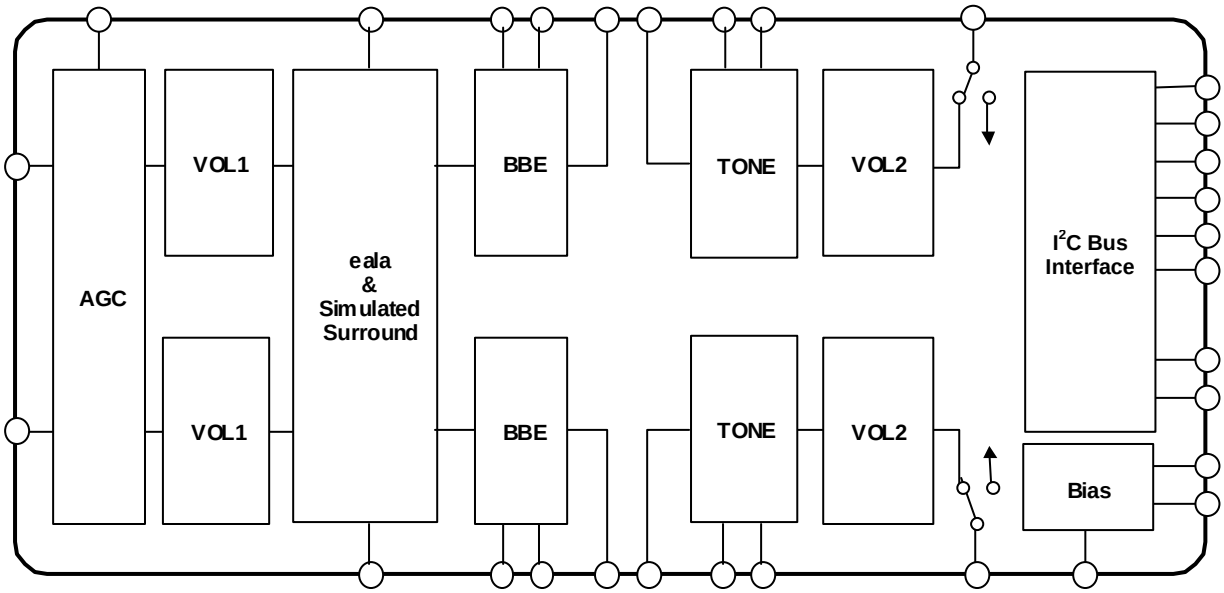


NJW1164M

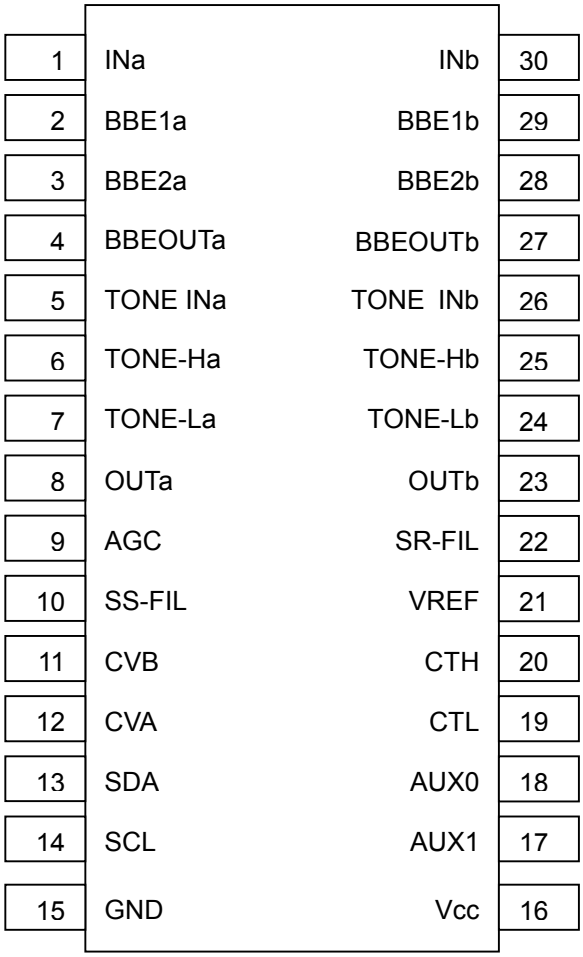
■ FEATURES

- Operating Voltage 7.5 to 13V
- I^2C BUS Interface
- BBE Sound Enhancement (Low Boost and High Boost: 15dB max.)
- eala (NJRC Original Surround)
- AGC Circuit (It reduces volume difference among input sources.)
- Simulated Surround
- Bi-CMOS Technology
- Package Outline SDIP30, SDMP30

■ BLOCK DIAGRAM



■ **PIN FUNCTION**



No.	Symbol	Function	No	Symbol	Function
1	INa	Ach Input	16	Vcc	Power Supply Pin
2	BBE1a	Ach BBE Filter1 (Process)	17	AUX1	Auxiliary Output1
3	BBE2a	Ach BBE Filter2 (Lo Contour)	18	AUX0	Auxiliary Output0
4	BBE OUTa	Ach Output for the Other Accessories	19	CTL	Pop Noise reduction for Bass Control
5	TONE INa	Ach Input From the Other Accessories	20	CTH	Pop Noise reduction for Treble Control
6	TONE-Ha	Ach Treble Filter	21	VREF	Reference Voltage
7	TONE-La	Ach Bass Filter	22	SR-FIL	Surround Filter
8	OUTa	Ach Output	23	OUTb	Bch Output
9	AGC	AGC Filter	24	TONE-Lb	Bch Bass Filter
10	SS-FIL	Simulated Stereo Filter	25	TONE-Hb	Bch Treble Filter
11	CVB	Pop Noise Reduction for Volume & Balance	26	TONE INb	Bch Input from the Other Accessories
12	CVA	Pop Noise Reduction for Volume & Balance	27	BBE OUTb	Bch Output for the Other Accessories
13	SDA	SDA Data Input (I^2C BUS)	28	BBE2b	Bch BBE Filter2 (Process)
14	SCL	SCL Data Input (I^2C BUS)	29	BBE1b	Bch BBE Filter1 (Lo Contour)
15	GND	GND	30	INb	Bch Input

■ **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, Rg=600Ω, R_L=47kΩ, Vin=100mVrms/1kHz unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
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%	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	BA_{BST}	CHS="0", BAL="11111"	-2.0	0.0	2.0	dB
Balance Cut A	BA_{CUT}	CHS="1", BAL="11111" Vin = 1Vrms	-	-	-70	dB
Balance Boost B	BB_{BST}	CHS="1", BAL="11111"	-2.0	0.0	2.0	dB
Balance Cut B	BB_{CUT}	CHS="0", BAL="11111" Vin = 1Vrms	-	-	-70	dB
Total Harmonic Distortion	THD	Vo=0.5Vrms BW=400Hz to 30kHz	-	-	0.5	%
Maximum Gain	G_{VMAX}	VOL= 0dB	-2.0	0.0	2.0	dB
Minimum Gain	G_{VMIN}	VOL= MUTE	-	-	-70	dB
Channel Separation	CS	Vin = 2Vrms Ain → Bout, Bin → Aout	-	-	-70	dB
Output Noise 1	V_{NO1}	VOL = 0dB BW=400Hz to 30kHz	- -	-90 (31.6)	-85 (56.2)	dBV (μVrms)
Output Noise 2	V_{NO2}	VOL = MUTE BW = 400Hz to 30kHz	- -	-106 (5.0)	-96 (15.8)	dBV (μVrms)
AUX Output Voltage	V_{AUX}	Logic Output: High	4.5	-	5.0	V
		Logic Output: Low	0	-	0.3	

BW: Band Width

♦ TONE CONTROL

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
High Frequency Boost	HF_{BST}	BCT="1", TREB="1111", f=10kHz	12.5	15.0	17.5	dB
High Frequency Flat	HF_{FLT}	TRBE="0000", f=10kHz	-2.0	0.0	2.0	dB
High Frequency Cut	HF_{CUT}	BCT="0", TRBE="1111", f=10kHz	-17.5	-15.0	-12.5	dB
Low Frequency Boost	LF_{BST}	BCB="1", BASS="1111", f=100Hz	12.5	15.0	17.5	dB
Low Frequency Flat	LF_{FLT}	BASS="0000", f=100Hz	-2.0	0.0	2.0	dB
Low Frequency Cut	LF_{CUT}	BCB="0", BASS="1111", f=100Hz	-17.5	-15.0	-12.5	dB

♦ SUB-TONE CONTROL

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

♦ AGC CONTROL

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
AGC Boost	AGC_{BST}	Vin=50mVrms, f=1kHz	1.5	3.5	5.5	dB
AGC Flat1	AGC_{FLT1}	Vin=150mVrms, f=1kHz	-2.5	0.0	2.5	dB
AGC Flat2	AGC_{FLT2}	Vin=300mVrms, f=1kHz	-2.5	0.0	2.5	dB
AGC Flat3	AGC_{FLT3}	Vin=400mVrms, f=1kHz	-2.5	0.0	2.5	dB
AGC Flat4	AGC_{FLT4}	Vin=540mVrms, f=1kHz	-2.5	0.0	2.5	dB
AGC Cut	AGC_{CUT}	Vin=2Vrms, f=1kHz	-14	-10	-6.0	dB

♦ BBE

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
BBE Low Frequency Boost Range	BBE_{LOW}	BBE-Low="1111", f = 50Hz	-	15.0	-	dB
BBE High Frequency Boost Range	BBE_{HIGH}	BBE-High="1111", f = 10KHz	-	15.0	-	dB

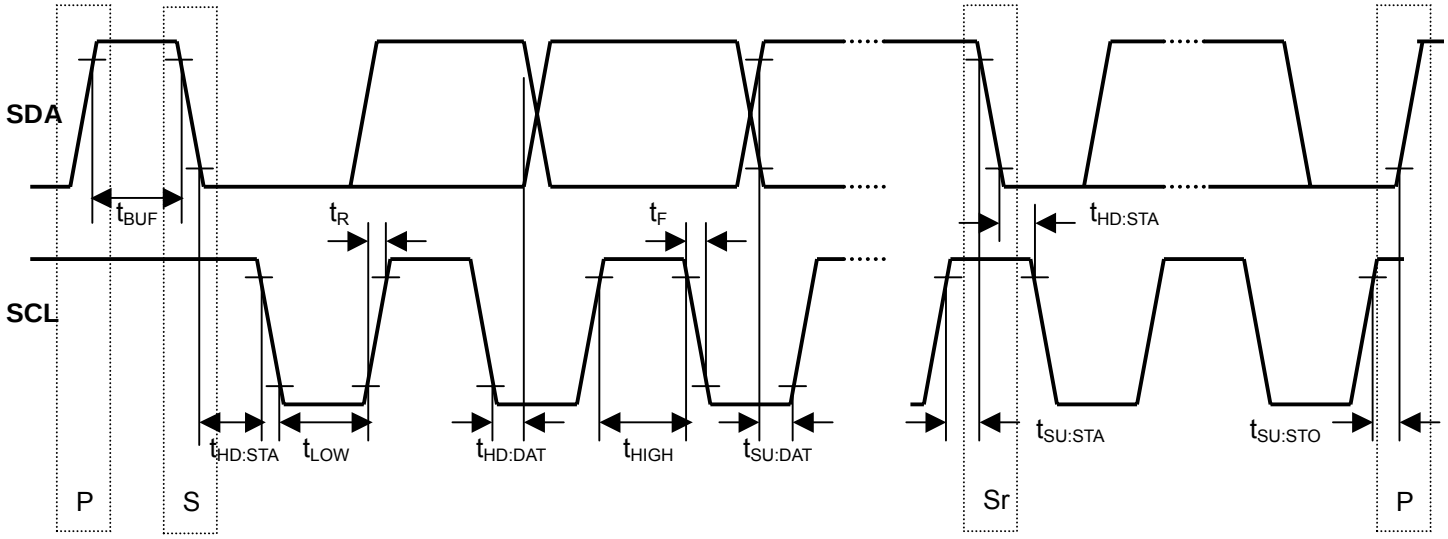
♦ SURROUND (SURROUND-ON)

PARAMETER	SYMBOL	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Surround Gain1	SR_{GAIN1}	Ain→Aout, f=100Hz SUR0="0", SUR="1"	6.0	8.0	10.0	dB
Surround Gain2	SR_{GAIN2}	Ain→Bout, f=100Hz SUR0="0", SUR="1"	1.6	3.6	5.6	dB
Surround Gain3	SR_{GAIN3}	Ain→Aout, f=100Hz SUR0="1", SUR="1"	10.7	12.7	14.7	dB
Surround Gain4	$SR_{GAIN\ 4}$	Ain→Bout, f=100Hz SUR0="1", SUR="1"	8.4	10.4	12.4	dB
Simulated Surround Gain1	SR_{SIM1}	Ain+Bin→Aout, f=1kHz SUR0="1", SUR="0"	1.0	3.0	5.0	dB
Simulated Surround Gain2	SR_{SIM2}	Ain+Bin→Bout, f=1kHz SUR0="1", SUR="0"	1.0	3.0	5.0	dB

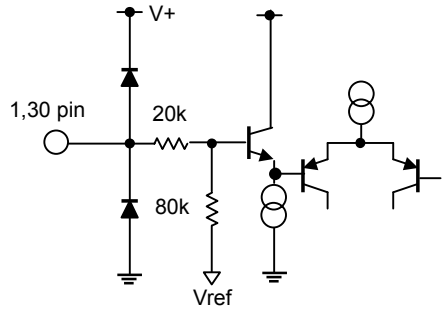
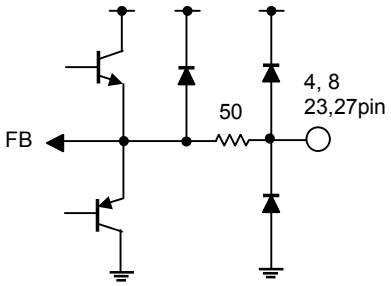
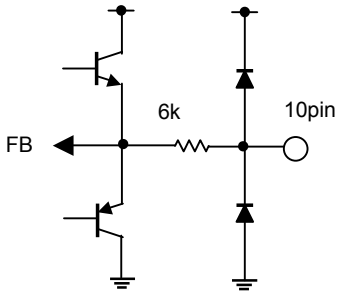
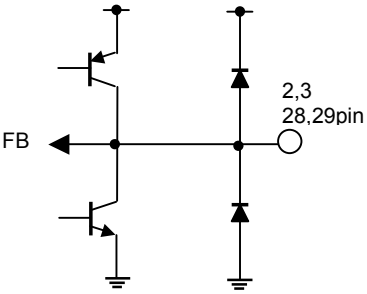
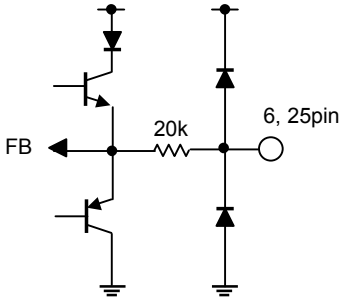
■ **I²C BUS BLOCK CHARACTERISTICS (SDA, SCL)**

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNIT
High Level Input Voltage	V_{IH}	2.5	-	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

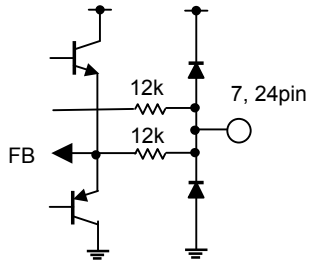
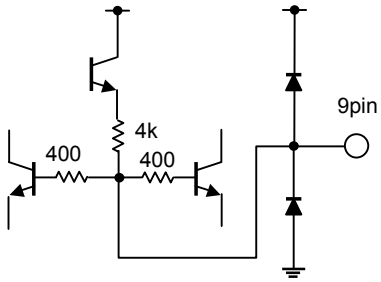
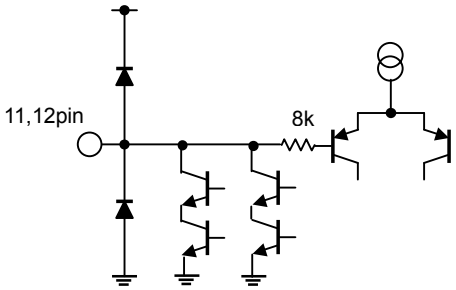
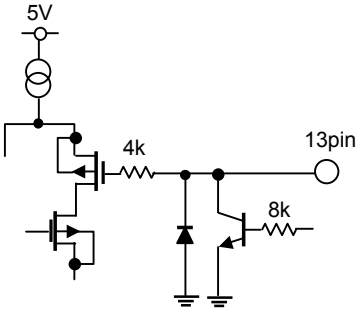
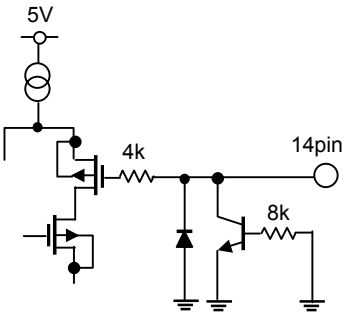
I²C BUS Load Condition: Pull up resistance 4kΩ (Connected to +5V)
Load capacitance 200pF (Connected to GND)



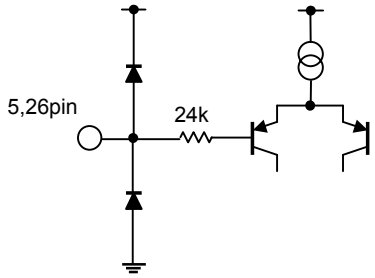
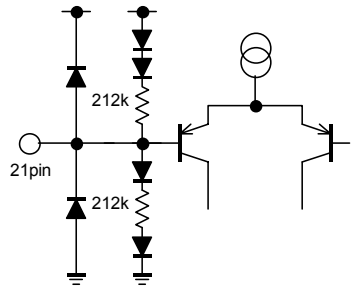
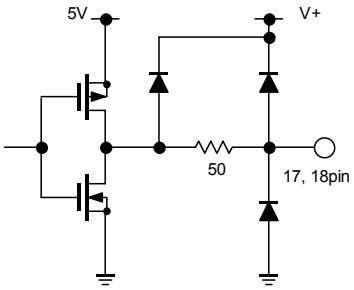
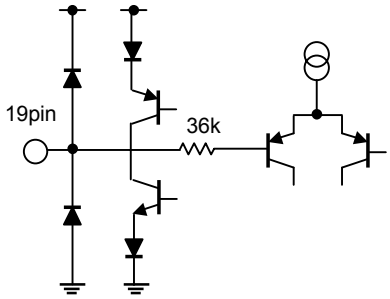
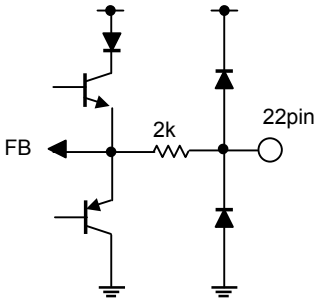
■TERMINAL DESCRIPTION

No.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	VOLTAGE
1 30	INa INb	Ach Input terminal Bch Input terminal		V+/2
4 8 23 27	BBE OUTa OUTa OUTb BBE OUTb	Ach Output for the Other Accessories Ach Output Bch Output Bch Output for the Other Accessories		V+/2
10	SS-FIL	Simulated Stereo Filter terminal		V+/2
2 3 28 29	BBE1a BBE2a BBE2b BBE1b	Ach BBE Filter1 (Process) Ach BBE Filter2 (Lo Contour) Bch BBE Filter2 (Lo Contour) Bch BBE Filter1 (Process)		V+/2
6 25	TONE-Ha TONE-Hb	Treble (tone control) filter terminal		V+/2

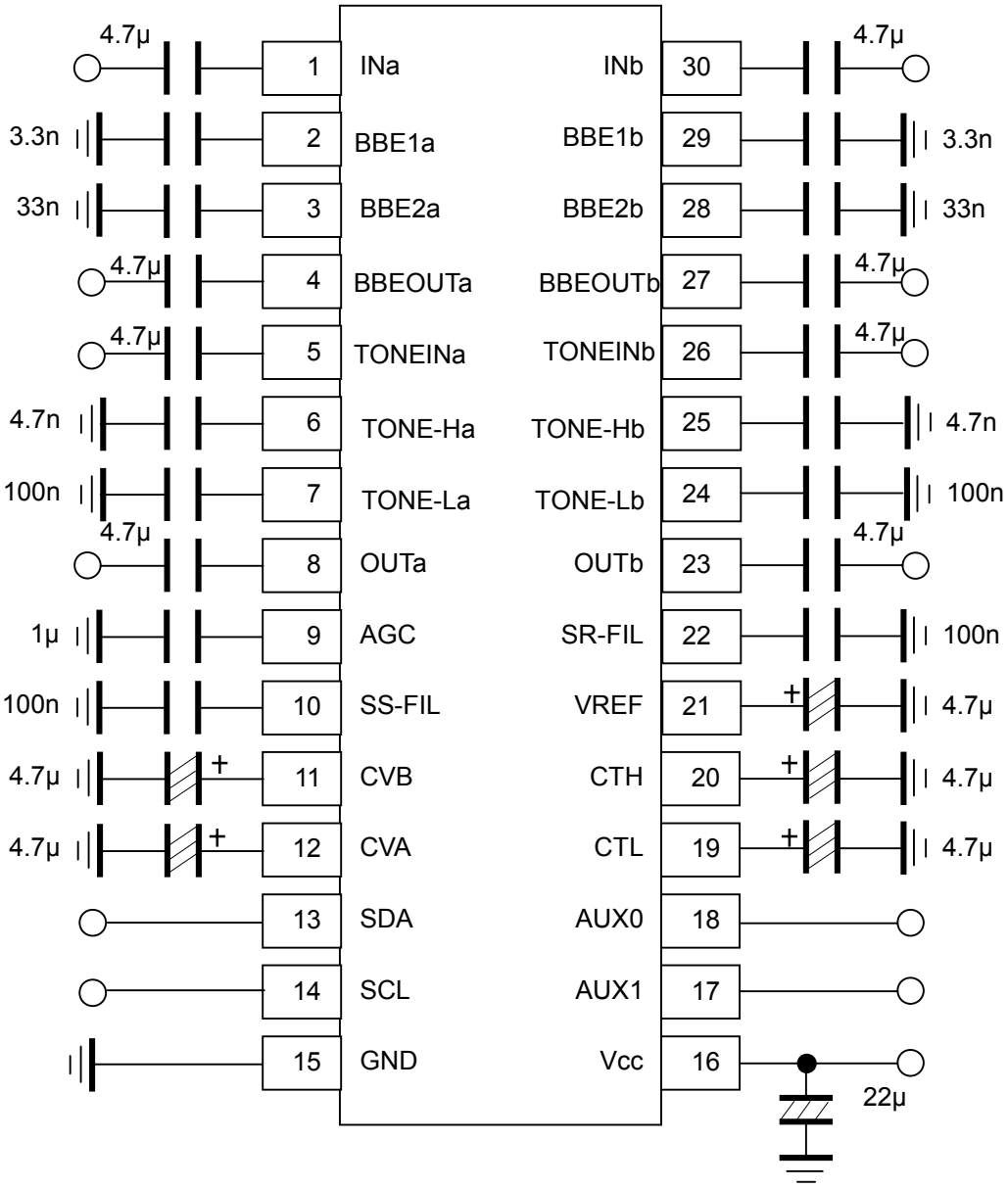
■TERMINAL DESCRIPTION

No.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	VOLTAGE
7 24	TONE-La TONE-Lb	Bass (tone control) filter terminal		V+/2
9	AGC	Capacitor connection terminal for AGC attack and recovery time setting		-
11 12	CVB CVA	Pop Noise Reduction for Volume & Balance		-
13	SDA	I^2C data terminal		-
14	SCL	I^2C clock terminal		-

■TERMINAL DESCRIPTION

No.	SYMBOL	FUNCTION	EQUIVALENT CIRCUIT	VOLTAGE
5 26	TONE INa TONE INb	Ach Input from the Other Accessories Bch Input from the Other Accessories		V+/2
21	Vref	Reference voltage terminal		V+/2
17 18	AUX0 AUX1	Auxiliary 2 values voltage output terminal		0/5V
20 19	CTH CTL	Pop Noise reduction for Bass Control Pop Noise reduction for Treble Control		-
22	SR-FIL	Surround filter terminal		V+/2
15 16	V+ GND	Ground terminal Supply voltage terminal	-	-

■ **APPLICATION CIRCUIT**



(NOTE)

1. Separate the I^2C 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
2	BBE1a	6	TONE-Ha	10	SS FIL	24	TONE-Lb	28	BBE2b
3	BBE2a	7	TONE-La	22	SR FIL	25	TONE-Hb	29	BBE1b

2. The constant of capacitors connected to the terminals No.2, 3, 28 and 29 are designated by BBE Sound Inc. Do not change the constant of these capacitors without the approval of BBE Sound Inc.

■ **APPLICATION NOTE**

1. AGC (Auto Gain Control) Circuit

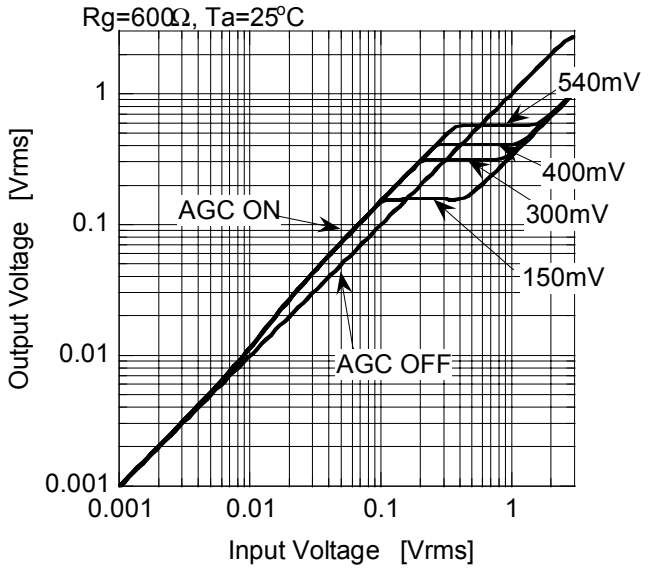
AGC circuit adjusts the input signal level with Boost/Attenuate circuit. AGC boost the low input signal level and attenuate high input signal level automatically.

The AGC flat levels (150mV, 300mV, 400mV and 540mV) are selectable via I^2C bus. (Refer to the following figure.)

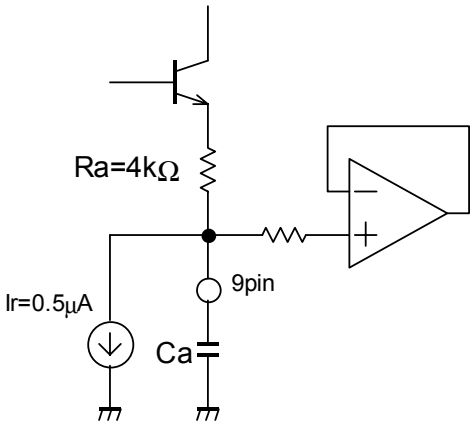
AGC Control

V+=9V, Vin(Ach+Bch), f=1kHz, Vo(Ach)OUTPUT

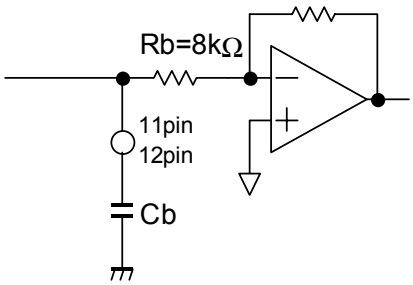
Rg=600Ω, Ta=25°C



Attack-Recovery



Smoothing circuit of Attenuate



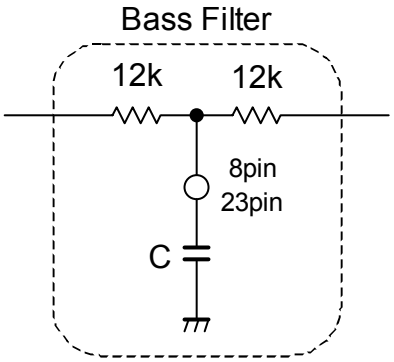
Smoothing circuit of Boost

Attack and recovery time in the attenuation processing depends on external part Ca, and it in the boost processing depends on external part Cb. They become longer as the capacity bigger and become shorter as it gets smaller. (Recommendation value: Ca=1μF, Cb=4.7μF)

Reducing the capacity of Ca may cause the distortion. As for Cb, since it serves as the click noise prevention, reducing the capacity may cause the click noise upon volume changing.

2. Tone Control

a) Bass: Setting the Cut-off frequency

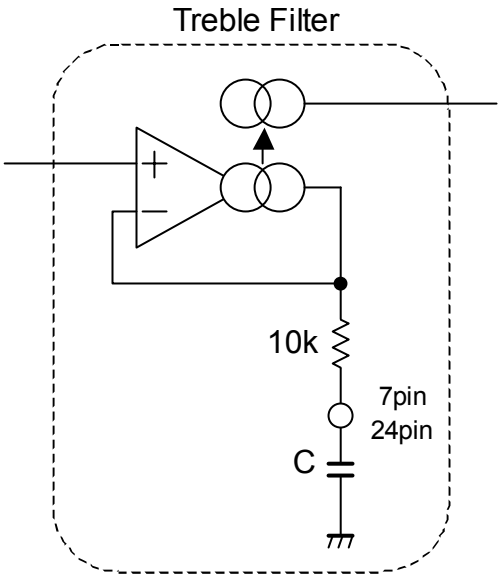


$$f_C = \frac{M}{2\pi \times C \times 12k}$$

M changes by gain setting of Tone.

M ≈ 2.65 (±15dB)
M ≈ 3.45 (±10dB)
M ≈ 8.10 (±5dB)

b) Treble: Setting the Cut-off frequency



$$f_C = \frac{N}{2\pi \times C \times 10k}$$

N changes by gain setting of Tone.

N ≈ 0.76 (±15dB)
N ≈ 0.58 (±10dB)
N ≈ 0.25 (±5dB)

3. BBE, Surround mode and "OUT" switch settings

The click noise may be generated by changing the BBE, Surround mode setting and “OUT” switch. Provide the external circuit for avoiding the click noise on above condition.

4. External parts for BBE circuits

The constant of capacitors connected to the terminals No.2, 3, 28 and 29 are designated by BBE Sound Inc. Do not change the constant of these capacitors without the approval of BBE Sound Inc.

5. AUX1, AUX0 Terminal

AUX1/0 are enable to control external logic circuit is

Source current : 1mA typ. (Ta=25˚C)
Sink current : 0.5mA typ. (Ta=25˚C)

6. Capacitor for Reference Voltage (21pin)

22µF should be recommended for ripple filter connected to Vref terminal (21pin). Reducing this capacity may cause to reduce the maximum attenuation level and to increase the output noise.

■ 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

MSB							LSB
1	0	0	0	0	1	0	R/$\overline{W}$

R/$\overline{W}$=0: Receive Only
R/$\overline{W}$=1: No Output Data

♦ CONTROL REGISTER TABLE

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

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	VOL							
01H	CHS	BAL					AGC	SUR
02H	BCB	BASS				BCSB	SUB-BASS	
03H	BCT	TREB				BCST	SUB-TREB	
04H	BBE (Lo Contour)				BBE (Process)			
05H	OUT	Don't care	Don't care	SUR0	AGC1	AGC0	AUX1	AUX0

♦ CONTROL REGISTER DEFAULT VALUE

Control register default value is all "0".

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
00H	0	0	0	0	0	0	0	0
01H	0	0	0	0	0	0	0	0
02H	0	0	0	0	0	0	0	0
03H	0	0	0	0	0	0	0	0
04H	0	0	0	0	0	0	0	0
05H	0	0	0	0	0	0	0	0

■INSTRUCTION CODE

a) MASTER VOLUME SETTING

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

The volume control for both Ach and Bch (0.33dB/step).
The volume is consisted of volume1 and volume2 and the level is divided into half to each volume1 and volume2.

b) BALANCE, AGC AND SURROUND SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
01H	CHS	BAL					AGC	SUR

- CHS: Channel select for balance control
  "0": Ach "Bch is attenuated"
  "1": Bch "Ach is attenuated"
- BAL: Balance control for both Ach and Bch (1dB/Step)
  The balance is consisted of volume1 and volume2 and the level is divided into half to each volume1 and volume2.
- AGC: AGC switch
  "0": AGC OFF
  "1": AGC ON
- SUR: Surround mode switch
  "0": Surround OFF
  "1": Surround ON

NOTE) The click noise may be generated by changing the Surround mode setting.
Provide the external circuit for avoiding the click noise on above condition.

c) TONE CONTROL BASS SETTING

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

- BCB: Boost cut select for Bass control
  "0": Cut
  "1": Boost
- BASS: BASS control
  Cut Level : -15dB to 0dB(1dB/Step)
  Boost Level : 0dB to +15dB(1dB/Step)
- BCSB: Boost cut select for SUB-BASS control
  "0": Cut
  "1": Boost
- SUB-BASS: SUB- BASS control (1dB/Step)
  Sub-Cut Level : -3dB to 0dB(1dB/Step)
  Sub-Boost Level : 0dB to +3dB(1dB/Step)

d) TONE CONTROL TREBLE SETTING

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

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

e) BBE Boost Level Setting

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
04H	BBE (Lo Contour)				BBE (Process)			

- BBE Lo Contour : 0dB to 15dB(1dB/step)
- BBE Process : 0dB to 15dB (1dB/step)

When all bits are "0"(=00H), BBE becomes off

NOTE) The click noise may be generated by changing the BBE setting.
Provide the external circuit for avoiding the click noise on above condition.

f) OUTPUT AND AUXILIARY SETTING

Select Address	BIT							
	D7	D6	D5	D4	D3	D2	D1	D0
05H	OUT	Don't Care	Don't Care	SUR0	AGC1	AGC0	AUX1	AUX0

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

NOTE) The click noise may be generated by changing the "OUT" switch.
Provide the external circuit for avoiding the click noise on above condition.

- Surround Setting

Surround Function	SUR0(05H:D4)	SUR(01H:D0),	Remarks
Surround OFF	0	0	Input through
Surround Effect1	0	1	Surround Effect Small (8.0dB typ.)
Surround Effect2	1	1	Surround Effect Large (12.7dB typ.)
Simulated Stereo	1	0	For monaural signal input only

NOTE) The click noise may be generated by changing the Surround mode setting.
Provide the external circuit for avoiding the click noise on above condition.

•AGC Level Setting

AGC Level	AGC1(D3)	AGC0(D2)
150mVrms	0	0
300mVrms	0	1
400mVrms	1	0
540mVrms	1	1

•AUX1/AUX0: Auxiliary port High/Low

"0": Logic output "Low"

"1": Logic output "High"

■MASTER VOLUME (Select Address: 00H)

		VOL							
Gain (dB)	HEX	D7	D6	D5	D4	D3	D2	D1	D0
0	FF	1	1	1	1	1	1	1	1
-1	FC	1	1	1	1	1	1	0	0
-2	F9	1	1	1	1	1	0	0	1
-3	F6	1	1	1	1	0	1	1	0
-4	F3	1	1	1	1	0	0	1	1
-5	F0	1	1	1	1	0	0	0	0
-6	ED	1	1	1	0	1	1	0	1
-7	EA	1	1	1	0	1	0	1	0
-8	E7	1	1	1	0	0	1	1	1
-9	E4	1	1	1	0	0	1	0	0
-10	E1	1	1	1	0	0	0	0	1
-11	DE	1	1	0	1	1	1	1	0
-12	DB	1	1	0	1	1	0	1	1
-13	D8	1	1	0	1	1	0	0	0
-14	D5	1	1	0	1	0	1	0	1
-15	D2	1	1	0	1	0	0	1	0
-16	CF	1	1	0	0	1	1	1	1
-17	CC	1	1	0	0	1	1	0	0
-18	C9	1	1	0	0	1	0	0	1
-19	C6	1	1	0	0	0	1	1	0
-20	C3	1	1	0	0	0	0	1	1
-21	C0	1	1	0	0	0	0	0	0
-22	BD	1	0	1	1	1	1	0	1
-23	BA	1	0	1	1	1	0	1	0
-24	B7	1	0	1	1	0	1	1	1
-25	B4	1	0	1	1	0	1	0	0
-26	B1	1	0	1	1	0	0	0	1
-27	AE	1	0	1	0	1	1	1	0
-28	AB	1	0	1	0	1	0	1	1
-29	A8	1	0	1	0	1	0	0	0
-30	A5	1	0	1	0	0	1	0	1
-31	A2	1	0	1	0	0	0	1	0
-32	9F	1	0	0	1	1	1	1	1
-33	9C	1	0	0	1	1	1	0	0
-34	99	1	0	0	1	1	0	0	1
-35	96	1	0	0	1	0	1	1	0
-36	93	1	0	0	1	0	0	1	1
-37	90	1	0	0	1	0	0	0	0
-38	8D	1	0	0	0	1	1	0	1
-39	8A	1	0	0	0	1	0	1	0
-40	87	1	0	0	0	0	1	1	1
-41	84	1	0	0	0	0	1	0	0
-42	81	1	0	0	0	0	0	0	1

■MASTER VOLUME (Select Address: 00H)

		VOL							
Gain (dB)	HEX	D7	D6	D5	D4	D3	D2	D1	D0
-43	7E	0	1	1	1	1	1	1	0
-44	7B	0	1	1	1	1	0	1	1
-45	78	0	1	1	1	1	0	0	0
-46	75	0	1	1	1	0	1	0	1
-47	72	0	1	1	1	0	0	1	0
-48	6F	0	1	1	0	1	1	1	1
-49	6C	0	1	1	0	1	1	0	0
-50	69	0	1	1	0	1	0	0	1
-51	66	0	1	1	0	0	1	1	0
-52	63	0	1	1	0	0	0	1	1
-53	60	0	1	1	0	0	0	0	0
-54	5D	0	1	0	1	1	1	0	1
-55	5A	0	1	0	1	1	0	1	0
-56	57	0	1	0	1	0	1	1	1
-57	54	0	1	0	1	0	1	0	0
-58	51	0	1	0	1	0	0	0	1
-59	4E	0	1	0	0	1	1	1	0
-60	4B	0	1	0	0	1	0	1	1
-61	48	0	1	0	0	1	0	0	0
-62	45	0	1	0	0	0	1	0	1
-63	42	0	1	0	0	0	0	1	0
-64	3F	0	0	1	1	1	1	1	1
-65	3C	0	0	1	1	1	1	0	0
-66	39	0	0	1	1	1	0	0	1
-67	36	0	0	1	1	0	1	1	0
-68	33	0	0	1	1	0	0	1	1
-69	30	0	0	1	1	0	0	0	0
-70	2D	0	0	1	0	1	1	0	1
-71	2A	0	0	1	0	1	0	1	0
-72	27	0	0	1	0	0	1	1	1
-73	24	0	0	1	0	0	1	0	0
-74	21	0	0	1	0	0	0	0	1
-75	1E	0	0	0	1	1	1	1	0
-76	1B	0	0	0	1	1	0	1	1
-77	18	0	0	0	1	1	0	0	0
-78	15	0	0	0	1	0	1	0	1
-79	12	0	0	0	1	0	0	1	0
-80	0F	0	0	0	0	1	1	1	1
-81	0C	0	0	0	0	1	1	0	0
-82	09	0	0	0	0	1	0	0	1
-83	06	0	0	0	0	0	1	1	0
-84	03	0	0	0	0	0	0	1	1
Mute	00	0	0	0	0	0	0	0	0

■**BALANCE (Select Address: 01H)**

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

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

■TONE CONTROL BASS (Select Address: 02H)

Bass Cut or Boost	BCB D7
Cut	0
Boost	1

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

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

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

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

■TONE CONTROL TREBLE (Select Address: 03H)

Treble Cut or Boost	BCT D7
Cut	0
Boost	1

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

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

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

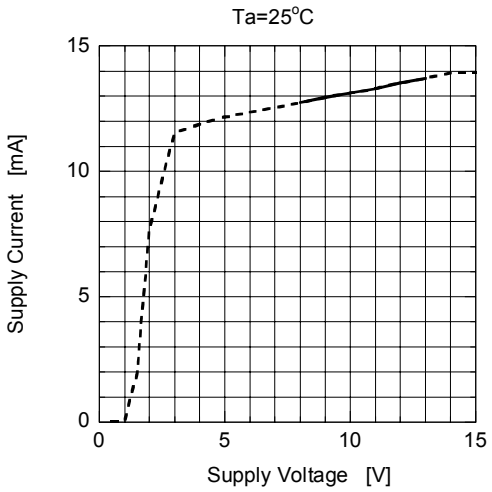
		SUB-TREB	
Cut Gain (dB)	Boost Gain (dB)	D1	D1
-3	3	1	1
-2	2	1	0
-1	1	0	1
0	0	0	0

■BBE (Lo Contour) / (Process) Gain Code (Select Address: 04H)

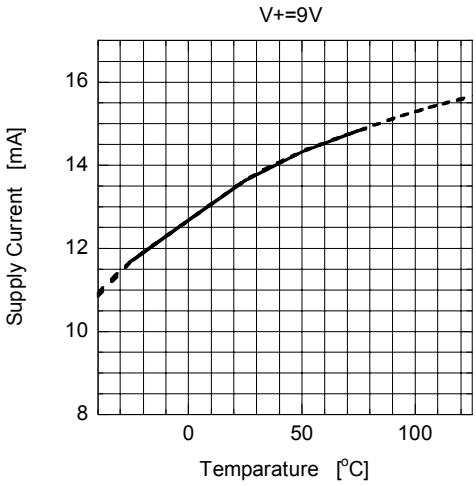
	Lo Contour				Process			
Gain (dB)	D7	D6	D5	D4	D3	D2	D1	D0
15	1	1	1	1	1	1	1	1
14	1	1	1	0	1	1	1	0
13	1	1	0	1	1	1	0	1
12	1	1	0	0	1	1	0	0
11	1	0	1	1	1	0	1	1
10	1	0	1	0	1	0	1	0
9	1	0	0	1	1	0	0	1
8	1	0	0	0	1	0	0	0
7	0	1	1	1	0	1	1	1
6	0	1	1	0	0	1	1	0
5	0	1	0	1	0	1	0	1
4	0	1	0	0	0	1	0	0
3	0	0	1	1	0	0	1	1
2	0	0	1	0	0	0	1	0
1	0	0	0	1	0	0	0	1
0	0	0	0	0	0	0	0	0

■TYPICAL CHARACTERISTICS

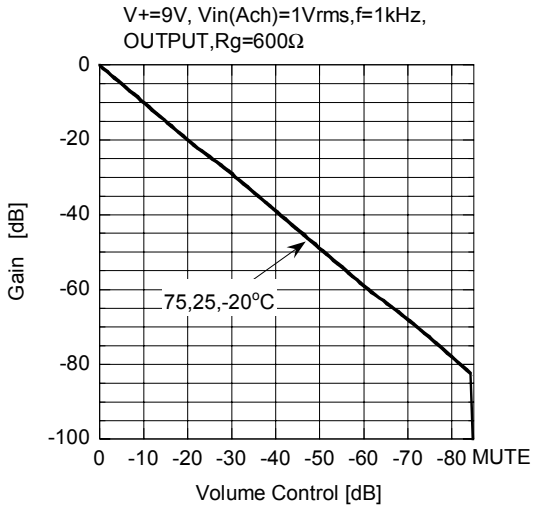
Supply Current vs Supply Voltage



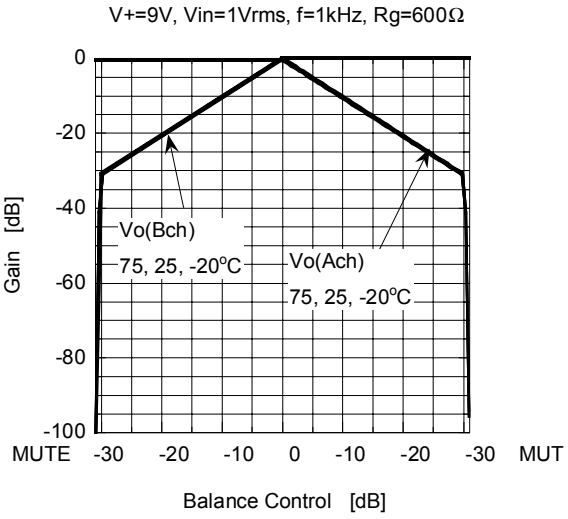
Supply Current vs Temparature



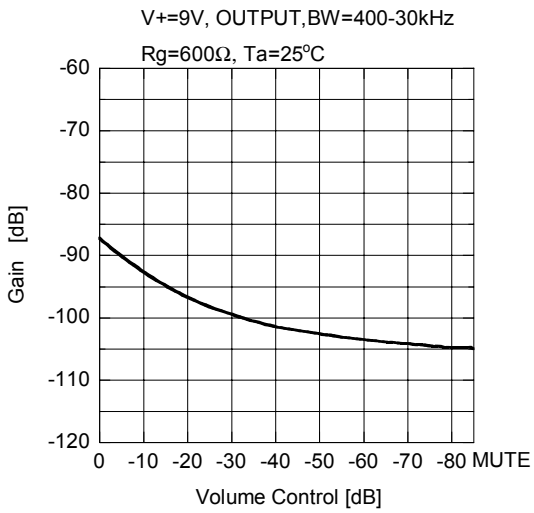
Gain vs Volume Control



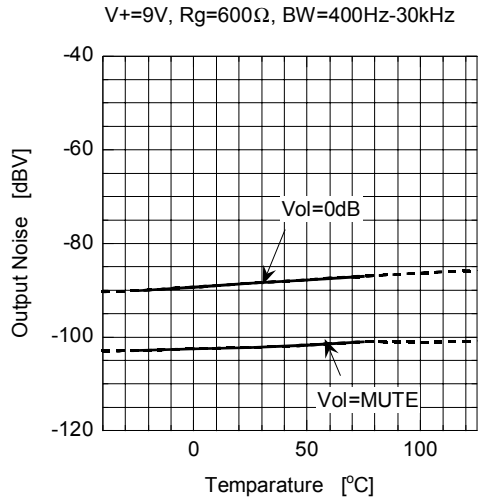
Gain vs Balance Control



Output Noise vs Volume Control



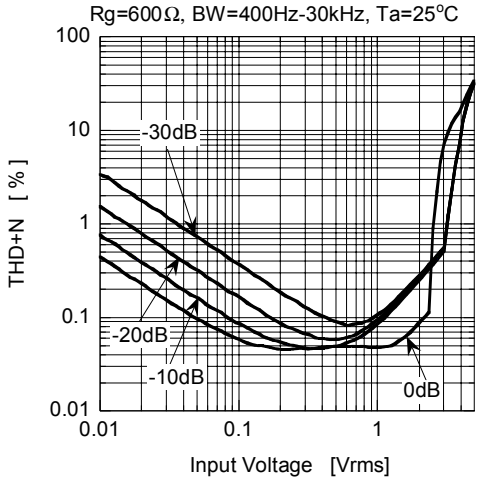
Output Noise vs Temperature



■TYPICAL CHARACTERISTICS

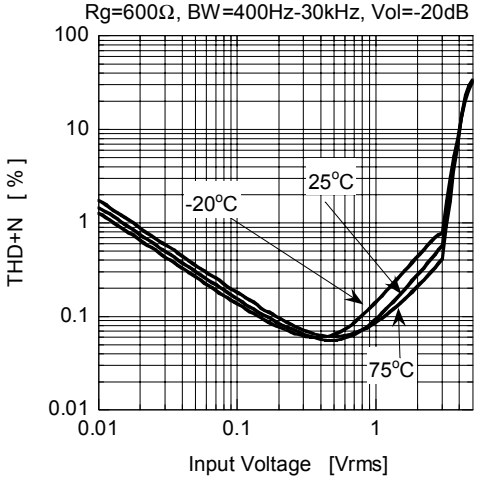
THD+N vs Input Voltage

V+=9V, Vin(Ach), f=1kHz, Vo(Ach)OUTPUT
Rg=600Ω, BW=400Hz-30kHz, Ta=25°C



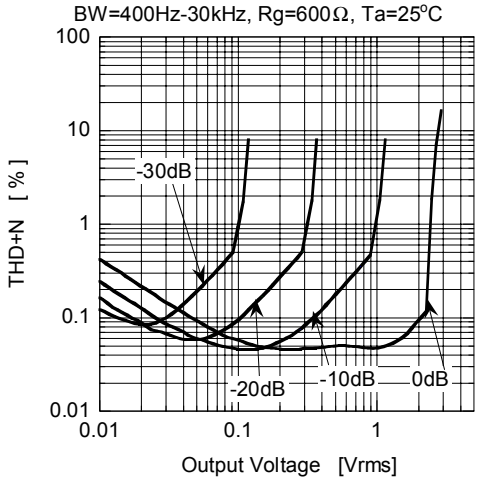
THD+N vs Input Voltage

V+=9V, Vin(Ach), f=1kHz, Vo(Ach)OUTPUT
Rg=600Ω, BW=400Hz-30kHz, Vol=-20dB



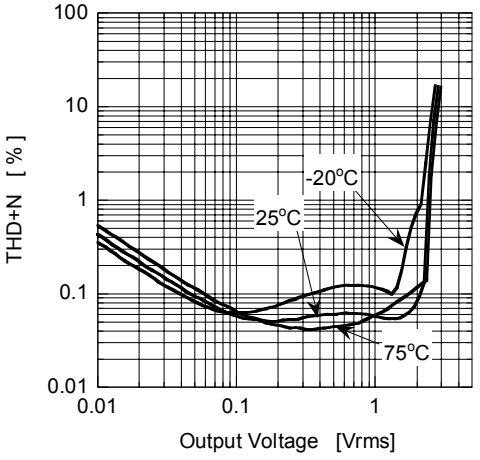
THD+N vs Output Voltage

V+=9V, Vin(Ach), f=1kHz, Vo(Ach)OUTPUT
BW=400Hz-30kHz, Rg=600Ω, Ta=25°C



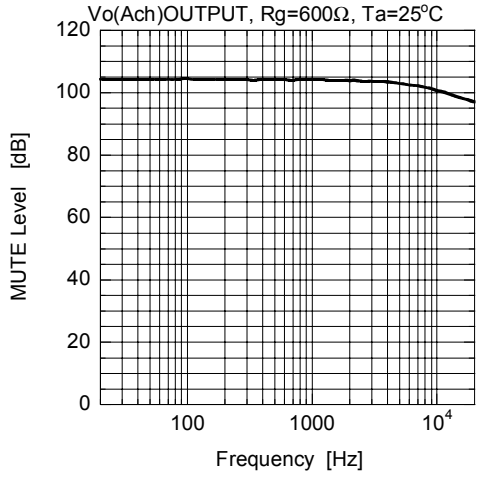
THD+N vs Output Voltage

V+=9V, Vin(Ach), f=1kHz, Vo(Ach)OUTPUT
Rg=600Ω, BW=400Hz-30kHz, Vol=0dB



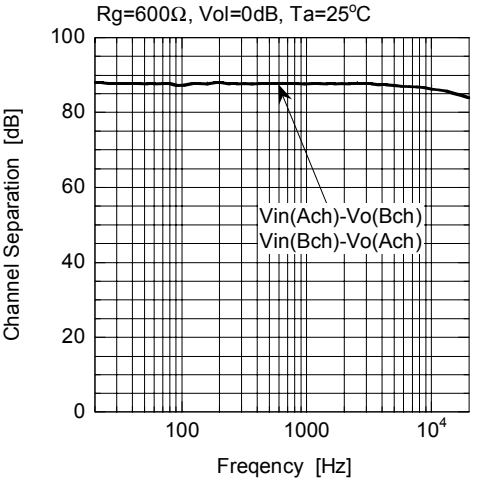
MUTE Level vs Frequency

V+=9V, Vin(Ach)=1Vrms, Vol=MUTE
Vo(Ach)OUTPUT, Rg=600Ω, Ta=25°C



Channel Separation vs Frequency

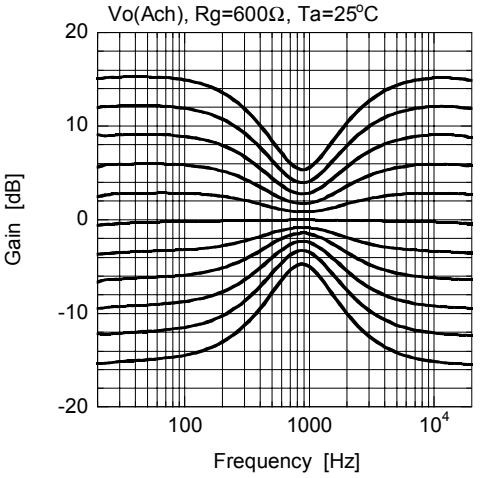
V+=9V, Vin=2Vrms, f=1kHz, Vo=OUTPUT
Rg=600Ω, Vol=0dB, Ta=25°C



■TYPICAL CHARACTERISTICS

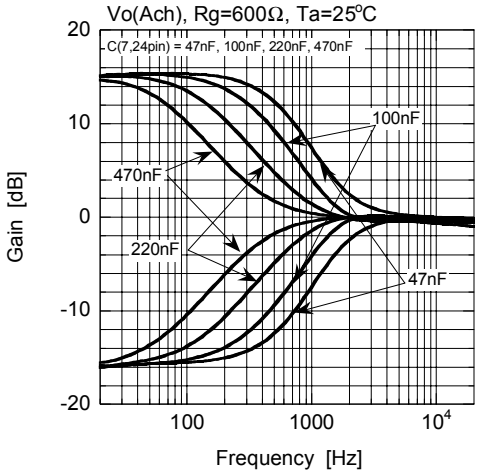
Gain vs Frequency (TONE)

V+=9V, Vin(Ach)=0.1Vrms,Gv:3dB steps
Vo(Ach), Rg=600Ω, Ta=25°C



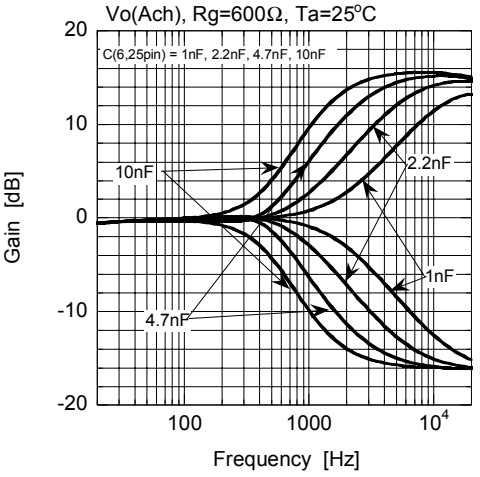
Gain vs Frequency (TONE)

V+=9V, Vin(Ach)=0.1Vrms,Gv= +-15dB
Vo(Ach), Rg=600Ω, Ta=25°C



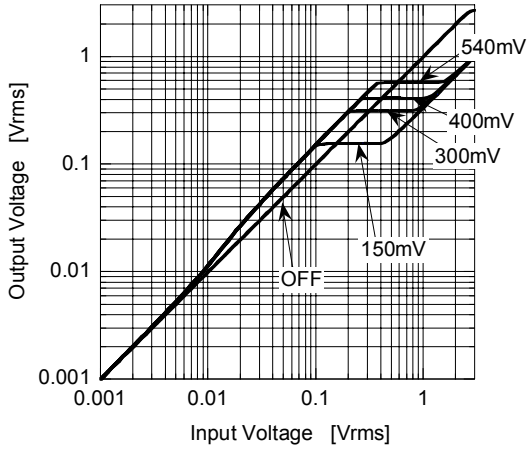
Gain vs Frequency (TONE)

V+=9V, Vin(Ach)=0.1Vrms,Gv= +-15dB
Vo(Ach), Rg=600Ω, Ta=25°C



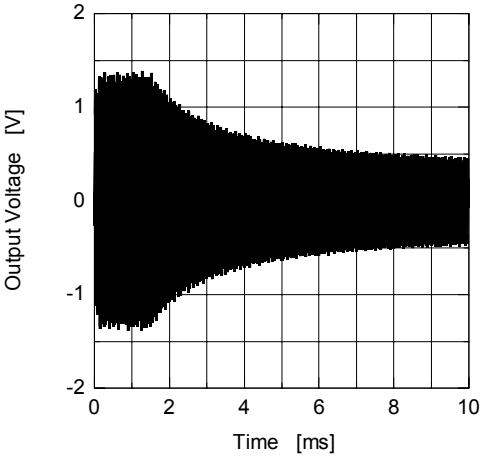
AGC Control

V+=9V, Vin(Ach+Bch), f=1kHz, Vo(Ach)OUTPUT
Rg=600Ω, Ta=25°C



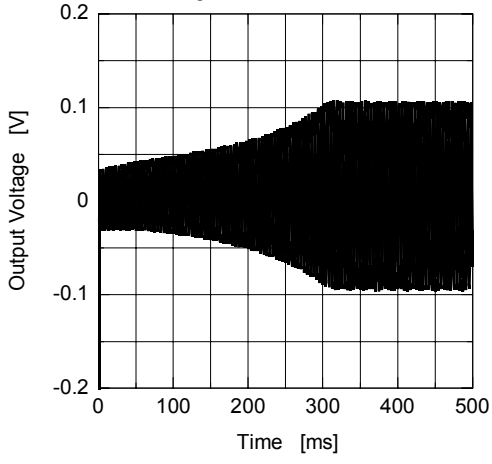
AGC Attack Time (C:9pin=1μF)

V+=9V, Vin(Ach+Bch)=1Vrms,f=20kHz,Vo(Ach)OUTPUT
AGC level=0.15V,Rg=600Ω,Ta=25°C



AGC Recovery Time (C:9pin=1μF)

V+=9V, Vin(Ach+Bch)=1Vrms, f=10kHz,Vo(Ach)OUTPUT
AGC level=0.15V,Rg=600Ω,Ta=25°C

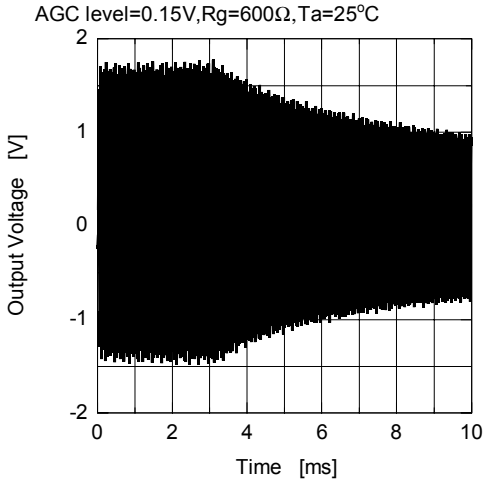


■TYPICAL CHARACTERISTICS

AGC Attack Time (C:9pin=2.2 μF)

V+=9V, Vin(Ach+Bch)=1Vrms,f=20kHz,Vo(Ach)OUTPUT

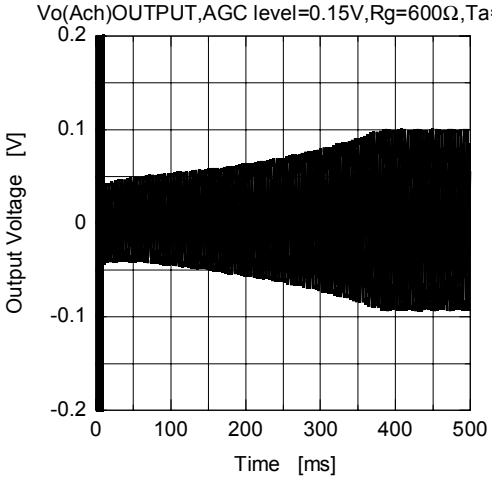
AGC level=0.15V,Rg=600Ω,Ta=25°C



AGC Recovery Time (C:9pin=2.2 μF)

V+=9V, Vin(Ach+Bch)=1 to 0.05Vrms, f=10kHz,

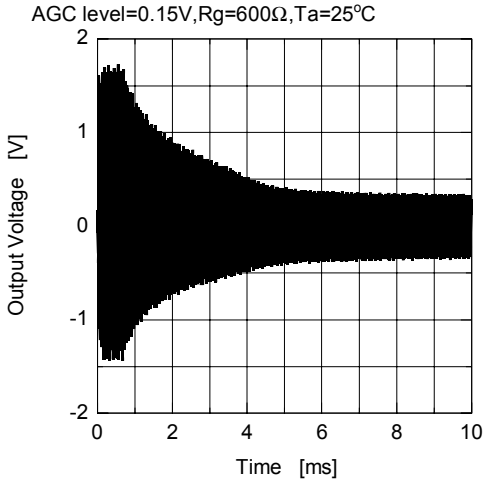
Vo(Ach)OUTPUT,AGC level=0.15V,Rg=600Ω,Ta=25°C



AGC Attack Time (C:9pin=0.47 μF)

V+=9V, Vin(Ach+Bch)=1Vrms,f=20kHz,Vo(Ach)OUTPUT

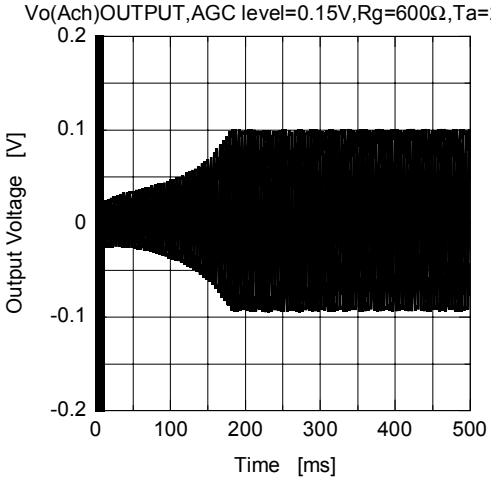
AGC level=0.15V,Rg=600Ω,Ta=25°C



AGC Recovery Time (C:9pin=0.47 μF)

V+=9V, Vin(Ach+Bch)=1 to 0.05Vrms, f=10kHz,

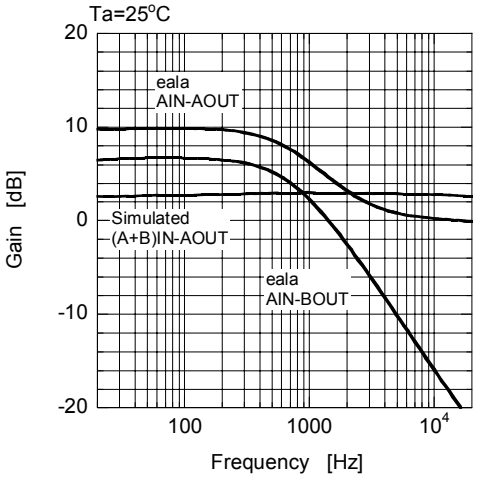
Vo(Ach)OUTPUT,AGC level=0.15V,Rg=600Ω,Ta=25°C



■TYPICAL CHARACTERISTICS

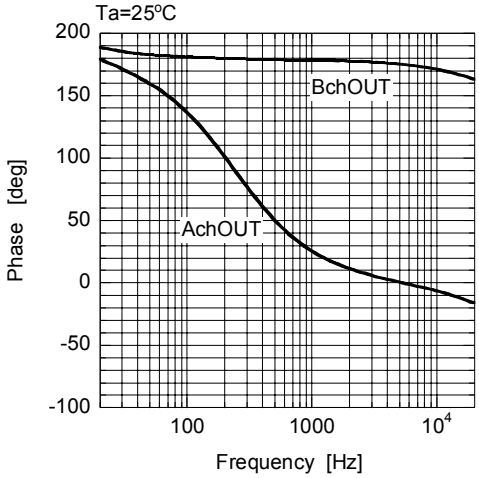
Gain vs Frequency (eala&Simulated)

V+=9V, Vin=0.1Vrms,OUTPUT, Rg=600Ω, Ta=25°C



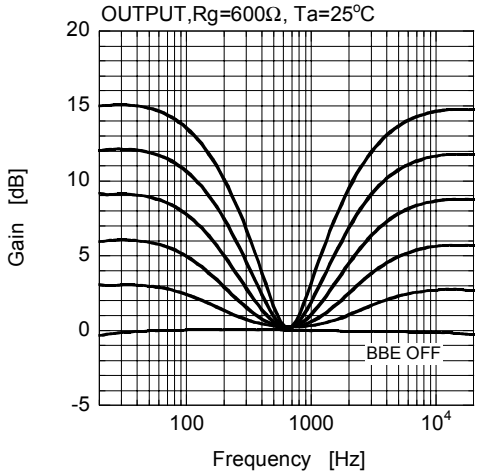
Phase vs Frequency (Simulated)

V+=9V, Vin(A+Bch)=0.1Vrms, Rg=600Ω, Ta=25°C



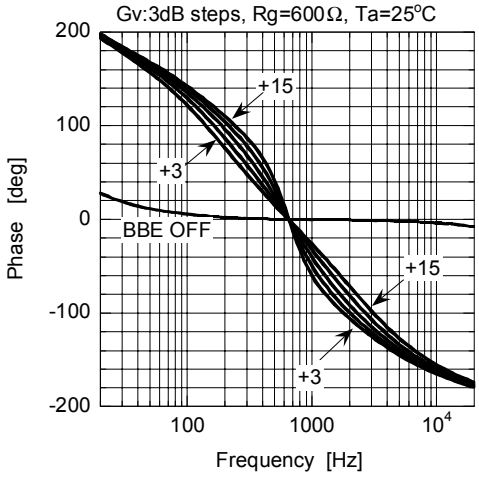
Gain vs Frequency (BBE)

V+=9V, Vin(Ach)=0.1Vrms,Gv=3dB steps OUTPUT,Rg=600Ω, Ta=25°C



Phase vs Frequency (BBE)

V+=9V, Vin(Ach)=0.1Vrms, Vo(Ach) Gv:3dB steps, Rg=600Ω, Ta=25°C



■**NOTE**

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