1.5V/15mW dual power amplifier
BA5152F

The BA5152F is a dual-channel power amplifier designed for 1.5V headphone stereos. The circuit consists of a power supply circuit, mute circuit, bias circuit, and two amplifier circuits. To simplify assembly, the gain is fixed, so external negative-feedback components are not required.

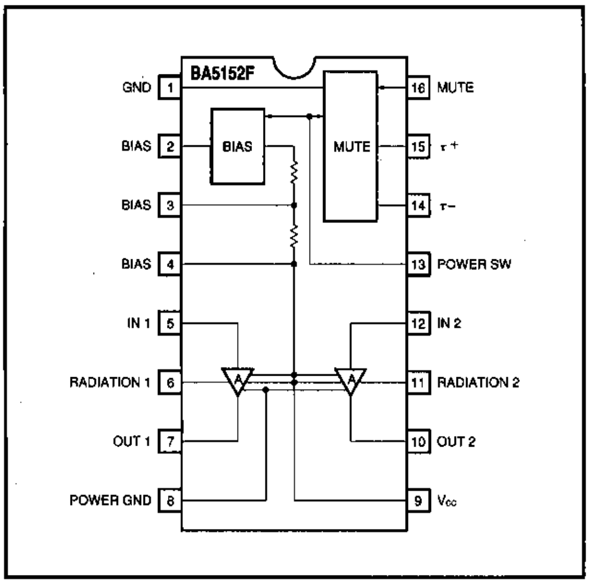
● Applications

1.5V headphone Hi-Fi stereos

● Features

1) High output. P_{OUT} = 15mW (R_L = 16Ω).
2) Small "pop" noise.
3) Mute circuit terminal provided.
4) Terminals provided for radiation countermeasures.
5) Good ripple rejection.
6) Few external components required.
7) Good low-voltage characteristics.
8) Built-in power switch circuit.

● Block diagram



● Absolute maximum ratings (Ta = 25℃)

Parameter	Symbol	Limits	Unit
Supply voltage	V_{CC}	4.5	V
Power dissipation	Pd	500*	mW
Operating temperature	Topr	−25~75	℃
Storage temperature	Tstg	−55~125	℃

* Reduced by 5.0mW for each increase in Ta of 1°C over 25°C (when mounted on a 50mm x 50mm x 1.6mm glass epoxy PCB).

●Recommended operating conditions (Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	1.0	1.5	1.8	V

●Electrical characteristics (unless otherwise specified Ta = 25°C, V_{CC} = 1.5V, f= 1kHz and R_L = 16Ω)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Quiescent current	I_Q	—	12	18	mA	V_{IN}=0V_{rms}	Fig.1
Closed-circuit voltage gain	G_{VC}	18	21	24	dB	V_{IN}=−46dBm	Fig.1
Rated output	P_{OUT}	10	15	—	mW	THD=10%	Fig.1
Total harmonic distortion	THD	—	1	3	%	P_O=2.5mW	Fig.1
Output noise voltage	V_{NO}	—	23	47	μV_{rms}	R_g=0Ω, BPF=20Hz~20kHz	Fig.1
Input resistance	R_{IN}	6.6	9.5	12.4	kΩ	—	Fig.1
Ripple rejection ratio	RR	35	45	—	dB	V_{RR}=−30dBm, f_{RR}=100Hz, R_g=0Ω	Fig.1
Standby current	I_{ST}	—	0	10	μA	13pin : OPEN	Fig.1
Channel balance	CB	—	—	2	dB	—	Fig.1
Mute level	MUTE	70	—	—	dB	V_{IN}=−20dBm, 16pin : V_{CC}	Fig.1

●Measurement circuit

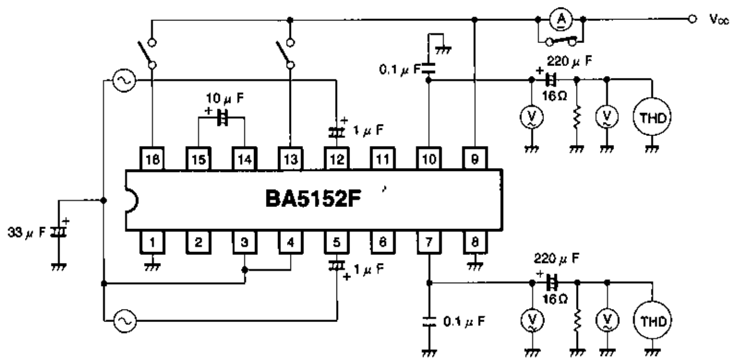


Fig. 1

●Application example

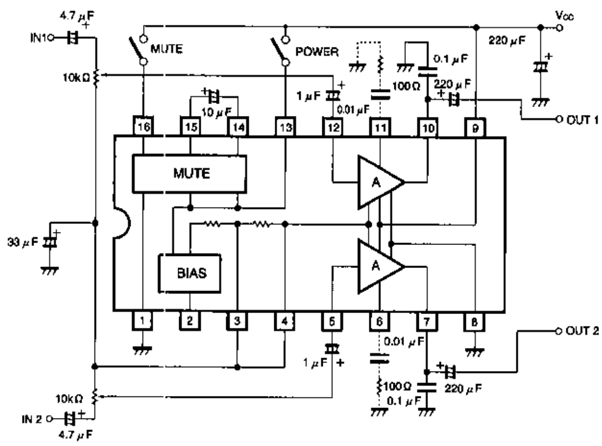
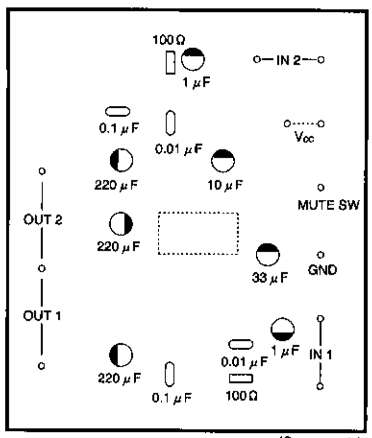


Fig. 2

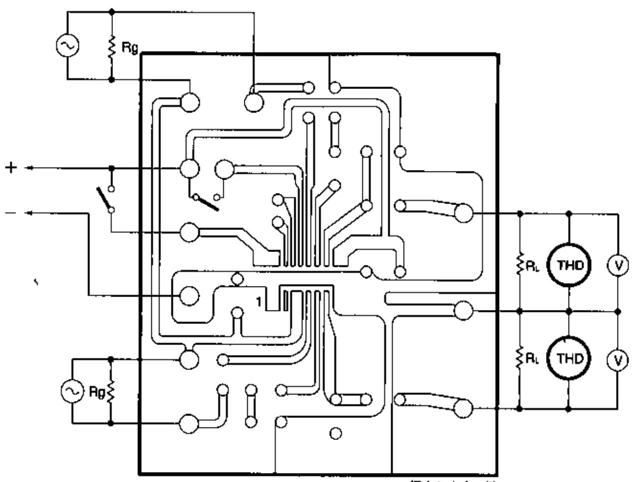
●Application example circuit PCB



(Components)

Fig. 3

●Application example component layout



(Printed circuit)

Fig. 4

●Complete application example circuit

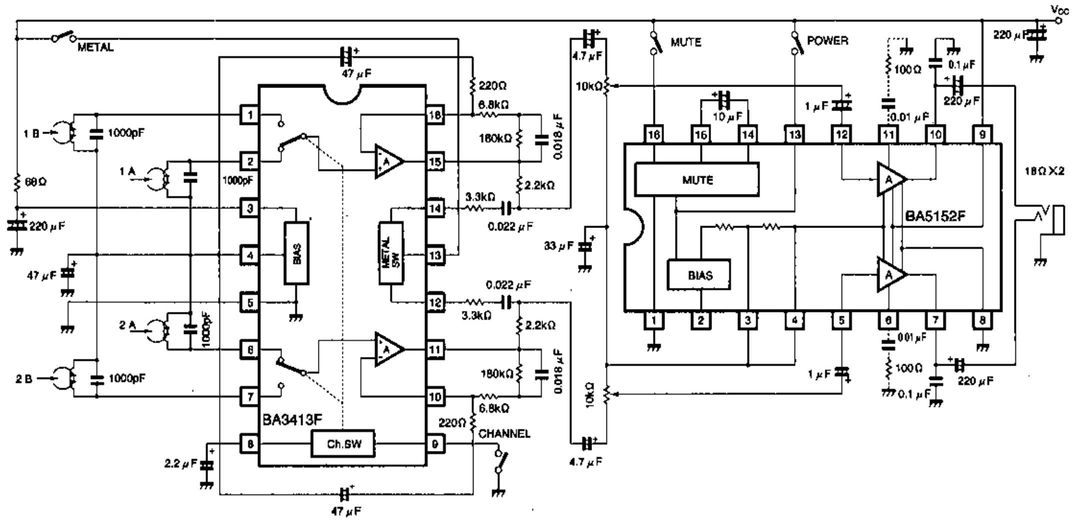


Fig. 5

●Circuit description

(1) Power supply block

The BA5152F has an internal power switch, so the Vcc terminal (pin 9) connects directly to the power source. Pin 13 is the power switch, and if it is left open, no bias current flows in the circuit and the IC will not operate.

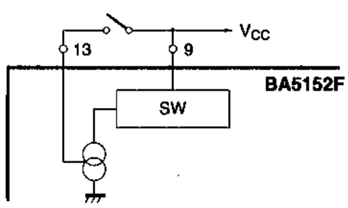


Fig. 6

(2) Mute circuit block

When pin 13 is connected to Vcc, the IC starts up, but the mute circuit operates to suppress a "pop" sound from being generated. The time constant of the power-on mute circuit is determined by the capacitor connected between pins 14 and 15. It is also possible to force the mute circuit to operate by connecting pin 16 to Vcc. There is no time constant in this case.

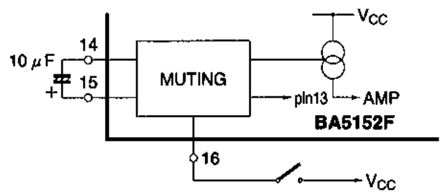


Fig. 7

(3) Bias block

The components connected to pins 2, 3, and 4 set the bias point and V_{ODC}. When pin 2 is open circuit, and V_{CC} = 1.25V, the output pin V_{ODC} voltage is internally set to 1 / 2V_{CC}. By connecting a resistor to pin 2 and changing the voltage divider ratio, it is possible to vary V_{ODC}.

Pins 3 and 4 are shorted and connected to earth via an electrolytic capacitor to generate the bias point. When a 33 μF component is used, it is possible to obtain 45dB of ripple rejection. This can be improved if pins are independently grounded through capacitors.

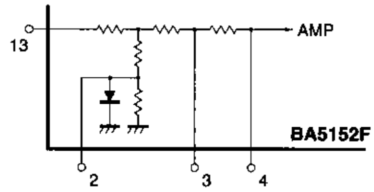


Fig. 8

(4) Amplifier block

The amplifier circuits have a fixed gain of G_V = 21dB. The negative-feedback circuits are on the chip, and the ground point of the negative-feedback circuit uses the bias point as its reference, so connect the input potentiometer to the bias point pins (3 and 4). Connect bypass capacitors to the output pin to prevent oscillation. When the IC is used in sets containing an AM radio, it is possible to reduce unnecessary radiation from the power amplifiers by connecting CR circuits to pins 6 and 11.

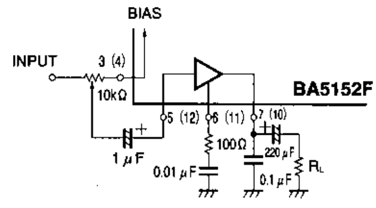


Fig. 9

●Electrical characteristics curves (Ta = 25°C)

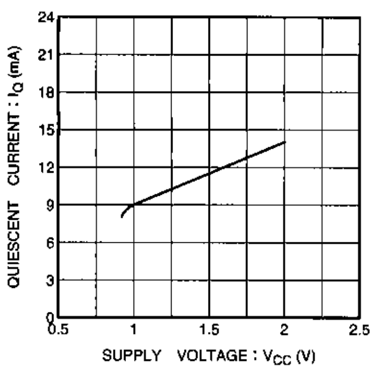


Fig. 10 Quiescent current vs. supply voltage

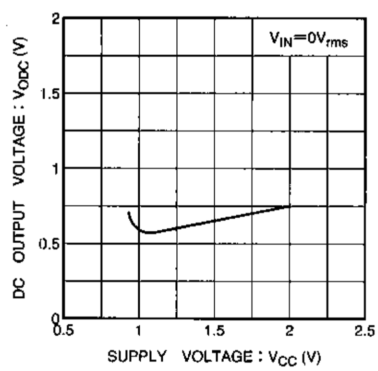


Fig. 11 DC output voltage vs. supply voltage

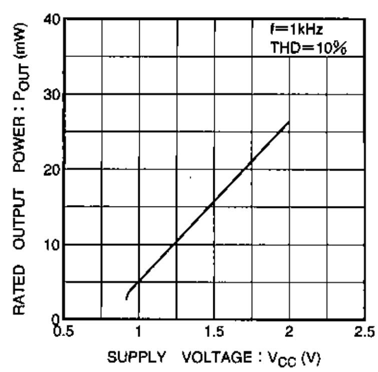


Fig. 12 Output voltage vs. supply voltage

● Electrical characteristics curves

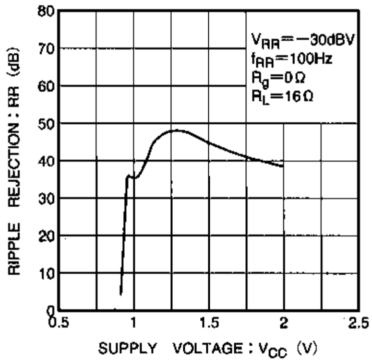


Fig. 13 Ripple rejection ratio vs. supply voltage

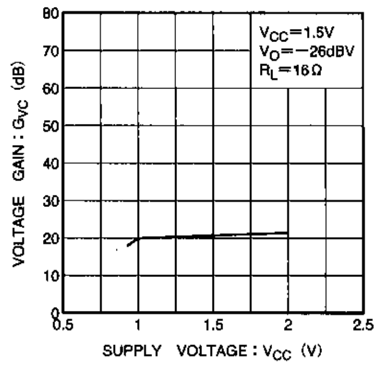


Fig. 14 Voltage gain vs. supply voltage

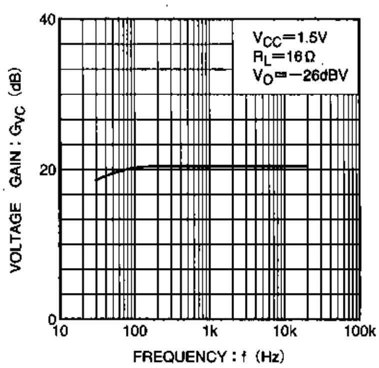


Fig. 15 Voltage gain vs. frequency

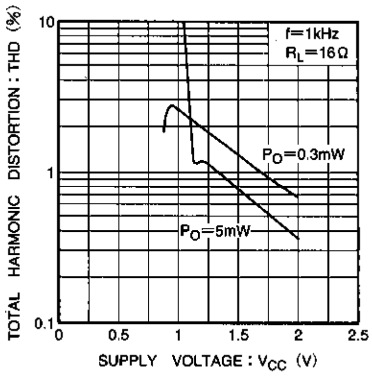


Fig. 16 Total harmonic distortion vs. supply voltage

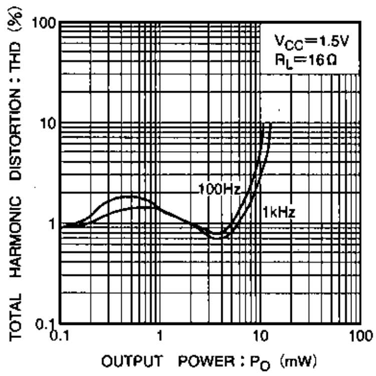
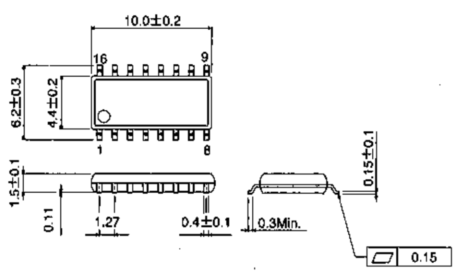


Fig. 17 Total harmonic distortion vs. output voltage

● External dimensions (Unit: mm)



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3V/35mW dual power amplifier

BA5204F

The BA5204F is a dual-channel power amplifier designed for 3V stereo headphone tape players. There is almost no "pop" sound generated when the power is switched on and off, so this IC is ideal for headphone applications. Input coupling capacitors are not required, and only one filter capacitor is needed which helps reduce set size. In addition to operating off low voltage, the IC has low distortion, making it suitable for Hi-Fi applications. The circuit can operate down to 1.5V, and has excellent ripple rejection, so it is not adversely influenced by the motor or tape transport systems.

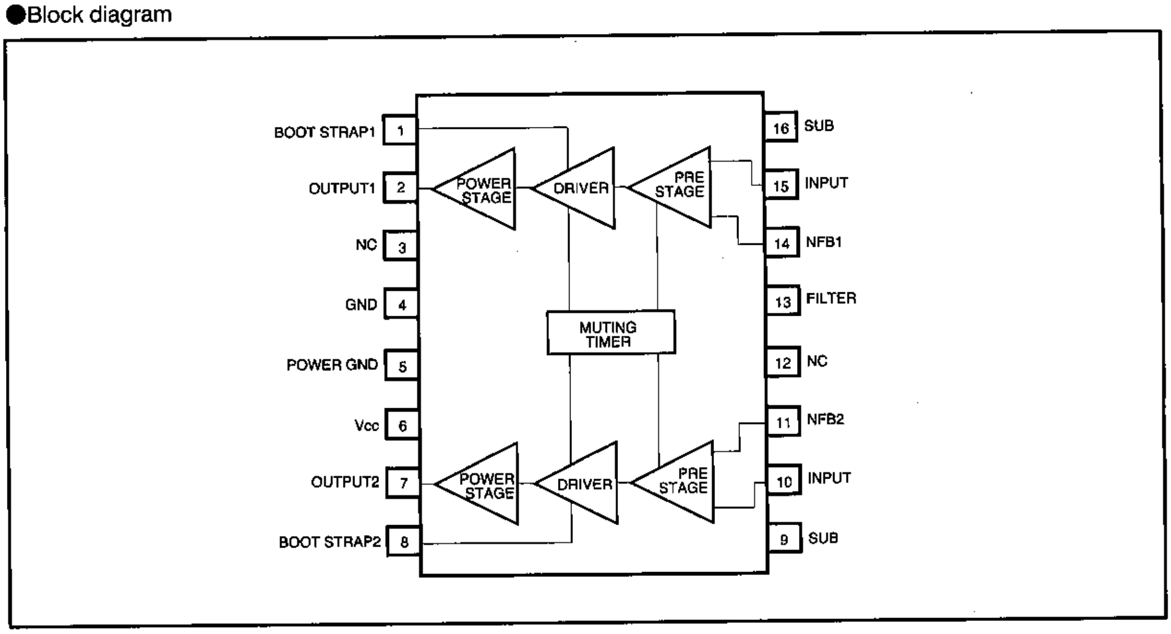
●Applications

3V compact cassette headphone stereos players, micro cassette players, and FM stereo radios.

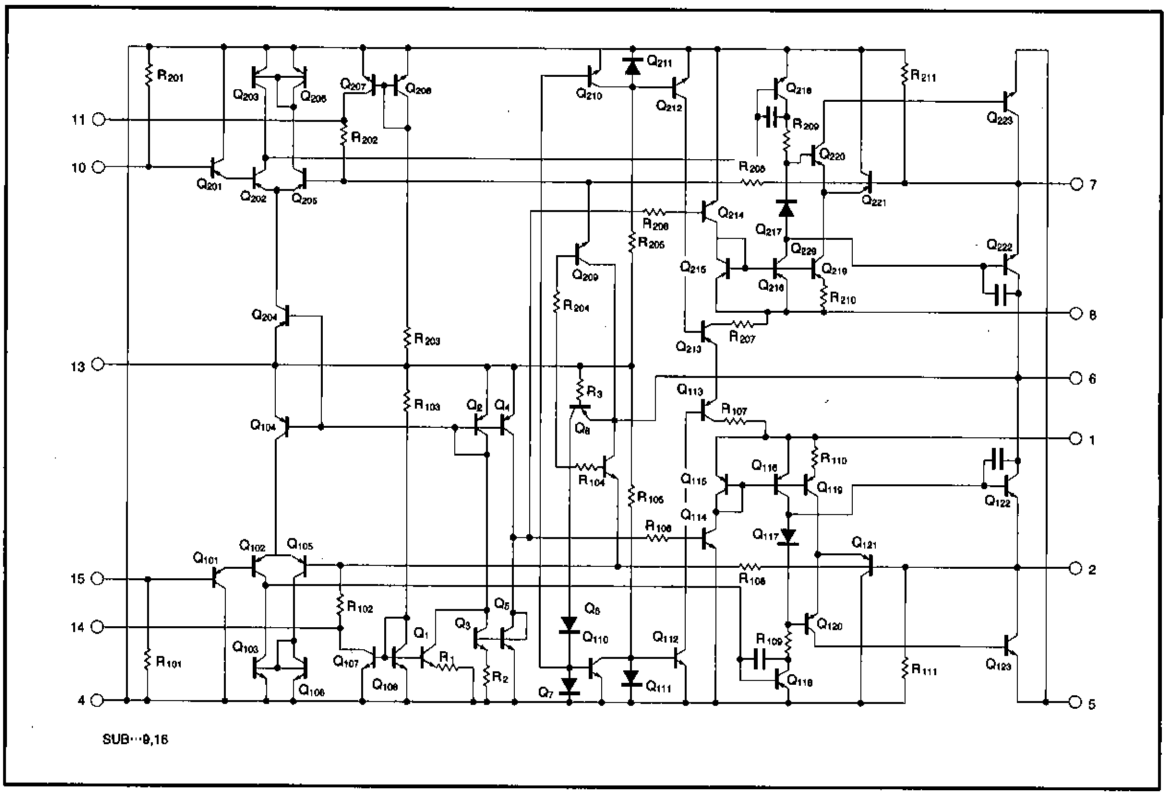
●Features

1) Rated output of 35mW (RL = 32Ω) off a 3V power supply.
2) Low "pop" noise when power is switched on and off.
3) Low quiescent current (13mA).
4) Excellent ripple rejection (38dB).
5) Begins operating at 1.5V.
6) Low distortion (0.05% at P_O = 5mW).
7) Good voltage gain balance between channels.
8) Good channel separation (60dB typ.).
9) Input coupling capacitors not required.
10) Symmetrical pin layout facilitates PCB design.

●Block diagram



● Internal circuit diagram



● Circuit explanation (refer to the Internal Circuit diagram)

(1) Preamplifier Stage

The preamplifier is comprised of the level-shift transistor Q_{101}, a differential amplifier (Q_{102} and Q_{105}), and the active load (Q_{103} and Q_{106}). The input is a PNP transistor that does not require a coupling capacitor.

(2) Pre-drive stage

Q_{118} is the pre-drive transistor. Q_{122} and Q_{120} form the load.

(3) Power stage

Comprised of phase-inverting transistor Q_{120}, and power transistors Q_{122} and Q_{123}.

(4) Idling current setting circuit

The idling current is controlled so that the difference between the V_{BE} of the power transistor Q_{122} and the V_{BE} of the phase-inverting transistor Q_{120} is the same as the difference between the V_F of the constant-voltage diode Q_{117} and the V_{BE} of Q_{121}.

(5) Negative-feedback circuit

The closed-circuit gain with negative feedback is determined by R_{108}, R_{102}, and the value of the resistor connected to the NFB pin. Part of the gain setting resistance is on the chip (R_{102}) to reduce variance between components.

(6) "Pop" noise elimination circuit

The IC has an internal timing circuit (with switch for operation) to reduce the "pop" noise that occurs when power is applied.

●Absolute maximum ratings (Ta = 25℃)

Parameter	Symbol	Limits	Unit
Supply voltage	Vcc	6.0	V
Power dissipation	Pd	500*	mW
Operating temperature	Topr	−25~75	℃
Storage temperature	Tstg	−55~125	℃
Junction temperature	Tj	125	℃

* Reduced by 5.0mW for each increase in Ta of 1°C over 25°C
(when mounted on a 70mm x 70mm x 1.6mm glass epoxy PCB).

●Electrical characteristics (unless otherwise specified Ta = 25℃, Vcc = 3V, f= 1kHz and RL = 32Ω)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Quiescent circuit current	I_Q	−	13	20	mA	V_{IN}=0Vrms
Closed-circuit voltage gain	G_{VC}	32	35	38	dB	V_{IN}=−45dBm
Rated output	P_{OUT}	23	35	−	mW	THD=10%
Distortion	THD	−	0.05	0.3	%	P_O=5mW
Output noise voltage	V_{NO}	−	80	200	μVrms	R_g=0Ω、G_{VC}=35dB B.P.F.20Hz~20kHz
Input resistance	R_{IN}	2.0	30	−	kΩ	−
Ripple rejection ratio	RR	28	38	−	dB	V_{RR}=−20dBm、f=100Hz、 R_g=0Ω
Operation start voltage	V_S	−	1.5	1.8	V	−

●Measurement circuit

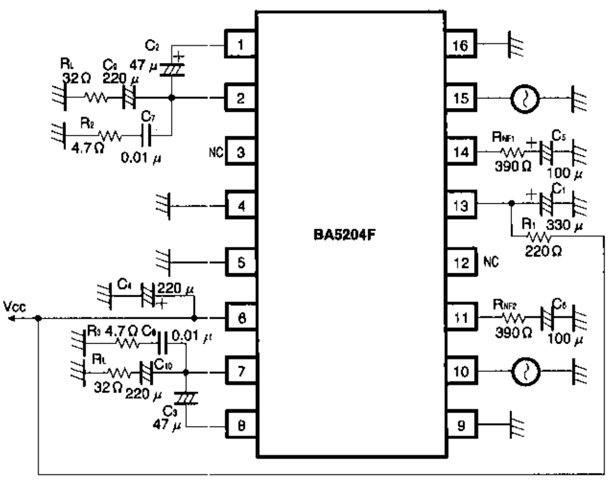


Fig. 1

●Application example

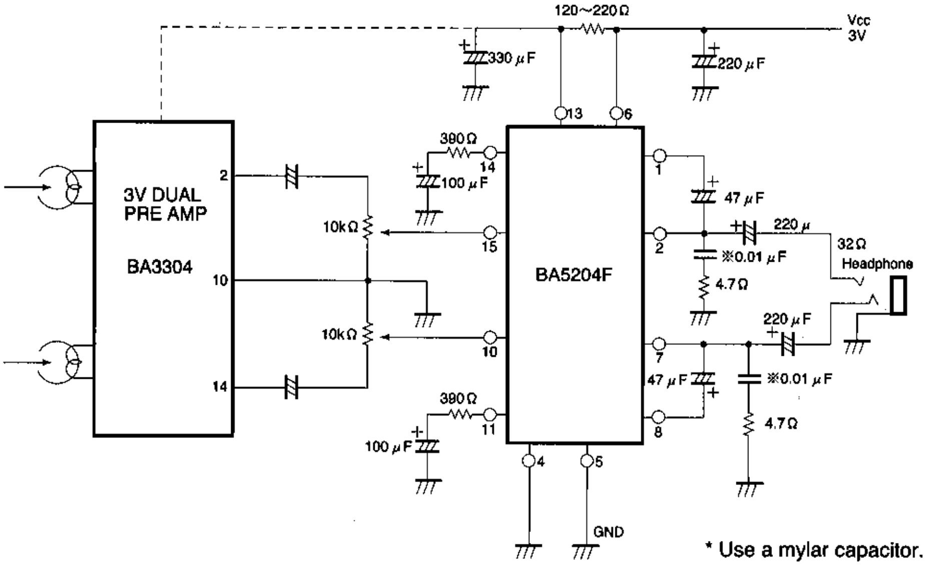


Fig. 2 Application example circuit for a 3V stereo compact-cassette player.

●External components (Fig. 15)

C_1 : filter capacitor

The recommended value is 330μF. If this is reduced too much, the ripple rejection ratio will drop. This capacitor also sets the muting time when power is applied. Reduce the value of this capacitor if you wish to shorten the startup time. On the other hand, if you wish to reduce the "pop" noise further, increase the value of this capacitor to lengthen the startup time.

C_2 and C_3 : bootstrap capacitors

The recommended value is 47μF. If the capacitance is too small, the IC will not be able to produce its rated power in the bass region and distortion will increase.

C_5 and C_6 : feedback circuit DC blocking capacitors

These capacitors and RNF set the bass cutoff frequency.

$$ch_1 \cdots\cdots f_{LC1} = \frac{1}{2\pi \cdot C_5 \cdot (R_{NF1}+R_{102})}$$

$$ch_2 \cdots\cdots f_{LC2} = \frac{1}{2\pi \cdot C_6 \cdot (R_{NF2}+R_{202})}$$

R_{NF1} and R_{NF2} determine the amount of feedback for the feedback circuit. These resistors determine the closed-circuit voltage gain (G_{VC}).

C_7 and C_8 : depending on the PCB design, and output circuit wiring, feedback may be applied to the IC's internal circuits and cause high-frequency oscillation. These capacitors prevent this from happening. They also increase the amount of design freedom with regard to the output wiring and PCB artwork. Design the PCB so that the length of the wiring from ch1 and ch2 to capacitors and from the capacitors to GND is as short as possible. Mylar capacitors of about 0.01μF are appropriate for this application, although active capacitors may also be used. The residual impedance and resonant frequency will differ depending on the type of capacitor and therefore have some influence on the effectiveness.

C_9 and C_{10} : output coupling capacitors

The recommended value is 220μF. If the capacitance is too small, the IC will not be able to produce its rated power in the treble region and distortion will increase.

●Electrical characteristics curves

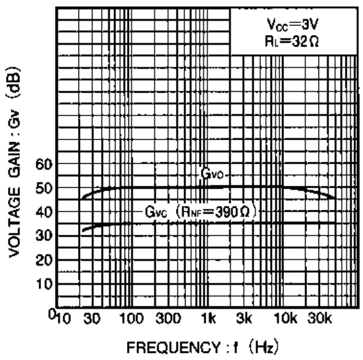


Fig. 3 Voltage gain vs. frequency

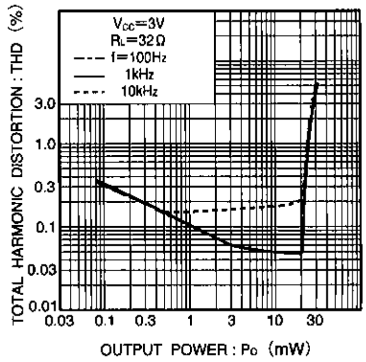


Fig. 4 Distortion vs. output power

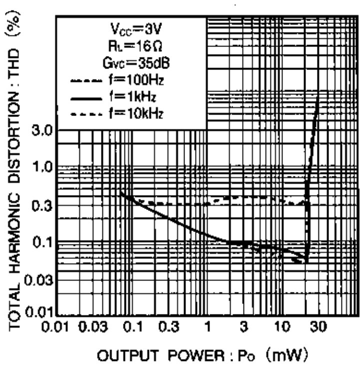


Fig. 5 Distortion vs. output power

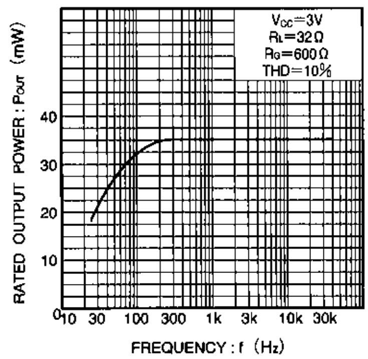


Fig. 6 Rated output power vs. frequency

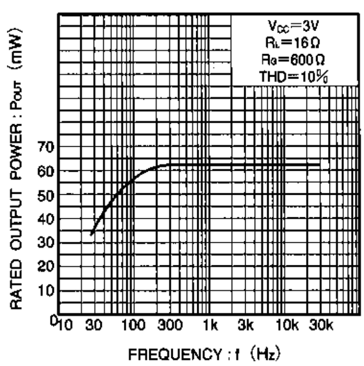


Fig. 7 Rated output power vs. frequency

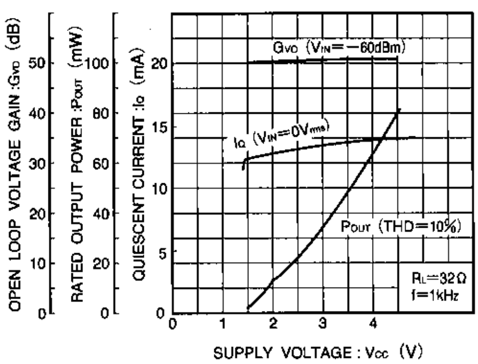


Fig. 8 Open-loop voltage gain/quiescent current/rated output power vs. supply voltage

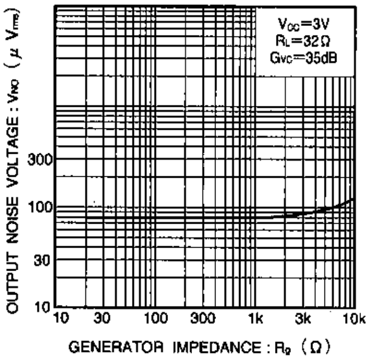


Fig. 9 Output noise voltage vs. signal source impedance

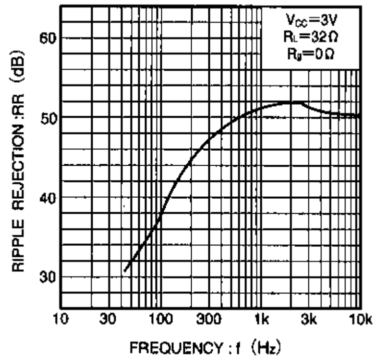


Fig. 10 Ripple rejection ratio vs. frequency

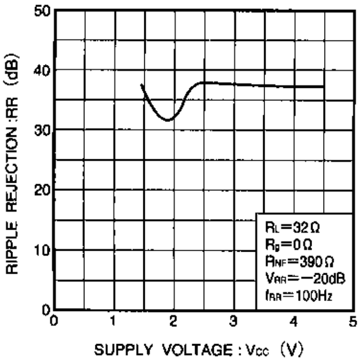


Fig. 11 Ripple rejection ratio vs. supply voltage

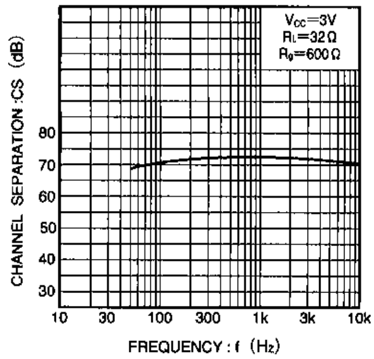


Fig. 12 Channel separation vs. frequency

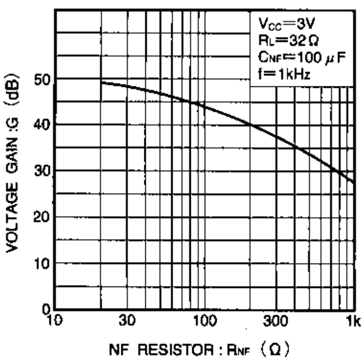


Fig. 13 Voltage gain vs. feedback resistor value

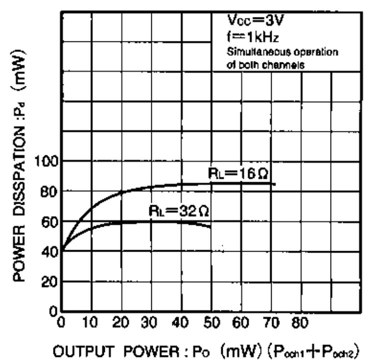


Fig. 14 Power dissipation vs. output power

Power amplifiers
Low-frequency amplifiers

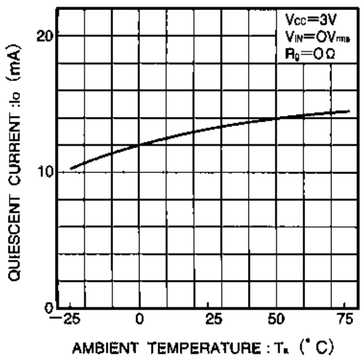


Fig. 15 Quiescent current vs. ambient temperature

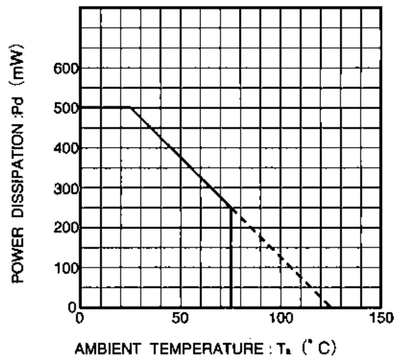
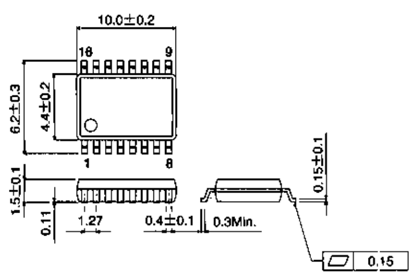


Fig. 16 Allowed power dissipation vs. ambient temperature

●External dimensions (Unit: mm)



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Speaker/headphone switch power amplifier

BA5210FS

The BA5210FS is a power amplifier with a built-in monaural speaker/stereo headphone switch. The speaker drive is BTL for large output, and when the headphones are connected, the "center-amp" design means that coupling is not required. This significantly reduces the number of external components required, and makes this IC ideal for compact sets that have high component density. Mute and standby functions are provided, and direct microprocessor control is possible.

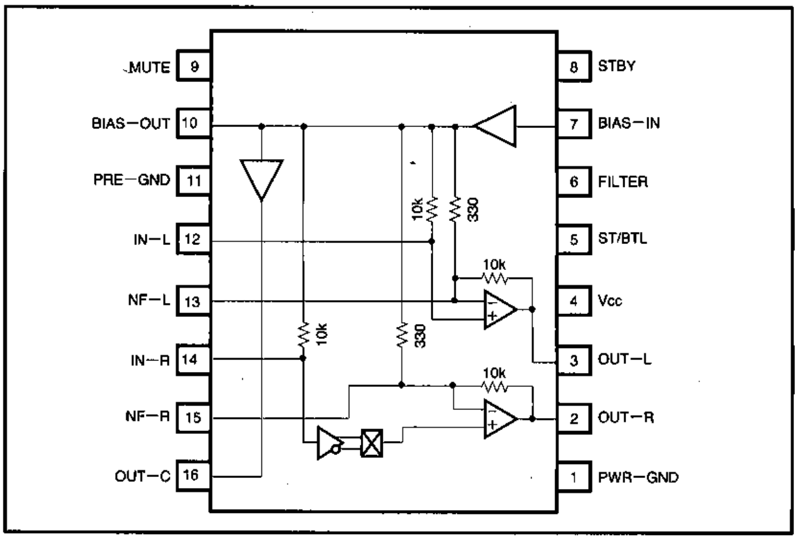
●Applications

Notebook computers, electronic books, portable CD players, video cameras with built-in monitors, LCD TVs, radios, and electronic instruments

●Features

1) Built-in BTL/stereo switch circuit.
2) Mute function.
3) Standby function.
4) Few external components required.
5) Low current consumption and good sound quality.

●Block diagram



ROHM

●Absolute maximum ratings (Ta = 25℃)

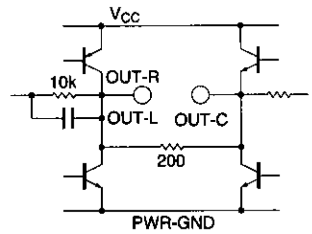
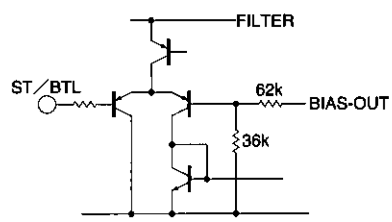
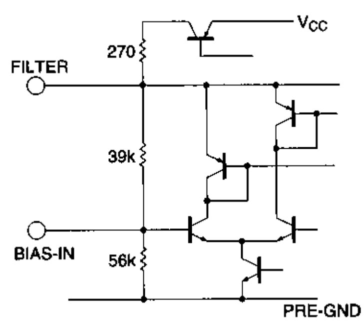
Parameter	Symbol	Limits	Unit
Supply voltage	Vcc	6	V
Power dissipation	Pd	650*	mW
Operating temperature	Topr	−10~60	℃
Storage temperature	Tstg	−55~125	℃

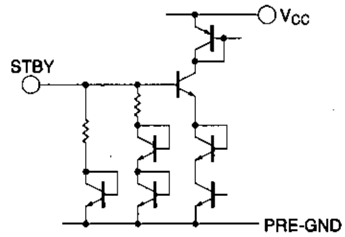
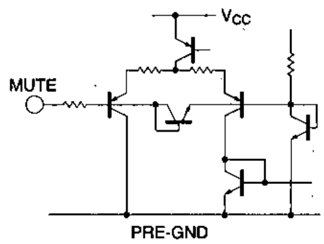
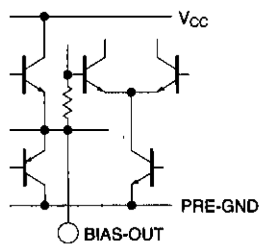
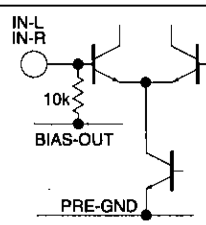
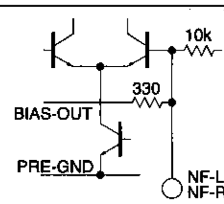
* When mounted on a 90mm x 50mm x 1.6mm glass-epoxy PCB, reduced by 6.5mW for each increase in Ta of 1°C over 25°C.

●Recommended operating conditions (Ta = 25℃)

Parameter	Symbol	Limits	Unit
Supply voltage	Vcc	2.5~6.0	V

●Pin descriptions

Pin No.	Name	Function / No-signal DC voltage (V)	Equivalent circuit
1	PWR−GND	Power amplifier system ground 0	———
2	OUT−R	Power amplifier and system amplifier output terminal This has low output impedance during operation, so if it is shorted to Vcc or GND the IC will probably be destroyed. 1.8	
3	OUT−L		
16	OUT−C		
4	Vcc	Power supply terminal 3.3	———
5	ST/BTL	Stereo/BTL switch terminal The threshold voltage is approximately 0.2 x Vcc. BTL mode when high, and stereo mode when low. 0.9 (BTL) 0 (stereo)	
6	FILTER	Ripple filter During operation a voltage close to the supply voltage is generated. The output impedance is low, so if it is shorted to GND or low impedance power sources, a large current will flow and destroy the IC. 3.0	
7	BIAS−IN	Bias amplifier input This terminal sets the DC operating point for all amplifiers on the IC. 1.8	

Pin No.	Name	Function / o-signal DC voltage (V)	Equivalent circuit
8	STBY	Standby control terminal The more slowly that the voltage rises on this terminal, the lower the noise that occurs when standby is released. 2.6 (E1=3.3V)	
9	MUTE	Mute control terminal The more slowly that the voltage rises and falls on this terminal, the lower the noise that occurs when mute is turned on and off. 1.6 (E2=3.3V) 0 (E2=0V)	
10	BIAS−OUT	Bias amplifier output This is the impedance conversion point for the operating point voltage set by BIAS-IN for supply to the other amplifiers. The output impedance is low, so if it is shorted to Vcc or GND a large current will flow, and the IC will probably be destroyed. 1.8	
11	PRE−GND	Small signal GND 0	————
12	IN−L	Input terminal 1.8	
14	IN−R		
13	NF−L	Feedback terminal 1.8	
15	NF−R		

●Electrical characteristics (unless otherwise specified Ta = 25℃, V_{CC} = 3.3V R_L = 8Ω, f= 1kHz and RG = 600Ω)

<table>
<tr><th>Parameter</th><th>Symbol</th><th>Min.</th><th>Typ.</th><th>Max.</th><th>Unit</th><th colspan="2">Conditions</th></tr>
<tr><td>Circuit current 1</td><td>Icc1</td><td>2</td><td>8</td><td>14</td><td>mA</td><td colspan="2">V_{IN}=0Vrms, R_L=∞</td></tr>
<tr><td>Circuit current 2</td><td>Icc2</td><td>2</td><td>11</td><td>22</td><td>mA</td><td colspan="2">V_{IN}=0Vrms, R_L=8Ω</td></tr>
<tr><td>Voltage gain 1</td><td>Gv1</td><td>32</td><td>35</td><td>38</td><td>dB</td><td colspan="2"></td></tr>
<tr><td>Voltage gain 2</td><td>Gv2</td><td>9</td><td>12</td><td>15</td><td>dB</td><td colspan="2">Stereo operation, R_L = 100 + 16Ω, measured at end of 16Ω</td></tr>
<tr><td>Rated output power 1</td><td>P_{OUT}1</td><td>350</td><td>450</td><td>—</td><td>mW</td><td colspan="2">THD=10%</td></tr>
<tr><td>Rated output power 2</td><td>P_{OUT}2</td><td>1.2</td><td>1.7</td><td>—</td><td>mW</td><td>Measured at end of 16Ω</td><td rowspan="2">Stereo operation, R_L = 100 + 16Ω, THD = 10%</td></tr>
<tr><td>Maximum output voltage</td><td>V_{OM}</td><td>0.9</td><td>1.2</td><td>—</td><td>Vrms</td><td>Measured between L/R output terminal and center amplifier output</td></tr>
<tr><td>Total harmonic distortion 1</td><td>THD1</td><td>—</td><td>0.5</td><td>1.0</td><td>%</td><td colspan="2">Po=50mW</td></tr>
<tr><td>Total harmonic distortion 2</td><td>THD2</td><td>—</td><td>0.2</td><td>0.6</td><td>%</td><td colspan="2">Stereo operation, R_L = 100 + 16Ω, measured between L/R output terminal and center amplifier output Vo=0.5Vrms</td></tr>
<tr><td>Output noise voltage</td><td>V_{NO}</td><td>—</td><td>50</td><td>100</td><td>μVrms</td><td colspan="2">Stereo operation, R_L = 100 + 16Ω, Rg = 0Ω, measured between L/R output terminal and center amplifier output</td></tr>
<tr><td>Ripple rejection ratio</td><td>RR</td><td>58</td><td>65</td><td>—</td><td>dB</td><td colspan="2">Stereo operation, R_L = 100 + 16Ω, V_{RR} = -20dBm, f_{RR} = 1kHz, Rg = 0Ω, measured at end of 16Ω</td></tr>
<tr><td>Channel separation</td><td>CS</td><td>55</td><td>65</td><td>—</td><td>dB</td><td colspan="2">Stereo operation, R_L = 100 + 16Ω, Vo = 0dBm, at end of 100 + 16Ω</td></tr>
<tr><td>Input resistance</td><td>R_{IN}</td><td>8</td><td>10</td><td>12</td><td>kΩ</td><td colspan="2"></td></tr>
<tr><td>Standby release threshold</td><td>VthSA</td><td>—</td><td>1.5</td><td>2.0</td><td>V</td><td colspan="2">Stereo operation, R_L = 100 + 16Ω, measured at end of 16Ω, GV2 > 6dB</td></tr>
<tr><td>Standby threshold</td><td>VthSB</td><td>0.2</td><td>0.6</td><td>—</td><td>V</td><td colspan="2">V_{IN} = 0Vrms, R_L = 8Ω, Icc2 < 10μA</td></tr>
<tr><td>Mute on threshold</td><td>VthMA</td><td>—</td><td>0.8</td><td>2.0</td><td>V</td><td colspan="2">Stereo operation, R_L = 100 + 16Ω, V_{IN} = -25dBm, Vo < -80dB (end of 16Ω)</td></tr>
<tr><td>Mute off threshold</td><td>VthMB</td><td>0.2</td><td>0.7</td><td>—</td><td>V</td><td colspan="2">Stereo operation, R_L = 100 + 16Ω, measured at end of 16Ω, GV2 > 6dB</td></tr>
<tr><td>Standby terminal source current</td><td>I_{SS}S</td><td>—</td><td>30</td><td>100</td><td>μA</td><td colspan="2"></td></tr>
<tr><td>Mute terminal source current</td><td>I_{SS}M</td><td>—</td><td>20</td><td>100</td><td>μA</td><td colspan="2"></td></tr>
</table>

●Measurement circuit

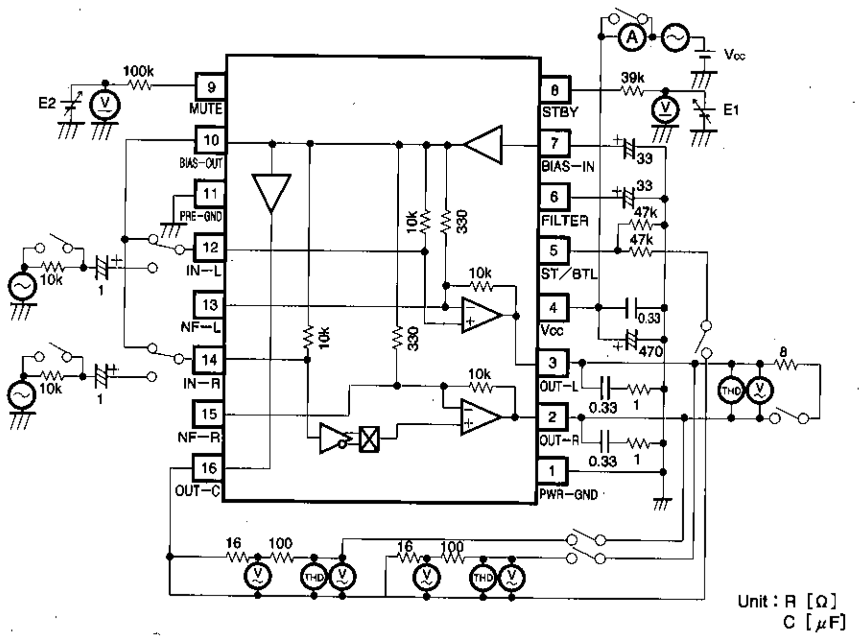
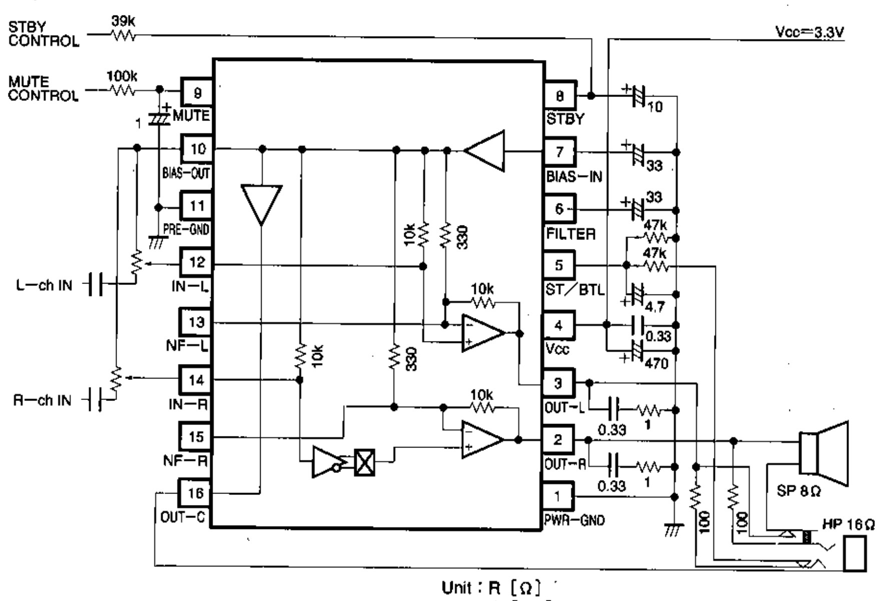


Fig. 1

●Application example



Unit : R [Ω]
C [μF]

STBY: operating when H, standby when L
MUTE: mute on when H, off when L

Fig. 2

● Operation notes

A characteristic of this IC is that if it is used with a supply voltage that is less than the recommended value (2.5V), the OUT-R offset increases. When using the IC with a BTL 8 Ω load, if the voltage drops, the supply current will increase accompanied by an increase in power supply impedance, which can lead to low-frequency blocking oscillation. For this reason, we recommend that you use a low-voltage detection circuit that puts the IC in the standby state when the voltage drops below 2.5V.

● Electrical characteristics curves

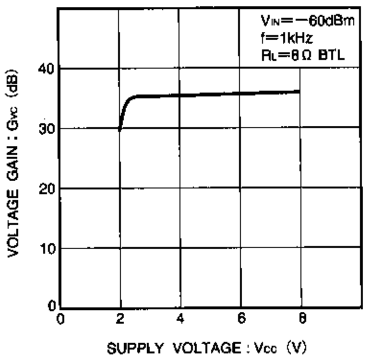


Fig. 3 Voltage gain vs. supply voltage

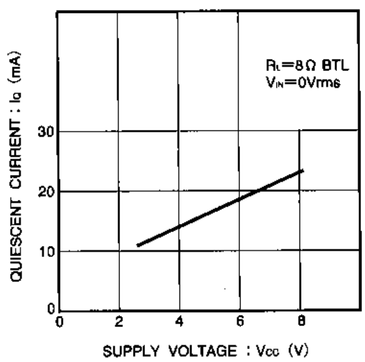


Fig. 4 Quiescent current vs. supply voltage

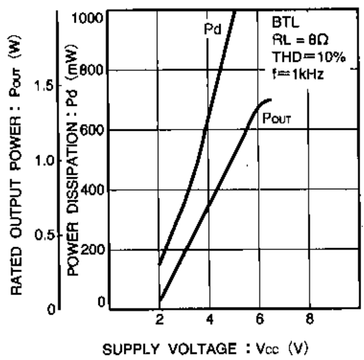


Fig. 5 Power dissipation and rated output power vs. supply voltage

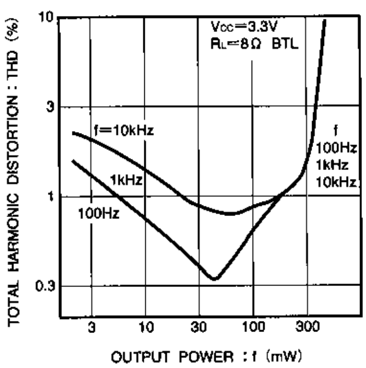


Fig. 6 Distortion vs. output

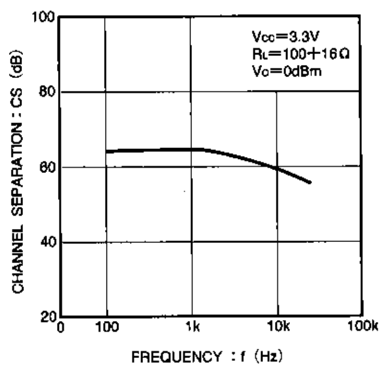


Fig. 7 Channel separation vs. frequency

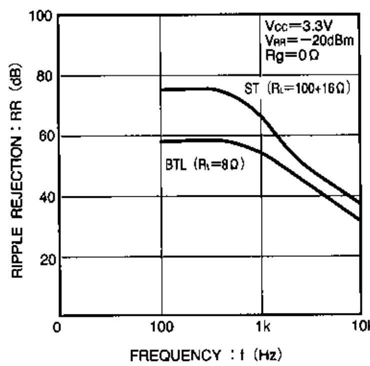


Fig. 8 Ripple rejection vs. frequency

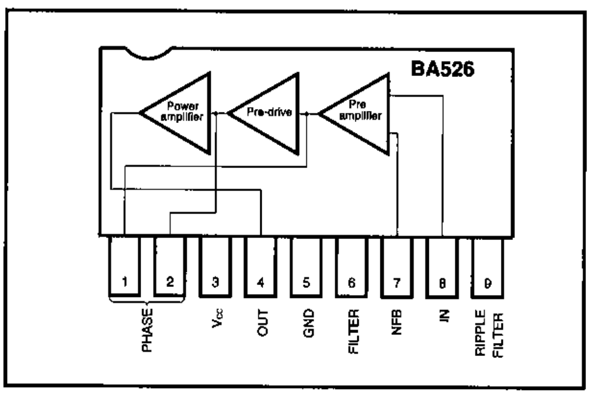
6V/430mW single-channel power amplifier
BA526

The BA526 is a high-output monolithic power amplifier with excellent audio quality. With a 6V power supply, it has a rated output of 430mW into an 8Ω load (THD = 10%), and a maximum output of 700mW. It comes in a compact 9-pin SIP package.

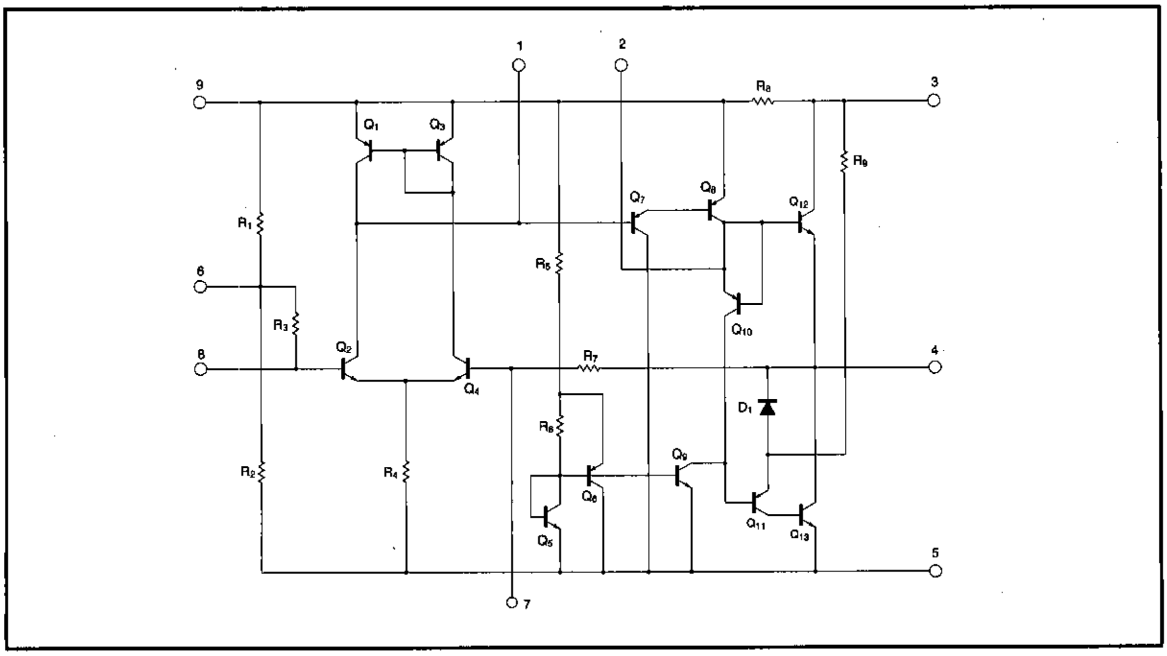
●Applications
Portable radios,
TV sets,
cassette recorders,
interphones,
and wireless tranceivers

●Features
1) High output. P_{OUT} = 430mW (V_{CC} = 6V and an 8Ω load (THD = 10%).
2) Good low voltage characteristics. Begins operating at 2V.
3) Easy-to-mount 9-pin SIP package.
4) Extremely low high-frequency distortion with small signals. Uses soft clipping for good audio quality.
5) Power-on "pop" noise is suppressed.
6) Low noise.

●Block diagram



●Internal circuit diagram



●Absolute maximum ratings (Ta = 25℃)

Parameter	Symbol	Limits	Unit
Supply voltage	V_{CC}	9	V
Power dissipation	Pd	950*	mW
Operating temperature	Topr	−10~65	℃
Storage temperature	Tstg	−30~125	℃

* Reduced by 9.5mW for each increase in Ta of 1°C over 25°C.

●Electrical characteristics (unless otherwise specified Ta = 25℃, V_{CC} = 6V, R_L = 8Ω and f= 1kHz)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition	Measurement Circuit
Quiescent circuit current	I_Q	−	12	24	mA	V_{IN}=0V_{rms}	Fig.1
Closed-circuit voltage gain	G_{VC}	48	52	54	dB	R_{NF}=47Ω、V_{IN}=2.5mV_{rms}	Fig.1
Maximum output power	P_{OM}	600	700	−	mW	V_{IN}=25mV_{rms}	Fig.1
Rated output power	P_{OUT}	350	430	−	mW	THD=10%	Fig.1
Output noise voltage	V_{NO}	−	0.25	0.7	mV_{rms}	R_g=0Ω	Fig.1
Total harmonic distortion	THD	−	0.4	2	%	P_O=50mW	Fig.1
Input resistance	R_{IN}	−	22	−	kΩ	P_O=50mW	Fig.1

●Measurement circuit

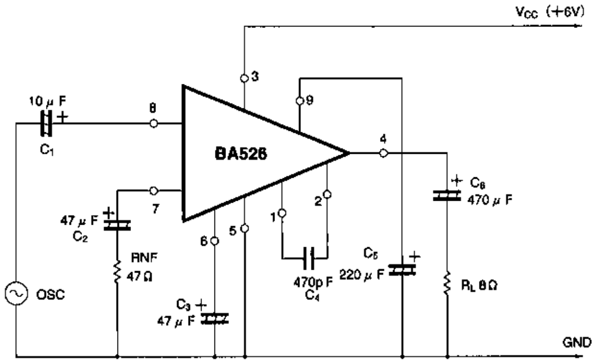


Fig. 1

●Application example

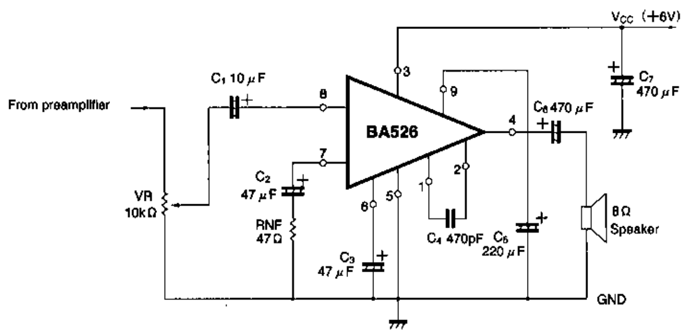
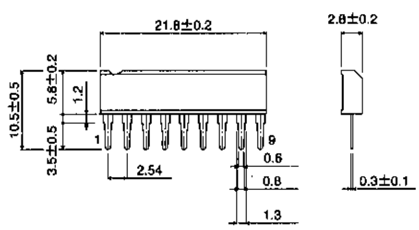


Fig. 2

●External dimensions (Unit: mm)



SIP9

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6V/800mW single-channel power amplifier

BA527

The BA527 is a monolithic power amplifier designed for portable cassette players and radio cassette players. With a 6V power supply, it has a rated output of 800mW into a 4Ω load (THD = 10%). It is a high-grade design that generates almost no audible switching noise, and is ideal for high-end compact cassette players (including those with radio).

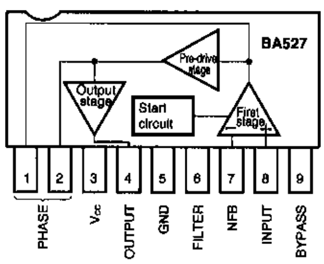
●Applications

Portable cassette recorders and radio cassette recorders

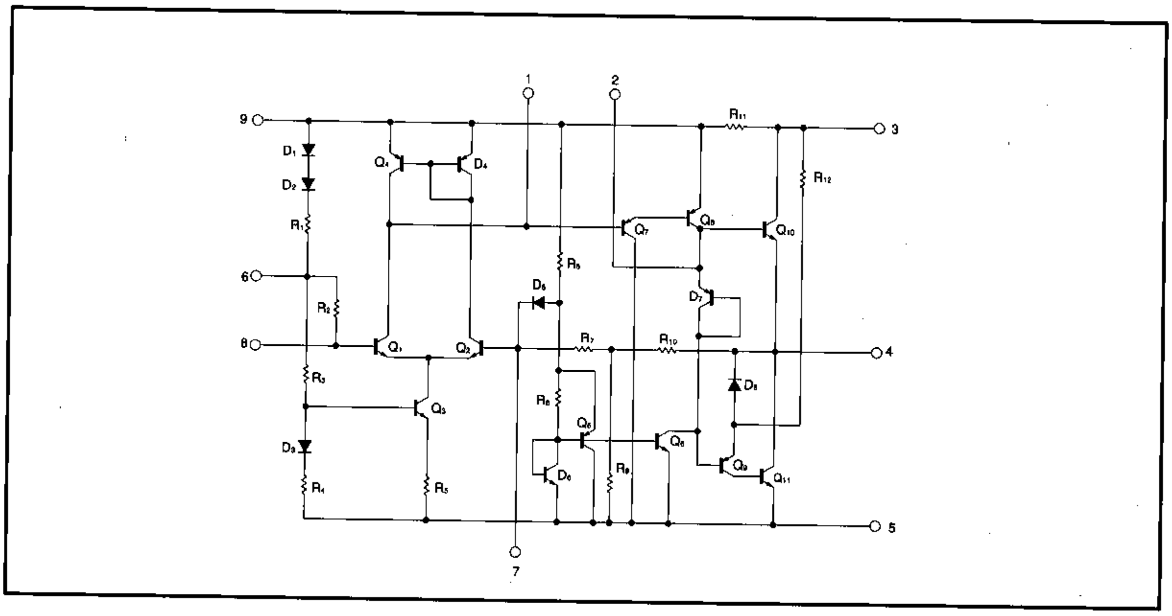
●Features

1) Rated power output is 800mW (V_{CC} = 6V and a 4Ω load (THD = 10%). Maximum output is 1300mW.
2) Pin compatible with the Rohm BA526 power amplifier, and can be interchanged to suit the application.
3) Compact 9-pin SIP package that does not require a heatsink. Allows more compact set designs, and is easy to mount.
4) High ripple-rejection ratio (55dB) and generates almost no "pop" noise.
5) Excellent low voltage characteristics (starts operating at SV <2.8V).

●Block diagram



●Internal circuit diagram



●Absolute maximum ratings (Ta = 25°C)

Parameter	Symbol	Limits	Unit
Supply voltage	Vcc	9	V
Power dissipation	Pd	950*	mW
Operating temperature	Topr	−10~65	°C
Storage temperature	Tstg	−30~125	°C

* Reduced by 9.5mW for each increase in Ta of 1°C over 25°C.

●Electrical characteristics (unless otherwise specified Ta = 25°C, V_{CC} = 6V, R_L = 4Ω, f= 1kHz and R_{NF} = 220Ω)

Parameter	Symbol	Min	Typ.	Max.	Unit	Conditions	Measurement Circuit
Quiescent circuit current	I_Q	−	16	25	mA	V_{IN}=0V_{rms}	Fig.1
Closed-circuit voltage gain	G_{VC}	43	46	49	dB	V_O=0.45V_{rms}	Fig.1
Maximum output power	P_{OM}	900	1300	−	mW	−	Fig.1
Rated output power	P_{OUT}	700	800	−	mW	THD=10%	Fig.1
Output noise voltage	V_{NO}	−	0.2	0.7	mV_{rms}	R_g=0Ω	Fig.1
Total harmonic distortion	THD	−	0.45	1.8	%	P_O=50mW, 1kHz	Fig.1
Input resistance	R_{IN}	−	47	−	kΩ	P_O=50mW	Fig.1

● Measurement circuit

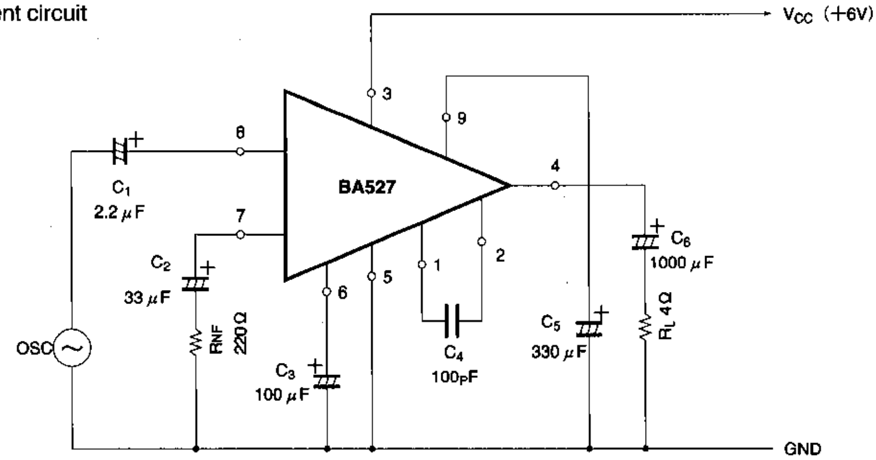


Fig. 1

● Application example

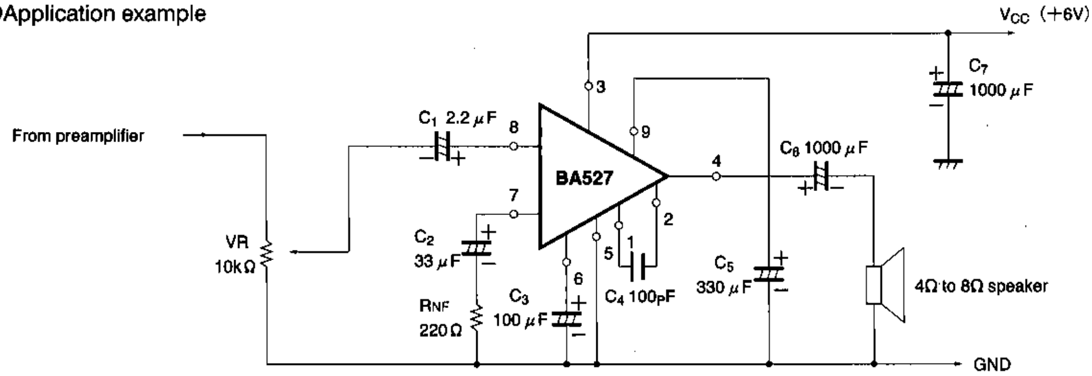
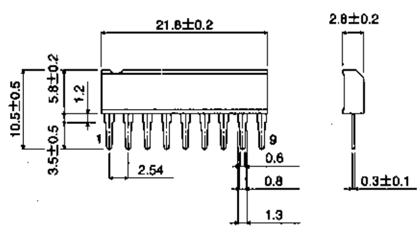


Fig. 2

● External dimensions (Unit: mm)



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9V/2.3W single-channel power amplifier
BA534

The BA534 is a monolithic power amplifier designed for portable cassette players and radios. With a 9V power supply, it has a rated output of 2.3W into a 4Ω load (THD = 10%). It has high ripple rejection, and the "pop" noise when power is applied has been suppressed to an absolute minimum.

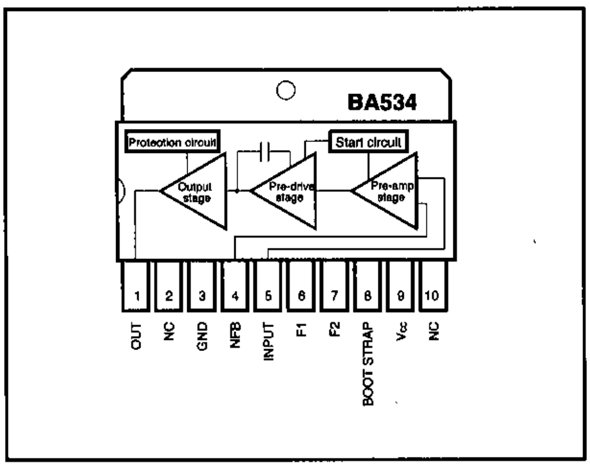
●Applications

Portable cassette recorders and radios.

●Features

1) High power output.
   When V_{CC} = 9V, R_L = 4Ω and THD = 10% : P_{OUT} = 2.3W
   When V_{CC} = 9V, R_L = 3Ω and THD = 10% : P_{OUT} = 2.8W
2) The "pop" noise that occurs when the power is applied is extremely low.
3) Excellent ripple rejection ratio.

●Block diagram

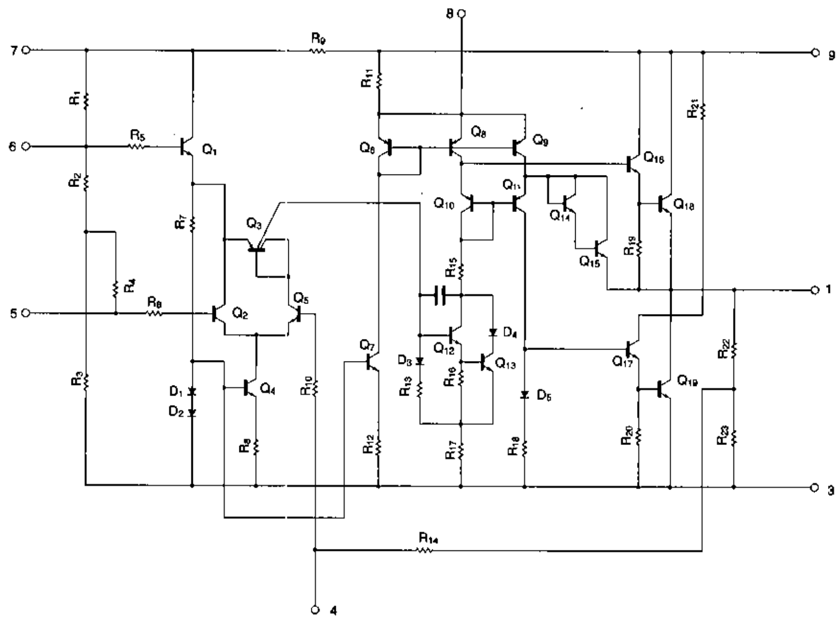


●Absolute maximum ratings (Ta = 25℃)

Parameter	Symbol	Limits	Unit
Supply voltage	V_{CC}	14	V
Power dissipation	Pd	2.5*	W
Operating temperature	Topr	−25~75	℃
Storage temperature	Tstg	−55~125	℃

* Reduced by 25mW for each increase in Ta of 1 °C over 25°C.
(without radiation board)

●Internal circuit diagram



●Electrical characteristics (unless otherwise specified Ta = 25℃, V_{CC} = 6V, R_L = 4Ω and R_{NF} = 100Ω)

Parameter	Symbol	Min	Typ.	Max.	Unit	Conditions	Measurement Circuit
Quiescent circuit current	I_Q	−	20	50	mA	−	Fig.1
Closed-circuit voltage gain	G_{VC}	47	50	53	dB	f=1kHz	Fig.1
Rated output	P_{OUT}	1.7	2.3	−	W	THD=10%	Fig.1
Output noise voltage	V_{NO}	−	0.7	3.0	mV_{rms}	R_g=10kΩ	Fig.1
Input resistance	R_{IN}	−	200	−	kΩ	−	Fig.1
Total harmonic distortion	THD	−	0.3	2	%	P_O=0.5W	Fig.1

●Measurement circuit

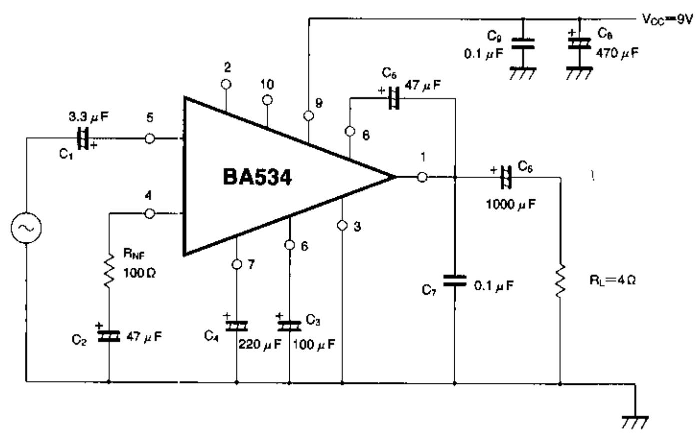


Fig. 1

●Application example

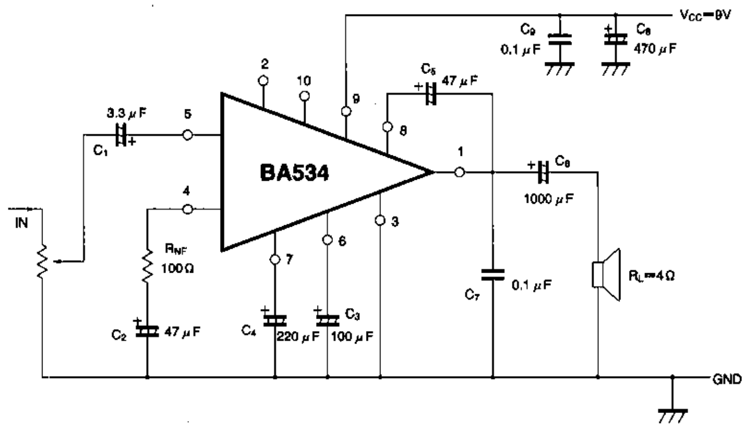


Fig. 2

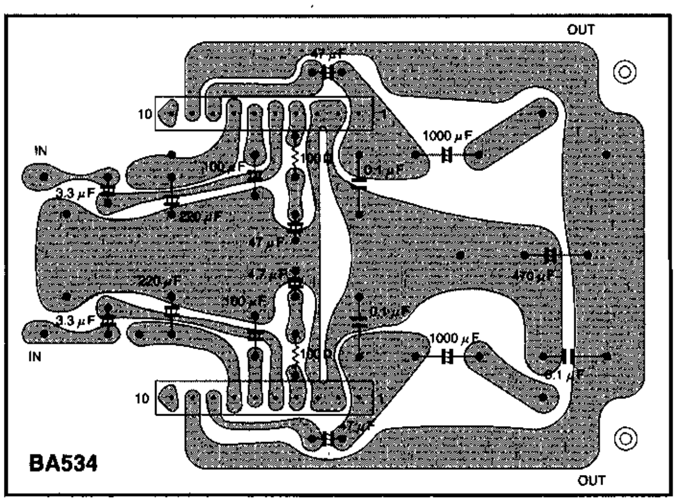
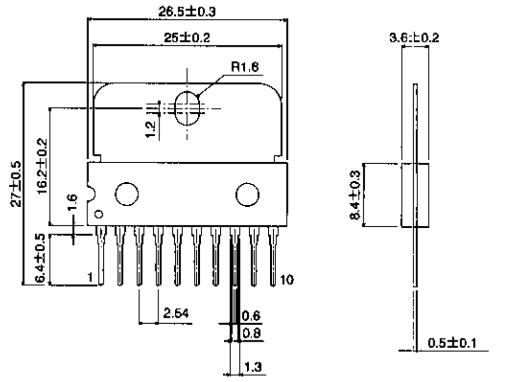


Fig. 3 PCB diagram

●External dimensions (Unit: mm)



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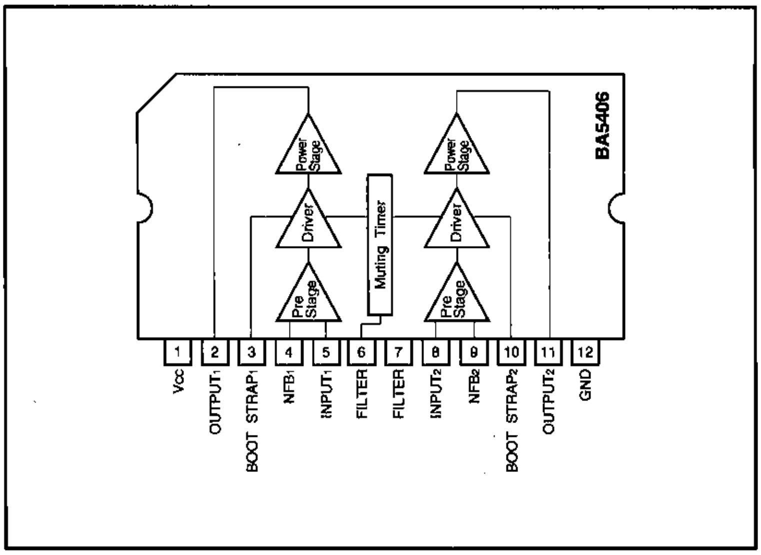
12V/5W dual power amplifier
BA5406

The BA5406 is a dual-OTL monolithic power IC with two high-output, low-frequency power amplifiers. With a 12V power supply, it has a rated output of 5W × 2 into a 3Ω load, and with a 9V power supply, it has a rated output of 2.8W × 2 into a 3Ω load.
The BA5406 has good low-voltage characteristics, and the "pop" sound when power is applied is small. It generates little radio-band noise, and is ideal for use in stereo radio cassette players.

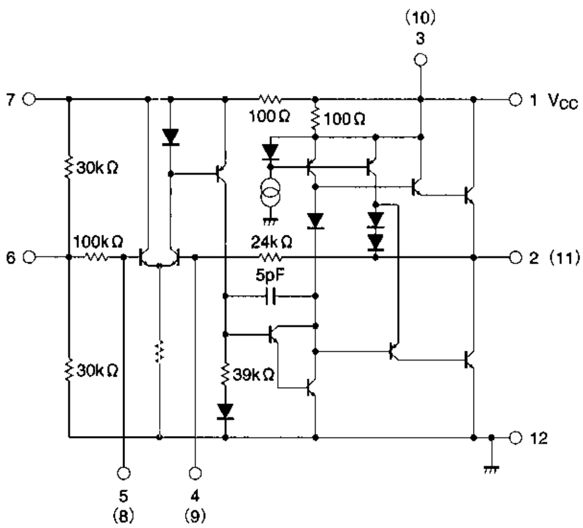
●Applications
Stereo radio cassette players, stereo component systems, and TVs.

●Features
1) Small "pop" noise.
2) Good low voltage characteristics. Begins operating V_{CC} = 5V (typ.).
3) Good channel balance.
4) Good distortion characteristics (THD = 0.3% when P_O = 0.5W)
5) Easy-to-mount 12-pin SIP-M package that requires little PCB space.
6) The ripple filter pin (pin 6) can be used for muting (by setting it to ground potential).
7) Symmetrical pin layout simplifies PCB artwork.
8) Package has low thermal resistance to simplify heatsink design.
9) Built-in treble phase compensation capacitors.
10) Low radio-band noise generated. Can be freely positioned in the set.

●Block diagram



●Internal circuit diagram



●Absolute maximum ratings (Ta = 25℃)

Parameter	Symbol	Limits	Unit
Supply voltage	V_{CC}	18*1	V
Power dissipation	Pd	20*2	W
Operating temperature	Topr	−20~75	℃
Storage temperature	Tstg	−30~125	℃
Junction temperature	Tj	150	℃

*1 No signal

*2 Back metal temperature: 75°C.

●Recommended operating conditions (Ta = 25℃)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	5	12	15	V

●Electrical characteristics (unless otherwise specified Ta = 25℃ and Vcc = 12V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Quiescent circuit current	I_Q	20	40	70	mA	V_{IN}=0V_{rms}
Closed-circuit voltage gain	G_{VC}	43	46	49	dB	f=1kHz, V_{IN}=−46dBm
Rated output 1	$P_{OUT\ 1}$	4.0	5.0	−	W	f=1kHz, THD=10%, R_L=3Ω
Rated output 2	$P_{OUT\ 2}$	3.4	4.2	−	W	f=1kHz, THD=10%, R_L=4Ω
Total harmonic distortion	THD	−	0.3	1.5	%	f=1kHz, P_O=0.5W
Output noise voltage	V_{NO}	−	0.6	1.0	mV_{rms}	Rg=10kΩ
Input resistance	R_{IN}	50	100	−	kΩ	f=1kHz, V_{IN}=5mV_{rms}

● Measurement circuit

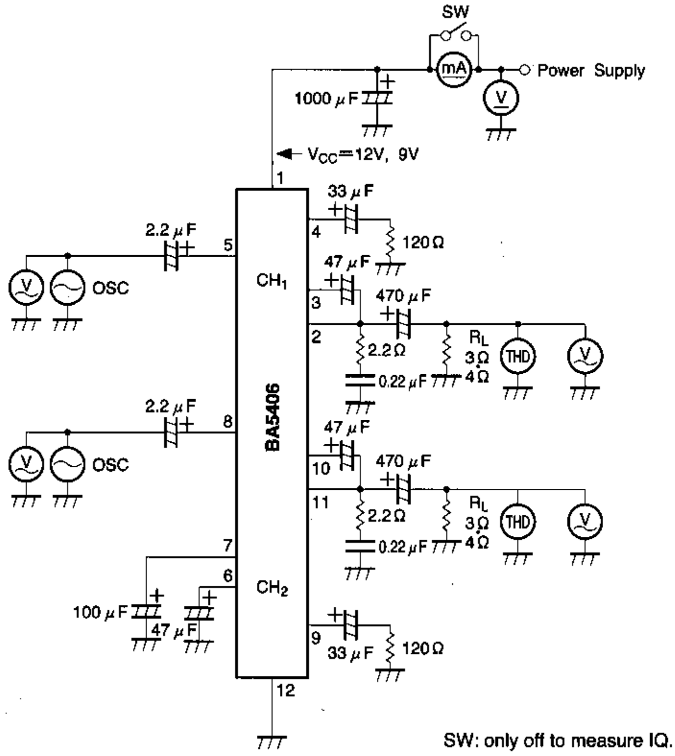


Fig. 1

● Application example

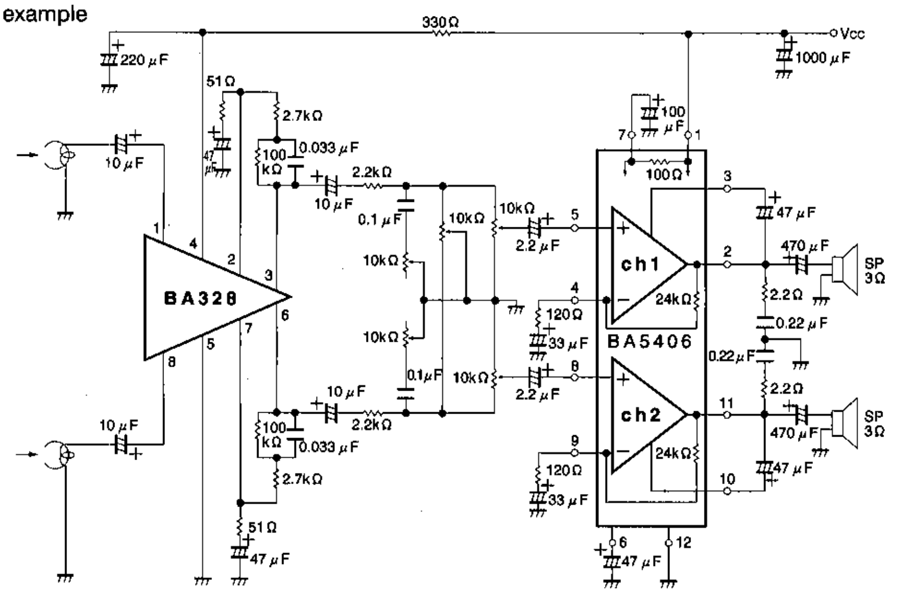


Fig. 2

●Electrical characteristics curves

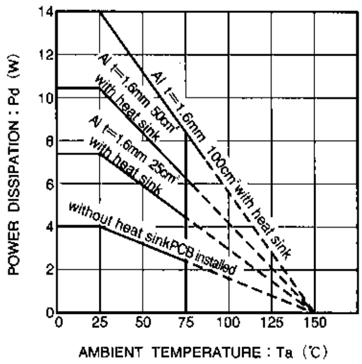


Fig. 3 Power dissipation vs. ambient temperature

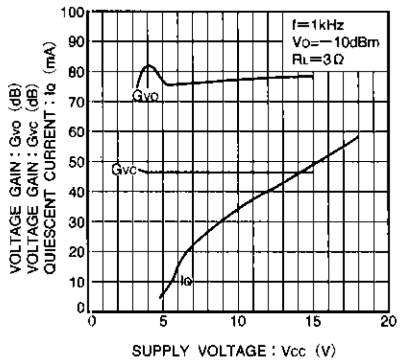


Fig. 4 Quiescent current and voltage gain vs. supply voltage

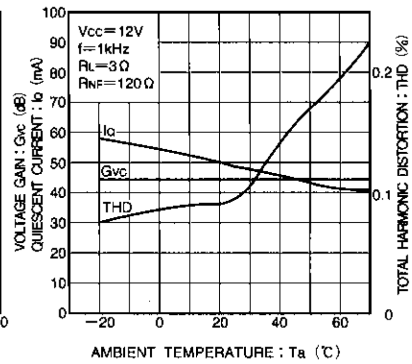


Fig. 5 Distortion, voltage gain and quiescent current vs. frequency

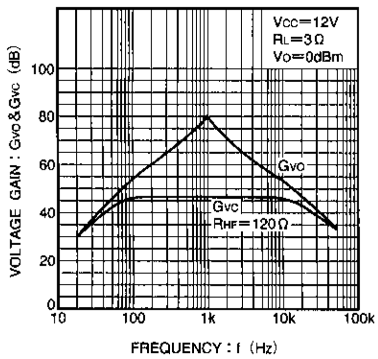


Fig. 6 Voltage gain vs. frequency

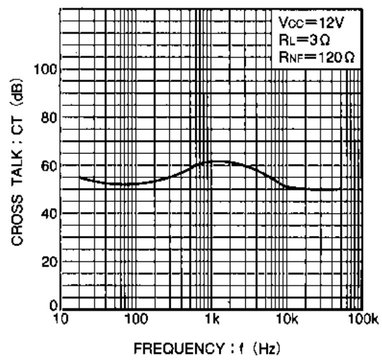


Fig. 7 Crosstalk vs. frequency

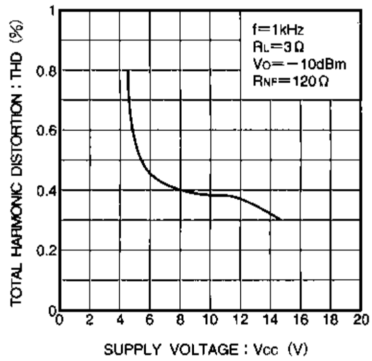


Fig. 8 Distortion vs. supply voltage

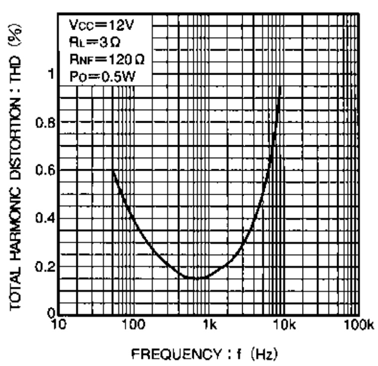


Fig. 9 Distortion vs. frequency

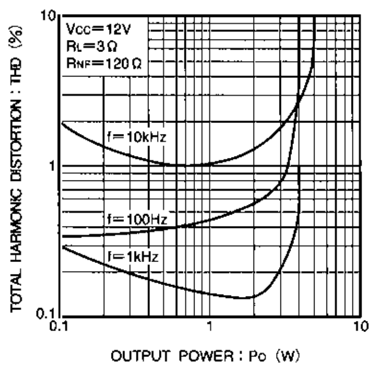


Fig. 10 Distortion vs. Output power

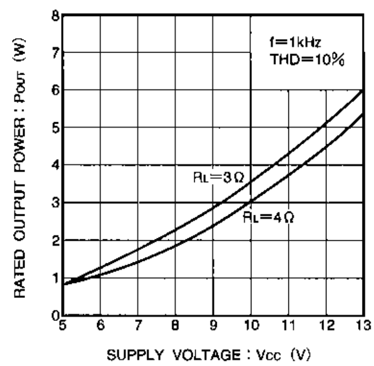


Fig. 11 Output power vs. supply voltage

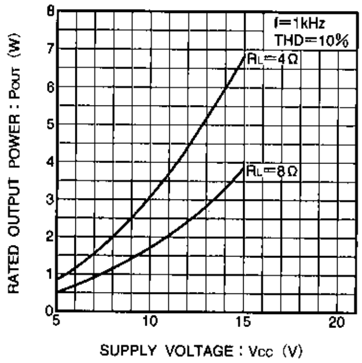


Fig. 12 Output power vs. supply voltage

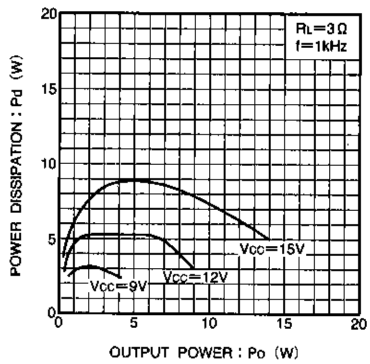


Fig. 13 Power dissipation vs. output power

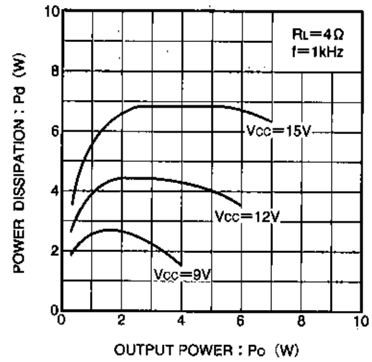


Fig. 14 Power dissipation vs. output power

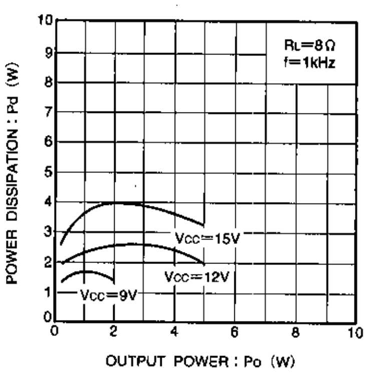


Fig. 15 Power dissipation vs. output power

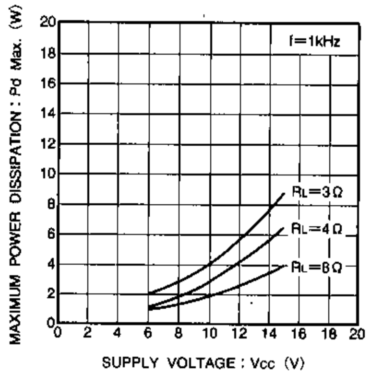


Fig. 16 Maximum power dissipation vs. supply voltage

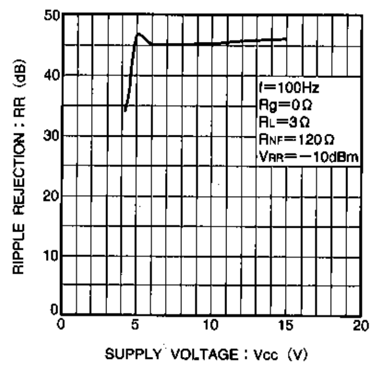
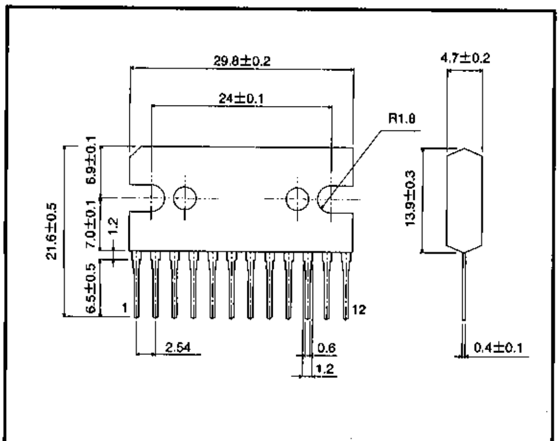


Fig. 17 Ripple rejection vs. supply voltage

●External dimensions (Unit: mm)



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High-output dual power amplifier
BA5415A/BA5416

The BA5415A and BA5416 are dual power amplifier ICs that operate off a 9V to 15V supply. When driving a 4Ω load off a 9V supply, the BA5415A does not require a heatsink. The BA5416 uses a lost-cost package. The basic characteristics (total harmonic distortion etc.) of the amplifiers are excellent, and both ICs include a standby switch function.

●Applications

Radio cassette players.

●Features

1) High output.
   P_{OUT} = 5.4W (V_{CC} = 12V, R_L = 3Ω and THD = 10%)
   P_{OUT} = 2.5W (V_{CC} = 9V, R_L = 4Ω and THD = 10%)
2) Excellent audio quality.
   THD = 0.1% (f = 1kHz, P_O = 0.5W)
   V_{NO} = 0.3mV_{rms} (Rg = 10kΩ)
   RR = 60dB (f_{RR} = 100Hz)
3) V_{CC} = 5.0V to 18.0V (BA5416 : 5.0V to 15.0V)
4) Switching noise ("pop" noise) generated when the power is switched on and off is small.
5) Ripple mixing when motor starts has been prevented.
6) Built-in thermal shutout.
7) Built-in standby switch. Output is not influenced by the standby pin voltage.
8) "On" mute time does not depend on V_{CC}.
9) Soft clipping.
10) Heatsink not required (for BA5415A, with V_{CC} = 9V and $R_L \geqq$ 4Ω).

●Absolute maximum ratings (Ta = 25℃)

Parameter		Symbol	Limits	Unit
Supply voltage		V_{CC}	24*1	V
Power dissipation	BA5415A	Pd	20*2	W
			4.0*3	
	BA5416		15*4	
Operating temperature		Topr	−25~75	℃
Storage temperature		Tstg	−55~150	℃

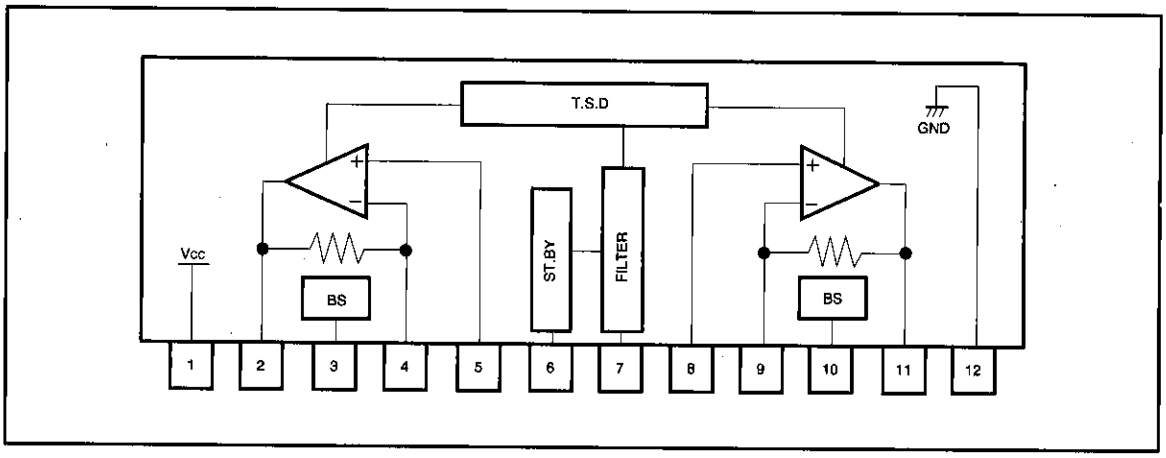
*1 Within ASO.
*2 Ta = 75°C (see Fig. 10).
*3 Reduced by 40mW for each increase in Ta of 1°C over 25°C.(without radiation board)
*4 Ta = 75°C (see Fig. 11).

●Recommended operating conditions (Ta = 25℃)

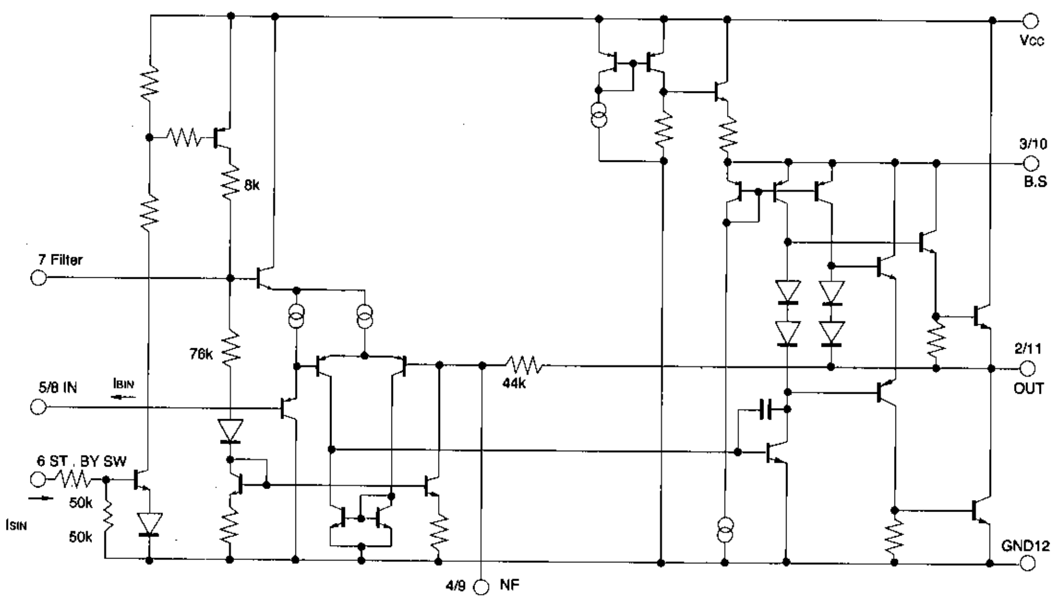
Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	5	12	18*	V

* When BA5416 is 15V

●Block diagram



●Internal circuit diagram



●Electrical characteristics (unless otherwise specified Ta = 25˚C, V_{CC} = 12V, R_L = 3Ω, R_F = 240Ω, Rg = 600Ω, and f = 1kHz)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Quiescent current	I_Q	–	28	45	mA	V_{IN}=0V_{rms}
Maximum output voltage	P_{OM}	–	8.3	–	W	V_{IN}=−20dBm
Rated output 1	P_{OUT1}	4.5	5.4	–	W	THD=10%
Rated output 2	P_{OUT2}	2.0	2.5	–	W	THD=10%、V_{CC}=9V、R_L=4Ω
Closed circuit voltage gain	G_{VC}	43	45	47	dB	
Output noise voltage	V_{NO}	–	0.3	1.0	mV_{rms}	Rg=10kΩ、DIN AUDIO
Total harmonic distortion	THD	–	0.1	0.7	%	P_{OUT}=0.5W
Ripple rejection	RR	45	60	–	dB	f_{RR}=100Hz、V_{RR}=−10dBm
Crosstalk	CT	45	60	–	dB	V_O=0dBm
Circuit current (ST. BY SW. OFF)	I_{OFF}	–	0	–	μA	
ST. BY PIN current (ST. BY SW. ON)	I_{SIN}	–	0.3	–	mA	$V_{ST.BY}$=V_{CC}
Input bias current	I_{BIN}	–	0.1	0.5	μA	Rg=0Ω

●Measurement circuit

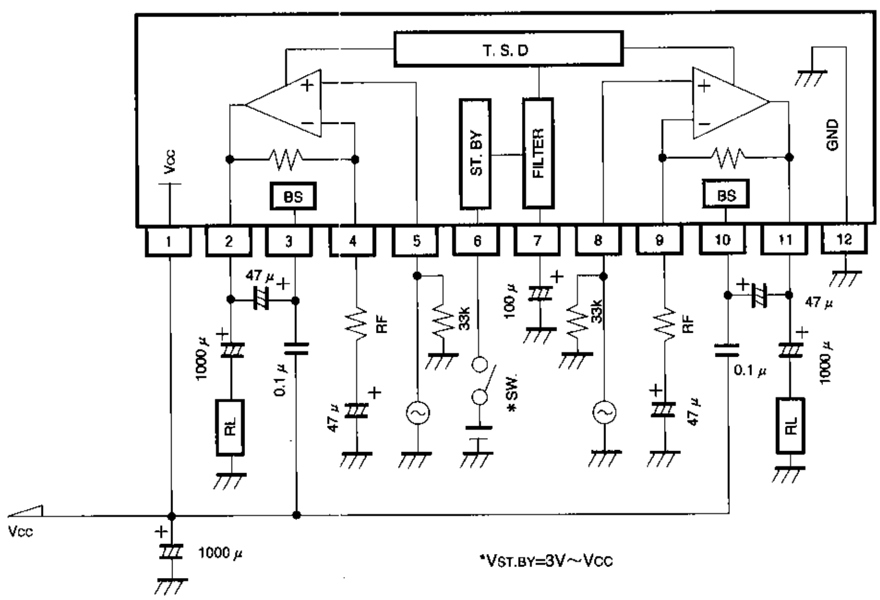


Fig. 1

●Application example

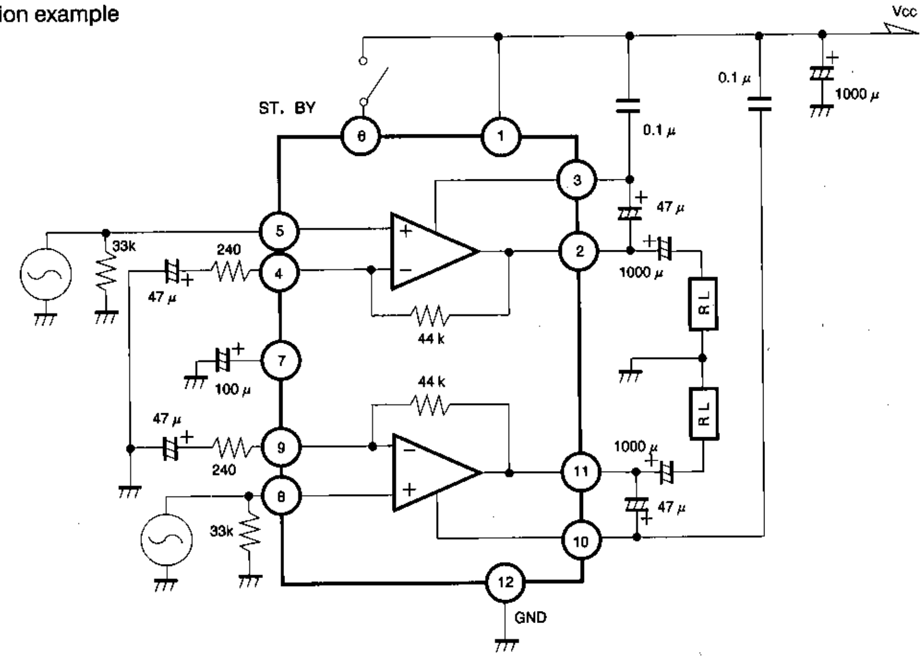


Fig. 2 OTL Applicastion circuit example

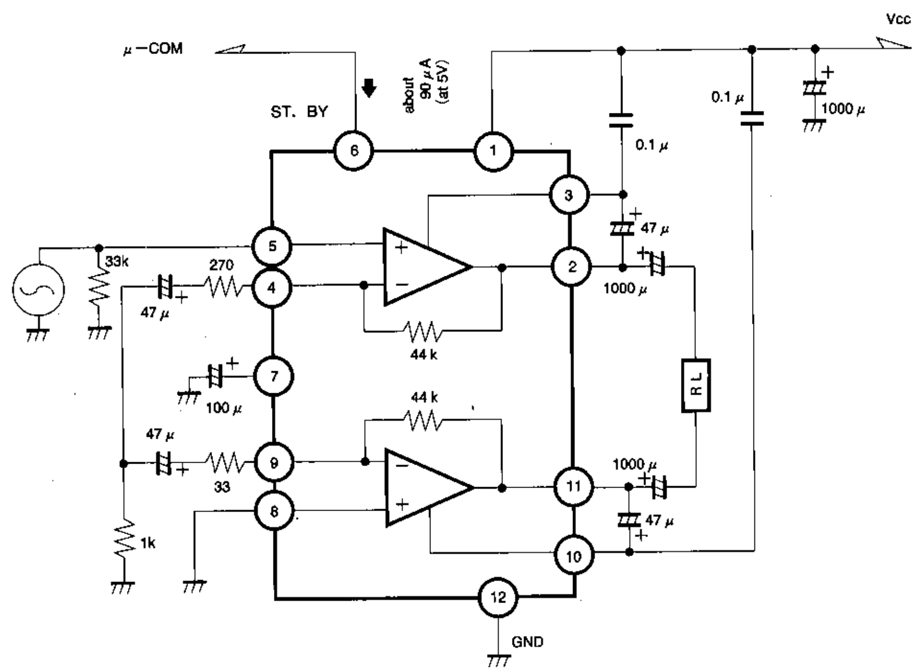


Fig. 3 BTL Applicastion circuit example

●Operation notes

1. Input circuit

The structure of the input circuit is shown in Fig. 4. The IC can be used without coupling capacitors, but a maximum of 0.5 μA of bias current (I_{BIN}) flows from the input pin, so if potentiometer sliding noise results from this, connect an input capacitor C_{IN} as shown below.

To prevent degradation of the IC characteristics, the input bias resistor is not built into the IC. Connect an input bias resistor (R_{IN}) between the input and GND (the recommended value is about 33kΩ).

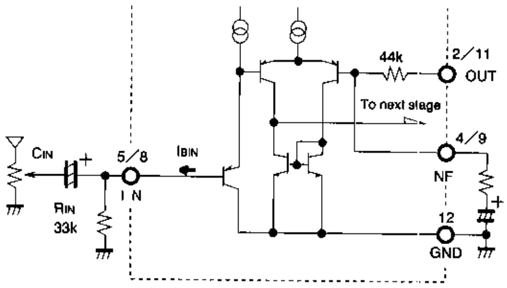


Fig. 4

2. Gain adjustment

The gain is given by the following formula.

$$G_V = 20\log\frac{R_{NF}+R_F}{R_F}$$

It is possible to reduce the gain by increasing R_F, but the amount of feedback will increase, and oscillation will be more likely to occur. We recommend that you set the gain to 30dB or higher.

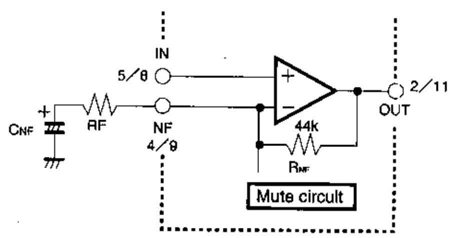


Fig. 5

3. Oscillation countermeasures

We recommend that the capacitor (C1) connected between the B. S pin and the Vcc pin for oscillation prevention be a metal-film component with good temperature and high-frequency characteristics. Ceramic capacitors have poor temperature characteristics, so if used, allow sufficient oscillation margin. It is also possible to connect a capacitor for oscillation prevention between the output and GND (C2).

The oscillation margin depends on the PCB pattern and the mounting position of the capacitor. Design your PCB after referring to the application example PCB.

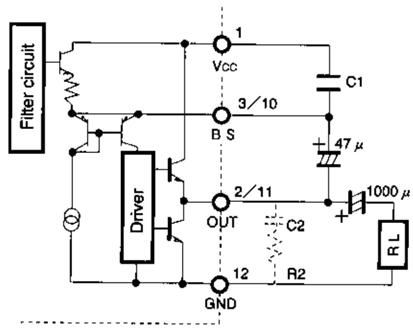


Fig. 6

4. Vcc and GND lines

The Pre. GND and Pow. GND are joined at pin 12, so there is a chance of crosstalk or degraded distortion performance due to common ground impedance in the PCB pattern. In addition, the power supply capacitor connected between Vcc and GND is influenced by the PCB pattern, and common Vcc and GND impedance may degrade the ripple rejection and distortion. Design the PCB after referring to the application example PCB (the recommended value for the power supply capacitor is 1000 μF of greater).

●Operation notes

5. Standby switch

The IC has a built-in standby switch (pin 6), so the IC can be powered on and off by a switch with low current capacity. The on voltage V_1 can be in the range 3V to V_{CC}, so the standby switch will not adversely influence circuit characteristics as with conventional methods. This also increases design freedom. At normal temperatures, the switch operates at a voltage of V_1 = 3V or higher, but we recommend that you use it at 3.5V or higher to allow for low temperatures.

A small "pop" noise may be generated when the power is switched off using the external switch. If this is the case, connect a capacitor of about C_3 = 0.022 μF in parallel with the switch.

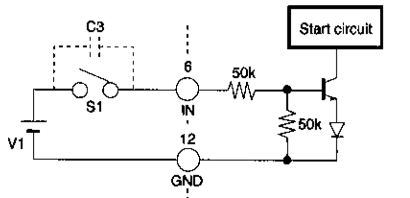


Fig. 7

6. Filter pin

Pin 7 is for connection of a ripple filter. The ripple rejection can be increased somewhat by increasing the capacitance, but this also affects the starting time, so we recommend a value in the range 100 μF to 220 μF. The standard starting time is 0.8sec.

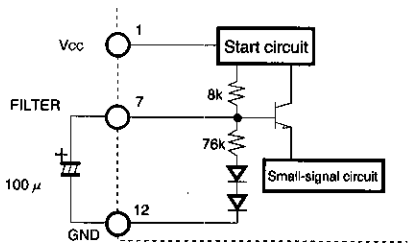


Fig. 8

7. Applied voltage

As long as the output power transistor is operated within the ASO (safe operating range Fig. 9), the IC can be operated to its absolute maximum ratings (V_{CC}MAX. = 24.0V). During normal operation, operate the IC within its recommended operating voltage range; exceeding this range will result in destruction of the IC. When the standby switch is off, the IC is guaranteed up to V_{CC}Max. = 24.0V, but when the standby switch is on, set the power supply regulation characteristics (including the capacitance of the power supply capacitor connected between V_{CC} and GND) so that V_{CC} is 18.0V or less (15.0V or less for the BA5416). If the IC is inserted backwards, V_{CC} and GND will be reversed and the IC will be destroyed instantly.

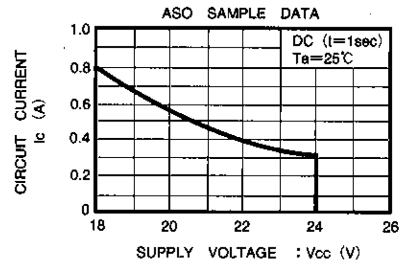


Fig. 9

8. Thermal shutdown

If the load is shorted or there is insufficient heat dissipation, the thermal shutdown circuit will operate limit the output and prevent damage to the IC. This occurs when the temperature of the heatsink plate exceeds a temperature of about 175℃.

9. Other

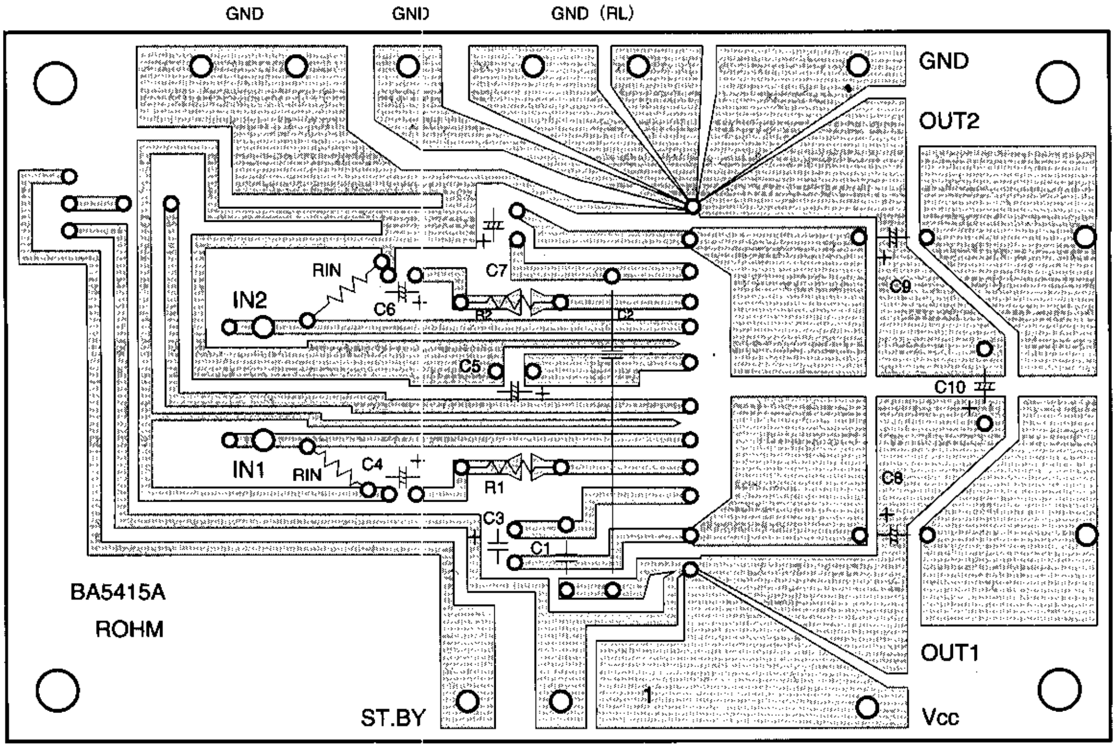
Provided the recommended circuit constants are used, the application circuit will function correctly. However, we recommend that you confirm the characteristics of the circuit in actual use.

If you change the circuit constants, check both the static and transient characteristics of the circuit, and allow sufficient margin to accommodate variations in both ICs and external components.

10. Standard values for the DC voltages on each pin (V_{CC} = 12V, Ta = 25℃, test circuit : Fig. 1)

Pin No	1	2	3	4	5	6	7	8	9	10	11	12
DC (V)	V_{CC}	6.0	10.0	0.6	0.004	$V_{ST.BY}$	10.9	0.004	0.6	10.0	6.0	GND

Application example circuit PCB



●Electrical characteristics curves

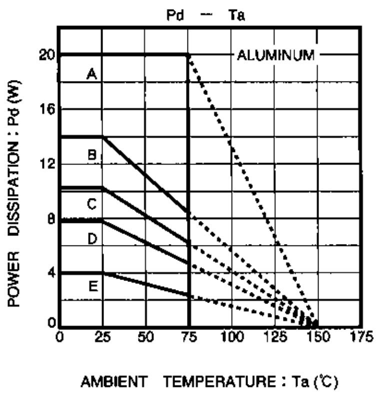


Fig. 10 Power dissipation curves (BA5415A)

A : INFINITE HEAT SINK θjc=3.75℃/W
B : 100cm²×1.6mm
C : 50cm²×1.6mm
D : 25cm²×1.6mm
E : WITHOUT HEAT SINK θja=31℃/W

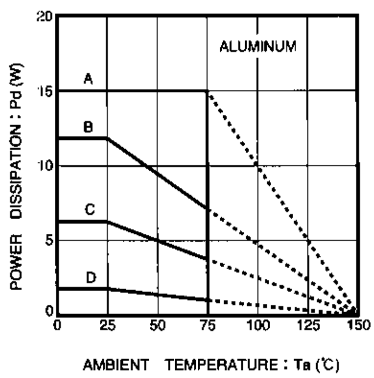


Fig. 11 Power dissipation curves (BA5416)

A : INFINITE HEAT SINK θjc=5.0℃/W
B : 100cm²×2.0mm
C : 25cm²×2.0mm
D : WITHOUT HEAT SINK θja=56.8℃/W

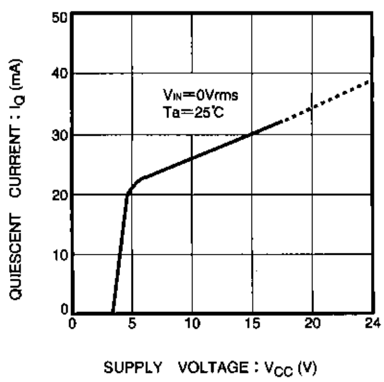


Fig. 12 Quiescent current vs. supply voltage

High-output dual power amplifier
BA5415A/BA5416

The BA5415A and BA5416 are dual power amplifier ICs that operate off a 9V to 15V supply. When driving a 4Ω load off a 9V supply, the BA5415A does not require a heatsink. The BA5416 uses a lost-cost package. The basic characteristics (total harmonic distortion etc.) of the amplifiers are excellent, and both ICs include a standby switch function.

●Applications
Radio cassette players.

●Features
1) High output.
   P_{OUT} = 5.4W (V_{CC} = 12V, R_L = 3Ω and THD = 10%)
   P_{OUT} = 2.5W (V_{CC} = 9V, R_L = 4Ω and THD = 10%)
2) Excellent audio quality.
   THD = 0.1% (f = 1kHz, P_O = 0.5W)
   V_{NO} = 0.3mV_{rms} (Rg = 10kΩ)
   RR = 60dB (f_{RR} = 100Hz)
3) V_{CC} = 5.0V to 18.0V (BA5416 : 5.0V to 15.0V)
4) Switching noise ("pop" noise) generated when the power is switched on and off is small.
5) Ripple mixing when motor starts has been prevented.
6) Built-in thermal shutout.
7) Built-in standby switch. Output is not influenced by the standby pin voltage.
8) "On" mute time does not depend on V_{CC}.
9) Soft clipping.
10) Heatsink not required (for BA5415A, with V_{CC} = 9V and R_L ≧ 4Ω).

●Absolute maximum ratings (Ta = 25℃)

Parameter		Symbol	Limits	Unit
Supply voltage		V_{CC}	24*1	V
Power dissipation	BA5415A	Pd	20*2	W
			4.0*3	
	BA5416		15*4	
Operating temperature		Topr	−25~75	℃
Storage temperature		Tstg	−55~150	℃

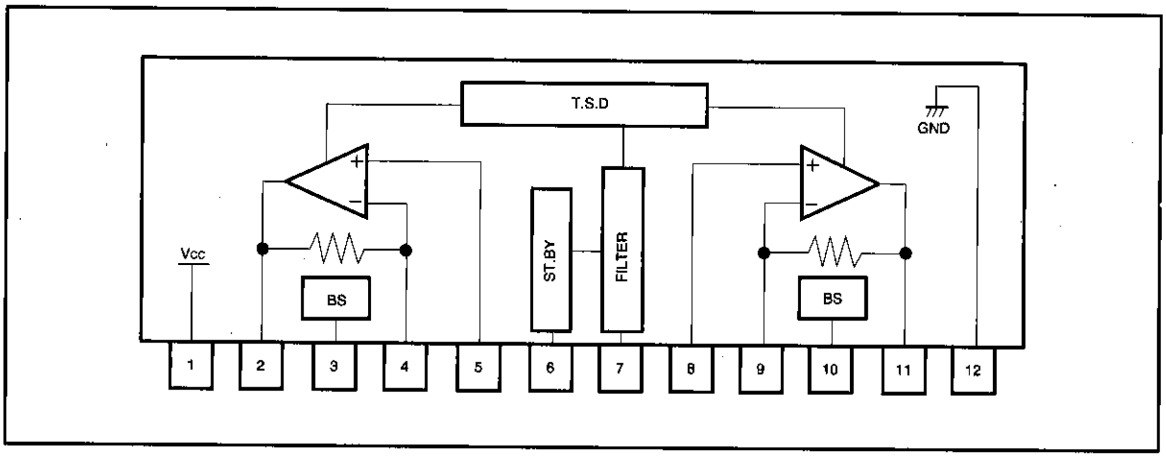
*1 Within ASO.
*2 Ta = 75°C (see Fig. 10).
*3 Reduced by 40mW for each increase in Ta of 1°C over 25°C.(without radiation board)
*4 Ta = 75°C (see Fig. 11).

●Recommended operating conditions (Ta = 25℃)

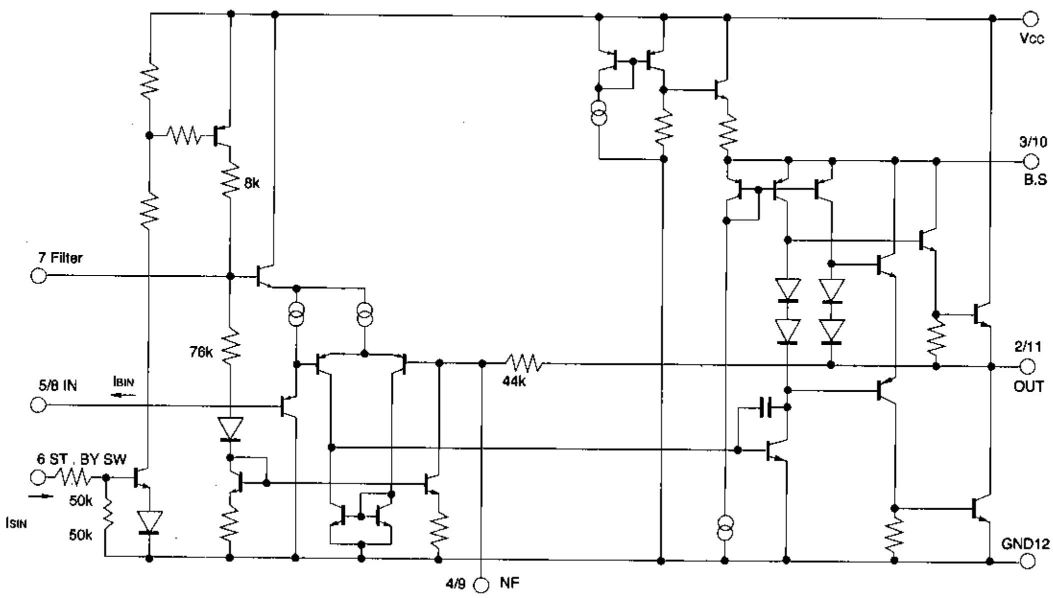
Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply voltage	V_{CC}	5	12	18*	V

* When BA5416 is 15V

●Block diagram



●Internal circuit diagram



●Electrical characteristics (unless otherwise specified Ta = 25°C, V_{CC} = 12V, R_L = 3Ω, R_F = 240Ω, Rg = 600Ω, and f = 1kHz)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Quiescent current	I_Q	—	28	45	mA	V_{IN}=0V_{rms}
Maximum output voltage	P_{OM}	—	8.3	—	W	V_{IN}=−20dBm
Rated output 1	P_{OUT1}	4.5	5.4	—	W	THD=10%
Rated output 2	P_{OUT2}	2.0	2.5	—	W	THD=10%、V_{CC}=9V、R_L=4Ω
Closed circuit voltage gain	G_{VC}	43	45	47	dB	
Output noise voltage	V_{NO}	—	0.3	1.0	mV_{rms}	Rg=10kΩ、DIN AUDIO
Total harmonic distortion	THD	—	0.1	0.7	%	P_{OUT}=0.5W
Ripple rejection	RR	45	60	—	dB	f_{RR}=100Hz、V_{RR}=−10dBm
Crosstalk	CT	45	60	—	dB	V_O=0dBm
Circuit current (ST. BY SW. OFF)	I_{OFF}	—	0	—	μA	
ST. BY PIN current (ST. BY SW. ON)	I_{SIN}	—	0.3	—	mA	$V_{ST.BY}$=V_{CC}
Input bias current	I_{BIN}	—	0.1	0.5	μA	Rg=0Ω

●Measurement circuit

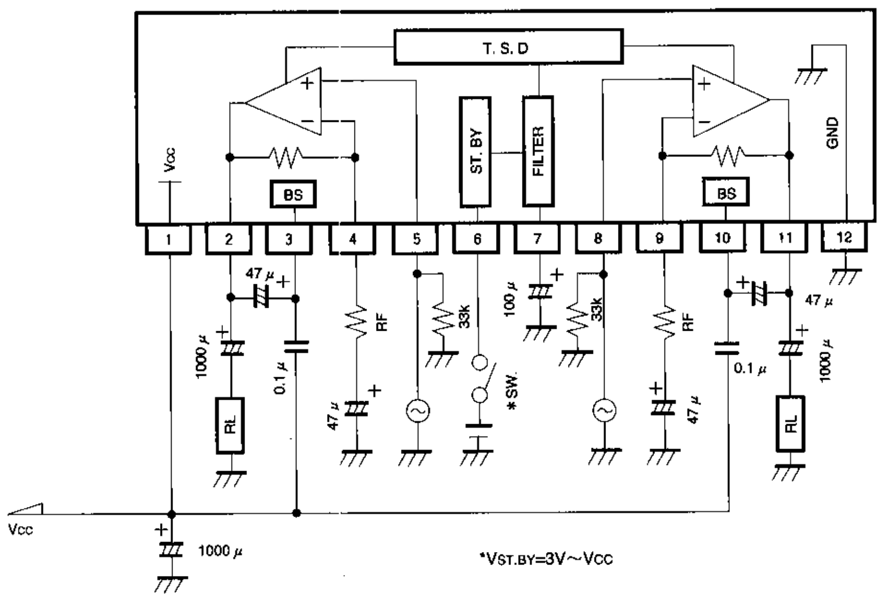


Fig. 1

●Application example

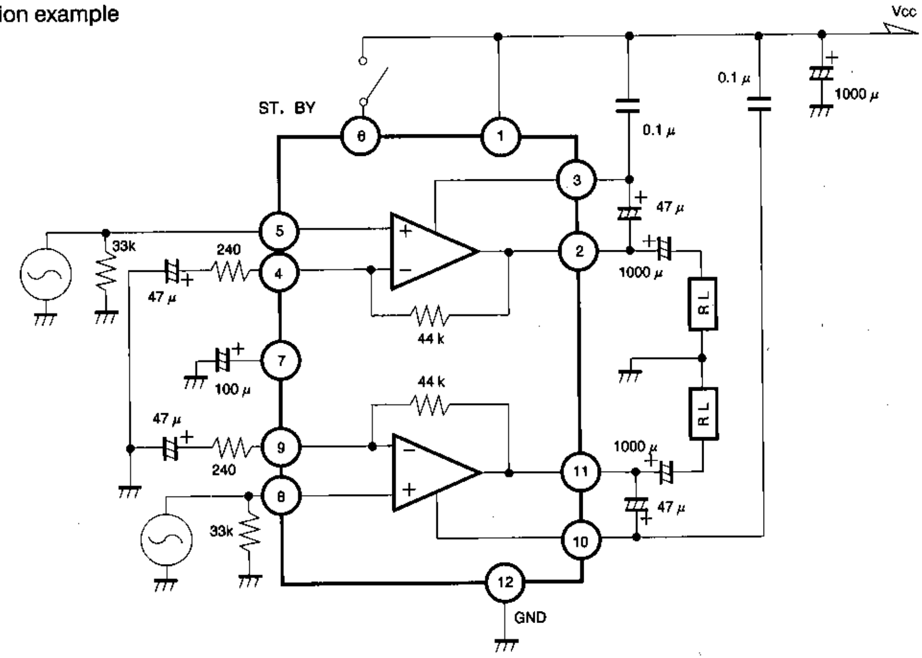


Fig. 2 OTL Applicastion circuit example

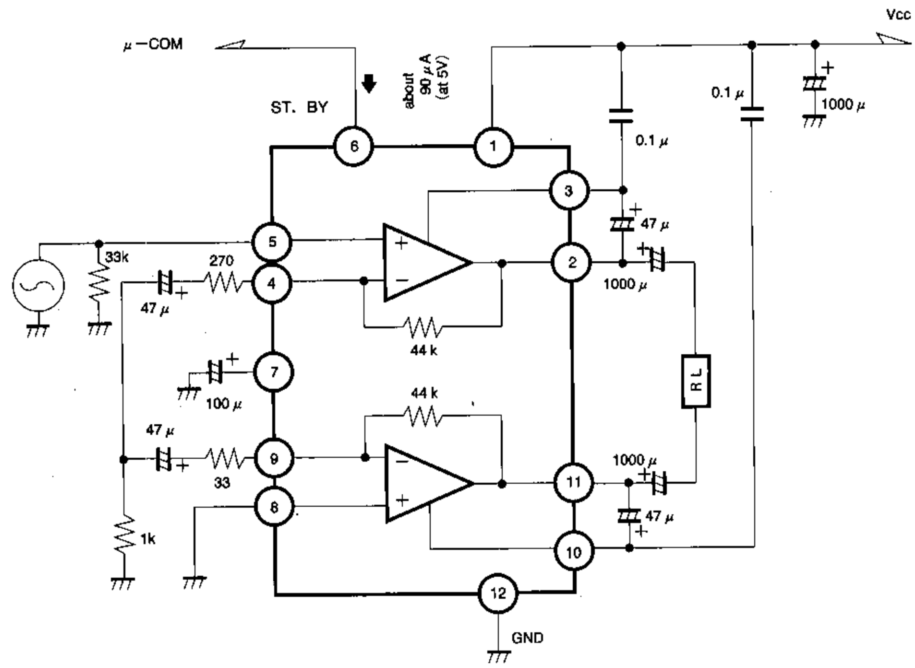


Fig. 3 BTL Applicastion circuit example

●Operation notes

1. Input circuit

The structure of the input circuit is shown in Fig. 4. The IC can be used without coupling capacitors, but a maximum of 0.5 μA of bias current (I_{BIN}) flows from the input pin, so if potentiometer sliding noise results from this, connect an input capacitor C_{IN} as shown below.

To prevent degradation of the IC characteristics, the input bias resistor is not built into the IC. Connect an input bias resistor (R_{IN}) between the input and GND (the recommended value is about 33kΩ).

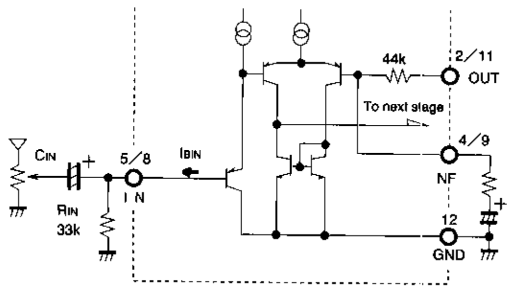


Fig. 4

2. Gain adjustment

The gain is given by the following formula.

$$G_V = 20\log\frac{R_{NF}+R_F}{R_F}$$

It is possible to reduce the gain by increasing R_F, but the amount of feedback will increase, and oscillation will be more likely to occur. We recommend that you set the gain to 30dB or higher.

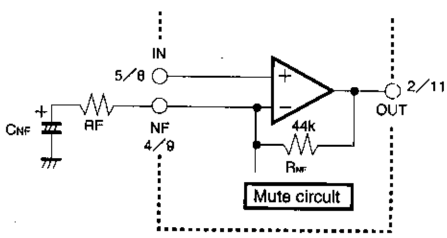


Fig. 5

3. Oscillation countermeasures

We recommend that the capacitor (C1) connected between the B. S pin and the Vcc pin for oscillation prevention be a metal-film component with good temperature and high-frequency characteristics. Ceramic capacitors have poor temperature characteristics, so if used, allow sufficient oscillation margin. It is also possible to connect a capacitor for oscillation prevention between the output and GND (C2).

The oscillation margin depends on the PCB pattern and the mounting position of the capacitor. Design your PCB after referring to the application example PCB.

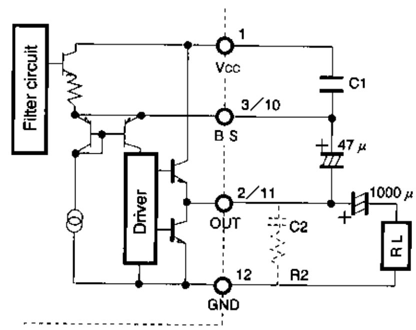


Fig. 6

4. Vcc and GND lines

The Pre. GND and Pow. GND are joined at pin 12, so there is a chance of crosstalk or degraded distortion performance due to common ground impedance in the PCB pattern. In addition, the power supply capacitor connected between Vcc and GND is influenced by the PCB pattern, and common Vcc and GND impedance may degrade the ripple rejection and distortion. Design the PCB after referring to the application example PCB (the recommended value for the power supply capacitor is 1000 μF of greater).

●Operation notes

5. Standby switch

The IC has a built-in standby switch (pin 6), so the IC can be powered on and off by a switch with low current capacity. The on voltage V_1 can be in the range 3V to V_{CC}, so the standby switch will not adversely influence circuit characteristics as with conventional methods. This also increases design freedom. At normal temperatures, the switch operates at a voltage of V_1 = 3V or higher, but we recommend that you use it at 3.5V or higher to allow for low temperatures.

A small "pop" noise may be generated when the power is switched off using the external switch. If this is the case, connect a capacitor of about C_3 = 0.022 μF in parallel with the switch.

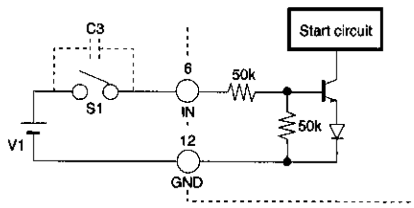


Fig. 7

6. Filter pin

Pin 7 is for connection of a ripple filter. The ripple rejection can be increased somewhat by increasing the capacitance, but this also affects the starting time, so we recommend a value in the range 100 μF to 220 μF. The standard starting time is 0.8sec.

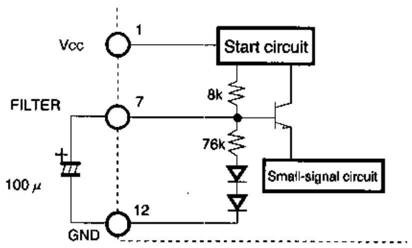


Fig. 8

7. Applied voltage

As long as the output power transistor is operated within the ASO (safe operating range Fig. 9), the IC can be operated to its absolute maximum ratings (V_{CC}MAX. = 24.0V). During normal operation, operate the IC within its recommended operating voltage range; exceeding this range will result in destruction of the IC. When the standby switch is off, the IC is guaranteed up to V_{CC}Max. = 24.0V, but when the standby switch is on, set the power supply regulation characteristics (including the capacitance of the power supply capacitor connected between V_{CC} and GND) so that V_{CC} is 18.0V or less (15.0V or less for the BA5416). If the IC is inserted backwards, V_{CC} and GND will be reversed and the IC will be destroyed instantly.

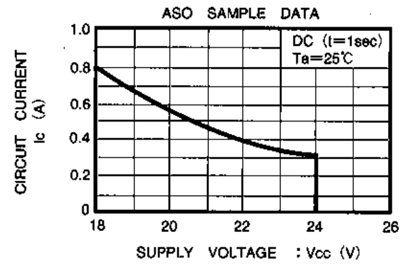


Fig. 9

8. Thermal shutdown

If the load is shorted or there is insufficient heat dissipation, the thermal shutdown circuit will operate limit the output and prevent damage to the IC. This occurs when the temperature of the heatsink plate exceeds a temperature of about 175℃.

9. Other

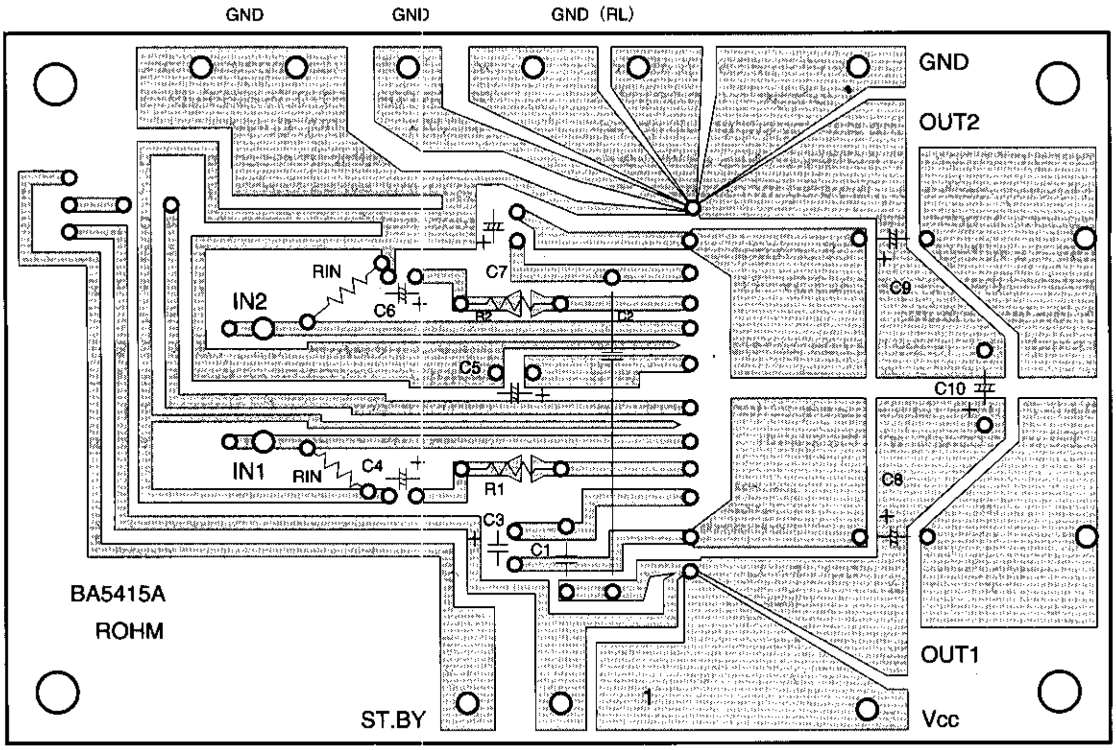
Provided the recommended circuit constants are used, the application circuit will function correctly. However, we recommend that you confirm the characteristics of the circuit in actual use.

If you change the circuit constants, check both the static and transient characteristics of the circuit, and allow sufficient margin to accommodate variations in both ICs and external components.

10. Standard values for the DC voltages on each pin (V_{CC} = 12V, Ta = 25℃, test circuit : Fig. 1)

Pin No	1	2	3	4	5	6	7	8	9	10	11	12
DC (V)	V_{CC}	6.0	10.0	0.6	0.004	$V_{ST.BY}$	10.9	0.004	0.6	10.0	6.0	GND

Application example circuit PCB



●Electrical characteristics curves

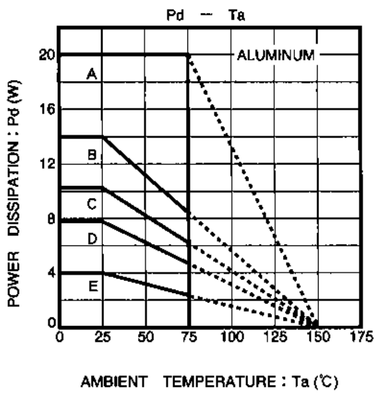


Fig. 10 Power dissipation curves (BA5415A)

A : INFINITE HEAT SINK θjc=3.75℃/W
B : 100cm²×1.6mm
C : 50cm²×1.6mm
D : 25cm²×1.6mm
E : WITHOUT HEAT SINK θja=31℃/W

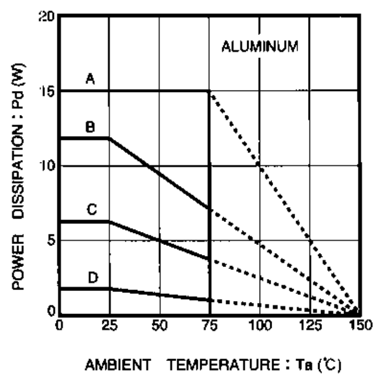


Fig. 11 Power dissipation curves (BA5416)

A : INFINITE HEAT SINK θjc=5.0℃/W
B : 100cm²×2.0mm
C : 25cm²×2.0mm
D : WITHOUT HEAT SINK θja=56.8℃/W

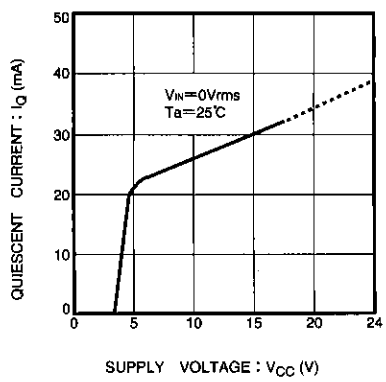


Fig. 12 Quiescent current vs. supply voltage

6V/330mW single-channel power amplifier

BA546

The BA546 is a monolithic power amplifier designed for use in portable radios, tape recorders and interphones. With a 6V power supply, it has a rated output of 330mW into an 8Ω load (THD = 10%), and a maximum output of 550mW. It comes in a compact 9-pin SIP package with no heatsink fins.

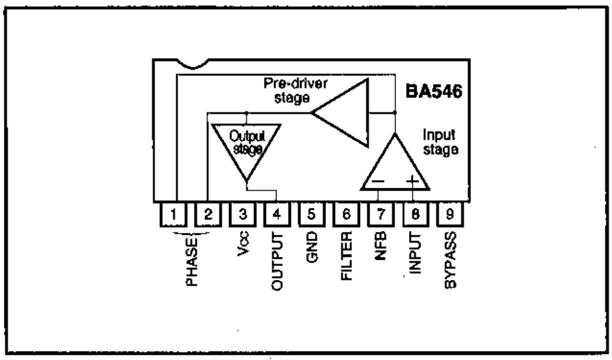
●Applications

Portable radios, cassette recorders, and interphones.

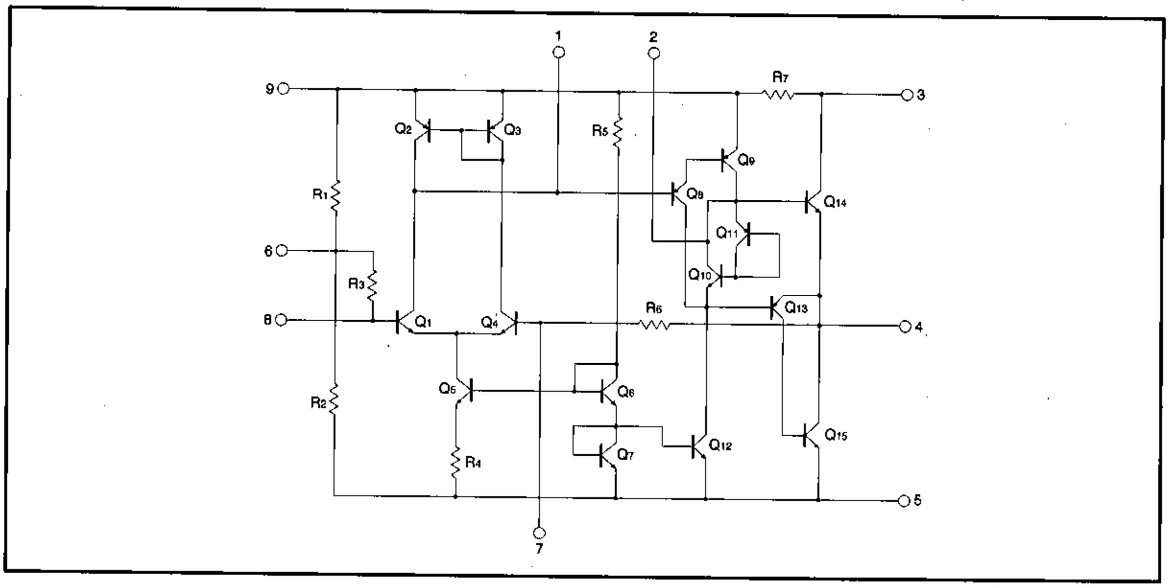
●Features

1) High output. POUT = 330mW (V_{CC} = 6V and an 8Ω load (THD = 10%)). See Fig. 2.
2) Good low voltage characteristics. Begins operating at less than 2V (see Fig. 1).
3) 9-pin SIP package; around the same size as a pre-amplifier.
4) Pin compatible with the Rohm BA526 and BA527 power ICs. Choose to suit your application.
5) Low current consumption (4.8mA typ.).

●Block diagram



●Internal circuit diagram



●Absolute maximum ratings (Ta = 25℃)

Parameter	Symbol	Limits	Unit
Supply voltage	V_{CC}	12	V
Power dissipation	Pd	950*	mW
Operating temperature	Topr	−30~75	℃
Storage temperature	Tstg	−40~125	℃

* Reduced by 9.5mW for each increase in Ta of 1°C over 25°C.

●Electrical characteristics (unless otherwise specified Ta = 25℃, V_{CC} = 6V, R_L = 8Ω and f= 1kHz)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions	Measurement Circuit
Quiescent circuit current	I_Q	−	4.8	7	mA	V_{IN}=0V_{rms}	Fig.10
Closed-circuit voltage gain	G_{VC}	47	50	53	dB	R_{NF}=68Ω	Fig.10
Rated output	P_{OUT}	250	330	−	mW	THD=10%	Fig.10
Total harmonic distortion	THD	−	1.1	2.5	%	P_O=100mW	Fig.10
Output noise voltage	V_{NO}	−	1.0	2.5	mV_{rms}	Rg=10kΩ	Fig.10
Input resistance	R_{IN}	−	25	−	kΩ	−	Fig.10

● Electrical characteristics curves

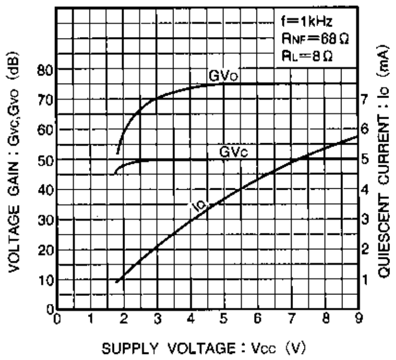


Fig. 1 Quiescent current and voltage gain vs. supply voltage

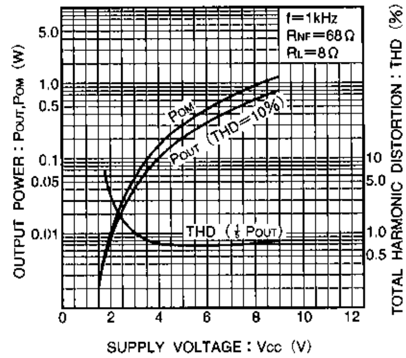


Fig. 2 Rated and max. output power and total harmonic distortion vs. supply voltage

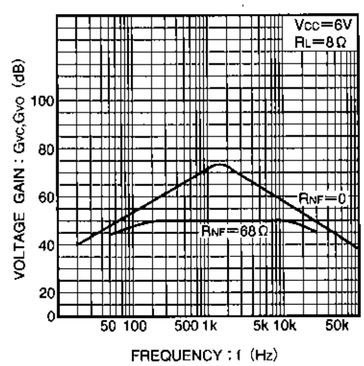


Fig. 3 Voltage gain vs. frequency

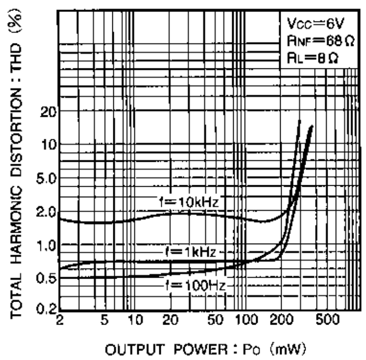


Fig. 4 Total harmonic distortion vs. output power

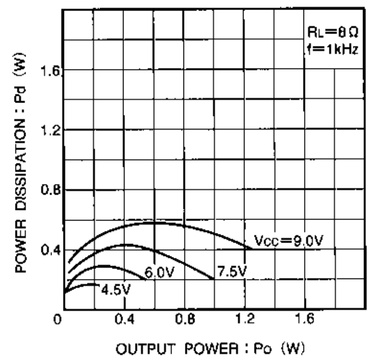


Fig. 5 Power dissipation vs. output power

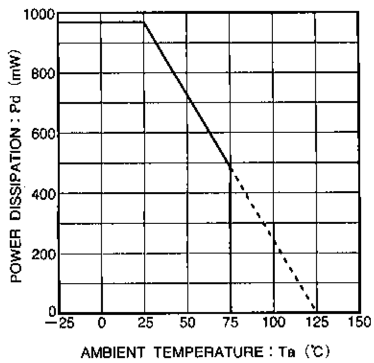


Fig. 6 Power dissipation vs. ambient temperature

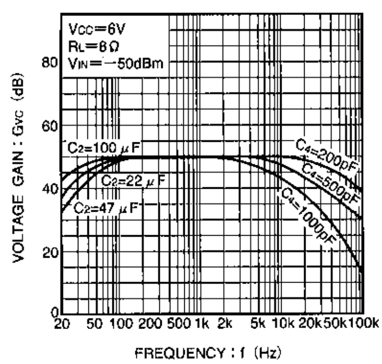


Fig. 7 Voltage gain vs. frequency

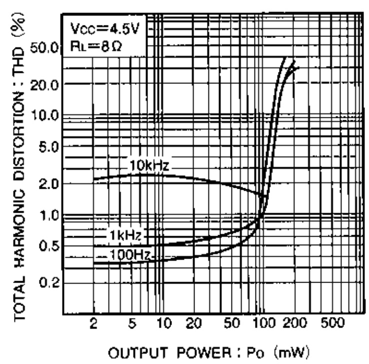


Fig. 8 Total harmonic distortion vs. output power

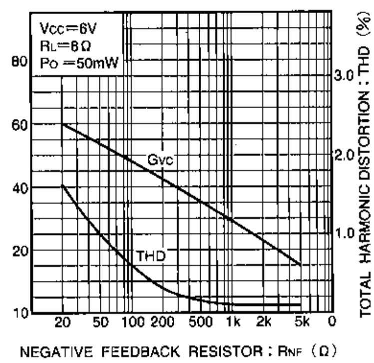


Fig. 9 Voltage gain and total harmonic distortion vs. feedback resistance

●Measurement circuit

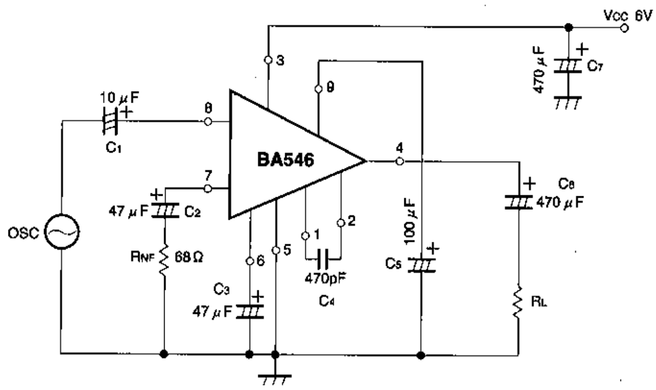


Fig. 10

●External components (see Fig. 10)

C_1 : input coupling capacitor

The recommended value is 10 μF. This capacitor and R_{IN} determine the bass cutoff frequency f_{LC1} for the input stage according to the following formula :

$$f_{LC1} = \frac{1}{2\pi C_1 R_{IN}} \ \text{[Hz]}$$

If the capacitance value of C_1 is too small, the signal source reactance will increase, and cause the noise to increase and f_{LC1} will become higher. Conversely, if it is too large, the startup time after power is applied will be longer, and if the potentiometer is adjusted while the capacitor is charging, the charging current will flow through the slider current, and cause noise.

C_2 : DC cutoff resistor for the feedback circuit

The recommended value is 47 μF. This capacitor and R_{NF} determine feedback circuit bass cutoff frequency f_{LC2}. f_{LC2} is given by the following formula :

$$f_{LC2} = \frac{1}{2\pi C_2 R_{NF}} \ \text{[Hz]}$$

Fig. 7 illustrates how changing C_2 varies the bass characteristics.

C_3 : ripple filter capacitor

The recommended value is 47 μF.

C_4 : Phase compensation capacitor

This capacitor determines the treble cutoff frequency f_{HC}. f_{HC} is given by the following formula :

$$f_{HC} = \frac{4000}{C4\ \text{[pF]}} \ \text{[kHz]}$$

(however, G_{VC} = 50dB)

If G_{VC} is not 50dB, f_{HC} doubles for each decrease in G_{VC} of 6dB.

Fig. 7 illustrates how changing C_4 varies the treble characteristics.

C_5 : ripple filter and pre-driver bypass capacitor

The recommended value is 100 μF. If this capacitor is made too small, the ripple rejection and power output will deteriorate.

C_6 : Output coupling capacitor

The recommended value is 470 μF.

C_7 : Power supply filter capacitor

Determine based on the amount of power supply ripple and the regulation.

●Circuit construction (See Fig. 11)

(1) Voltage amplification stage

This circuit is comprised of a differential amplifier (Q_1 and Q_4), a constant current source (Q_5), and an active load (Q_2 and Q_3). This active load is the input to the pre-driver (via Q_8 and Q_9).

(2) Pre-driver

The pre-driver is an earthed-emitter amplifier with transistors Q_8 and Q_9 forming a Darlington PNP transistor. The Q_9 collector load is the input impedance looking from the base of Q_{14} and the constant-current load due to Q_{12}.

(3) Idling loop

The idling loop is the Q_{13}, Q_{10}, Q_{11} and Q_{14} loop. The V_{BE} of Q_{13} is subtracted from the V_F of Q_{10} and Q_{11} and is biased by Q_{14}.

(4) Power stage

The power stage is a quasi-complementary circuit made up of a Darlington PNP transistor (Q_{13} and Q_{15}), and an NPN transistor (Q_{14}).

(5) The AC gain is determined by the ratio between R_6 (24kΩ) and R_{NF} connected to pin 7. The formula is as follows:

$$G_{VC} \fallingdotseq 20\log \frac{24k\Omega}{R_{NF}} \quad [dB]$$

Variation of G_{VC} and THD with R_{NF} is shown in Fig. 9.

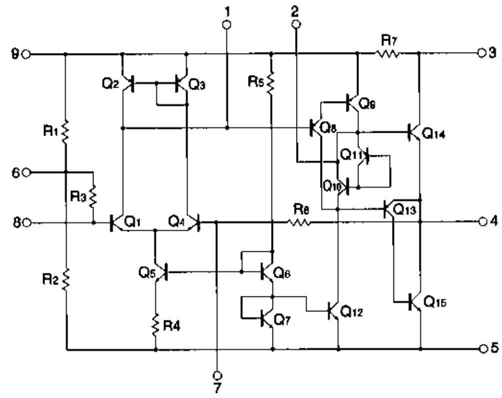


Fig. 11

●Application example

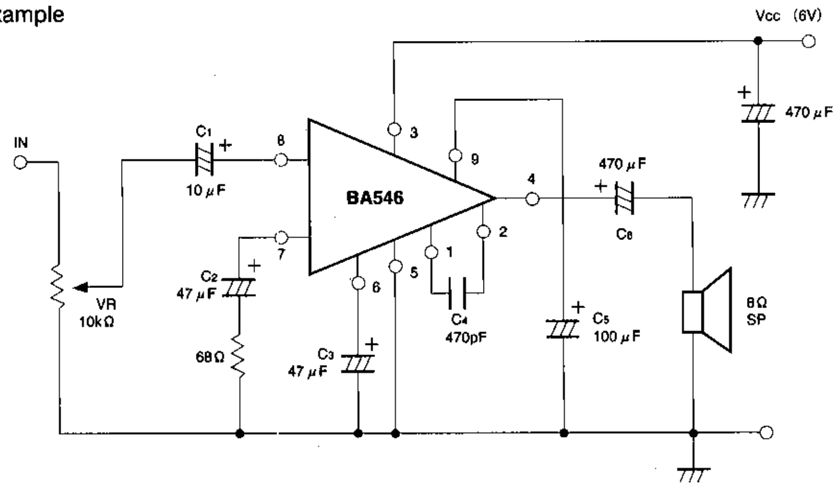
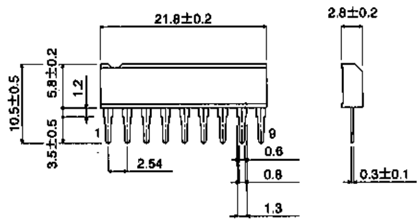


Fig. 12

The BA546 will generally be used as a power amplifier for portable cassette players and similar equipment, and will usually have a preamplifier before it, so insert the volume control between the stages. The gain of the power stage alone is determined by R_{NF}. Use Fig. 9 to choose a value for R_{NF} that gives the required gain.

When R_{NF} is 68Ω, the standard G_{VC} is 50dB. When combining the BA546 with an ALC-equipped preamplifier as the previous stage, the control voltage for the ALC can be taken from pin 4, and the power supply for the preamplifier from pin 9.

●External dimensions (Unit: mm)



SIP9

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