Sound control IC

BH3852S / BH3852FS

The BH3852S and BH3852FS are signal processing ICs designed for volume and tone control in CD radio cassettes and other audio products. They can be used without a microcomputer because they use DC current for control.

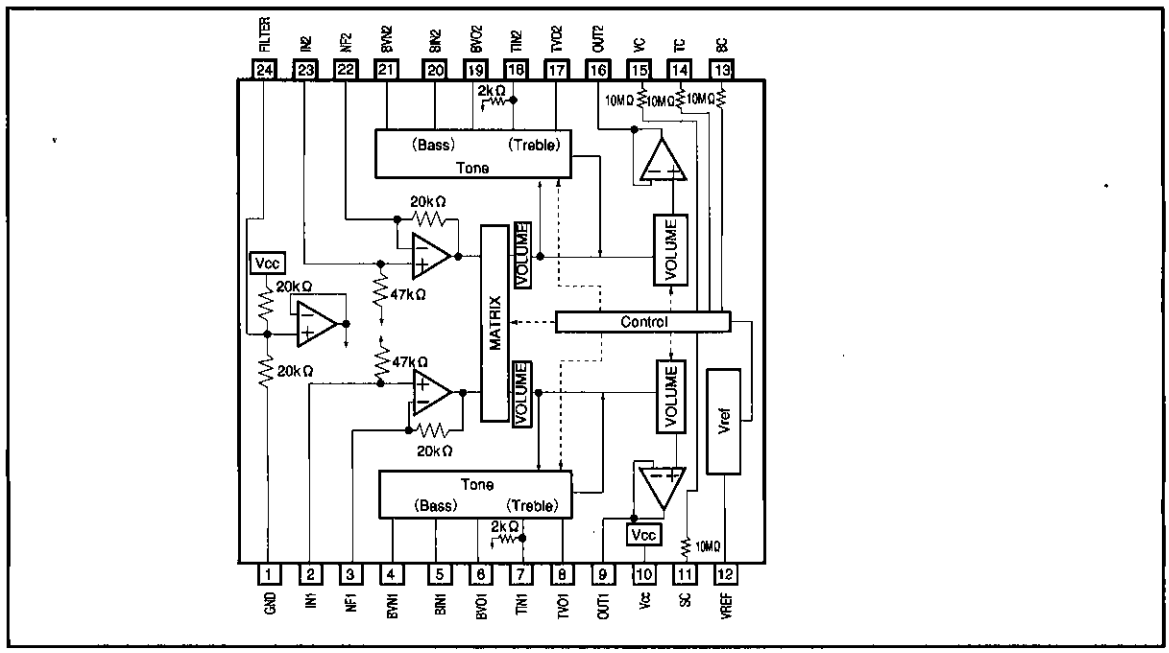
●Applications

CD radio cassettes, micro components, car stereos, televisions

●Features

1) Can control volume (main volume) and tone (bass, treble).
2) Volume is produced by a low-distortion, low-noise VCA, is controlled with DC current, and, due to an internal reference voltage with temperature compensation, can control two channels with a single variable resistor.
3) Input amp can be used for gain adjustment, and matrix surround yields powerful sound.

●Block diagram



ROHM

●Absolute maximum ratings (Ta = 25℃)

Parameter		Symbol	Limits	Unit
Supply voltage		Vcc	10.0	V
Power dissipation	BH3852S	Pd	1050*1	mW
	BH3852FS		800 *2	
Operating temperature		Topr	−40～+85	℃
Storage temperature		Tstg	−55～+125	℃

*1 Reduced by 10.5mW for each increase in Ta of 1℃ over 25℃.
*2 Reduced by 8mW for each increase in Ta of 1℃ over 25℃.

●Recommended operating conditions

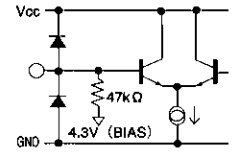
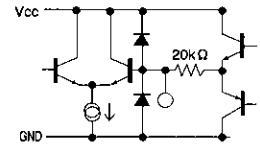
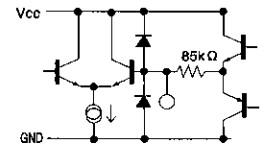
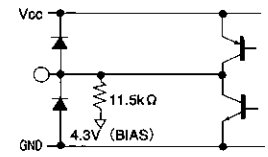
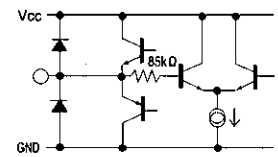
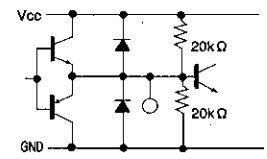
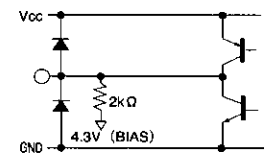
Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	Vcc	5.4	—	9.5	V

●Pin description

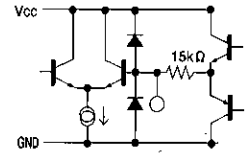
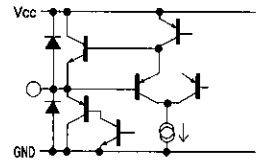
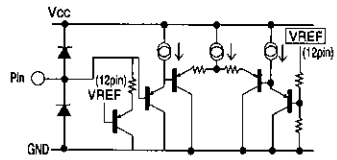
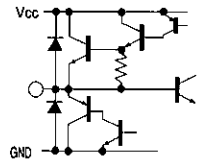
Pin No.	Pin Name	Function
1	GND	Ground
2	IN1	Ch1 volume input pin
3	NF1	Port for adjustment of input AMP gain
4	BVN1	Port for connection to ch 1 low-band filter
5	BIN1	Port for connection to ch 1 low-band filter
6	BVO1	Port for connection to ch 1 low-band filter
7	TIN1	Port for connection to ch 1 high-band filter
8	TVO1	Port for connection to ch 1 high-band filter
9	OUT1	Port for ch 1 volume output
10	Vcc	Power supply port
11	SC	Surround control pin
12	VREF	Standard voltage output pin

Pin No.	Pin Name	Function
13	BC	Bass control pin
14	TC	Treble control pin
15	VC	Volume control pin
16	OUT2	Port for ch 2 volume output
17	TVO2	Port for connection to ch 2 high-band filter
18	TIN2	Port for connection to ch 2 high-band filter
19	BVO2	Port for connection to ch 2 low-band filter
20	BIN2	Port for connection to ch 2 low-band filter
21	BVN2	Port for connection to ch 2 low-band filter
22	NF2	Port for adjustment of input AMP gain
23	IN2	Port for ch 2 volume input
24	FILTER	Filter pin

●Input/output circuit

Symbol	Pin no.	Pin voltage	Equivalent circuit	Description
IN1 IN2	2pin 23pin	4.3V 4.3V		Main volume input pin. Designed for input impedance of 47 kΩ (Typ).
NF1 NF2	3pin 22pin	4.3V 4.3V		Pin for adjustment of input amp gain. Approximately +6 dB with connection of 20 kΩ resistance.
BVN1 BVN2	4pin 21pin	4.3V 4.3V		Pin for low band filter connection.
BIN1 BIN2	5pin 20pin	4.3V 4.3V		Pin for low band filter connection.
BV01 BV02	6pin 19pin	4.3V 4.3V		Pin for low band filter connection.
FILTER	24pin	4.0V		Filter input pin.Filter input pin designed to operate at approximately 1/2 Vcc.Please install a capacitor of a bout 10 μF to the filter pin. Has built-in precharge and discharge circuits.
TIN1 TIN2	7pin 18pin	4.3V 4.3V		Pin for high band filter connection.

●Input/output circuit

Symbol	Pin no.	Pin voltage	Equivalent circuit	Description
TV01 TV02	8pin 17pin	4.3V 4.3V		Pin for high band filter connection.
OUT1 OUT2	9pin 16pin	4.0V 4.0V		Main volume output pin. OUT1 is the volume output for CH1. OUT2 is the volume output for CH2.
SC BC TC VC	11pin 13pin 14pin 15pin			VC: Volume pin TC: Treble pin BC: Bass pin SC: Surround pin
V_{REF}	12pin	3.8V		Regulator output pin. Output requires capacitor for stopping oscillation.Output pin has built-in precharge and discharge circuits, so there is no problem when turned on or off, even with a large capacitor.
VCC	10pin	8V	Power supply voltage pin.	
GND	1pin	0V	GND pin. Connected to IC board.	

Note: All figures for pin voltage assume a power supply voltage (VCC) of 8V.

●Electrical characteristics (Unless otherwise specified, Ta = 25℃, V_{CC} = 8V, f = 1kHz, BW = 20 ~ 20kHz, VOL = Max., TONE = ALL FLAT, R_g = 600Ω, R_L = 10kΩ, INPUT_AMP_GAIN = 0dB)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Quiescent current	I_Q	8	17	25	mA	No signal
Max. input	Vim	1.8	2.0	—	Vrms	THD=1%, VOL=−20dB(ATT)
Max. output	Vom	1.8	2.0	—	Vrms	THD=1%
Voltage gain	G_V	−3.0	−1.0	1.0	dB	Vin=1Vrms
Max. attenuation	ATT	90	110	—	dB	V_O =1Vrms
Cross talk	V_{CT}	57	67	—	dB	V_O=1Vrms, BPF=400Hz~30kHz
Low-band control width	VBmax	12	15	18	dB	75Hz, Vin=100mVrms
	VBmin	−18	−15	−12	dB	75Hz, Vin=100mVrms
High-band control width	VTmax	12	15	18	dB	10kHz, Vin=100mVrms
	VTmin	−18	−15	−12	dB	10kHz, Vin=100mVrms
Mute attenuation	V_{MT}	90	110	—	dB	V_O=1Vrms *
Total Harmonic distortion	THD	—	0.03	0.1	%	V_O=0.3Vrms, BPF=400Hz~30kHz
Output noise voltage	$V_{NO}1$	—	25	35	μVrms	No signal VOL=MAX, Rg=0 *
Output noise voltage during full boost	$V_{NO}2$	—	73	113	μVrms	No signal TONE=ALL MAX, VOL=MAX, Rg=0 *
Residual output noise voltage	VM_{NO}	—	2	10	μVrms	No signal VOL=−∞, Rg=0 *
Standard power supply output voltage	V_{REF}	3.54	3.84	4.41	V	I_{REF}=3mA
Standard power supply output current power	I_{REF}	3.0	10	—	mA	VREF voltage drop of 0.1V or less
Channel balance	G_{CB}	−2.0	0	2.0	dB	CH1 taken as the standard for measurements.
Volume attenuation (-10 dB)	ATT10	−12.6	−10.6	−8.6	dB	V_{IN}=0dBV,VC=0.665XV_{REF}
VC port discharge current	IVC	—	0.2	0.4	μA	Pin 15 discharge current
TC port discharge current	ITC	—	0.2	0.4	μA	Pin 14th discharge current
BC port discharge current	IBC	—	0.2	0.4	μA	Pin 13th discharge current
SC port discharge current	ISC	—	0.2	0.4	μA	Pin 11th discharge current

* Items marked with an asterisk (*) were measured with the VP-9690A (displays mean detection and effective value), produced by Matsushita Communication Industrial.

◎Not designed for radiation resistence.

●Measurement circuit

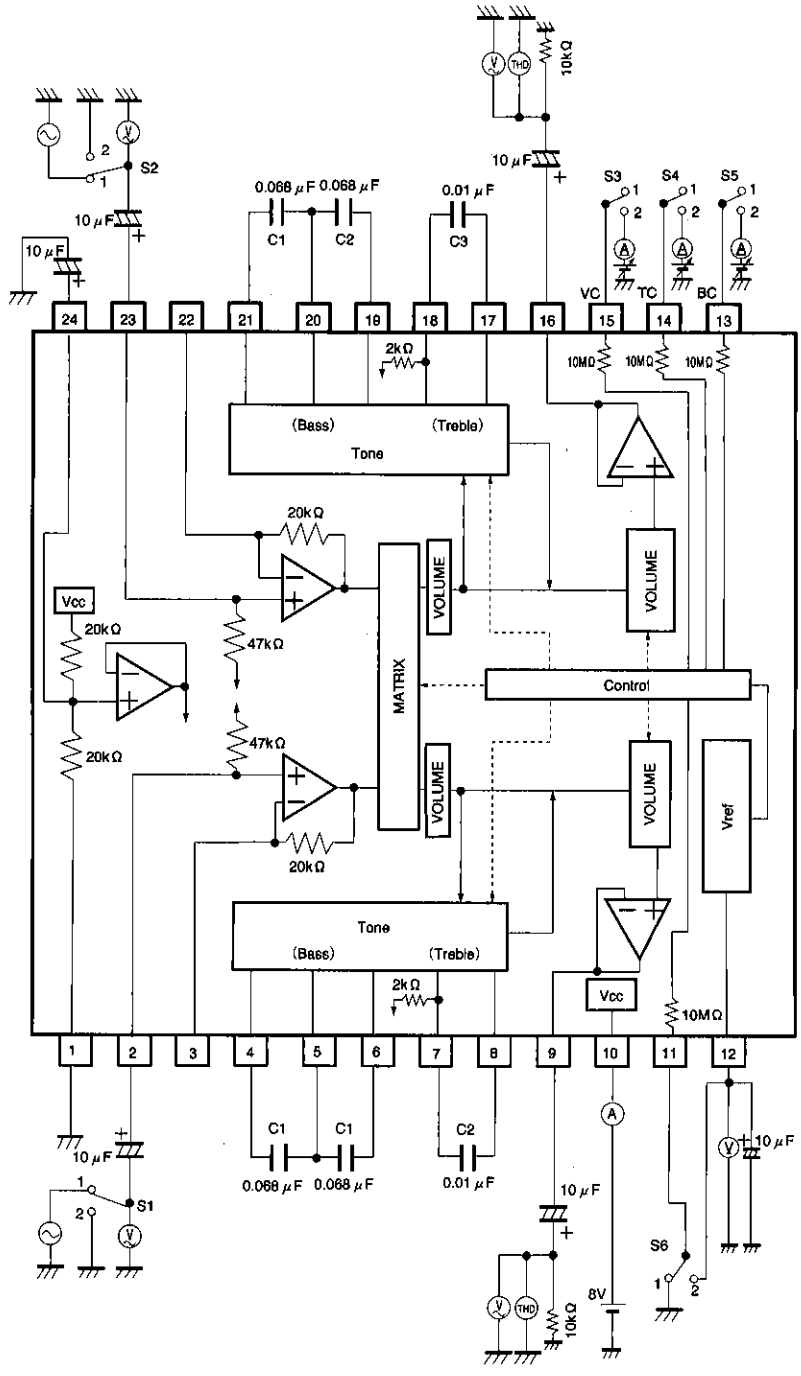


Fig. 1

●Application example

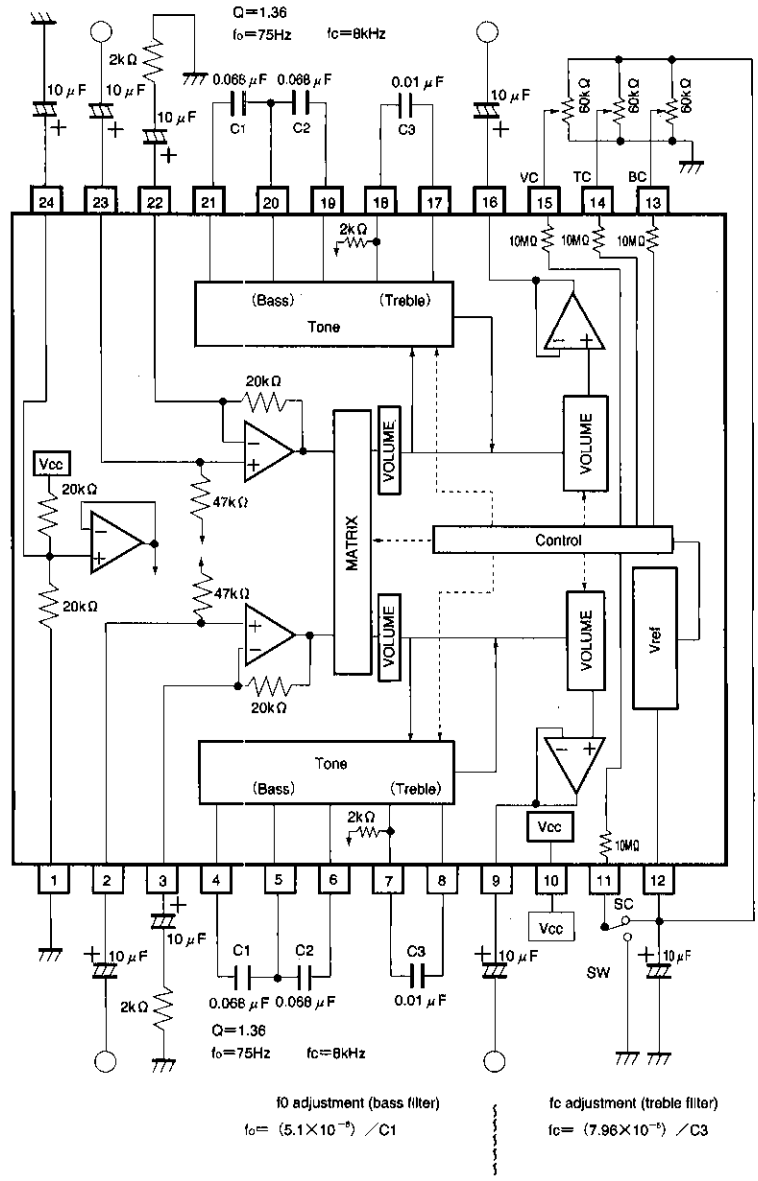
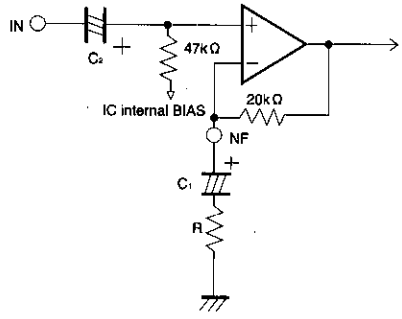


Fig. 2

●Operation notes

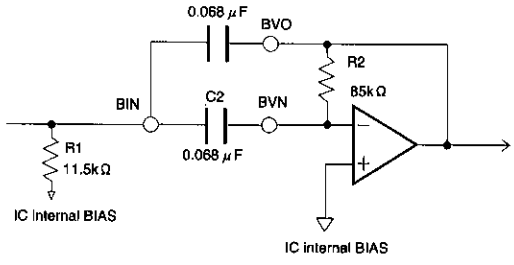
1. Operating power supply voltage range
   As long as the operating power supply voltage and ambient temperature are kept within the specified range, the basic circuits are guaranteed to function, but be sure to check the constants as well as the element settings, voltage settings, and temperature settings. Also, volume curves sometimes depart from target values when there is a combination of low temperature and reduced power.

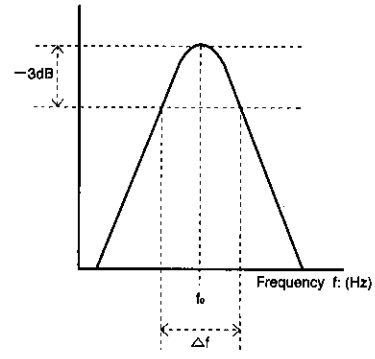
2. Primary amp



- The input impedance is 47kΩ.
- A buffer if R and C_1 are not present.
- The gain can be set by R and the 20kΩ.
  $G_{VC} = (R + 20k\Omega)/R$
  Note: Set C_2 (input coupling) and C_1 (used to set the gain) depending on the frequency band used.

3. Bass filter





- The BPF is composed of a multifeedback active filter.
  f_o can be varied according to the value of C.
  (theoretical equation)

$$f_o = \frac{1}{2\pi} \times \left(\frac{1}{R_1 R_2 C_1 C_2} \right)^{\frac{1}{2}} \qquad Q \fallingdotseq \left\{ \left(\frac{R_1}{R_2 C_1 C_2} \right)^{\frac{1}{2}} \times (C_1 + C_2) \right\}^{-1}$$

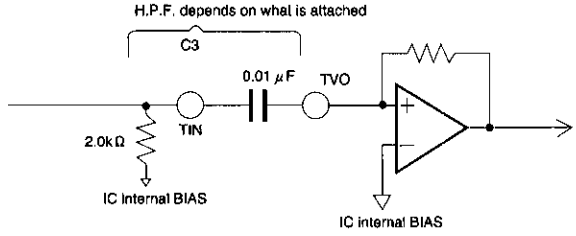
$$G = \frac{R_2}{5k\Omega} \times \left(1 + \frac{C_1}{C_2} \right)^{-1}$$

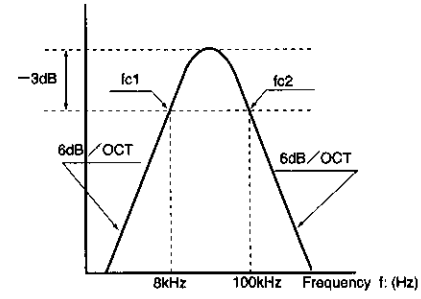
Note: Filter gain is calculated using the equation on the left. Total output gain is the sum of the gain for each of the internal circuits.

(When $R_1 = 11.5k\Omega$, $R_2 = 85k\Omega$, $C_1 = C_2 = C$)

$$f_o = \frac{5.1 \times 10^{-6}}{C} \qquad Q = 1.36 \quad G = 8.5$$

4. Treble filter





- Cutoff frequency (f_{c1}) for the bypass filter can be changed using the attached C_3.

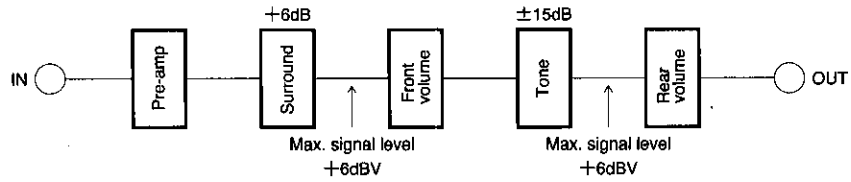
$$f_{c1} = \frac{1}{2\pi \times C_3 \times 2k\Omega}$$

The f_{c1} for the recommended constant is approximately 8 kHz.

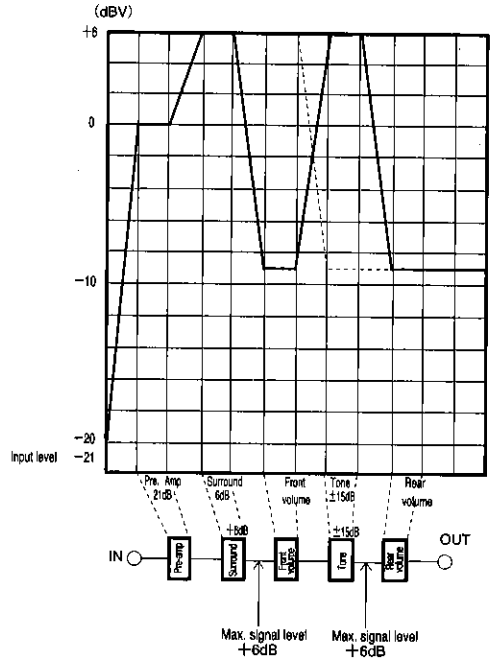
- f_{c2} is determined by the band of the built-in amp. f_{c2} is approximately 100 kHz.

Tone control is designed to yield a variation of ±15dB (Typ.) when the frequency to be boosted or cut is at the peak or bottom of the filter frequency characteristic, so please take the frequency characteristic into consideration in designing the filter.

5. Signal level setting
The following figure represents the standard setting for the BH3852FS.

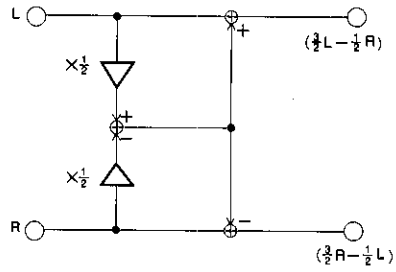


★As indicated above, if the front volume and rear volume input level are set so as not to exceed +6dBV (2Vrms), the pre-amp gain setting can be used to improve the S/N ratio.



The figure on the left is a level diagram.
Solid line: Input level during tone boost
Dotted line: Input level during tone cut

6. Matrix surround



◎ The structure of the matrix surround is as shown in the figure above. Use the equations shown in the figure to calculate gain.

In-phase gain	0dB
Negative-phase gain	3.5dB

(Negative-phase gain only occurs when input is carried out at a single Ch.)

7. DC control
It is recommended that DC control of the VC, TC, BC, and SC pins be performed by voltage delivered in variable volume from the VREF pin (12th pin). When using variable volume, take the discharge current of each pin into account in determining its settings.
Note:The voltage range for DC control is 0 (V) to V_{REF}(V). Be sure not to apply voltage greater than V_{REF}(V) to any pin.

8. GND
If several capacitors with good high-frequency characteristics are connected in parallel to the 12th-pin capacitor, the characteristics will be improved with respect to static electricity noise. (Recommended : ceramic capacitors of 0.001 μF to 0.1 μF)

●Electrical characteristic curves

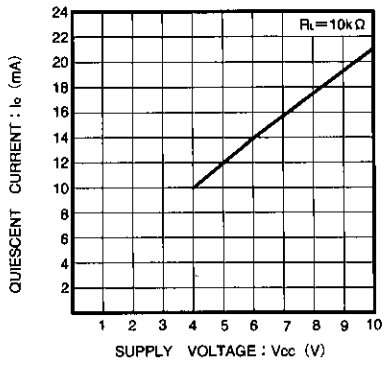


Fig. 3 Quiescent curve vs. supply voltage characteristics

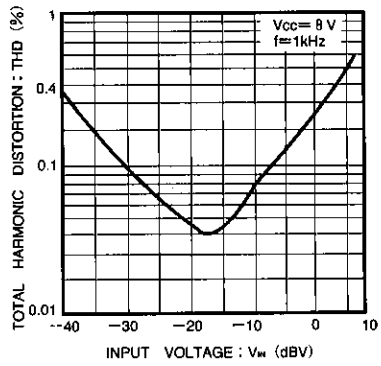


Fig.4 Harmonic distortion vs. Input voltage characteristics

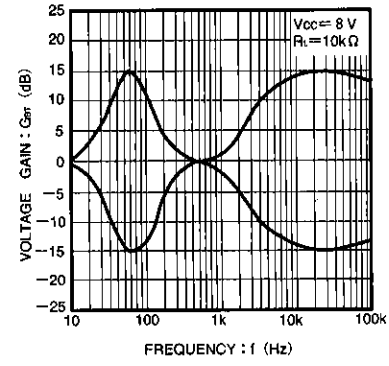
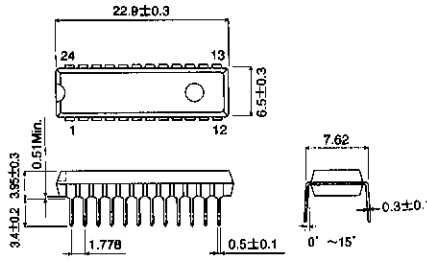


Fig. 5 Output gain vs. Frequency

●External dimensions (Unit: mm)

BH3852S



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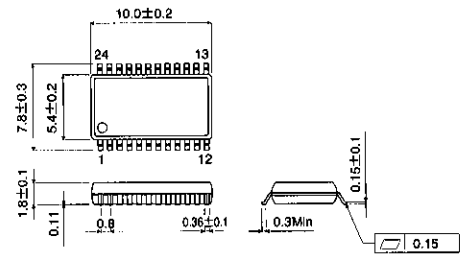

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