DATA SHEET

TDA1011
2 to 6 W audio power amplifier

Product specification
File under Integrated Circuits, IC01

November 1982
The TDA1011 is a monolithic integrated audio amplifier circuit in a 9-lead single in-line (SIL) plastic package. The device is especially designed for portable radio and recorder applications and delivers up to 4 W in a 4 Ω load impedance. The device can deliver up to 6 W into 4 Ω at 16 V loaded supply in mains-fed applications. The maximum permissible supply voltage of 24 V makes this circuit very suitable for d.c. and a.c. apparatus, while the very low applicable supply voltage of 3,6 V permits 6 V applications. Special features are:

- single in-line (SIL) construction for easy mounting
- separated preamplifier and power amplifier
- high output power
- thermal protection
- high input impedance
- low current drain
- limited noise behaviour at radio frequencies

**QUICK REFERENCE DATA**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage range V_P</td>
<td>3,6 to 20 V</td>
</tr>
<tr>
<td>Peak output current I_OM max.</td>
<td>3 A</td>
</tr>
<tr>
<td>Output power at d_tot = 10%</td>
<td></td>
</tr>
<tr>
<td>V_P = 16 V; R_L = 4 Ω</td>
<td>P_o typ.</td>
</tr>
<tr>
<td>V_P = 12 V; R_L = 4 Ω</td>
<td>6,5 W</td>
</tr>
<tr>
<td>V_P = 9 V; R_L = 4 Ω</td>
<td>4,2 W</td>
</tr>
<tr>
<td>V_P = 6 V; R_L = 4 Ω</td>
<td>2,3 W</td>
</tr>
<tr>
<td>P_o typ.</td>
<td>1,0 W</td>
</tr>
<tr>
<td>Total harmonic distortion at P_o = 1 W; R_L = 4 Ω d_tot typ.</td>
<td>0,2 %</td>
</tr>
<tr>
<td>Input impedance</td>
<td></td>
</tr>
<tr>
<td>preamplifier (pin 8)</td>
<td></td>
</tr>
<tr>
<td>power amplifier (pin 6)</td>
<td></td>
</tr>
<tr>
<td>Total quiescent current I_tot typ.</td>
<td>14 mA</td>
</tr>
<tr>
<td>Operating ambient temperature T_amb</td>
<td>−25 to + 150 °C</td>
</tr>
<tr>
<td>Storage temperature T_stg</td>
<td>−55 to + 150 °C</td>
</tr>
</tbody>
</table>

**PACKAGE OUTLINE**

9-lead SIL; plastic (SOT110B); SOT110-1; 1996 July 23.
Fig. 1. Circuit diagram.
RATINGS
Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage
Peak output current
Total power dissipation
Storage temperature
Operating ambient temperature
A.C. short-circuit duration of load
during sine-wave drive; \( V_P = 12 \) V

\[
\begin{align*}
V_P & \quad \text{max.} & 24 \text{ V} \\
I_{OM} & \quad \text{max.} & 3 \text{ A} \\
T_{stg} & & -55 \text{ to } +150 \text{ °C} \\
T_{amb} & & -25 \text{ to } +150 \text{ °C} \\
t_{sc} & \quad \text{max.} & 100 \text{ hours}
\end{align*}
\]

**HEATSINK DESIGN**
Assume \( V_P = 12 \) V; \( R_L = 4 \ \Omega \); \( T_{amb} = 60 \) °C maximum; \( P_o = 3.8 \) W.
The maximum sine-wave dissipation is 1.8 W.
The derating of 10 K/W of the package requires the following external heatsink (for sine-wave drive):

\[
R_{th\ j-a} = R_{th\ j-tab} + R_{th\ tab-h} + R_{th\ h-a} = \frac{150 - 60}{1.8} = 50 \text{ K/W.}
\]

Since \( R_{th\ j-tab} = 10 \) K/W and \( R_{th\ tab-h} = 1 \) K/W, \( R_{th\ h-a} = 50 - (10 + 1) = 39 \) K/W.
2 to 6 W audio power amplifier  

**TDA1011**

**D.C. CHARACTERISTICS**

Supply voltage range  
\[ V_P = 3.6 \text{ to } 20 \text{ V} \]

Repetitive peak output current  
\[ I_{ORM} < 2 \text{ A} \]

Total quiescent current at \( V_P = 12 \text{ V} \)  
\[ I_{tot} \text{ typ. } 14 \text{ mA} \]

\[ I_{tot} < 22 \text{ mA} \]

**A.C. CHARACTERISTICS**

\( T_{amb} = 25 \degree C; V_P = 12 \text{ V}; R_L = 4 \Omega; f = 1 \text{ kHz} \) unless otherwise specified; see also Fig.3.

A.F. output power at \( d_{tot} = 10\% \) (note 1)

- with bootstrap:
  - \( V_P = 16 \text{ V}; R_L = 4 \Omega \)
  - \( P_0 \text{ typ. } 6.5 \text{ W} \)
  - \( V_P = 12 \text{ V}; R_L = 4 \Omega \)
  - \( P_0 > 3.6 \text{ W} \)
  - \( V_P = 9 \text{ V}; R_L = 4 \Omega \)
  - \( P_0 \text{ typ. } 2.3 \text{ W} \)
  - \( V_P = 6 \text{ V}; R_L = 4 \Omega \)
  - \( P_0 \text{ typ. } 1.0 \text{ W} \)

- without bootstrap:
  - \( V_P = 12 \text{ V}; R_L = 4 \Omega \)
  - \( P_0 \text{ typ. } 3.0 \text{ W} \)

Voltage gain:

- preamplifier (note 2)  
  \[ G_{v1} \text{ typ. } 23 \text{ dB} \]
  \[ 21 \text{ to } 25 \text{ dB} \]

- power amplifier  
  \[ G_{v2} \text{ typ. } 29 \text{ dB} \]
  \[ 27 \text{ to } 31 \text{ dB} \]

- total amplifier  
  \[ G_{v_{tot}} \text{ typ. } 52 \text{ dB} \]
  \[ 50 \text{ to } 54 \text{ dB} \]

Total harmonic distortion at \( P_0 = 1.5 \text{ W} \)  
\[ d_{tot} \text{ typ. } 0.3 \% \]

\[ < 1 \% \]

Frequency response; \( -3 \text{ dB} \) (note 3)

- Input impedance:
  - preamplifier (note 4)  
    \[ |Z_{i1}| > 100 \text{ k}\Omega \]
    \[ \text{typ. } 200 \text{ k}\Omega \]
  - power amplifier  
    \[ |Z_{i2}| \text{ typ. } 20 \text{ k}\Omega \]

Output impedance preamplifier  
\[ |Z_{o1}| \text{ typ. } 1 \text{ k}\Omega \]

Output voltage preamplifier (r.m.s. value)  
\[ d_{tot} < 1\% \) (note 2)

\[ V_{o(\text{rms})} > 0.7 \text{ V} \]

Noise output voltage (r.m.s. value; note 5)

- \( R_S = 0 \text{ \Omega} \)
  \[ V_{n(\text{rms})} \text{ typ. } 0.2 \text{ mV} \]
  \[ < 0.6 \text{ mV} \]

- \( R_S = 10 \text{ k}\Omega \)
  \[ V_{n(\text{rms})} < 1.4 \text{ mV} \]

Noise output voltage at \( f = 500 \text{ kHz} \) (r.m.s. value)

- \( B = 5 \text{ kHz}; R_S = 0 \text{ \Omega} \)
  \[ V_{n(\text{rms})} \text{ typ. } 8 \text{ \mu V} \]
Philips Semiconductors

2 to 6 W audio power amplifier

Ripple rejection (note 6)

\[
\begin{align*}
\text{f} & = 1 \text{ to } 10 \text{ kHz} & \text{RR typ.} & = 42 \text{ dB} \\
\text{f} & = 100 \text{ Hz; } C2 = 1 \mu\text{F} & \text{RR} & > 35 \text{ dB} \\
\end{align*}
\]

Bootstrap current at onset of clipping; pin 4 (r.m.s. value)

\[
I_{4\text{(rms)}} \text{ typ.} = 35 \text{ mA}
\]

Notes

1. Measured with an ideal coupling capacitor to the speaker load.
2. Measured with a load resistor of 20 kΩ.
3. Measured at \( P_o = 1 \text{ W} \); the frequency response is mainly determined by \( C1 \) and \( C3 \) for the low frequencies and by \( C4 \) for the high frequencies.
5. Unweighted r.m.s. noise voltage measured at a bandwidth of 60 Hz to 15 kHz (12 dB/octave).
6. Ripple rejection measured with a source impedance between 0 and 2 kΩ (maximum ripple amplitude: 2 V).
7. The tab must be electrically floating or connected to the substrate (pin 9).

Fig. 3 Test circuit.
APPLICATION INFORMATION

Fig. 4 Circuit diagram of a 4 W amplifier.

Fig. 5 Total quiescent current as a function of supply voltage.
Fig. 6  Track side of printed-circuit board used for the circuit of Fig.4; p.c. board dimensions 62 mm × 48 mm.

Fig. 7  Component side of printed-circuit board showing component layout used for the circuit of Fig.4.
Fig. 8  Total harmonic distortion as a function of output power across $R_L$; - - - with bootstrap; --- without bootstrap; $f = 1$ kHz; typical values. The available output power is 5% higher when measured at pin 2 (due to series resistance of $C_{10}$).

Fig. 9  Output power across $R_L$ as a function of supply voltage with bootstrap; $d_{tot} = 10\%$; typical values. The available output power is 5% higher when measured at pin 2 (due to series resistance of $C_{10}$).
Fig. 10  Voltage gain as a function of frequency; $P_o$ relative to 0 dB = 1 W; $V_p = 12$ V; $R_L = 4 \, \Omega$.

Fig. 11  Total harmonic distortion as a function of frequency; $P_o = 1$ W; $V_p = 12$ V; $R_L = 4 \, \Omega$. 
Fig. 12 Ripple rejection as a function of R2 (see Fig. 4); $R_S = 0$; typical values.

Fig. 13 Noise output voltage as a function of R2 (see Fig. 4); measured according to A-curve; capacitor C5 is adapted for obtaining a constant bandwidth.
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Fig. 14 Noise output voltage as a function of frequency; curve a: total amplifier; curve b: power amplifier; B = 5 kHz; R_S = 0; typical values.

Fig. 15 Voltage gain as a function of R2 (see Fig. 4).
PACKAGING OUTLINE

SIL9MPF: plastic single in-line medium power package with fin; 9 leads

**DIMENSIONS** (mm are the original dimensions)

<table>
<thead>
<tr>
<th>UNIT</th>
<th>A</th>
<th>A2 max.</th>
<th>A3</th>
<th>A4</th>
<th>b1</th>
<th>b2</th>
<th>c</th>
<th>D (1)</th>
<th>D1 (1)</th>
<th>E (1)</th>
<th>e</th>
<th>L</th>
<th>P</th>
<th>P1</th>
<th>Q</th>
<th>q1</th>
<th>q2</th>
<th>w</th>
<th>z (1) max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>18.5</td>
<td>3.7</td>
<td>8.7</td>
<td>8.0</td>
<td>15.8</td>
<td>15.4</td>
<td>1.40</td>
<td>1.40</td>
<td>0.67</td>
<td>0.50</td>
<td>1.14</td>
<td>0.87</td>
<td>0.38</td>
<td>21.8</td>
<td>21.4</td>
<td>21.4</td>
<td>6.48</td>
<td>6.20</td>
<td>2.54</td>
</tr>
<tr>
<td></td>
<td>17.8</td>
<td></td>
<td>8.0</td>
<td>5.5</td>
<td>15.8</td>
<td>15.4</td>
<td>1.14</td>
<td>1.14</td>
<td>0.67</td>
<td>0.50</td>
<td>1.14</td>
<td>0.87</td>
<td>0.38</td>
<td>21.8</td>
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<td>21.4</td>
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<td>6.20</td>
<td>2.54</td>
</tr>
</tbody>
</table>

**Note**
1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.
SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our “IC Package Databook” (order code 9398 652 90011).

Soldering by dipping or by wave

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

DEFINITIONS

<table>
<thead>
<tr>
<th>Data sheet status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective specification</td>
</tr>
<tr>
<td>Preliminary specification</td>
</tr>
<tr>
<td>Product specification</td>
</tr>
</tbody>
</table>

Limiting values

Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.

Application information

Where application information is given, it is advisory and does not form part of the specification.

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.