Monolithic Linear IC

No.2087C

LA 4 5 5 7

2-CHANNEL AF POWER AMP. FOR RADIO, TAPE RECORDER USE

Features
- Low quiescent current
- On-chip 2 channels permitting use in stereo and bridge amplifier applications.
- High output
- Minimum number of external parts required (9 pos. minimum)
- Good ripple rejection (55dB)
- Soft tone at the output saturation mode
- Good channel separation
- Easy thermal design
- Small pop noise at the time of power supply ON/OFF
- On-chip muting

Maximum Ratings at Ta=25°C

<table>
<thead>
<tr>
<th>Parameter</th>
<th>VCCmax</th>
<th>Quiescent</th>
<th>Operating</th>
<th>unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Supply Voltage</td>
<td></td>
<td>15 V</td>
<td>12 V</td>
<td></td>
</tr>
<tr>
<td>Allowable Power Dissipation</td>
<td>Pdmax</td>
<td>With recommended PCB</td>
<td>4 W</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>Topr</td>
<td></td>
<td></td>
<td>-20 to +75 °C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>Ttsg</td>
<td></td>
<td></td>
<td>-55 to +150 °C</td>
</tr>
</tbody>
</table>

Operating Conditions at Ta=25°C

<table>
<thead>
<tr>
<th>Parameter</th>
<th>VCC</th>
<th>RL</th>
<th>BTL</th>
<th>unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended Supply Voltage</td>
<td></td>
<td>7.5 to 9.0 V</td>
<td>3 to 8 ohm</td>
<td></td>
</tr>
<tr>
<td>Load Resistance</td>
<td>Rl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Voltage Range</td>
<td>VCCop</td>
<td></td>
<td></td>
<td>4.5 to 12 V</td>
</tr>
</tbody>
</table>

Package Dimensions 3022A-D12FIC
(unit: mm)

SANYO Electric Co., Ltd. Semiconductor Business Headquarters
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110 JAPAN

9037AT/2146KI/0155KI,TS No.2087-1/8
Operating Characteristics at $T_a=25^\circ C, V_{CC}=9V, f=1kHz, R_{g}=500\text{ohms}, R_L=4\text{ohms}, V_{G}=50\text{dB}$, See specified Test Circuit.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quiescent Current</td>
<td>$I_{cc0}$</td>
<td>mA</td>
<td>20</td>
</tr>
<tr>
<td>Voltage Gain</td>
<td>$V_{G}$</td>
<td>dB</td>
<td>48</td>
</tr>
<tr>
<td>Voltage Gain Difference</td>
<td>$\Delta V_{G}$</td>
<td>dB</td>
<td>52</td>
</tr>
<tr>
<td>Output Power</td>
<td>$P_o$</td>
<td>W</td>
<td>1.7</td>
</tr>
<tr>
<td>Output Noise Voltage</td>
<td>$V_{NO}$</td>
<td>mV</td>
<td>0.5</td>
</tr>
<tr>
<td>Ripple Rejection</td>
<td>$R_{r}$</td>
<td>mV</td>
<td>0.8</td>
</tr>
<tr>
<td>Crosstalk</td>
<td>$R_{C}$</td>
<td>dB</td>
<td>45</td>
</tr>
<tr>
<td>Muting Attenuation</td>
<td>$A_{MT}$</td>
<td>dB</td>
<td>70</td>
</tr>
</tbody>
</table>

Equivalent Circuit Block Diagram

Sample Application Circuit: Stereo Use

Unit (resistance: $\Omega$, capacitance: $F$)
Sample Printed Circuit Pattern (Cu-foiled side)

Sample Application Circuit: Bridge Amp Use

Unit (resistance: Ω, capacitance: F)

Description of External Parts

C1(C2): Feedback capacitor. The low cutoff frequency is determined by the following formula.

\[ f_L = \frac{1}{2\pi R_f C_1} \]

- \( f_L \): Low cutoff frequency
- \( R_f \): Feedback resistor

Since this capacitor as well as decoupling capacitor affects the starting time, the capacitor value must be fixed with the necessary low frequency band fully considered.

C3(C4): Bootstrap capacitor. The output at low frequencies depends on this capacitor. Decreasing the capacitor value lowers the output at low frequencies. A capacitor value of 47μF or more is required.

C5(C6): Oscillation blocking capacitor. Use a polyester film capacitor that is good in high frequency response and temperature characteristic. The use of an electrolytic capacitor, ceramic capacitor may cause oscillation to occur at low temperatures.

C7(C8): Output capacitor. The low cutoff frequency is determined by the following formula.

\[ f_L = \frac{1}{2\pi R_f C_7} \]

- \( f_L \): Low cutoff frequency
- \( R_f \): Load resistance

To make the low frequency response in the bridge amplifier mode identical with that in the stereo mode, the capacitor value must be doubled.
C9: Decoupling capacitor. Used for the ripple filter. Since the rejection effect is saturated at a certain capacitor value, it is meaningless to increase the capacitor values more than needed. This capacitor, being also used for the time constant of the muting circuit, affects the starting time.

C10: Power source capacitor

Application Circuits
Voltage gain adjust

- Stereo mode
  The voltage gain is determined by on-chip resistor R1(R2) and external feedback resistor $R_f$ as follows:
  \[ V_{\text{G}} = 20 \log \frac{R_1}{R_f + R_2} \text{ [dB]} \]
  Any voltage gain can be obtained by external resistor $R_f$.

- Bridge amplifier mode

The CH1 is a noninverting amplifier and the CH2 is an inverting amplifier. The total voltage gain, being apparently higher than that of the CH1 by 6dB, is approximately calculated by the following formula.

\[ V_{\text{G}} = 20 \log \frac{R_2}{R_f + R_1 + 6(\text{dB})} \]

To reduce the voltage gain, $R_f$ is connected and the following formula is used.

\[ V_{\text{G}} = 20 \log \frac{R_2}{R_f + R_1 + 6(\text{dB})} \]

Proper cares in using LA4557-applied set
1. Slider contact noise of variable resistor
   Since the input circuit uses PNP transistors, no input coupling capacitor is required. However, if slider contact noise of the variable resistor presents any problem, connect a capacitor in series with input.
2. Pop noise
   If pop noise generated at the time of power ON/OFF disturbs you, connect a resistor of 500ohms to 1kohm across the middle point and GND.

Thermal design
Since the DIP12F package is such that the Cu-foiled area of the printed circuit board is used to dissipate heat, make the Cu-foiled area in the vicinity of the heat sink of the IC as large as possible when designing the printed circuit board. Power dissipation $P_d$ is increased depending on the supply voltage and load. So, it is recommended to use the printed circuit board together with the heat sink. The following is a formula to be used to calculate $P_d$ (for stereo use). For AC power supply, however, it is recommended to actually measure $P_d$ on the transformer of each set. For bridge amplifier use, $P_d$ is calculated at 1/2 of the load.
(1) DC power supply
\[ P_d \text{ max} = \frac{V_{cc}^2}{\pi^2 RL} + I_c \cdot V_{cc}(\text{for stereo use}) \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots}
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