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 ratio, 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 ratio (38dB).
5) Begins operating at 1.5V.
6) Low distortion (0.05% at Po = 5mW).
7) Good voltage gain balance between channels.
8) Good channel separation (60dB Typ.).
9) Input coupling capacitors not required.
10) Symmetrical pin assignments facilitates PCB design.

● Block diagram
(1) Preamplifier Stage
The preamplifier is comprised of the level-shift transistor Q101, a differential amplifier (Q102 and Q105), and the active load (Q103 and Q106). The input is a PNP transistor that does not require a coupling capacitor.

(2) Pre-drive stage
Q118 is the pre-drive transistor. Q122 and Q120 form the load.

(3) Power stage
Comprised of phase-inverting transistor Q120, and power transistors Q122 and Q123.

(4) Idling current setting circuit
The idling current is controlled so that the difference between the VBE of the power transistor Q122 and the VBE of the phase-inverting transistor Q120 is the same as the difference between the VF of the constant-voltage diode Q117 and the VBE of Q121.

(5) Negative-feedback circuit
The closed-circuit gain with negative feedback is determined by R106, R102, and the value of the resistor connected to the NFB pin. Part of the gain setting resistance is on the chip (R102) 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°C)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Limits</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power supply voltage</td>
<td>Vcc</td>
<td>6.0</td>
<td>V</td>
</tr>
<tr>
<td>Power dissipation</td>
<td>Pd</td>
<td>500mW</td>
<td>mW</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>Toper</td>
<td>-25°C to +75°C</td>
<td>°C</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>Tstg</td>
<td>-55°C to +125°C</td>
<td>°C</td>
</tr>
<tr>
<td>Junction temperature</td>
<td>Tj</td>
<td>125°C</td>
<td></td>
</tr>
</tbody>
</table>

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

● Electrical characteristics (Ta = 25°C, Vcc = 3V, f = 1kHz and RL = 32Ω)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
<th>Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quiescent current</td>
<td>IQ</td>
<td>—</td>
<td>13</td>
<td>20</td>
<td>mA</td>
<td>VIN=0Vrms</td>
</tr>
<tr>
<td>Closed loop voltage gain</td>
<td>Gvcc</td>
<td>32</td>
<td>35</td>
<td>38</td>
<td>dB</td>
<td>VIN=-45dBm</td>
</tr>
<tr>
<td>Rated output power</td>
<td>Pout</td>
<td>23</td>
<td>35</td>
<td>—</td>
<td>mW</td>
<td>THD=10%</td>
</tr>
<tr>
<td>Distortion</td>
<td>THD</td>
<td>—</td>
<td>0.05</td>
<td>0.3</td>
<td>%</td>
<td>PO=5mW</td>
</tr>
<tr>
<td>Output noise voltage</td>
<td>VNO</td>
<td>—</td>
<td>80</td>
<td>200</td>
<td>μVrms</td>
<td>Rg=0Ω, Gvcc=95dB</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>B.P.F.20kHz ~ 20kHz</td>
</tr>
<tr>
<td>Input resistance</td>
<td>Rin</td>
<td>2.0</td>
<td>30</td>
<td>—</td>
<td>kΩ</td>
<td></td>
</tr>
<tr>
<td>Ripple rejection ratio</td>
<td>RR</td>
<td>28</td>
<td>38</td>
<td>—</td>
<td>dB</td>
<td>Vrr=-20dBm, f=100Hz, Rg=0Ω</td>
</tr>
<tr>
<td>Operation start voltage</td>
<td>VS</td>
<td>—</td>
<td>1.5</td>
<td>1.8</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

● Measurement circuit

![Measurement circuit diagram](Image)
Audio ICs

BA5204F

● Application example

![Circuit Diagram]

* Use a mylar capacitor.

○ Attached components (Fig. 15)
C1: 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.
C2 and C3: 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.
C5 and C6: feedback circuit DC blocking capacitors
These capacitors and RNF set the bass cutoff frequency.

\[
\begin{align*}
\text{ch1} \cdots \cdots f_{\text{LC1}} &= \frac{1}{2\pi \cdot C_5 \cdot (R_{\text{NF1}} + R_{\text{102}})} \\
\text{ch2} \cdots \cdots f_{\text{LC2}} &= \frac{1}{2\pi \cdot C_6 \cdot (R_{\text{NF2}} + R_{\text{202}})}
\end{align*}
\]

R_{\text{NF1}} and R_{\text{NF2}} determine the amount of feedback for the feedback circuit. These resistors determine the closed-circuit voltage gain (GVC).
C7 and C8: 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.
C9 and C10: 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/quietcurrent/rated output power vs. power supply voltage**
Fig. 9 Output noise voltage vs. signal source impedance

Fig. 10 Ripple rejection ratio vs. frequency

Fig. 11 Ripple rejection ratio vs. power supply voltage

Fig. 12 Channel separation vs. frequency

Fig. 13 Voltage gain vs. feedback resistor value

Fig. 14 Power dissipation vs. output power
Audio ICs

Fig. 15 Quiescent current vs. ambient temperature

Fig. 16 Thermal derating curve

External dimensions (Units: mm)

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